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EMF

ELECTRICAL YEAR BOOK

A Combined Dictionary, Encyclopedia and Trade Directory of the Electrical Industry

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EMF

ELECTRICAL YEAR BOOK

AN ENCYCLOPEDIA OF CURRENT INFORMATION ABOUT EACH BRANCH OF THE ELECTRICAL INDUSTRY

WITH

A DICTIONARY OF ELECTRICAL TERMS

AND

A CLASSIFIED DIRECTORY OF ELECTRICAL AND RELATED PRODUCTS AND THEIR MANUFACTURERS

In the United States and Canada

Edited by Frank H. Bernhard

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PREFACE

DEVELOPMENTS in electrical science and engineering have been so rapid during the last forty or so years, that from them one of the leading industries has been created to cater to the electrical needs of the country. Before this period the telegraph was the only practical application in use. Now there are almost countless such applications and they are being added to day by day. They represent a tremendous increase in the use of electricity in offices, factories, households and every activity of life. To meet these varied needs efficiently, the electrical industry has become specialized in about a dozen important branches.

This specialization has further accelerated progress, but has made it difficult for electrical men themselves, as well as laymen, to keep informed on electrical developments in all lines. No single text book, reference book or periodical has covered all branches of recent electrical activities, and many of the excellent books on special electrical topics have soon become obsolete because of the rapid advances of the art.

To meet the growing need for an up-to-date compendium of electrical developments, the publishers of the EMF ELECTRICAL YEAR BOOK have aimed to make this a convenient annual reference book of current information about the electrical industry as a whole and each of its branches, its service or products and their producers, its terminology, and other frequently sought facts and data not hitherto readily available.

Three main classes of information are included in this volume as follows:

(A) Development, present standing and data of the entire industry and its leading branches; growth and status of the most important electrical applications; a sketch with the latest facts about each of the national electrical associations; data concerning each of the electrical engineering colleges and other electrical schools; lists of electrical periodicals, libraries and testing laboratories; biographical sketches of the leading electrical scientists and inventors; facts about electrical codes, patents, exports and numerous other electrical developments and activities. These various subjects are so treated as to constitute an encyclopedia of current electrical information not elsewhere readily available for convenient reference.

(B) Definitions of practically all electrical words, terms, abbreviations, also of words closely related to the electrical. These include words of theoretical, technical, engineering and practical or trade interest and make a modern electrical dictionary for the scientist, engineer, business man, student, artisan and layman.

(C) Classification of about 3,000 electrical and other closely related products made by and used by the electrical industry. Each of these is descriptively defined and followed by a list of its American and Canadian manufacturers. Separate entries are also made of these manufacturers under company or firm name, together with information regarding their principal output, organization and branches. There are also separate entries of thousands of trade names of products and by whom they are used. These three classes of entries constitute the most complete directory of electrical products and manufacturers ever conceived and enable one to find quickly all the producers of any class of electrical machinery, appliances, instruments, devices or miscellaneous supplies. Whether the product is looked for

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under its technical, common or trade name, the names of its producers are readily found, also the address of their main and branch offices or agencies, location of factories and other information, so that the manufacturer can be reached with minimum delay.

For the greatest convenience of reference, all topics, whether they be in classes A, B or C referred to above, are arranged in one continuous alphabetical series throughout the book as in any encyclopedia or dictionary. This eliminates the time lost in first searching through an index. Copious cross-references enable one to find any topic regardless of whatever name it may be sought under. In some cases these cross-references give all the information required without looking up the main entry. The latter is usually under the noun, excepting in cases where it is believed the item will be sought more frequently under an adjective than noun, for instance Circuit breakers instead of Breakers, circuit. In cross-references the initial letter of the main entry is capitalized.

In the selection and treatment of topics, the aim has been to include all matters of general interest covering every branch of electrical development, and to describe them in a simple and pithy manner that the nontechnical reader may grasp as readily as the electrical engineer. In general, mathematical formulas, tables of technical data, discussions of design, details of processes, equipment, etc., are omitted because adequately covered in electrical engineering reference books. The text contains the great mass of up-to-date useful information about things electrical most sought by everyone directly or indirectly connected with any branch of the electrical industry, by purchasers of electrical equipment, and by others who need a ready and reliable source of facts and figures on electrical matters. This last extensive group includes bankers financing electrical undertakings, architects and builders, government and municipal authorities, libraries and colleges, newspapers, etc.

To keep the various classes of information up to date, the EMF ELECTRICAL YEAR BOOK will be revised from cover to cover, added to, and issued as a new volume each year. This revision will bring all encyclopedia entries and data in accord with the latest developments, all definitions abreast of current usage, and all listings of products and producers corrected to the date of each yearly edition. It will also permit adding many new items suggested as desirable by users of the book, so as to make it still more complete and useful year by year.

A large part of the text of this first edition has been prepared by a staff of thirty contributing editors who are specialists on their respective subjects. Their contributions are found chiefly among the encyclopedia and dictionary topics. The remaining entries in these groups and the listings of manufacturers and their products were prepared by the office editorial staff, aided by numerous writers on special topics. Statistical data have been derived from government reports, the technical and trade press, and from private reliable sources.

The information from which the classified listings of manufacturers, the separate company entries and the trade-name items were prepared, was obtained almost exclusively direct from the manufacturers, a special questionnaire being sent them for this purpose. Although regular listings are entirely free, it was found difficult in some cases to obtain prompt, complete and accurate replies. Every reasonable attempt was made to assure accuracy and completeness in all listings as well as in all topics and entries throughout the book. If errors have crept in, or omissions are noted, they are due to editors, like other human beings, not being infallible or to lack of adequate co-operation on the part of some manufacturers. Special efforts will be made to rectify any errors, to check all listings and add to them in the next edition. Manufacturers can aid greatly in this matter by keeping the editor supplied with their latest catalogs.

Manufacturers were given the privilege of inserting advertisements of a descriptive nature in place of the regular listing of their name under the classified products. All such ad-

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vertisements inserted in the text are marked with the abbreviation Adv. and are intended to furnish additional information supplementing the general definition of the product which does not attempt to point out features peculiar to each manufacturer's goods. The advertisements following the text are of the more customary display character; an index to them is given in the last pages of the book.* The advertisers have rendered a double service to the readers of the book, by furnishing additional descriptive data and by making it possible to issue the book at a reasonable price. In communicating with them, readers will therefore confer a special favor by mentioning having observed their advertisements in this book.

The publishers wish to express their appreciation of many valuable ideas contributed by leaders of the industry toward making the EMF ELECTRICAL YEAR BOOK what it is. They are especially indebted to Mr. William L. Goodwin for first suggesting the possible scope and usefulness of a book of this kind, which is believed to be unique among the year books of any industry. The editor makes acknowledgment of the incalculable aid rendered by the contributing editors and other outside writers, and of the untiring and painstaking service of the associate and assistant editors. He also appreciates the constructive criticism that has been received from many electrical men to whom portions of the proofs have been submitted. Suggestions for correction of errors and for further improvement of the book will be gladly received.

A Service Bureau has been established by the publishers for the benefit of subscribers of the EMF ELECTRICAL YEAR BOOK. This will endeavor to furnish any electrical information not covered by the book aside from highly technical and consulting engineering service. It will also be prepared to supply promptly any information covered by the book for which facts or figures are desired that are later than those that were available at the time of going to press with the last edition. Subscribers to the book will thereby be able to obtain between the regular annual editions the latest data on any subject or listings on any product for which they have urgent need.

THE EDITOR.

Chicago, Ill., June, 1921.

*Index to display advertising section on pages 1403, 1404.

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EMF

ELECTRICAL YEAR BOOK

A Combined Encyclopedia, Dictionary and Trade Directory of the Electrical Industry

A

A.—Abbreviation for ampere or amperes, used especially on name plates of electrical machines and appliances in giving ampere rating or current-carrying capacity. In text matter the abbreviation amp. is preferably used after numerical values of amperes.

A-A.—Trade name for lighting reflectors manufactured by the A-A Electric Mfg. Co., 303 Center St., Bridgeport, Conn.

AABALL.—Trade name for steam specialties manufactured by the Page Boiler Co., 815-819 Larrabee St., Chicago, Ill.

A-A ELECTRIC MFG. CO., THE.—Bridgeport, Conn. Manufacturer of street lighting fixtures, metal shades and reflectors. President, J. E. Heath; secretary, C. M. Alvord; treasurer and general manager, E. C. Spargo. Main office and factory, 303 Center St., Bridgeport, Conn. Branch office, 98 Park Pl., New York, N. Y.

A-A NEW CODE, A-A RED, A-A 30%.—Trade names for rubber-covered wire manufactured by the A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.

A-A WIRE CO., INC.—50 E. 42nd St., New York, N. Y. Manufacturer of insulated wire and cables. Business established 1912. President, George T. Cottle; vice-president, D. R. G. Palmer; secretary, George H. Savage; treasurer, William C. Hall. Sales representatives, Central Electric Co., 320 S. Wells St., Chicago, Ill.; Electric Supply Co., Toledo, Ohio; Philadelphia Electric Supply Co., Philadelphia, Pa.

A & F.—Trade name for electric heaters and battery charging panels manufactured by the Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash.

A. & J. MFG. CO., THE.—559 W. Lake St., Chicago, Ill. Manufacturer of brazing compounds and pipe fittings. President and treasurer, C. H. Blake; vice-president, H. Harris; secretary, H. C. Rumery.

A. & R. LAMP CO., THE.—121-123 Lafayette St., Newark, N. J. Manufacturer of table and reading lamps. Business established 1918. President and general manager, A. J. Rainaud; vice-president and treasurer, William J. Rainaud; secretary, M. G. Rainaud. Sales representatives, T. U. Hamilton, 139 5th Ave., New York, N. Y.; Himmelstern Bros., San Francisco, Cal., and Los Angeles, Cal.; George D. Donkel, 44 Federal St., Boston, Mass.; Marcus S. Kopf, 180 N. Dearborn St., Chicago, Ill.

A. & S.—Trade name for power plant gas producers manufactured by Akerlund & Semmes, Inc., 17 Battery Pl., New York, N. Y.

A & W ELECTRIC SIGN CO., THE.—Cleveland, Ohio. Manufacturer of electric signs, flashers, time switches, reflectors and color shades. President and general manager, H. J. Walser; vice-president and treasurer, C. F. Bryan; secretary, J. A. Cline.

A-1.—Trade name for battery clips manufactured by Charles F. Hartung, 802 Higgins Bldg., Los Angeles, Cal.

ABAMPERE.—The magnetic property of an electric current is made the basis of the definition of the absolute unit of electric current. The absolute electromagnetic unit of current is that current which when flowing through a conductor bent into a ring of one centimeter radius exerts a force of 2π dynes on a unit magnet pole placed at the center of the ring. This unit is too large for many practical purposes. It has no name, but is usually known as the abampere. One abampere equals 10 amperes.

ABAROID.—Trade name for fiber insulating material made by the Campbell Fibre Co., Stanton, Del.

ABBOTT.—Trade name for pull chain acorns manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

ABBOTT BALL CO., THE.—Hartford, Conn. Manufacturer of ball bearings. Business established 1909. President and treasurer, George E. Abbott; secretary, C. H. Abbott; sales manager, C. R. Abbott.

ABC.—Trade name for storage batteries and storage battery equipment made by the Alberta Battery Co., Ltd., 420-422 9th Ave., E., Calgary, Alta., Can.

ABC.—Trade name for electric ironing machine manufactured by the Altorfer Bros. Co., Peoria, Ill.

ABC.—Trade name for electric ventilating fans, blowers and steam engines manufactured by the American Blower Co., Detroit, Mich.

ABC.—Trade name for plugs and receptacles manufactured by Albert & J. M. Anderson Mfg. Co., Boston, Mass.

A. B. C.—Trade name for conduit and pipe hanger manufactured by Fee & Mason, 81 Beekman St., New York, N. Y.

A. B. C. GENERATOR CO.—1115-17 S. Olive St., Los Angeles, Cal. Manufacturer of generators for automobile lighting and starting. C. Will Risden, sole owner.

ABC SUPER ELECTRIC.—Trade name for oscillating cylinder type electric washing machine manufactured by the Altorfer Bros. Co., Peoria, Ill.

ABCO MFG. CO.—1633 Walnut St., Chicago, Ill. Manufacturer of lighting fixtures.

ABCOULOMB.—The absolute unit of quantity of electricity is that quantity which is transferred or delivered by one abampere in one second. It has no distinctive name, but is usually called the abcoulomb. One abcoulomb equals 10 coulombs.

AB-CUM-O-GRAPH.—Trade name for miniature motion-picture machines made by A. B. Cummings, 53-59 Falmouth St., Attleboro, Mass.

ABELL-HOWE CO.—332 S. Michigan Ave., Chicago, Ill. Manufacturer of power transmission chains. President and treasurer, O. J. Abell; secretary, C. E. Kane.

A-BEST-O.—Trade name for electric irons manufactured by the Dover Mfg. Co., Dover, Ohio.

ABFARAD.—The capacitance of a conductor or system of conductors is measured by the quantity or charge of electricity required to raise the potential of the conductor one unit. The absolute unit of capacitance is that capacitance whose potential is raised one abvolt by one abcoulomb. This unit, which is sometimes called the abfarad, is much too large for practical purposes and a smaller one, the farad, is used. One abfarad equals 10^9 farads.

ABHENRY.—Whenever the intensity of a current in a conductor changes, an electromotive force is developed which opposes the change. The value of this electromotive force depends upon certain physical characteristics of the circuit which when grouped are called its inductance. The absolute unit of inductance is that in which one abvolt is induced when the current changes at the rate of one abampere per second. This is a small unit and has no distinctive name, although sometimes called the abhenry; 1 abhenry$=10^{-9}$ henry.

ABJOULE.—The unit of work in the absolute electromagnetic system of units is the work done in a circuit by a unit quantity of electricity (abcoulomb) against a unit potential difference (abvolt). Although this small unit of work has no universally accepted name, it is often called the abjoule; 1 abjoule$=1$ erg$=10^{-7}$ joule.

ABLETT CO., CHARLES R.—199 Fulton St., New York, N. Y. Manufacturer of incandescent lamps.

ABOHM.—The absolute unit of electrical resistance is that resistance which requires an electromotive force of one abvolt to force one abampere through it. This is a very small unit and is usually called the abohm. It equals one-billionth of an ohm, or 10^9 abohms equal one ohm.

ABOLITE.—Trade name for porcelain enameled reflectors manufactured by the National Screw & Tack Co., AB Products Division, Cleveland, Ohio.

ABRASIVE CO.—Philadelphia, Pa. Manufacturer of electrically produced abrasives and grinding wheels. Business established 1894. President, Louis T. Byers; vice-presidents, J. Harvey Byers, Lawrence J. Morris; secretary and treasurer, Samuel P. Byers; general manager, J. Harvey Byers. Main office, James & Fraley Sts., Philadelphia, Pa. Factories, Philadelphia, Pa., and Hamilton, Ont., Can. Branch office and warehouse, 566 W. Washington Blvd., Chicago, Ill. Sales representative, D. W. Grover, 30 Church St., New York, N. Y.

ABRASIVE BLOCKS, HONES, STONES, ETC.—Abrasives, many of which are produced electrically, are often made up in the form of blocks or bricks, hones, stones, etc., as well as grinding wheels and commutator stones. The blocks are used for special purposes, such as for cleaning castings and other rough work, rubbing down concrete, marble, slate and mosaic work and in the finer grades as whetstones and hones for sharpening knives and other industrial and household cutting tools and devices.

Manufacturers:

ACME ABRASIVE CO., 2221-23 Orchard St., Chicago, Ill. "Acme."

ABRASIVES, ELECTRICALLY PRODUCED.—Many of the abrasives now in use for grinding, smoothing and polishing tools, metal parts, etc., are electrically produced. This industry has become more prominent within the last few years because of the practical cessation of international shipping during the war, which prevented many of the natural abrasives, such as emery, garnet, quartz, corundum, pumice, tripoli, etc., from being imported in large quantities. At the same time the high-speed production of munitions necessitated a greater use of abrasives, and the electrically produced abrasives were found to be superior to the natural abrasives in most cases.

Those produced electrically are known under various trade names, of which the most common is carborundum. Some of the others are electrolon, exolon, silundum, carbonite, aloxite, alundum and borolon. The last three are electrically fused alumina, while the others are silicon carbide, which see. These materials are made in various degrees of hardness, some of them approaching that of the diamond, which is the hardest known substance.

The furnace much used for fusing alumina is a special arc furnace in the form of a truncated cone. High-grade bauxite or other aluminous ore is fed in at the top continuously and melted down until the

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furnace is full. The mass of several tons is then allowed to crystallize and finally is broken and crushed to grains of desired sizes. In preparing the silicon carbide products a furnace consisting of a fire-brick bed mounted in sections is used. Brick walls are used for the ends and a bundle of carbon electrodes is supported in each end. A more complete description of the process is given under Silicon carbide.

Manufacturers:

Abrasive Co., James & Fraley Sts., Philadelphia, Pa. "Borolon," "Electrolon."
Canadian Aloxite Co., The, Niagara Falls, Ont., Can.
Carborundum Co., The, Niagara Falls, N. Y.
Exolon Co., Blasdell, N. Y. "Carbolon," "Exolon."
Foote Mineral Co., Inc., 407 N. 19th St., Philadelphia, Pa.
General Abrasive Co., Inc., College Ave., Niagara Falls, N. Y. "Lionite," "Carbonite."
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Norton Co., Worcester, Mass. "Alundum," "Crystolon," "Silundum."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.

AB-REC.—Trade name for electrolytic rectifiers manufactured by the American Battery Co., 1134 Fulton St., Chicago, Ill.

A. B. S.—Trade name for casting copper produced by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

ABSOLUTE BLOCK SYSTEM.—See Signaling systems, railway block and interlocking.

ABSOLUTE CON-TAC-TOR CO.—127 N. Dearborn St., Chicago, Ill. Manufacturer of switches, contactors, sign flashers, thermostats, relays and interrupters. Business established 1917. President and general manager, Louis A. M. Phelan; vice-president, Paul K. Cramblet; secretary, James A. Crotty; treasurer, Herman Larson; sales manager, William P. Templeman.

ABSOLUTE UNITS.—See Units, systems of.

ABSORBERS, SHOCK, FOR LAMPS.—Special spring or other resilient suspension devices for lamps that are mounted in factories or other places where they are subjected to violent vibration. In the early days of the tungsten-filament lamp the filaments were very fragile and there was frequent need for shock absorbers. This has been gradually removed by the improvement in filament manufacture, especially the production of drawn-wire filaments. More recently a specially rugged tungsten lamp (mill type Mazda) has been introduced for use in places where the most violent vibration is met with. The need for special shock absorbers has consequently been greatly reduced.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Shock Absorbers furnished separately or with fixture aligners or with suspension fittings.—Adv.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1228.)

ABVOLT.—Whenever a conductor is moved across a magnetic field an electromotive force is induced in the conductor. This physical principle is made the basis of the definition of the absolute unit of electromotive force. One absolute unit of electromotive force is induced in a conductor when it cuts one magnetic line per second. It is usually called the abvolt. This is a small unit and is equal to one hundred-millionth of a volt; 10^8 abvolts equal one volt.

ABWATT.—The absolute unit of electric power or rate of doing work in a circuit is the work done in a noninductive circuit by a unit current (abampere) acting against a unit potential (abvolt). This power unit is frequently called the abwatt. It is a very small unit; 1 abwatt=1 abjoule per second=1 erg per second=10^{-7} watt.

A. C.—Trade name for electric horn manufactured by the Russell Electric Co., Danbury, Conn.

A-C. OR A. C.—Abbreviations for alternating current. The form a-c. is preferred when used adjectively, as in a-c. circuit, a-c. voltmeter. A. C. is the older form. Present practice tends toward spelling out alternating current, unless used adjectively as above.

A-C ELECTRICAL MFG. CO., THE.—4th St. U. B. Bldg., Dayton, Ohio. Manufacturer of motors, generators, switchboards and farm lighting and power plants. Business established 1918. President, Kelly R. Jacoby; vice-president and general manager, R. Harry Croninger; secretary and treasurer, C. H. Bosler.

ACCESSORIES MFG. CO.—2311-29 N. Crawford Ave., Chicago, Ill. Manufacturer of electrical automobile accessories. Business established 1916. President and general manager, Fillmore W. Todd, secretary, G. G. Barry; treasurer, Carl Otrennba. Sales representative, W. L. Marsh, David Whitney Bldg., Detroit, Mich.

ACCUMULATORS.—A term formerly much used for storage batteries or secondary cells and still so used abroad, but rarely in the United States. See Batteries, storage.

ACE.—Trade name for fractional horsepower motors manufactured by the A-C Electrical Mfg. Co., 4th St. U. B. Bldg., Dayton, Ohio.

ACE.—Trade name for commercial lighting fixture manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

ACETIC ACID.—$HC_2H_3O_2$; can be made by the electrolytic oxidation of acetylene, C_2H_2.

ACETONE.—CH_3 CO CH_3; can be made by the electrolytic oxidation of acetylene, C_2H_2.

ACETYLENE.—C_2H_2; a gas made by the action of water on calcium carbide; can be converted by electrolytic oxidation into acetone and acetic acid.

ACHESON, EDWARD GOODRICH.—An American inventor, electrochemist and manufacturer, born at Washington, Pa., in 1856. At the age of 16 he was taken from school to fill a position at his father's blast furnace. In 1873 his father died and from then until 1880, when he began to work for Thomas A. Edison as an assistant draftsman, he had an unsettled career, being successively chainman in a surveying party, railroad ticket clerk, engineer, bookkeeper and iron miner. While in Paris in 1881, a chance remark made by a famous gem expert caused young Acheson to appreciate the value of an efficient abrasive, and this led to researches that in 1891 resulted in his discovery of carborundum. Now millions of pounds are being produced annually at the Acheson plant at Niagara Falls, where there are installed some of the largest electric furnaces in the world. Between 1895 and 1899, Dr. Acheson worked out a process for making pure graphite, produced for the first time from nongraphitic amorphous carbon. This discovery led to a new realm of scientific development, resulting in the much wider use of the electric furnace commercially. An important discovery of Dr. Acheson's came as the result of an attempt in 1906 to increase the abrasive value of carborundum. Instead of a harder, a softer material was discovered, an ideal lubricating product. He discovered the underlying principle of deflocculation, or dividing the particles of matter into a finer state, and from his experiments in this field a number of highly regarded commercial lubricants have resulted. The mixture of deflocculated graphite and water has made possible the preciseness with which tungsten wire is drawn for incandescent lamp filaments. In 1909 he received the Perkin medal from the Society of Chemical Industry; from the Academy of Arts and Science, the Rumford medal (1907), and twice from the Franklin Institute the John Scott medal.

ACHESON GRAPHITE CO.—Niagara Falls, N. Y. Manufacturer of graphite and graphite products. Business established 1900. President, Dr. Edward G. Acheson; first vice-president and general manager, Acheson Smith; second vice-president, E. G. Acheson, Jr.; secretary, Orrin E. Dunlap; treasurer, Frank N. Coe; sales manager, William H. Arison. Main office, Niagara Falls, N. Y. Factories, Niagara Falls, N. Y., Buffalo, N. Y., and Niagara Falls, Ont., Can. Branch offices, 20 E. Jackson Blvd., Chicago, Ill.; 90 West St., New York, N. Y.

ACHESON OILDAG CO.—Port Huron, Mich. Manufacturer of lubricating oils and graphite. President, Dr. Edward G. Acheson; vice-president, Edward G. Acheson, Jr.; acting secretary, M. Warren Taylor; acting treasurer, H. L. Miller; sales manager, George R. Siegrist.

ACHESON TOOL & DIE CO.—609 N. 4th St., Columbus, Ohio. Manufacturer of special tools, dies, jigs, fixtures, etc. H. S. Acheson, general manager.

ACID AND ALKALI PROOF COATING.—Trade name for insulating varnish manufactured by the Reisenman Mfg. Co., Ltd., Franklin, Pa.

ACKER PROCESS.—A process for the production of chlorine and caustic soda by the electrolysis of fused sodium chloride. The cell is of cast iron, lined with magnesite brick, the anodes of graphitized carbon, and the cathode a layer of molten lead in the bottom of the cell. The cells are operated at a temperature of about 850° C., each absorbing between 6 and 7 volts, with a current density of about 300 amp. per square decimeter. Chlorine is drawn off mixed with about nine times its volume of air. The cathodic lead-sodium alloy passes out to a small chamber where the sodium is oxidized to caustic soda by a steam jet. The molten lead and caustic are separated by gravity, the caustic flowing off continuously, and the lead being conducted back to the cell, while the hydrogen generated burns at the mouth of the chamber. The process was operated for several years at Niagara Falls, but was abandoned after the destruction of the plant by fire.

ACKERMAN.—Trade name for friction tape manufactured by the Ackurate Rubber Co., Inc., 253 Broadway, New York, N. Y.

ACKERMAN-JOHNSON CO. — 625 W. Jackson Blvd., Chicago, Ill. Manufacturer of expansion anchors. Business established 1915. President, C. N. Ackerman; secretary, J. L. Johnson; treasurer, William A. Stein.

ACKLEY ADJUSTABLE.—Trade name for brakes for electric railway cars made by the National Brake Co., Inc., 888 Ellicott Sq., Buffalo, N. Y.

ACKURATE RUBBER CO., INC.—253 Broadway, New York, N. Y. Manufacturer of insulating tape. Business established 1920. President, Willard C. Candee; secretary and treasurer, Charles V. Ackerman. Factory, Clifton, N. J.

ACME.—Trade name for commutator stones, grinding wheels, abrasives, etc., manufactured by the Acme Abrasive Co., 2221-23 Orchard St., Chicago, Ill.

ACME.—Trade name for transformers and radio apparatus made by the Acme Apparatus Co., 27 Windsor St., Cambridge, Mass.

ACME.—Trade name for power transmission belting manufactured by the Acme Belting Co., Niles, Mich.

ACME.—Trade name for battery-charging equipment manufactured by the Acme Electric & Mfg. Co., 1444 Hamilton Ave., Cleveland, Ohio.

ACME.—Trade name for steel squares and levels manufactured by the Acme Level & Mfg. Co., Toledo, Ohio.

ACME.—Trade name for packing and shipping hardware and supplies manufactured by the Acme Steel Goods Co., 2840 Archer Ave., Chicago, Ill.

ACME.—Trade name for storage batteries made by the Acme Storage Battery Corp., 19 Main St., Poughkeepsie, N. Y.

ACME.—Trade name for wire manufactured by the Acme Wire Co., Dixwell Ave., New Haven, Conn.

ACME.—Trade name for pipe threading tools manufactured by the American Tap & Die Co., Greenfield, Mass.

ACME.—Trade name for bells and buzzers manufactured by the Ansonia Electrical Co., Ansonia, Conn.

ACME.—Trade name for steam engines manufactured by the Automatic Furnace Co., 1st & Harshman Sts., Dayton, Ohio.

ACME.—Trade name for weatherproof sockets, cleat rosettes and receptacles manufactured by the Crescent Electric Co., Mountain Grove, Mo.

ACME.—Trade name for motors, generators, motor-driven polishing machines, fans, etc., manufactured by the Dilg Mfg. & Trading Co., 27 E. 125th St., New York, N. Y.

ACME.—Trade name for oil filters manufactured by the Walter L. Flower Co., 312-314 S. 8th St., St. Louis, Mo.

ACME.—Trade name for switches and connectors manufactured by the Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill.

ACME.—Trade name for oilers manufactured by the Waterbury Mfg. Co., Waterbury, Conn.

ACME.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

ACME ABRASIVE CO.—2221-23 Orchard St., Chicago, Ill. Manufacturer of commutator stones, grinding wheels, abrasives, etc. Business established 1917. President

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and general manager, William L. Weber; vice-president, Frank Gass; secretary and treasurer, K. M. Qualey.

ACME APPARATUS CO.—27 Windsor St., Cambridge, Mass. Manufacturer of transformers and radio apparatus. Business established 1919. President, Ashley C. Zwicker; secretary, Melville Eastham; treasurer, Claude F. Cairns.

ACME BELTING CO.—Niles, Mich. Manufacturer of belting for motors and generators. Main office and factory, Niles, Mich. Branch offices, Chicago, Ill.; New Orleans, La.; Kansas City, Mo.

ACME DIE CASTING CORP.—Brooklyn, N. Y. Manufacturer of die castings. Business established 1915. President, G. W. Bungay; vice-president and treasurer, A. G. Hamilton; secretary and sales manager, H. I. Mulligan. Main office, 87 35th St., Brooklyn, N. Y. Factory, Brooklyn, N. Y. Branch offices, 176 Federal, Boston, Mass.; Philadelphia, Pa.; Detroit, Mich.; 175 W. Jackson Blvd., Chicago, Ill.; Cleveland, Ohio; 244-46 St. Paul St., Rochester, N. Y.

ACME ELECTRIC & MFG. CO., THE.—1444 Hamilton Ave., Cleveland, Ohio. Manufacturer of battery-charging equipment. Business established 1917. President and general manager, G. R. Hillstrom; vice-president and sales manager, R. A. Lals; secretary and treasurer, C. H. Bunch.

ACME ENGINEERING CO.—Louisville, Ky. Manufacturer of farm lighting plants.

ACME GAS & ELECTRIC FIXTURE CO.—132 W. 14th St., New York, N. Y. Manufacturer of portable electric lamps.

ACME LAMP WORKS.—55 Cambridge Ave., Jersey City, N. J. Manufacturers of nitrogen lamps. Business established 1919. President, Nathan Schwartzer; general manager, R. A. Berrenberg.

ACME LEVEL & MFG. CO.—Toledo, Ohio. Manufacturer of steel squares, levels and racks.

ACME LIGHTING FIXTURE CO., INC.—132-136 W. 14th St., New York, N. Y. Manufacturer of lighting fixtures and portable lamps. President, D. R. Weil; treasurer, H. S. Weil.

ACME PIPE STRAP CO.—Detroit, Mich. Manufacturer of conduit and pipe straps. Andrew J. Weatherwax, proprietor.

ACME RUBBER MFG. CO.—Trenton, N. J. Manufacturer of rubber belting for motors and generators.

ACME STEEL & MALLEABLE IRON WORKS, INC.—245 Military Rd., Buffalo, N. Y. Manufacturer of malleable iron castings. Business established 1895. President, D. J. Carson; vice-president, D. W. Roper; secretary, C. J. Brandt; treasurer, F. K. Hiser; general manager, W. C. Letchworth.

ACME STEEL GOODS CO.—Chicago, Ill. Manufacturer of packing and shipping hardware and supplies. Business established 1880. President, James E. MacMurray; vice-president and secretary, R. H. Norton; vice-president, F. C. Gifford; treasurer, Donald MacMurray. Main office, 2840 Archer Ave., Chicago, Ill. Factories, Chicago, Ill., and Riverdale, Ill. Branch offices, 295 Lafayette St., New York, N. Y.; 10-14 Tift St., Atlanta, Ga.; 311 California St., San Francisco, Cal.

ACME STORAGE BATTERY CORP.—19 Main St., Poughkeepsie, N. Y. Manufacturer of storage batteries. Business established 1918. President, William H. Reid; vice-president and general manager, Aldo Bologuesi; secretary and treasurer, Frederick L. Reid; sales manager, H. Eggleston. Sales representative, A. J. Fisk, 967 Woodward Ave., Detroit, Mich.

ACME WIRE CO., THE.—New Haven, Conn. Manufacturer of wire and wire products. Business established 1904. President, Victor Morris Tyler; vice-presidents, E. L. Hartpence, L. S. Horner, L. Styler; secretary, James E. Wheeler; treasurer, Brower Hewitt; general manager, Edgar L. Hartpence; sales manager, Leonard S. Horner. Main office and factory, Dixwell Ave., New Haven, Conn. Branch offices, 52 Vanderbilt Ave., New York, N. Y.; 521 Guardian Bldg., Cleveland, Ohio.; 53 W. Jackson Blvd., Chicago, Ill.

ACMETAL.—Trade name for lighting fixtures and portable electric lamps manufactured by the Acme Gas & Electric Fixture Co., 132 W. 14th St., New York, N. Y.

ACORN.—Trade name for threading dies manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

ACORN.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

ACORN.—Trade name for electric ranges manufactured by the Rathbone Sard Electric Co., Inc., Albany, N. Y.

ACORN INSULATED WIRE CO.—77 Richards St., Brooklyn, N. Y. Manufacturer of electric light and telephone wires. Business established 1914. Walter R. Prosser and Alfred L. Prosser, active partners.

ACORNS, PULL CHAIN.—At the lower end of the pull chain so often used with pull sockets, rosettes, ceiling and fixture switches, there is often provided an acorn-shaped brass ornament that also serves conveniently in grasping the chain. Sometimes this may be rendered luminous; for the latter type see Attachments, luminous, for switch buttons, pull chains, etc.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Eade, John E., 1245 Eddy St., Providence, R. I.
Hubbell, Inc., Harvey, Bridgeport, Conn. "Abbott."
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display advertisement on page 1327.)
Stimpson Co., E. B., Brooklyn, N. Y.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

ACOUSTICON.—Trade name for hearing device for the deaf and for detective service, manufactured by the Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.

ACTINIC RAYS.—A term applied to that portion of the spectrum which is especially active in producing chemical reaction, as for example in a photographic plate. The shorter waves of light in the violet and ultra-violet, perhaps on account of their high frequency, produce chemical reactions not occurring when waves of less frequency are used. These short waves are readily absorbed by water and glass and even by air. For their study lenses and prisms of quartz or fluorite must be employed.

ACTIONS, PIPE ORGAN, ELECTRIC.—The use of electrically operated pipe organs is increasing rapidly, because of the fact that the console or keyboard may be located most advantageously, which often means at a distance from the organ pipes and air system. The electrical actions for the organs consist of sets of magnet coils which operate the valves controlling the inlet of air to the pipes. Contacts are provided at the keys and a cable of rather small wires runs to the valve magnets. These are all low-voltage coils, not over 15 volts, which low tension is supplied by a motor-generator or a primary battery. Sometimes the valve magnet and valve are supplied as a unit by the coil manufacturers.

Manufacturers:

WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

ACTIVE COMPONENT.—The active or inphase component of an alternating current is that component which is in phase with the voltage; it equals the product of the current by the cosine of the phase difference between it and the e. m. f. Similarly the in-phase or active component of an alternating e. m. f. is the product of the e. m. f. by the cosine of the phase difference.

ACTON ELECTRIC CO., INC.—Newark, N. J. Manufacturer of tungsten incandescent lamps. President, George K. Hamblin; vice-president, Eugene McOuat; secretary and treasurer, Edward S. Walsh. Main office and factory, 119 Sussex Ave., Newark, N. J. Branch office, 1133 Broadway, New York, N. Y.

ACYCLIC.—Without cycles or periodic changes; a term used to describe a generator in which there are no regular reversals of current in the conductors.

AD.—Trade name for bells manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

ADAM CO., THE E. C.—902 Pine St., St. Louis, Mo. Manufacturer of lighting fixtures. Business established 1920. President and general manager, E. C. Adam; vice-president, Herbert S. Griffin; secretary and treasurer, Richard N. Loeb.

ADAM ELECTRIC CO., FRANK.—St. Louis, Mo. Manufacturer of knife switches, switchboards, panelboards, steel cabinets and switchboard fittings. President and treasurer, Frank Adam; vice president, secretary and general manager, Fred B. Adam; sales manager, Philip Rabon. Main office and factory, 3650 Windsor Pl., St. Louis, Mo. Branch offices, 400 Penobscot Bldg., Detroit, Mich.; 1814 1st National Bank Bldg., Cincinnati, Ohio; 200 Builders Exchange Bldg., Minneapolis, Minn.; 821 Union St., New Orleans, La.; 506 Victor Bldg., Kansas City, Mo.; 208 N. Wells St., Chicago, Ill.; 1312 Great Southern Life Bldg., Dallas, Tex.

ADAMANT PORCELAIN CO.—East Liverpool, Ohio. Manufacturer of porcelain knobs.

ADAMANTINE.—Trade name for pipe threading tools manufactured by the American Tap & Die Co., Greenfield, Mass.

ADAMS.—Trade name for dental x-ray unit manufactured by the Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.

ADAMS.—Trade name for bell-ringing transformers manufactured by the R. Haas Electric & Mfg. Co., 305 E. Monroe St., Springfield, Ill.

ADAMS & WESTLAKE CO.—319 W. Ontario St., Chicago, Ill. Manufacturer of car lighting fixtures, headlights, signal lamps, etc. President, Ward W. Willis; vice-president and treasurer, Frederick T. Vaux; secretary, William S. Estell; general manager, W. H. Baldwin.

ADAMS MORGAN CO.—Alvin Place, Upper Montclair, N. J. Manufacturer of telegraph and radio apparatus, electrical toys, novelties, battery motors, etc. Business established 1910.

ADAMS X-RAY CO.—Maple & Rivard Sts., Detroit, Mich. Manufacturer of x-ray apparatus.

ADAMSON & CO., JOSEPH.—Columbia & Germantown Aves., Philadelphia, Pa. Manufacturers of insulating tapes, narrow fabrics, etc. Business established 1860.

ADAPTABLE.—Trade name for lamp changers manufactured by the McGill Mfg. Co., Valparaiso, Ind.

ADAPT-A-LITE.—Trade name for extension portable lamp with attachment plug manufactured by the Anderson Electric & Equipment Co., 154-160 Whiting St., Chicago, Ill.

ADAPTERS, CONDUIT BUSHING.—A malleable iron fitting screwed to the end of a threaded conduit and having either a reduced or enlarged threaded opening at the other end to make it possible to run small conduits into larger conduit holes and also to eliminate the work of enlarging knock-out holes in cabinets or boxes by reaming.

Manufacturers:

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. Write for descriptive Catalog 33.—Adv.

ADAPTERS, FLEXIBLE ARMORED CORD.—A metal fitting which clamps around the armor of the cord and on which is a short threaded tube. On this tube a socket may be screwed, the cord to the socket being led through the tube. A second type of this device, called a "rosette adapter", provides for attaching a flexible armored cord as a drop from a ceiling rosette to a socket.

Manufacturers:

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display advertisement on pages 1302-1304.)

ADAPTERS, FUSE.—Holders of insulating material, usually porcelain, each provided with a screw thread at one end and designed for using a ferrule-type cartridge fuse in a plug-fuse type screw receptacle or cutout base. The adapter is hollow and permits of the cartridge fuse being placed within it. Fuse adapters are also made to permit installing smaller cartridge fuses in a large size cutout block. Ferrule-type cartridge fuses may be installed in knife-blade contacts, or vice versa, by using appropriate adapters.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave & Montgomery St., Jersey City, N. J.

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Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant".
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."

ADAPTERS, LAMP, MISCELLANEOUS.—Devices for adapting usually an older type of lamp equipment for a more modern type of electric illuminant. They are of various types. One is arranged to convert a table oil lamp into an electric lamp by replacing the burner with a socket that fits securely in place. Another changes an old fashioned candle stick into an electric candle by inserting a candle socket. Other types convert oil signal lamps for railroads or ships into electric lamps. Still another type provides a socket and mounting therefor in an arc lamp housing, thus adapting the latter for the modern, efficient types of incandescent lamps. Adapters for adapting projecting arc lamps for incandescent lamps are separately listed below. For those adapters that adapt a socket for a different size lamp see Adapters, reducers and extensions, socket.

Manufacturers:

Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y. "Fittite."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Chemelectric Co., The, 4327 Kenmore Ave., Chicago, Ill. (Exclusive distributor, G & W Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill.
CONVENOLITE CO., THE, 231 N. Wells St., Chicago, Ill. General distributors, Schweitzer & Herz, 231 N. Wells St., Chicago, Ill. The "Convenolite" adapter. See entry under Fixtures, lighting, residence.—Adv.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Fulper Pottery Co., Flemington, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
IRON PRODUCTS CORP., 418 S. 2nd St., LaCrosse, Wis.
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Metal Specialties Mfg. Co., 338-53 N. Kedzie Ave., Chicago, Ill. "Presto." (automobile).
Morse, Frank W., 289 Congress St., Boston, Mass.
Motor Specialties Co., Waltham, Mass.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. The "Curtis" adapter for lighting the entire room from an ordinary table or floor lamp. See Adv. page 1405.—Adv.
Pennefather, James S., 358 W. 43rd St., New York, N. Y. "Vaselite."
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Timberlake & Sons, J. B., 114-116 E. Washington Ave., Jackson, Mich.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

ADAPTERS, LIGHTING FIXTURE.—Devices for changing the character of lighting fixtures from one type of lighting to another, for instance, from direct lighting to semi-indirect or total indirect lighting. One equipment includes an attachment plug that is screwed into a direct lighting fixture socket and carries one or two arms downward to an inverted socket and suitable shade or reflector holder. The downwardly turned reflector and pendent lamp can thus be inverted to make the outfit a semi-indirect lighting fixture in which a larger and more efficient lamp may be used without glare.

Manufacturers:

CONVENOLITE CO., THE, 231 N. Wells St., Chicago, Ill. "Convenolite." (General distributors, Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.)

ADAPTERS, PROJECTING LAMP.—Projecting machines for motion pictures, etc., were formerly all equipped for carbon arc lamps, but recently the many advantages of the special concentrated-filament gas-filled tungsten lamps for this purpose have led to their adoption. Adapters, consisting of a metal housing and lamp receptacle, are made to fit inside or in front of the original arc-lamp housing on the old machines. Another use of adapters for projecting lamps or floodlights is where it is desired to use a medium-base lamp in the mogul-base sockets usually provided. Adapters for this latter purpose are listed under Adapters, reducers and extensions, socket.

Manufacturers:

Argus Enterprises, Inc., The, 815-823 Prospect Ave., Cleveland, Ohio. "Argus-GE Mazda," "Sheck Universal."
Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill. "Motiograph."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.

ADAPTERS, RECEPTACLE.—A small fitting used to adapt an Edison screw type receptacle for use with attachment plugs having blade or prong contacts, or vice versa. The former type of adapter screws into the receptacle and has receiving contacts into which the blades or prongs are pushed. In the case of most separable or two-part attachment plugs, the body part of the plug with the screw contacts can serve as a receptacle or socket adapter. Adapters for receptacles intended to receive blade or prong type plugs have the prongs or blades at one end and a screw receptacle at the other end.

Manufacturers:

Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Sockets or receptacles are sometimes too short or have been installed too far back in some recess to permit insertion of lamps or attachment plugs, or the attaching of shades. No. 91 socket extension (at left) will



No. 91 No. 98 No. 4396

lengthen an Edison medium base socket 1¼ ins., and No. 4396 will extend a mogul base socket or receptacle 2½ ins. No. 98 socket reducer (center) makes it possible to connect a medium base lamp or plug to a mogul base socket. No. 1006 adapter (right) makes it possible to connect an Edison base attachment plug or lamp to a standard parallel slotted base receptacle.—Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Radio Electric Co., The, 3807 5th Ave., Pittsburgh, Pa.

ADAPTERS, REDUCERS AND EXTENSIONS, SOCKET.—Socket adapters are devices used chiefly for adapting a lamp socket for use with lamps of smaller bases or lamps of similar rating but different type of base. Since most of the adapters permit use of smaller lamps in sockets of higher rating, they are often called socket reducers. The commonest type resembles a plug fuse in appearance, but has an internal center contact and screw shell connected to the outer contact and shell, respectively. They are made in several sizes to adapt mogul-base sockets for medium-base lamps, medium-base sockets for candelabra lamps, candelabra sockets for miniature lamps. Adapters are also made to permit bayonet or Edi-Swan sockets, which are much used for automobile lamps, to be used for candelabra lamps; also to permit bayonet sockets with single contacts to be used for bayonet catch lamps having two contacts, or the reverse. The latter consists of reversible fiber disks with suitable metal rings on each side. Sometimes it is desired to have a lamp extend further from the socket than it does in order to have its light center (filament center) be at the proper point in the reflector. A socket extension is then used; it consists of a plug at one end and a socket at the other, the distance between the center contacts being the desired extension distance. Similar extensions (usually about 4½ ins. long) are made for candelabra sockets to permit putting a candle stem around the extension to simulate a candle. Another type of socket adapter is a modification of the socket extension but includes an adjustable joint to permit changing the angle of the lamp, usually from oblique to pendent position; this is sometimes called an angle adapter. For a description of the different types and ratings of lamp bases, see Bases, incandescent lamp.

Manufacturers:

Anylite Electric Co., Fort Wayne, Ind. "Anylite."
B. & W. Specialty Mfg. Co., 100 Boylston St., Boston, Mass.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See entry under Adapters, receptacle.—Adv.
Berghman Co., 5428 Fulton St., Chicago, Ill.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributer, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

ADAPTERS, SWITCH.—A metal frame used with metal molding or raceways and provided with tapped and threaded lugs for mounting single or gang flush switches. Adapters consisting of a metal ring with adjustable arms are also made to serve as a cover for standard outlet boxes and a mounting plate for surface switches.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich.

ADAPTI CO., THE.—919-925 West St., Cleveland, Ohio. Manufacturer of conduit fittings. Business established 1911. President and treasurer, William B. Greene; vice-president, M. C. Rosenfeld; secretary and general manager, J. C. Boyton.

ADAPTIBOX.—Trade name for conduit boxes manufactured by the Adapti Co., 919-925 West St., Cleveland, Ohio.

ADAPTI-TERMI-WIRE-TAP. — Trade name for conduit outlet box manufactured by the Adapti Co., 919-92 West St., Cleveland, Ohio.

ADBRO MFG. CO.—Pittsburgh, Pa. Manufacturer of electric vibrators.

ADCO.—Trade name for gears manufactured by the American Die & Tool Co., 2nd and Buttonwood Sts., Reading, Pa.

ADD WATER.—Trade name for dry batteries manufactured by the Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.

ADDIE.—Trade name for fuse testers manufactured by the Electric Specialty Co., 233 N. Elm St., Cresco, Iowa.

ADDITION AGENTS.—Substances added to electrolytic baths from which metal is being deposited, whose function is to make smoother and less crystalline the metal plating. They are usually organic substances, such as glue, albumin, acetone,

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tincture of aloes, oil of cloves, etc. They are supposed to act either as reducing agents preventing oxidation, or as colloidal substances hindering crystallization. They are almost indispensable in depositing metals such as lead, which usually plate out in mossy, fern-like or tree-like deposits.

ADDUCTION.—The reverse of reduction. The action taking place at the anode of an electrolytic cell, whereby this chemical action results. Speaking strictly chemically, it consists in raising the valence of the chemical affected, either by increasing the valence of the basic element of the compound or by liberating the acid element of this compound, which in effect is also a raising of the acid element's valence from a negative quantity to zero. Formerly called "oxidation." Examples are: adduction of ferrous sulphate to ferric sulphate; liberation of oxygen or chlorine gas.

ADJUSTABLE FIXTURE CO., THE.—62 Mason St., Milwaukee, Wis. Manufacturer of lighting fixtures, portable lamps, bases, shades, etc. Business established 1911. President, William L. Schumaker; vice-president, H. W. Schumaker; secretary and treasurer, George Honwers.

ADJUSTALITE.—Trade name for portable lamps manufactured by the Franks Mfg. Co., Rock Island, Ill.

ADJUSTAROD.—Trade name for guy anchors manufactured by the Crouse-Hinds Co., Wolf & 7th North Sts., Syracuse, N. Y.

ADJUSTERS. AUTOMATIC BRAKE SLACK, ELECTRIC RAILWAY.—A device to automatically adjust the brake rigging of a car and truck for the slack caused by brake shoe wear, in order to maintain, as nearly as practicable, a uniform piston travel. There are two principal types, those actuated by air pressure in the air-brake cylinder and those operating mechanically when the slack in the brake rigging exceeds a pre-determined amount.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill. "Anderson."
Westinghouse Traction Brake Co., Pittsburgh, Pa.

ADJUSTERS, CORD.—Devices for taking up slack cord to pendent lamps when these are raised or lowered. Made in many forms, ranging from a flat piece of fiber having two slots into which the cord is looped, to spring-operated take-up wheels, spring rollers or reels, and counterbalancing weights and pulleys.

Manufacturers:

American Enamel Co., Neville St., Providence, R. I.
American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Q & C."
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. "Reelite."
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill. "Gem."
Carter, J. W., Abilene, Tex. "Eclipse."
Electric Specialty Sales Co., 90 West St., New York, N. Y. "Slip-On."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Gund Mfg. Co., La Crosse, Wis. "Two Ball."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
King Electric Co., Canton, Ohio.
McGill Mfg. Co., Valparaiso, Ind. "Innovate," "Universal."
Morse, Frank W., 289 Congress St., Boston, Mass. "Handy."
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory, "Super Seasoned."
Novelty Turning Co., 34 Main St., Norway, Me.
Nygren Bros. Mfg. Co., Lindsborg, Kans. "Hagstrom."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.

ADJUSTERS, LAMP.—Devices to permit adjusting the angle of pendent lamps. A short arm is attached to the shade holder or to a collar around the socket; at the other end of the arm is an adjustable clamp that may be moved along the lamp cord, thus tilting the lamp to any desired angle from the vertical to practically the horizontal. Such lamp adjusters are often used in connection with cord adjusters, the latter raising and lowering the lamp without changing its angle. Adapters for changing the angle of lamp sockets are included under Adapters, reducers and extensions, socket. Where a lighting fixture arm or other part is adjustable it is usually called an adjustable fixture; see Fixtures, lighting, adjustable.

Manufacturers:

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
Faries Mfg. Co., Decatur, Ill.
Gund Mfg. Co., 326 Jay St., La Crosse, Wis.
Morse, Frank W., 289 Congress St., Boston, Mass. "Webster."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Yost Electric Mfg. Co., 1805 Hawthorne St., Toledo, Ohio.

ADJUSTERS, OUTLET PLATE OR BOX.—A much used form consists of a flat slotted bar which is fastened to studding or ceiling joists to save time in the installation of outlet or switch boxes or outlet plates. The box is moved along the slotted bar to the desired location and slot, and secured in place by tightening a locknut. For tile ceilings or floors in fire-resistive buildings an adjuster in the form of an adjustable hanger provides for the different thicknesses of tile.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Faries Mfg. Co., Decatur, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

ADLAKE.—Trade name for lighting specialties manufactured by the Adams & Westlake Co., 319 W. Ontario St., Chicago, Ill.

ADLIGHT.—Trade name for adjustable lighting fixtures manufactured by K. F. M. Lindblad, Boston, Mass.

ADMIRAL.—Trade name for oxy-acetylene cutting and welding apparatus and welding supplies manufactured by the Admiral Welding Machine Co., 413-415 E. 15th St., Kansas City, Mo.

ADMIRAL WELDING MACHINE CO., THE.—413-415 E. 15th St., Kansas City, Mo. Manufacturer of oxy-acetylene cutting and welding apparatus and welding supplies. W. A. McDougall, sole owner.

ADMITTANCE.—The admittance of an a-c. circuit is the factor by which the impressed e. m. f. must be multiplied to give the total current. Its symbol is Y. It is the reciprocal of the impedance. $Y=\sqrt{g^2+b^2}=1/Z$, where g is the conductance, b is the susceptance, and Z is the impedance.

ADON PRODUCTS, INC.—516 5th Ave., New York, N. Y. Manufacturer of electric radiators and electrotherapeutic apparatus. Business established 1919. President and general manager, H. A. Mackie; vice-president, C. J. Bippart; secretary and treasurer, J. Mackie; sales manager, W. J. Meyer.

AD-PHOTO-SCOPE CO.—308 N. Michigan Blvd., Chicago, Ill. Manufacturer of motion-picture machines. President, F. H. Hibberd, Jr.; vice-president, Adolf Monsen; secretary, Edwin L. Barker; treasurer, John Gulliksen.

ADRIAN.—Trade name for insulating pressboard manufactured by C. B. Hewitt & Bros., 16-24 Ferry St., New York, N. Y.

ADSCO.—Trade name for underground conduit systems for steam, etc., steam traps, valves, steam flow meters and other steam specialties. American District Steam Co., North Tonawanda, N. Y.

ADS-IT BATTERY MFG. CO.—825 Hennepin Ave., Minneapolis, Minn. Manufacturer of storage batteries. President and general manager, Frank W. Adsit; vice-president, C. A. Murphy; secretary, treasurer and sales manager, Thomas W. Hicks.

ADSIT LABORATORIES, THE.—825 Hennepin Ave., Minneapolis, Minn. Manufacturers of motors, switches, battery charging sets, rectifiers, etc. President and general mangaer, Frank W. Adsit; vice-president, C. A. Murphy; secretary, treasurer and sales manager, Thomas W. Hicks.

ADVANCE.—Trade name for a-c. motors made by the Advance Electric Co., 6315 Maple Ave., St. Louis, Mo.

ADVANCE.—Trade name for felt gaskets, washers, etc. manufactured by the Advance Felt & Cutting Co., 322 S. Jefferson St., Chicago, Ill.

ADVANCE.—Trade name for electric and steam pumps manufactured by the Advance Pump & Compressor Co., Battle Creek, Mich.

ADVANCE.—Trade name for resistance wire manufactured by the Driver-Harris Co., Harrison, N. J.

ADVANCE.—Trade name for pocket and panel ammeters, voltmeters and voltammeters manufactured by the Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.

ADVANCE.—Trade name for motor-driven ice cream freezers manufactured by Thomas Mills & Brother, 1301 N. 8th St., Philadelphia, Pa.

ADVANCE.—Trade name for electrically heated glue pots manufactured by the New Advance Machinery Co., Van Wert, Ohio.

ADVANCE ELECTRIC CO.—6315 Maple Ave., St. Louis, Mo. Manufacturer of a-c. motors. President and general manager, Edward Bretch; vice-president, secretary and sales manager, F. V. Potts; treasurer, A. L. Canavan.

ADVANCE FELT & CUTTING CO.—322 S. Jefferson St., Chicago, Ill. Manufacturer of felt gaskets, washers, etc. Business established 1912. President, S. W. Widney; treasurer and general manager, F. A. Conrad.

ADVANCE LAMP WORKS.—361 W. Superior St., Chicago, Ill. Manufacturers of automobile lamps. President, Jacob Alter; secretary and treasurer, Walter R. Armstrong.

ADVANCE PACKING & SUPPLY CO.—64 E. Lake St., Chicago, Ill. Manufacturer of asbestos sheet packing, etc. Business established 1892. President, A. W. Chesterton; vice-president, treasurer and general manager, P. T. French; secretary, C. H. Bischoff; sales manager, A. L. Small. Factory, Boston, Mass.

ADVANCE PUMP & COMPRESSOR CO.—Battle Creek, Mich. Manufacturer of electric and steam pumps. Business established 1902. President, Eugene Stewart; vice-president, Philo D. Ferguson; secretary, treasurer and general manager, Lewis B. Anderson; acting sales manager, G. H. Anderson.

ADVERTISING SPECIALTIES, ELECTRICAL.—Under this heading may be included all other methods of electrical advertising exclusive of electric signs. Among these devices are several types of window projecting outfits, usually automatic. They include a compact electric stereopticon outfit with screen, incandescent projecting lamp and motor-operated slide shifter. By displaying pictures on at least some of the slides the advertising message may be "put across" to a considerable number of passers-by that will be attracted to the window. Other outfits are arranged to throw a series of terse messages on the sidewalk, the outfit being mounted in the window.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Beacon Mfg. & Sales Co., Inc., Freeport, N. Y.
Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y. "Stereomotorgraph."
Bulletin Machine Co., 10-16 Lock St., Buffalo, N. Y.
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Re-Flect-A-Lite."
Continental Sales Display Corp., 2 W. 45th St., New York, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Herberts Engineering Co., Inc., 500 5th Ave., New York, N. Y. "Selfast."
International Devices Co., 326 Broadway, New York, N. Y.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
National Retailers Advertising Corp., 1846-48 Ogden St., Indianapolis, Ind. "Gritt."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y. "Projectograph."
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

A. E.—Trade name for electric house pumps manufactured by the Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

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A-E-CO.—Trade name for electric hoists manufactured by the American Engineering Co., Aramingo Ave. & Cumberland St., Philadelphia, Pa.

AELCO.—Trade name for battery ammeter manufactured by the Battery Appliance Corp., 3 E. 44th St., New York, N. Y.

A. E. M.—Trade name for electric testing instruments manufactured by A. E. Moeller, 261-3-5 Sumpter St., Brooklyn, N. Y.

AEOLIAN CO., THE.—29 W. 42nd St., New York, N. Y. Manufacturer of electrically operated musical instruments. Branch office, 529 S. Wabash Ave., Chicago, Ill.

AERCO.—Trade name for electric toy aeroplanes manufactured by the A. E. Rittenhouse Co., Honeoye Falls, N. Y.

AEREX.—Trade name for motor drive equipment for pianos manufactured by H. W. Yeager & Co., Inc., 154 N. 11th St., Philadelphia, Pa.

AERIAL, RADIO.—The elevated type of radio antenna, usually mounted on poles, masts, or towers. (See Antenna, radio.)

AERIO.—Trade name for compound for impregnating transformer coils manufactured by the Pittsburgh Transformer Co., Pittsburgh, Pa.

AERMOTOR CO.—2500 W. Roosevelt Rd., Chicago, Ill. Manufacturer of steel transmission towers, poles and windmills.

AERO.—Trade name for automatic fire alarm systems made by Aero Alarm Co., 26 Cortlandt St., New York, N. Y.

AERO.—Trade name for cable cars manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

AERO.—Trade name for ignition magneto generators manufactured by the Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

AERO ALARM CO.—New York, N. Y. Manufacturer of fire alarms and accessories. Established, 1914. President, F. J. Martin; vice-president and treasurer, J. H. S. Cone; secretary, H. H. Martin; manager, R. H. Armstrong. Main office, 26 Cortlandt St., New York, N. Y. Branch office, Central Bldg., Seattle, Wash.

AEROBELL.—Trade name for electric washing machines manufactured by the Bell Washer & Wringer Co., 1051 Power Ave., Cleveland, Ohio.

AEROFAN.—Trade name for electric fans manufactured by the Russell Electric Co., 140 W. Austin Ave., Chicago, Ill.

AEROLITE.—Trade name for windmills for driving generators manufactured by the Wind Electric Co., 1957 St. Anthony Ave., St. Paul, Minn.

AERON.—Trade name for pneumatic paint spraying machines manufactured by the DeVilbiss Mfg. Co., 3750 Detroit Ave., Toledo, Ohio.

AERTITE.—Trade name for boiler coverings manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

AETNA.—Trade name for electrical insulation manufactured by the Albert & J. M. Anderson Mfg. Co., Boston, Mass.

AETNA ELECTRIC APPLIANCE CO.—40 Court St., Boston, Mass. Manufacturer of electric water heaters. Business established 1920. President, Walter S. Wyman; vice-president, Albert L. Smith, Jr.; secretary, E. A. Ballentine; treasurer, Ralph J. Patterson. Factories, Boston, Mass., and Dexter, Me.

AETNA EXPLOSIVES CO., INC.—New York, N. Y. Manufacturer of electric blasting apparatus. President, C. B. O'Dell; secretary, Mr. Lloyd; treasurer, F. E. Fenton; general manager, T. A. Bigelow; sales manager, M. Whiteside. Main office, 120 Broadway, New York, N. Y. Branch office, 7 S. Dearborn St., Chicago, Ill.

AETNA NUT CO.—Southington, Conn. Manufacturer of crossarm braces.

AETNA RUBBER CO., THE.—811-815 E. 79th St., Cleveland, Ohio. Manufacturer of hard and soft rubber molded products. A. J. Huston, vice-president and sales manager.

AETNALITE COMPOUND.—Trade name for hard rubber products manufactured by the Aetna Rubber Co., 811-815 E. 79th St., Cleveland, Ohio.

A-F.—Trade name for conveying machinery manufactured by the Alvey-Ferguson Co., Cincinnati, Ohio.

AFFINITY, CHEMICAL.—The force which holds together the elements in chemical compounds. It is not a mutual force, but every element has a certain tendency to go into combination, and the sum of these tendencies for the elements concerned determines the stability of the compound formed. It is quantitatively determined by measuring the heat evolved when various compounds are formed from the elements, and deducing therefrom the thermochemical constants of the component elements. For common metals, commencing with the strongest, the order is: lithium, potassium, barium, strontium, sodium, calcium, magnesium, aluminum, vanadium, cerium, titanium, uranium, silicon, boron, zirconium, manganese, zinc, chromium, iron, tungsten, cadmium, cobalt, nickel, antimony, arsenic, tin, lead, bismuth, copper, hydrogen, tellurium, selenium, thallium, mercury, palladium, platinum, silver, gold; for acid elements, from strongest to weakest, fluorine, chlorine, bromine, oxygen, iodine, sulphur.

A-FRAMES, TRANSMISSION LINE.—Where strength is required to withstand transverse forces two poles are sometimes set together to form a structure shaped like a letter A. With steel structures the result is secured by building an A-frame tower with two legs, the longitudinal strength being secured by head guying and anchor towers at suitable intervals. By use of A-frames in place of three or four-legged towers considerable saving in construction cost is effected.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display advertisement on page 1257.)
Archbold-Brady Co., Syracuse, N. Y.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. "Bates." (See display advertisement on page 1258.)
Blaw-Knox Co., Farmers' Bank Bldg., Pittsburgh, Pa. "Triplex."
Chesapeake Iron Works, P. O. Box 1123, Baltimore, Md.
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Hull & Co., S. W., 3729 Prospect Ave., Cleveland, Ohio.

AGLITE.—Trade name for all-glass lighting fixtures manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

AGLOW SALES CO.—671 3rd Ave., New York, N. Y. Manufacturer of lighting fixtures and shades. Business established 1921. Partnership, Harry Aglow and Frank Aglow.

AGNEW ELECTRIC WELDER CO.—Milford, Mich. Manufacturer of electric welders. Business established 1909.

AGRIPPA.—Trade name for pipe wrenches manufactured by J. H. Williams & Co., 187 Vulcan St., Buffalo, N. Y.

AHERN CO., JAMES D.—1157 S. Wabash Ave., Chicago, Ill. Manufacturer of electric signs. President, James D. Ahern; secretary, C. F. Collins; treasurer, J. P. Collins.

AICO.—Trade name for molded insulation manufactured by the American Insulator Corp., New Freedom, Pa.

A. I. E. E.—Abbreviation for American Institute of Electrical Engineers.

AINSWORTH, GEORGE.—New Liggett Bldg., New York, N. Y. Manufacturer of commercial lighting units.

AIR CHAMBER.—An air chamber is used in water-power plants in connection with a standpipe. In cases where it is not desirable to increase the height of the pipe, it is closed at the top, leaving a chamber which is furnished with air by a compressor. (See Standpipe, also Water hammer.)

AIR COMPRESSORS, HEATERS, WASHERS.—See Compressors, air; Heaters, air or space; Washers, air.

AIR-CONDITIONING APPARATUS.—In general, this is any apparatus designed for the purpose of improving the quality of the air, either by introducing some desirable component or by removing an undesirable quality. Ozonators, which are one special form, are described elsewhere. The most common method of improving the air either for ventilating or cooling purposes is washing to remove the dust; see Washers, air. Very often the air-conditioning apparatus includes an air washer with other heating or humidifying apparatus. The heating is applied to air for ventilation and sometimes also for cooling, as it is not desirable to have too cold air blown on heated generator coils or other apparatus. Humidity control that will automatically maintain the humidity at a given point throughout an entire heating season is accomplished by means of special conditioning apparatus. Most of these systems operate with motor-driven ventilating blowers and are applied to large buildings, schools, theaters, etc., also to industrial plants where humidity and temperature control, also freedom from dust, are very important, such as textile mills, printing press rooms, telephone exchanges, etc.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco."
Atmospheric Conditioning Corp., 920 Lafayette Bldg., Philadelphia, Pa. "Webster."
Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill.
Badger & Sons Co., E. B., 75 Pitts St., Boston, Mass. "Badger."
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Carrier Air Conditioning Co. of America, Buffalo, N. Y.
Claxo Co., The, Iowa City, Iowa.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Spray Engineering Co., Boston, Mass. "Spraco."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

AIRDRY.—Trade name for electric hand and face driers manufactured by the Groton Electrical Devices, Inc., Main St., Groton, N. Y.

AIR-FRICTION.—Trade name for spark plugs manufactured by the Air-Friction Carburetor Co., 1st & Madison Sts., Dayton, Ohio.

AIR-FRICTION CARBURETOR CO.—1st & Madison Sts., Dayton, Ohio. Manufacturer of spark plugs. President and general manager, J. W. Raymond; secretary, Joseph A. Whyte; treasurer, May C. Raymond.

AIR GAP.—An air-filled gap in an electric or a magnetic circuit. The name is commonly applied to the space between the field poles and the armature, or between stator and rotor, of dynamoelectric machines. The area of an air gap is greater than the area of the pole face in salient-pole machines due to the spreading of the lines of force, and the length is generally greater than the mechanical clearance due to the presence of slots in the stator or rotor or both.

AIRPLANE.—Trade name for electric washing machines manufactured by the Brantford Washing Machine Co., Ltd., 72 Colborne St., Brantford, Ont., Can.

AIRPLANE.—Trade name for electric washing machines and vacuum cleaners manufactured by the Hugro Mfg. Co., Warsaw, Ind.

AIRPLANE STABILIZERS.—See Stabilizers, airplane and ship, motor-driven gyroscopic.

AIRVEYOR.—Trade name for pneumatic conveyor for handling pulverized or granular material made by the Guarantee Construction Co., 140 Cedar St., New York, N. Y.

AIR-WAY.—Trade name for electric vacuum cleaners and washing machines manufactured by the Air-Way Electric Appliance Corp., Toledo, Ohio.

AIR-WAY ELECTRIC APPLIANCE CORP.—Toledo, Ohio. Manufacturer of household labor-saving appliances. H. Haudenschild, general manager.

AIR-WAY JUNIOR.—Trade name for electric vacuum cleaners manufactured by the Air-Way Electric Appliance Corp., Toledo, Ohio.

AISLELITE.—Trade name for aisle lights manufactured by the Brookins Co., 1741 Euclid Ave., Cleveland, Ohio.

AJAX.—Trade name for fuses and grounding devices manufactured by the Ajax Electric Co., Montgomery St. & Baldwin Ave., Jersey City, N. J.

AJAX.—Trade name for portable lamps, plural sockets and wiring devices manufactured by the Ajax Electric Specialty Co., 1011 Market St., St. Louis, Mo.

AJAX.—Trade name for leather belting manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

AJAX.—Trade name for toggle and expansion bolts manufactured by the Chi-

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cago Nut Co., 2513 W. 20th St., Chicago, Ill.

AJAX.—Trade name for conduit and cable clamps manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

AJAX.—Trade name for insulating varnishes and compounds manufactured by the Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio.

AJAX.—Trade name for electric vibrators manufactured by Schunck & Ogg, 235 Canal St., New York, N. Y.

AJAX ELECTRIC CO.—Montgomery St. & Baldwin Ave., Jersey City, N. J. Manufacturer of switches, switchboards, panels, wiring devices, electric railway material, overhead trolley equipment, etc. President, W. C. Banks; sales manager, Eugene E. Smith. Sales representatives, Craven & Hopkins, 905 Walnut St., Philadelphia, Pa.

AJAX ELECTRIC SPECIALTY CO.—1011 Market St., St. Louis, Mo. Manufacturer of portable lamps and wiring devices. Business established 1918. President and general manager, James S. Cuming; vice-president, George N. Cuming; secretary, Oscar Walters; treasurer, E. H. Biehle. Sales representatives, A. F. McCarthy, 10 High St., Boston, Mass.; Electrical Sales, Kenyon Bldg., Louisville, Ky.; J. F. Kindee, Portland, Ore.; J. A. Jacobsen 17 N. Wabash Ave., Chicago, Ill.; F. H. Thompson Co., San Francisco, Cal.

AJAX ELECTROTHERMIC CORP.—636 E. State St., Trenton, N. J. Manufacturer of electric furnaces. Business established 1920. President and general manager, Guilliam H. Clamer; vice-president, Edwin F. Northrup; secretary and sales manager, Dudley Willcox; treasurer, Harry F. Porter.

AJAX-NORTHRUP.—Trade name for electric induction furnaces manufactured by the Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.

AJCO.—Trade name for fixture fittings manufactured by Arthur Johnsen & Co., 4802 Fullerton Ave., Chicago, Ill.

AKERLUND & SEMMES, INC.—17 Battery Pl., New York, N. Y. Manufacturer of power plant gas producers. Business established 1917. President, treasurer and general manager, Gustaf Akerlund; vice-president, George W. Semmes; secretary, H. E. Widmer. Sales manager, George W. Calden. Factory, Newman, Ga.

AKRO-METAL.—Trade name for gaskets for superheated steam piping made by Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.

AKRON.—Trade name for belting manufactured by the Akron Belting Co., Akron, Ohio.

AKRON.—Trade name for copper asbestos ribbed gaskets for general piping conditions and steel asbestos gaskets for boiler hand holes, made by Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.

AKRON.—Trade name for push buttons made by the Wadsworth Novelty Mfg. Co., Wadsworth, Ohio.

AKRON.—Trade name for friction clutches manufactured by the Williams Foundry & Machine Co., 56-66 Cherry St., Akron, Ohio.

AKRON BELTING CO., THE.—Akron, Ohio. Manufacturer of belting. President, A. B. Rinehart; vice-president, W. C. Metlin; secretary, George Wince; treasurer, H. F. Adams.

AKRON METALLIC GASKET CO.—150 N. Union St., Akron, Ohio. Manufacturer of metal gaskets and small stampings of any metal. Business established 1895. President and treasurer, W. B. Haynes; general manager, A. H. Kinzel.

AKRON-WILLIAMS.—Trade name for friction clutches manufactured by the Williams Foundry & Machine Co., 56-66 Cherry St., Akron, Ohio.

A. K. S. SIGN CO., THE.—936-940 W. Madison St., Chicago, Ill. Manufacturer of electric signs, lighting reflectors and advertising specialties Business established 1920. President and general manager, James Audley; vice-president, Tobin Stevenson; secretary and treasurer, T. H. Dempsey.

ALABAMA LIGHT AND TRACTION ASSOCIATION.—Secretary-treasurer, J. B. Ross, Birmingham Railway, Light & Power Co., Birmingham, Ala.

ALADDIN.—Trade name for plug-socket switch manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

ALADDIN MFG. CO.—Muncie, Ind. Manufacturer of portable electric lamps. Business established 1920. President, G. M. Spencer; vice-president, William F. Spencer, Jr.; secretary, treasurer and general manager, O. Sacksteder, Jr. Sales representatives, S. E. Wiedemer, 5822 Central St., Kansas City, Mo.; C. C. Schneider, 327 Broadway, Detroit, Mich.; Elbee Electric Sales Co., 180 N. Dearborn St., Chicago, Ill.; Phil R. Hinkley, 968 E. 78th St., Cleveland, Ohio; J. F. Meldon, 30 Childs St., Boston (36) Mass.; Eugene Rosenblatt, 5 Hopkins Pl., Baltimore, Md.; Western Agencies Co., 285 Mina St., San Francisco, Cal.; D. E. Whitney, Chaucer St., Homewood Sta., Pittsburgh, Pa.; J. E. Dufton, 26 Evergreen Ave., London, Ont., Can.

ALADOLAMP.—Trade name for portable lamps manufactured by the Perfecilte Co., 119 Main St., Seattle, Wash., and the First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.

ALAMO.—Trade name for gasoline and kerosene engines manufactured by the Alamo Engine Co., Hillsdale, Mich.

ALAMO ENGINE CO.—Hillsdale, Mich. Manufacturer of gasoline and kerosene engines.

ALAMO FARM LIGHT CO.—703 Tower Bldg., Chicago, Ill. Manufacturer of farm lighting and power plants. President, J. De F. Richards; vice-president and sales manager, F. L. Tubbs; secretary, George E. Tubbs; treasurer, R. H. Le Bron. Factory, Hillsdale, Mich. Sales representative, Nebraska Alamo Co., Omaha, Neb.

ALARM ACCESSORIES, BURGLAR.—See Annunciators, burglar alarm; Door trips, alarm; Drops, burglar alarm; Matting, burglar alarm; Springs, burglar alarm contact; Switches, burglar alarm; Traps, burglar alarm.

ALARM ACCESSORIES, FIRE.—See Annunciators, fire alarm; Bells, fire alarm; Boxes, fire alarm; Gongs, fire alarm; Horns, electric, fire alarm; Jokers, fire-alarm system; Registers, fire-alarm box number; Relays, fire alarm; switchboards, fire alarm; Tappers, fire alarm; Thermostats, fire alarm.

ALARM CLOCKS, ELECTRIC.—See Clocks, alarm, electric.

ALARM, NIGHT.—An audible signal or buzzer attached to a manual telephone switchboard to awaken a sleeping operator at night in a small exchange, or to attract the attention of an attendant who has other duties, as in a private branch exchange, etc.

ALARM SYSTEMS, FIRE, CITY OR TOWN.—Signaling systems for transmitting fire-alarm signals originating in manually operated alarm boxes, located throughout a city or town, to a central station of the fire department, where the signals are received or recorded. The system may be of the open-circuit type or closed-circuit type, the latter being more generally used as it is more reliable. In these systems the line circuit is normally closed, with a small current flowing. The various alarm boxes are connected in series and when the alarm is turned in, by some one breaking a glass or pulling a small chain or hook in the alarm box, the circuit is interrupted. In one system a clockwork mechanism in the signal box is released by this action, and the circuit is interrupted in accordance with a code system, each interruption giving a stroke on a single-stroke bell and indicating by the number the location of the box where the call originated. Noninterfering equipment is provided so that two calls coming in simultaneously from two boxes will not interfere, but will be given in sequence. The current in the main circuit is not sufficient to operate the alarm or recording register, when one is used, but merely closes a local circuit containing these devices through a special relay. Automatic supervisory equipment is usually included to indicate faulty conditions of lines, apparatus or batteries.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Electrical Automatic Appliance Co., The, 1749-51 Araphoe St., Denver, Colo.
Fire Detecting Wire Corp., 2 W. 45th St., New York, N. Y. "F. D. W."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Holtzer-Cabot."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill.
KLAXON CO., Newark, N. J.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.
Utica Fire Alarm Telegraph Co., Utica, N. Y.

ALARM SYSTEMS, FIRE, ELECTRICALLY SUPERVISED.—Signaling systems for transmitting fire alarms to central receiving or recording stations and having the circuits so arranged that any abnormal conditions which may develop, such as grounds, crosses, open or short circuits, or failure of operating current, will cause an indication to be given on equipment provided for that purpose, or will cause a trouble bell to ring. Electrically supervised systems are always used on closed-circuit systems, but may be used in conjunction with automatic signals or manually operated alarm boxes. They are more expensive than other systems, but have the advantage that it is possible to tell at a glance whether or not the system is operating properly.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electrical Automatic Appliance Co., The, 1749-51 Araphoe St., Denver, Colo.
Fire Detecting Wire Corp., 2 W. 45th St., New York, N. Y. "F. D. W."
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Holtzer-Cabot."
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess." "Circle H."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Relc Equipment Corp., 5 Beekman St., New York, N. Y. "Ideal."
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patteron, 34 Hubert St., New York, N. Y. "Faraday."
Utica Fire Alarm Telegraph Co., Utica, N. Y.

ALARM SYSTEMS, FIRE, MARINE.—All steamers more than 150 ft. in length carrying passengers are now required to have a fire-alarm system "which will automatically register at some central point or station, where it can be most quickly observed by the officers or crew of the steamer, the presence or indication of fire in the state-rooms and various compartments of the steamer which are not accessible to the observation of the officers and crew." Electrical systems are generally used, both the open and closed-circuit systems being employed with various forms of thermostat. Among these are mercurial thermometers especially made for this duty, thermostats embodying the use of low-temperature fusible metal, the expansion of metal in delicate springs, and metals differing in their characteristics of expansion. Fire breaking out aboard ship is usually much more serious than fire in a building, consequently reliability of the fire-alarm system must be given special consideration.

ALARM SYSTEMS, FIRE, MISCELLANEOUS INTERIOR.—Signaling systems for transmitting fire alarms originating in manually or automatically operated circuit-closing devices to one or more stations as applied to large industrial plants, hospitals, schools, etc., are often much more comprehensive than those described above. They are often operated in conjunction with the watch service or burglar-alarm systems and all of the signals sent in are kept in the form of a permanent record. There are many modifications of

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both the open and closed-circuit systems, some of which are arranged to operate with the automatic sprinkler system.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Only the most effective and dependable types of signals should be used in fire alarm systems. The Benjamin Electric Mfg. Co. in producing signals for this purpose has followed requirements of various departments of labor and suggestions of underwriters. These fire alarm signals are instantaneous in operation and will readily follow the most rapid signaling code impulses. Current carrying parts are effectively insulated and have ample capacity. Housings are of sufficient strength to give excellent mechanical protection. This line is made in styles suitable to all requirements; interior or exterior, water tight or non-water tight, alternating or direct current operation on voltages up to 250. Benjamin industrial fire signals have great volume of tone and peculiar tone pitch which make them effective above all other noises.—Adv.



Benjamin Industrial Fire Signal

EDWARDS & CO., INC., New York, N. Y. Fire alarm systems for hotels, industrial plants, schools, office buildings, etc. Closed-circuit, open-circuit, supervised, non-supervised, code or non-code types. These systems protect life and property and secure lower insurance rates.—Adv.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver., Colo.
FEDERAL ELECTRIC CO., 8700 State Street, Chicago, Ill. The Federal Electric siren with its weird, penetrating screech, gives a distinctive call for help—a fire emergency or danger signal that is instantly recognized by the men for whom it is intended. Equally serviceable as a fire alarm, starting and stopping signal, and call signal at factories, plantations, farms, etc. See display adv. page 1291.—Adv.



Federal Electric Siren

Fire Detecting Wire Corp., 2 W. 45th St., New York, N. Y. "F. D. W."
HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices; motor-generators and dynamos; hospital, fire alarm, factory call, school, bank and other signalling systems. Many of the largest buildings in the country are equipped throughout with Holtzer-Cabot fire alarm systems. These systems are designed to protect life and property in hospitals, schools, hotels, public buildings, warehouses, shipyards, factories, etc. Here also our engineers will gladly cooperate in laying out the type of system that will give the fullest measure of protection and service. Illustrative booklets on all Holtzer-Cabot signalling systems will be forwarded on request.—Adv.
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill.
KLAXON CO., Newark, N. J.
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Relc Equipment Corp., 5 Beekman St., New York, N. Y. "Ideal."
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.

ALARM SYSTEMS, FIRE, PRESIGNAL OR DUAL.—Fire-alarm systems for hospitals, schools, asylums, prisons, etc., are often of the presignal or dual type. In these signals when an alarm is turned in it is recorded at the station of the local fire department, which immediately goes to the place where the signal originated. If the blaze is only a small one and can easily be extinguished, no further alarm is given, but if it is beyond the control of the local department, a general alarm is sounded and in most cases an alarm is also sent to the city fire department. These systems are usually of the closed-circuit type and have the same kind of apparatus as those described above. An immediate general alarm is undesirable in many cases because of the needless confusion that is caused among patients, pupils, etc., when the blaze is a very small one and may be quickly put out.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver., Colo.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Holtzer-Cabot."
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess," "Circle H."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

ALARM SYSTEMS FOR BANKS, BURGLAR AND FIRE.—Banks are usually protected by very extensive and complicated burglar and fire-alarm systems. Very often, especially in large cities, several banks have their systems terminate in the office of a special watch service or protection company, which has a group of men ready to send out the instant a signal is received. The fire-alarm systems may be any of those described above, and the burglar-alarm systems are very complete. The vault is frequently so wired that anyone tampering with the lock after closing time or even trying to drill a hole through the wall or break through in some other way, gives the alarm. Other systems are arranged to operate during the day time in case of an attempted robbery by pressing any of several buttons or switches conveniently located in the tellers' booths.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Cannon Ball Alarm Co., 524 5th Ave., South, Minneapolis, Minn. (burglar) "Bug."
Duplex Electric Co., 75-77 Grand St., New York, N. Y. "Duplex." (burglar)
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Fire Detecting Wire Corp., 2 W. 45th St., New York, N. Y. "F. D. W."
HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices; motor-generators and dynamos, hospital, fire alarm, factory call, school, bank and other signalling systems. For protecting the bank by day as well as night. Silent signals may be given from and to any part of the bank. Audible signals also for calling messengers, clerks, porters, and if necessary, the police. Every industrial plant, warehouse, school, bank, or public building differ in construction and organization. Our engineers will be glad to lay out a signaling and protective system that will meet your specific condition exactly. Illustrative booklets on all Holtzer-Cabot signaling systems will be forwarded on request.—Adv.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill.
KLAXON CO., Newark, N. J.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I. "Holmes."
SAMSON ELECTRIC CO., Canton, Mass.
Simplex Alarm Co., 405 Montgomery Bldg., Milwaukee, Wis. "Simplex." (burglar)
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.

ALARMS, BURGLAR, CLOSED-CIRCUIT.—Signaling systems for burglar protection which operate with a circuit which is normally closed, and which carries a small current sufficient to operate an alarm relay. The circuit is usually a series one in which several circuit-opening switches are located at windows or doors, which when tampered with or opened by unauthorized persons cause an alarm to be given through a relay that controls an independent circuit. There are many attachments for opening these circuits, some even operating if a key is inserted in the lock after a certain time, others if a door or window is opened. The alarms are varied, in some cases simply a constant-ringing bell is operated, in others an annunciator locates the origin of the alarm, and in others a master switch is operated by the operator of the relay and the lights all over the house are turned on. Closed-circuit systems are by far the most reliable and are used a great deal more than open-circuit systems. They are frequently designed to meet special conditions.

Manufacturers:

American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Cannon Ball Alarm Co., 524 5th Ave., South, Minneapolis, Minn. "Bug."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253-7th Ave., New York, N. Y. "Hess," "Circle H."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I. "Holmes."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.

ALARMS, BURGLAR, OPEN-CIRCUIT.—Signaling systems for burglar protection operating normally with an open circuit which includes one or more circuit-closing devices usually located at windows and doors and connected in multiple, which when disturbed by unauthorized persons close the circuit and cause the alarm to be given. The alarm may operate an annunciator, designating the point of attempted entry or it may cause a contact-ringing bell to operate, or both. Open-circuit alarms are cheaper to install than a closed-circuit system, but are not as reliable, as the wires may be cut or broken accidentally and then the system will not operate.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Cannon Ball Alarm Co., 524 5th Ave., South, Minneapolis, Minn. "Bug."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H. & H."
KLAXON CO., Newark, N. J.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.

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ALARMS, FIRE, SIMPLE CLOSED-CIRCUIT.—Signaling systems for the transmission of alarms of fire, in which the main circuit connecting the various alarm boxes is normally closed and has a small current flowing in it, just sufficient to keep the armature of a relay pulled over against its stop. When an alarm is sent in, the circuit is interrupted, allowing the relay to open, which closes a local circuit and gives the alarm. The signals may originate by someone manually operating the circuit-interrupting device in an alarm box, or they may originate automatically when a thermostatic device opens the circuit at a predetermined temperature. Closed-circuit systems are more expensive than open-circuit systems, but are more reliable. They may be applied to a city or town system or to a small industrial plant, institutional or other interior system. City systems are nearly always more complex than the type contemplated in this classification.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
American Watchman's Clock Co., 150 Nassau St., New York, N. Y.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Holtzer-Cabot."
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J.
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
McFeil Signal Co., 2857 S. Halsted St., Chicago, Ill.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess," "Circle H."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Relc Equipment Corp, 5 Beekman St., New York, N. Y. "Ideal."
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.
Utica Fire Alarm Telegraph Co., Utica, N. Y.

ALARMS, FIRE, SIMPLE OPEN-CIRCUIT.—Systems for the transmission of fire-alarm signals which operate normally with open circuits. The signals may be originated by a number of thermostatically operated devices which close the circuit when the temperature reaches a certain value and cause an alarm to be given, or the alarm may be turned in by anyone at a fire-alarm box. The alarm boxes for a system of this type are connected in multiple. Open-circuit fire alarms are cheaper than closed-circuit types, as no closed-circuit primary battery or storage battery is required and the rest of the apparatus is simple. They are not used extensively, because there is no easy way of determining whether each separate alarm box circuit is in good condition, and they are therefore not as reliable as a closed-circuit system.

Manufacturers:

American Watchman's Clock Co., 150 Nassau St., New York, N. Y.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description under Alarm systems, fire, miscel. interior.—Adv.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display advertisement on page 1291.)
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Holtzer-Cabot."
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
KLAXON CO., Newark, N. J.
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253-7th Ave., New York, N. Y. "Hess," "Circle H."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass. "Standard."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.
Utica Fire Alarm Telegraph Co., Utica, N. Y.

ALARMS, HOT-BEARING.—A device for actuating an audible or visible signal in case of a bearing exceeding a safe operating temperature. It may either consist of a helical strip of thermostatic metal exposed to the air closely adjacent to a bearing and operating so as to close an electrical contact by expansion when the temperature of the bearing reaches a predetermined value, or a metal tube imbedded in the bearing metal itself and containing a fluid which, expanding under heat, in turn expands a thin metal bellows that operates an electrical contact in the alarm circuit. These hot-bearing alarms are frequently used in connection with rotating electrical machines in automatic generating stations and substations with no attendant in charge; in the event of a bearing becoming overheated, the device operates a relay tripping a circuit breaker and disconnecting the machine from its source of power.

Manufacturers:

National Co., Cambridge 39, Boston, Mass.

ALARMS, RAILWAY AND HIGHWAY CROSSING.—Apparatus placed at or near crossings of roads and railway tracks, often combined with standard crossing and warning signs, to warn drivers of vehicles and pedestrians of the approach of a car or train. The alarm is given by ringing of gongs or bells and usually with simultaneous display of warning lights. In most devices lights are displayed behind signs showing the word "Stop" or "Danger." To increase the arrestive effect of the sign, some apparatus is arranged so that the illuminated stop sign swings to and fro. All warning alarms are actuated by presence of the car or train a certain distance from the crossing either by electrical means, such as a track circuit, or mechanically through the depression of a roadside instrument by the wheels of the car or train. The gong continues to ring and the other apparatus to operate until the car or train has passed a point near the crossing.

Manufacturers:

American Luminous Products Co., Huntington Park, Cal.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Box Iron Works Co., William A., Blake & 33rd Sts., Denver, Colo.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Bryant Mfg. Co., 323 W. Jackson Blvd., Chicago, Ill.
Bryant Zinc Co., 600 Orleans St., Chicago, Ill. "Autoflag."
Federal Signal Co., Albany, N. Y.
Hall Switch & Signal Co., Garwood, N. J.
KLAXON CO., Newark, N. J.
Nachod Signal Co., Inc., 4771-4777 Louisville Ave., Louisville, Ky.
Paxton & Vierling Iron Works, Omaha, Neb.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Tecla Co., Inc., Detroit, Mich.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

ALARMS, TANK, HIGH AND LOW WATER.—Signaling appliances usually consisting of a float switch or its equivalent, to indicate by either a visual or audible alarm when liquids in storage tanks reach predetermined levels. They are frequently used to indicate high or low water levels in house service and sprinkler storage tanks, or in reservoirs where a nearly constant level is maintained. Alarm signals may also be arranged with relays to automatically start or stop motor-driven pumps when the signal is given.

Manufacturers:

Aero Alarm Co., 26 Cortlandt St., New York, N. Y.
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.
Chicago Automatic Switch Co., 2336 Wolfram St., Chicago, Ill.
Chicago Engineer Supply Co., 68 W. Lake St., Chicago, Ill.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
KLAXON CO., Newark, N. J.
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio.
Ostrander & Co., W. R. 371 Broadway, New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."
Stern, Louis, Philadelphia, Pa.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

ALASKA FREEZER CO.—Winchendon, Mass. Manufacturer of motor-driven ice cream freezers.

ALASKAN.—Trade name for motor-driven refrigerating machinery manufactured by the Armstrong Machinery Co., 3201-3219 E. Riverside Ave., Spokane, Wash.

ALBA.—Trade name for illuminating glassware manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

ALBANY.—Trade name for lubricating oils and greases manufactured by Adam Cook's Sons, 708-710 Washington St., New York, N. Y.

ALBANY PUMP CO.—159 Richmond St., W., Toronto, Ont., Can. Manufacturer of electric pumps. Business established 1906. President and general manager, A. W. Bennet.

ALBANY STEAM TRAP CO., THE.—Albany, N. Y. Manufacturer of steam traps, valves, pumps and other steam specialties. Business established 1870. President and treasurer, Charles H. Carter; vice-president and secretary, A. R. Carter; general manager, James A. Foy; sales manager, J. Warren Carter.

ALBAUGH-DOVER CO.—Chicago, Ill. Manufacturer of electric washing machines, cream separators, gears and pinions. President and treasurer, G. S. Albaugh; vice-presidents, O. T. Dover, H. W. Eden; secretary, H. B. Albaugh. Main office and factory, 2100 Marshall Blvd., Chicago, Ill. Branch office, 130 W. 42nd St., New York, N. Y.

ALBERENE STONE CO.—New York, N. Y. Manufacturer of soapstone for electrical purposes. President, N. N. Moneypenny. Main office, 223 E. 23rd St., New York, N. Y. Branch offices and warehouses. 214 N. Clinton St., Chicago, Ill.; 51 Bristol St., Boston, Mass. District offices, Newark, N. J.; Philadelphia, Pa.

ALBERGER PUMP & CONDENSER CO.—New York, N. Y. Manufacturer of condensing and other steam auxiliaries. Business established 1902. President, W. S. Doran; vice-president, W. R. Wilson; secretary and treasurer, R. C. Williams. Main office, 140 Cedar St., New York, N. Y. Factory, Newburgh, N. Y. Branch offices, 88 Broad St., Boston, Mass.; 22 W. Monroe St., Chicago, Ill.; Pennsylvania Bldg., Philadelphia, Pa.; 2211 Olive St., St. Louis, Mo.

ALBERTA BATTERY CO., LTD.—420 9th Ave., E., Calgary, Alta., Can. Manufacturer of storage batteries and storage battery equipment. Business established 1914. President and general manager, Clyde J. Wells; secretary and treasurer, Donald M. Barker.

ALBRO-CLEM ELEVATOR CO., THE.—Erie Ave. & D St., Philadelphia, Pa. Manufacturer of electric passenger and freight elevators and hoists. President, B. F. Mechling, Jr.; secretary and treasurer, W. H. Mechling.

ALBY FURNACE.—A type of electric furnace used for the manufacture of calcium carbide. The hearth consists of a steel grating into which a mixture of carbon and tar is compressed, and five carbon electrodes are embedded in the hearth.

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The side walls are of sheet iron with a thin refractory lining. Molten carbide is tapped every 45 minutes from a hole in the end wall. A ton of carbide is produced from about 900 kg. of lime and 600 kg. of anthracite coal, at an expenditure of 4200 to 4500 kw-hr. per ton.

ALCO.—Trade name for dolly type electric washing machine manufactured by the Altorfer Bros. Co., Peoria, Ill.

ALCOHOL.—Ordinary name for ethyl alcohol, C_2H_5OH; a liquid with a characteristic sweetish odor. B. p. 78.3° C.; f. p.—112° C. Usually manufactured by the fermentation of sugar by yeast, the alcohol produced being separated by distillation, giving a product containing 95 to 96% of alcohol. Alcohol is used extensively as a raw material in many industrial electrochemical processes, as a solvent of shellac, certain lacquers, etc.

ALDEN-NAPIER CO.—54 Willow St., Springfield, Mass. Manufacturer of molded insulation products. Business established 1915. President, Charles Napier; secretary, Francess Playdon; treasurer, Milton Alden.

ALDON CO., THE.—3338 Ravenswood Ave., Chicago, Ill. Manufacturer of rail benders, car replacers and other track equipment. Business established 1904. President, E. W. K. Roe; vice-president, C. V. Roe; secretary, G. V. Johnston.

ALEMITE DIE-CASTING & MFG. CO.—341-51 W. Chicago Ave., Chicago, Ill. Manufacturer of die castings. Business established 1912. President and general manager, John S. Gullborg; vice-president, Carl M. Hedman; secretary, Herbert R. Hedman; treasurer, Douglas F. Fesler.

ALENCO.—Trade name for leather belting and belt lacing device manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

ALERT.—Trade name for belt ringers manufactured by the States Co., 72 Francis Ave., Hartford, Conn.

ALEXALL.—Trade name for rubber tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

ALEXALITE CO., THE.—434 E. 23rd St., New York, N. Y. Manufacturer of indirect lighting fixtures. Harry Alexander, president.

ALEXANDER & COX CO.—Ogden & Western Aves., Chicago, Ill. Manufacturer of gears and pinions. Business established 1887. President, treasurer and general manager, E. L. Cox; secretary, H. Spector.

ALEXANDER BROS.—Philadelphia, Pa. Manufacturers of leather belting and belt dressing. Main office, 3rd & Callowhill Sts., Philadelphia, Pa. Factories, Philadelphia, Pa.; Chicago, Ill.; New Haven, Conn.; Atlanta, Ga. Branch offices, 100 Lafayette St., New York, N. Y.; Boston, Mass.; Detroit, Mich.; New Orleans, La.; Cleveland, Ohio.

ALEXANDER CAR REPLACER MFG. CO.—Mears Bldg., Scranton, Pa. Manufacturer of car replacers. President, J. F. Mears; treasurer, J. T. Richards.

ALEXAPOPE.—Trade name for insulating varnishes manufactured by the Impervious Metal Corp., 421 Wood St., Pittsburgh, Pa.

ALFCO.—Trade name for lighting fixtures manufactured by the Artistic Lighting Fixture Corp., 21-25 E. Houston St., New York, N. Y.

ALGOMA STEEL CORP., LTD.—Sault Ste. Marie, Ont., Can. Manufacturer of brass and bronze castings, tie plates, track rails, structural steel, etc. Business established 1901. President, W. C. Franz; vice-presidents, James Hawson, Sidney Mason; secretary, Alex Taylor; treasurer, E. W. Shell; general manager, J. D. Jones; sales manager, J. D. Gray.

ALGOR.—Trade name for outlet plates, cable clamps and electrical boxes manufactured by the Collinson-Holland Co., 253 Medford St., Malden, Mass.

ALIGNMENT.—An old spelling of alinement, which form is used throughout this book.

ALINEMENT.—A formation in a straight line. This form is the modern and more significant spelling of the old word alignment.

ALKALI, ELECTROLYTIC.—When aqueous alkali-chloride solutions are subjected to electrolysis, chlorine is liberated at the anode, while the metal ion reacts with water at the cathode, liberating hydrogen and forming caustic alkali in the electrolyte. If the catholyte is allowed to reach the anolyte or to be acted on by the chlorine, hypochlorite or chlorate is formed; but if the electrolysis is carried on in a cell designed to keep apart the products formed at the two electrodes, electrolytic alkali can be produced, and it is so produced commercially in great quantities. The large number of cells which are used for this purpose can be divided into four principal types: those in which the separation of alkali and chlorine is accomplished by (1) a diaphragm of nonconducting material; (2) a mercury diaphragm which acts as an intermediate electrode; (3) a mercury cathode which collects the alkali metal, permitting removal to another vessel before the reaction with water to produce caustic takes place; and (4) inclosing the anode in an inverted, nonconducting bell, with the cathode outside, and effecting separation by specific gravity. These cells include the McDonald, Hargreaves-Bird, Castner, Castner-Kellner, Whiting, Solvay, Jaice, Rhodin, Wildermann, Griesheim, Outhenin-Chalandre, Billiter-Leykam, Billiter-Siemens, Finlay, Wheeler, Nelson, and others. Many of these cells are used primarily for the production of chlorine and chlorine products, especially bleach liquor in the paper industry. Where pure chlorine is produced, caustic alkali is a by-product and frequently is allowed to go to waste. Electrolytic alkali may also be made from electrolytes of fused alkali chlorides, as in the Acker process, collecting the alkali metal with a cathode of molten lead instead of with mercury as in type (3) above.

ALL-IN-O.—Trade name for outlet boxes manufactured by Habermaas & Delporte, Inc., 1325-1327 S. 7th St., St. Louis, Mo.

ALL-IN-ONE.—Trade name for ground clamps manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

ALL-IN-ONE.—Trade name for electric washing and ironing machines manufactured by the Sieben Merchandising Co., Kansas City, Mo.

ALL-NITE-LITE.—Trade name for low-voltage transformers manufactured by the General Electric Co., Schenectady, N. Y.

ALL PURPOSE.—Trade name for farm lighting and power plants manufactured by the Automatic Electrical Devices Co., 120-122 W. 3rd St., Cincinnati, Ohio.

ALL-REDI.—Trade name for battery connector manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

ALL-SPARK IGNITION CO., INC.—13 Water St., New York, N. Y. Manufacturer of ignition equipment. Business established 1919. President, E. Maynz; vice-president, S. V. Steiner.

ALL STEEL.—Trade name for tool kits manufactured by the Kennedy Mfg. Co., Van Wert, Ohio.

ALL-STEEL-EQUIP CO.—Aurora, Ill. Manufacturer of cutout boxes and cabinets, covers, pipe straps, etc. President, John Knell; secretary, treasurer and general manager, C. H. Lembcke; sales manager, H. Earl Sweitzer. Main office, Aurora, Ill. Branch offices, 231 Insurance Exchange, Chicago, Ill.; 507 Pereles Bldg., Milwaukee, Wis. Sales representatives, W. Lester Baker, 511 Woodward Bldg., Washington, D. C.; H. Bryan, The Bourse, Philadelphia, Pa.; S. H. Stover & Co., 609 Chamber of Commerce Bldg., Pittsburgh, Pa.; W. H. Beaven, Jefferson County Bank Bldg., Birmingham, Ala.

ALLAN MFG. & WELDING CORP.—163 Adams St., Buffalo, N. Y. Manufacturer of electric welding outfits. Business established 1919. President and general manager, Frederick W. Allan; vice-president and sales manager, James E. Ferguson; secretary, E. M. Anthony; treasurer, Allan Drake. Sales representative, Metals Welding Corp., 4400 Perkins Ave., Cleveland, Ohio.

ALLEN.—Trade name for solder, soldering outfits and accessories manufactured by the L. B. Allen Co., Inc., 4519-29 N. Lincoln St., Chicago, Ill.

ALLEN.—Trade name for meter testing rheostats manufactured by the Standard Scientific Co., 9 Barrow St., New York, N. Y.

ALLEN-BRADLEY CO.—Milwaukee, Wis. Manufacturer of electric controlling apparatus. Business established 1904. President, Lynde Bradley; vice-president and treasurer, Harvey Bradley; secretary, Lewis Quarles; general manager, F. F. Loock. Main office and factory, 286 Greenfield Ave., Milwaukee, Wis. Branch offices, Boston, Mass.; Buffalo, N. Y.; 57 E. Jackson Blvd., Chicago, Ill.; Cleveland, Ohio; Philadelphia, Pa.; Pittsburgh, Pa.; 50 Church St., New York, N. Y. Sales representatives, Garland-Affolter Engineering Co., Seattle, Wash.; San Francisco, Cal.; Los Angeles, Cal.; Franklin Sales Co., Denver, Colo.; W. H. Beaver, Birmingham, Ala.

ALLEN CO., INC., L. B.—4519-29 N. Lincoln St., Chicago, Ill. Manufacturer of solder, soldering outfits and accessories. Business established 1893. President, C. A. Crippen, Jr.; vice-president, Stuart S. Crippen, Jr.; secretary, treasurer and general manager, Stuart S. Crippen. Sales representatives, H. B. Squires Co., San Francisco, Cal.; E. C. Coffin Co., 503 Dooly Bldg., Salt Lake City, Utah; Norton-Munter Co., Seattle, Wash.; Bissell & Webb, Winnipeg, Man., Can.

ALLEN CRUCIBLE CO.—714 50th Ave., Oakland, Cal. Manufacturer of graphite, plumbago and black lead. Sole owner, James G. Allen.

ALLEN MFG. CO., W. D.—566 W. Lake St., Chicago, Ill. Manufacturer of leather belting and belt dressing. President, William B. Allen; vice-president, T. L. Ryerson; secretary, W. H. Symonds; treasurer, E. H. Pease.

ALLENDALE.—Trade name for portable electric lamps manufactured by the W. T. Burt Co., New Cumberland, W. Va.

ALLEY ARM.—A modified type of crossarm which projects to one side of the pole only instead of on both sides. It is used on electric light, power and telephone distribution lines that are run in alleys where the poles are set close to the rear lot lines so that ordinary crossarms might interfere with barns or other buildings at the rear of the lots. They are also called side arms. For manufacturers, see Crossarms and side arms, wood.

ALLIED BELTING CO., THE.—Greenville, Ohio. Manufacturer of power transmission belting.

ALLIGATOR.—Trade name for testing clamps manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

ALLIGATOR.—Trade name for belt lacing manufactured by the Flexible Steel Lacing Co., 4607-4631 Lexington St., Chicago, Ill.

ALLIGATOR-JAW.—Trade name for test clamps manufactured by Albert & J. M. Anderson Mfg. Co., 289-305 A St., Boston, Mass.

ALLIS-CHALMERS MFG. CO.—Milwaukee, Wis. Manufacturer of motors, generators and other electrical machinery; steam and hydraulic turbines, engines, pumps, mining machinery, etc. President, Otto H. Falk; vice-president, Max W. Babb; secretary and treasurer, H. Woodland. Main office, Milwaukee, Wis. Factories, West Allis and Milwaukee, Wis., and Norwood, Ohio. Branch offices, 1104-1106 Healey Bldg., Atlanta, Ga.; 1010-1012 Brown-Marx Bldg., Birmingham, Ala.; 723 State Mutual Bldg., Boston, Mass.; 574 Ellicott Square Bldg., Buffalo, N. Y.; 212 Chamber of Commerce Bldg., Charlotte, N. C.; 2026 Peoples Gas Bldg., Chicago, Ill.; 1720 1st National Bank Bldg., Cincinnati, Ohio; 1119-1121 Schofield Bldg., Cleveland, Ohio; 510 Sumpter Bldg., Dallas, Tex.; 316 Foster Bldg., Denver, Colo.; 1828-1829 Ford Bldg., Detroit, Mich.; 709 Alworth Bldg., Duluth, Minn.; 1410-1412 Waldheim Bldg., Kansas City, Mo.; 623-625 Title Insurance Bldg., Los Angeles, Cal.; 707 Metropolitan Life Bldg., Minneapolis, Minn.; 719-723 Maison Blanche Bldg., New Orleans, La.; 50 Church St., New York, N. Y.; 806-810 Franklin Trust Bldg., Philadelphia, Pa.; 1207-1210 Park Bldg., Pittsburgh, Pa.; 604-606 Lumbermen's Bldg., Portland, Ore.; 2188-2189 Railway Exchange Bldg., St. Louis, Mo.; 608-610 Kearns Bldg., Salt Lake City, Utah; 741-751 Rialto Bldg., San Francisco, Cal.; 115 Jackson St., Seattle, Wash.; 819 Ohio Bldg., Toledo, Ohio; 904 Coal Exchange Bldg., Wilkes Barre, Pa.

ALLITH-PROUTY CO.—Danville, Ill. Manufacturer of electric garage door openers. President and treasurer, H. C. Smith; vice-president, Andrews Allen; secretary, Emil Stuedli.

ALLMAN GAS ENGINE CO.—461 Canal St., New York, N. Y. Manufacturer of motor-driven ice cream freezers, refrigerating and ice making machinery and ice breakers. Business established 1898. President, George P. Lawson; secretary and treasurer, Albert McDougal.

ALLMUR MFG. CO.—Marion, Ind. Manufacturer of electric fireless cookers. President and general manager, Morton Murphy; vice-president, Xen Fagan; secretary and treasurer, J. A. Hardesty. Sales representatives, A. J. Wilson & Son, 285 Washington St., Buffalo, N. Y.; Unna & Grubbe, 718 Mission St., San Francisco, Cal. Ex-

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clusive distributors, Paul Davis D. G. Co., Waterloo, Iowa; Smith & Perry Electric Co., Dallas, Tex.; Western States Electric Co., Seattle, Wash.; Domestic Appliance Co., Denver, Colo.; United Electric Co., Wichita, Kans.; J. F. Beechman & Co., Philadelphia, Pa.; E. B. Latham & Co., New York, N. Y.; Electric Sales Co., Columbus, Ohio; Clark & Johnson, Detroit, Mich.

ALLOY METAL WIRE CO.—154 Nassau St., New York, N. Y. Manufacturer of electrical wires. Business established 1919. President, S. A. Murray; vice-president and general manager, M. L. Murray; secretary and treasurer, J. A. Marcato. Factory, Yonkers, N. Y.

ALLOY STEEL PRODUCTS CORP.—123 Liberty St., New York, N. Y. Manufacturer of brass and copper sheets and tubing, welding wire and iron bars.

ALLY.—Trade name for transmission belting manufactured by the Allied Belting Co., Greenville, Ohio.

ALMETAL.—Trade name for electric washing machine manufactured by the Almetal Mfg. Co., 7227 Manchester Ave., St. Louis, Mo. Exclusive distributor, Manufacturer's Distributing Co., 403 Fullerton Bldg., St. Louis, Mo.

ALMETAL MFG. CO., THE.—7227 Manchester Ave., St. Louis, Mo. Manufacturer of electric washing machines. Business established 1910. President, N. D. Thompson, Jr.; vice-president and general manager, N. N. Nunn; secretary, L. P. Huey; treasurer, L. P. Thompson. Exclusive distributor, Manufacturer's Distributing Co., 403 Fullerton Bldg., St. Louis, Mo.

ALMOND MFG. CO., T. R.—Ashburnham, Mass. Manufacturer of flexible arms for portable lamps and micrometer gages. Business established 1880. President, C. A. Hubbell; vice-president, A. C. Hawkins; secretary and treasurer, H. S. Hubbell.

ALPHA RAYS.—Positively charged particles shot out by radium and other radioactive bodies. They have a mass about four times the mass of a hydrogen atom and carry two units of positive charge. They are believed to be identical with the helium atom. Their velocity is considerably less than that of beta rays, but on account of their larger mass they are very effective in ionizing gases.

ALPHADUCT CO., THE.—136 Cator Ave., Jersey City, N. J. Manufacturer of flexible nonmetallic conduit. Business established 1902. Russel Dart, owner. Sales representatives, S. B. Condit, Jr., & Co., Boston, Mass.; William S. Brown Electric Co., New York, N. Y.; L. P. Clark, Philadelphia, Pa.; Electrical Sales Co., Baltimore, Md.; C. S. Broward, Atlanta, Ga.; S. H. Stover, Pittsburgh, Pa.; McNair Electric Sales Co., Detroit, Mich.; William P. Crockett Co., St. Louis, Mo., Chicago, Ill.; R. S. Wakefield, Dallas, Tex.; B. K. Sweeney, Denver, Colo.; H. B. Squires Co., San Francisco, Cal.

ALPHALOOM.—Trade name for flexible nonmetallic conduit manufactured by the Alphaduct Co., 136 Cator Ave., Jersey City, N. J.

ALSOP-ALL-SPARK.—Trade name for ignition equipment manufactured by the All-Spark Ignition Co., Inc., 13 Water St., New York, N. Y.

ALSOPS.—Trade name for electrically heated water baths manufactured by the George H. Wahmann Mfg. Co., 520 W. Baltimore St., Baltimore, Md.

ALTELITE.—Trade name for lighting fixtures manufactured by the Alt-Le Lighting Fixture Co., 262 Bowery, New York, N. Y.

ALTERNARC.—Trade name for electric cutting and welding machines manufactured by the Electric Arc Cutting & Welding Co., 153-58 Jelliff Ave., Newark, N. J.

ALTERNATING CURRENT.—A periodic current which alternates or reverses its direction of flow at regular intervals. An alternating current, in addition to reversing in direction at regular intervals, constantly changes in intensity but has its successive half waves of the same shape and area. The abbreviation a-c. is commonly used for alternating current, especially when used adjectively, as a-c. generator, a-c. power.

ALTERNATING WAVE FORM.—The intensity of an alternating current or e. m. f. changes from instant to instant. A curve showing the variation of the intensity with time is usually of a wave form. The simplest form of an a-c. wave is the sine wave, of which a concrete notion may be obtained by moving a paper at uniform speed and at right angles to the plane of vibration of a pendulum. If the pendulum is provided with a funnel filled with dry sand, the sand as it flows out will trace a path on the paper which closely approximates the shape of a simple sine curve. The equation of an a-c. wave of sine form is $i=I_m \sin \omega t$, where i is the current value at any instant corresponding to t, which is in seconds; $\omega=2\pi f$, where f is the frequency; I_m is the maximum value of the current.

A-c. waves may have widely different shapes. Any alternating wave may, however, be represented by a series of sine and cosine functions of different frequencies and different phases in the form:

$$i=A_1\sin \omega t+A_2\sin 2\omega t+A_3\sin 3\omega t+\text{....} \text{ etc.}$$
$$+B_1\cos \omega t+B_2\cos 2\omega t+B_3\cos 3\omega t+\text{....} \text{ etc.}$$

Since the positive and negative loops of an a-c. wave are usually alike, the terms containing the even values of ω drop out and the form reduces to:

$$i=A_1\sin \omega t+A_3\sin 3\omega t+A_5\sin 5\omega t+\text{....} \text{ etc.}$$
$$+B_1\cos \omega t+B_3\cos 3\omega t+B_5\cos 5\omega t+\text{....} \text{ etc.}$$

The number of terms necessary to completely represent the wave will depend upon its shape. Alternating e. m. f.'s can be represented in exactly the same manner as currents. Also see Harmonic analysis.

ALTERNATOR.—A synchronous alternating-current generator, of any number of phases. The term "alternator" is widely used, but is not as descriptive as "alternating-current generator." The latter, or its abbreviated form "a-c. generator," is therefore preferable. See Generator, synchronous.

ALTERNATOR, INDUCTOR.—An a-c. generator, either single-phase or polyphase, in which both field and armature windings may be stationary and a rotating part carrying projections and magnetized by the field winding causes pulsations, but no reversals of the magnetic flux through the armature coils. The inductor alternator has greater weight and poorer voltage regulation than a-c. generators of the usual type. Its chief advantage lies in the extreme ruggedness of the rotating part, enabling it to be driven at very high speeds. It thus becomes the type used to generate high-frequency currents, such as those required for radio telegraphy. It is practically obsolete as a low-frequency generator.

ALTERNATOR, RADIO.—See Generator, high-frequency, radio.

ALT-LE LIGHTING FIXTURE CO.—262 Bowery, New York, N. Y. Manufacturer of lighting fixtures.

ALTMAN.—Trade name for desk and table push buttons made by the Minerallac Electric Co., 1045 Washington Blvd., Chicago, Ill.

ALTORFER BROS. CO.—Peoria, Ill. Manufacturer of electric washing and ironing machines. Business established 1909. President and general manager, S. H. Altorfer; vice-president and treasurer, A. W. Altorfer; secretary, C. A. Sauder. Main office, Peoria, Ill. Factories, Peoria, Ill., and Roanoke, Ill. Branch offices and warehouses, San Francisco, Cal., and 49 Broadway, New York, N. Y.

ALUMAC.—Trade name for die castings manufactured by the Acme Die Casting Corp., 87 35th St., Brooklyn, N. Y.

ALUMADUCT.—Trade name for rigid metallic interior conduit manufactured by the National Enameling & Mfg. Co., Renshaw Blvd., Pittsburgh, Pa.

ALUMINA.—Oxide of aluminum, Al_2O_3. Commercially it is used for the production of aluminum metal, and also for the manufacture of abrasive and refractory materials. For the former purpose it is prepared by purification of bauxite (which see), usually by the Bayer process (which see). For the latter purpose it is fused in electric furnaces, after washing and calcination of the raw material, the product being called alundum, diamantin, aloxite or other trade names.

ALUMINUM.—A white metal, soft and light, but malleable and ductile, and a good conductor of heat and electricity. Symbol Al; at.wt. 27.1; sp.gr. 2.56; m.p. 657° C.; b.p. 2300° C. It is obtained from purified bauxite (alumina, Al_2O_3), the process being carried on in an electrolytic furnace (see Hall process). The United States is the leading producer, with an output of 90,000 metric tons in 1919, out of a total world's production of about 170,000 metric tons. It is used for electrical conductors, cooking utensils, and many articles requiring lightness, as well as in many light alloys, particularly alloys used in the automobile and airplane industries; these alloys are much stronger than the pure metal and only a few per cent heavier.

ALUMINUM CO. OF AMERICA.—Pittsburgh, Pa. Manufacturer of aluminum rods, cables, wire, etc. Vice-president and secretary, George Gibbons. Main office, 2400 Oliver Bldg., Pittsburgh, Pa. Branch offices, Albany, N. Y.; Baltimore, Md.; Boston, Mass.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Dallas, Tex.; Detroit, Mich.; Indianapolis, Ind.; Kansas City, Mo.; Minneapolis, Minn.; New Haven, Conn.; Newark, N. J.; New York, N. Y.; Philadelphia, Pa.; Rochester, N. Y.; San Francisco, Cal.; St. Louis, Mo.; Washington, D. C.; Northern Aluminum Co., Ltd., Toronto, Ont., Can.

ALUMINUM SHEETS, RODS, ETC.—Aluminum in the form of sheets and rods is used in the manufacture of many products. Its light weight and strength make it very useful as a casing for many electrical appliances, such as instruments of all kinds, small motors, portable vacuum cleaners, drink-mixers, vibrators and other small appliances of various kinds. The rods are used in a number of machine operations to give small parts of special shapes.

Manufacturers:

Aluminum Co. of America, 2400 Oliver Bldg., Pittsburgh, Pa.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass. "Raluminum."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

ALUNDUM.—Trade name for electrically produced abrasives and grinding wheels, manufactured by the Norton Co., Worcester, Mass.

ALVEY-FERGUSON CO., THE.—Cincinnati, Ohio. Manufacturer of conveying machinery. President, M. U. Burnham; vice-president, E. Palmer Burnham; secretary, W. H. Argabright; treasurer, Oscar Koehler. Main office and factory, Cincinnati, Ohio. Branch offices, 80 E. Jackson Blvd., Chicago, Ill.; 110 W. 40th St., New York, N. Y.; Old South Bldg., Boston, Mass.; Real Estate Trust Bldg., Philadelphia, Pa.; Chamber of Commerce Bldg., Rochester, N. Y.; Marshall Bldg., Cleveland, Ohio; Absopure Bldg., Detroit, Mich.; Marsh Strong Bldg., Los Angeles, Cal.

ALVEY MFG. CO.—St. Louis, Mo. Manufacturer of electric conveying machinery. Business established 1911. President, Ira L. Bretzfelder; secretary and treasurer, Robert H. Mayer. Main office and factory, 3200 S. Broadway, St. Louis, Mo. Branch offices, 105 W. 40th St., New York, N. Y.; Webster Bldg., Chicago, Ill.; The Arcade, Cleveland, Ohio; Liberty Bldg., Philadelphia, Pa.; 88 Broad St., Boston, Mass.; Los Angeles, Cal.; Mutual Life Bldg., Buffalo, N. Y.

ALVO-LITE.—Trade name for lighting reflector manufactured by the A-A Electric Mfg. Co., 303 Center St., Bridgeport, Conn.

ALWAYS READY.—Trade name for wrenches manufactured by J. H. Williams & Co., 187 Vulcan St., Buffalo, N. Y.

ALWAYS RELIABLE.—Trade name for brazing outfits, torches, soldering coppers and fire pots manufactured by the Otto Bernz Co., 17-37 Ashland St., Newark, N. J.

ALWO.—Trade name for nitrogen lamps manufactured by the Acme Lamp Works, 55 Cambridge Ave., Jersey City, N. J.

ALYEAR.—Trade name for lubricating oils and greases manufactured by the Franklin Oil Works, Franklin, Pa.

AMALGAMS.—Alloys of metals or nonmetals with mercury which have metallic appearance and properties. This also includes mercury which has dissolved in it small quantities of metals or nonmetals (for instance, ammonia) and remains liquid at ordinary temperatures.

AMATEUR RADIO.—The laws of the United States permit anyone interested in radio communication to install a receiving station. Transmitting stations of 1 kw. power input and 200 meters wave length may be installed and operated by amateurs who can satisfy government inspectors as to their fitness. There are over 5,000 licensed transmitting stations in the United States alone. The number of receiving stations is probably over three times as great. Reliable data on receiving stations are not available, as no license is required.

AMAZON.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

AMBEST.—Trade name for packing for ammonia compressors made by the Eureka Packing Co., 78 Murray St., New York, N. Y.

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AMBEST.—Trade name for flexible metallic packing manufactured by James L. Robertson & Sons, 78-80 Murray St., New York, N. Y.

AMBIENT TEMPERATURE.—This is the temperature of the cooling medium, whether air or water, that on coming into contact with the heated parts of a machine carries off its heat. This is an important element in making rating tests of electrical machinery.

AMBLER.—Trade name for asbestos yarn, tubing, tape, etc., manufactured by the Keasbey & Mattison Co., Ambler, Pa.

AMBOY.—Trade name for bronze rods manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

AMBRINE LABORATORIES.—347 Madison Ave., New York, N. Y. Manufacturer of first-aid equipment.

AMBU.—Trade name for batteries and battery repair shop equipment manufactured by the American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill.

AMCO.—Trade name for telegraph and radio apparatus manufactured by the Adams-Morgan Co., Alvin Place, Upper Montclair, N. J.

AMCO.—Trade name for electric conveying machinery manufactured by the Alvey Mfg. Co., 3200 S. Broadway, St. Louis, Mo.

AMCO.—Trade name for lighting fixtures manufactured by the Art Metal Mfg. Co., Cleveland, Ohio.

AMELITE.—Trade name for commercial lighting units manufactured by the Consolidated Lamp & Glass Co., Coraopolis, Pa.

AMERICA.—Trade name for electric vacuum cleaners made by the Wise-McClung Mfg. Co., New Philadelphia, Ohio.

AMERICAN.—Trade name for ball bearings and ball end thrust bearings made by the American Ball Co., 115 Clifford St., Providence, R. I.

AMERICAN.—Trade name for storage batteries, battery-charging sets and electrolytic rectifiers made by the American Battery Co., 1132-1134 Fulton St., Chicago, Ill.

AMERICAN.—Trade name for bearings manufactured by the American Bearing & Die Casting Corp., 212 W. McCarty St., Indianapolis, Ind.

AMERICAN.—Trade name for shade holders manufactured by the American Brass & Copper Co., 138 Lafayette St., New York, N. Y.

AMERICAN.—Trade name for electric elevators manufactured by the American Elevator & Machine Co., 500 E. Main St., Louisville, Ky.

AMERICAN.—Trade name for enameled magnet wire manufactured by the American Enameled Magnet Wire Co., Muskegon, Mich.

AMERICAN.—Trade name for fiber conduit for underground electric systems manufactured by the American Fibre Conduit Corp., 103 Park Ave., New York, N. Y.

AMERICAN.—Trade name for adjustable lighting fixtures manufactured by the American Fixture Co., Milwaukee, Wis.

AMERICAN.—Trade name for motor-driven floor surfacing machines manufactured by the American Floor Surfacing Machine Co., 518 S. St. Clair St., Toledo, Ohio.

AMERICAN.—Trade name for railway track equipment manufactured by the American Frog & Switch Co., 1028 Main St., Hamilton, Ohio.

AMERICAN.—Trade name for wire drawing, enameling, winding, taping machines and other wire insulating machines manufactured by the American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa.

AMERICAN.—Trade name for motor-driven weighing, and vegetable peeling and paring machines manufactured by the American Machinery Co., Inc., 330 N. 12th St., Philadelphia, Pa.

AMERICAN.—Trade name for armored cable and flexible steel conduit manufactured by the American Metal Moulding Co., 141-145 New Jersey Railroad Ave., Newark, N. J.

AMERICAN.—Trade name for lubricating oils and greases manufactured by the American Oil Corp., 172 S. Water St., Jackson, Mich.

AMERICAN.—Trade name for motor-driven perforating machines manufactured by the American Perforator Co., 617 W. Jackson Blvd., Chicago, Ill.

AMERICAN.—Trade name for motor-driven motion-picture machines manufactured by the American Projecting Co., 6231-33 Broadway, Chicago, Ill.

AMERICAN.—Trade name for car wheels, reels, pulleys, etc., manufactured by the American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa.

AMERICAN.—Trade name for electric key cutting machine manufactured by the American Sharpening Machine Co., 184 W. Washington St., Chicago, Ill.

AMERICAN.—Trade name for oil and grease cups manufactured by the American Stamping Co., Battle Creek, Mich.

AMERICAN.—Trade name for power plant specialties manufactured by the American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass.

AMERICAN.—Trade name for wire rope, springs, rail bonds, rail bonding tools, ignition wire, starting and lighting cables manufactured by the American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.

AMERICAN.—Trade name for sterilizing and disinfecting apparatus made by the American Sterilizer Co., Erie, Pa.

AMERICAN.—Trade name for transformers made by the American Transformer Co., 178-182 Emmett St., Newark, N. J.

AMERICAN.—Trade name for watchman's time detector manufactured by the American Watchman's Clock Co., 150 Nassau St., New York, N. Y.

AMERICAN.—Trade name for deep well, centrifugal and turbine pumps, well sinking and prospecting machinery manufactured by the American Well Works, Aurora, Ill.

AMERICAN.—Trade name for oil filters manufactured by the Burt Mfg. Co., Akron, Ohio.

AMERICAN.—Trade name for coal and ash handling machinery manufactured by the Conveyors Corp. of America, 326 W. Madison St., Chicago, Ill.

AMERICAN.—Trade name for motor-driven ice cream freezers manufactured by R. A. Dewsberry, 1932-36 W. Lake St., Chicago, Ill.

AMERICAN.—Trade name for electric clothes driers manufactured by the Domestic Laundry Equipment Co., 224 W. 26th St., New York, N. Y.

AMERICAN.—Trade name for electrocardigraphic equipment made by Charles F. Hindle, 45 Spring St., Ossining, N. Y.

AMERICAN.—Trade name for projecting arc lamp compensator manufactured by the Kentucky Electrical Co., 817 Lewis St., Owensboro, Ky.

AMERICAN.—Trade name for flashlights and flashlight batteries manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

AMERICAN ABRASIVE METALS CO.—New York, N. Y. Manufacturer of safety stair treads and insulating matting. President, William H. Sayre; vice-president, R. S. Edmondson; secretary, R. P. Spooner. Main office, Hudson Terminal Bldg., New York, N. Y. Branch offices, 136 Federal St., Boston, Mass.; Conway Bldg., Chicago, Ill.; Arcade Bldg., Philadelphia, Pa.; Farmers Bank Bldg., Pittsburgh, Pa.

AMERICAN ACE.—Trade name for spark plugs and electric heating appliances manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

AMERICAN APPLIANCE PRODUCTS CO.—1231 W. Madison St., Chicago, Ill. Manufacturer of electric washing machines. A. Selleg, sole owner.

AMERICAN ARMATURE.—Trade name for sheet steel for electrical purposes manufactured by the American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa.

AMERICAN ART CO.—114 E. Grand Ave., Chicago, Ill. Manufacturer of lamp bases. A. Brunicarbi, sole owner.

AMERICAN ART METAL WORKS.—348 N. 3rd St., Philadelphia, Pa. Manufacturers of fixture fittings and parts.

AMERICAN ASBESTOS CO.—Norristown, Pa. Manufacturer of asbestos products. Business established 1909. President and general manager, J. G. Tyson; assistant general manager, J. C. Johnston.

AMERICAN AUTO LAMP CO.—Union Hill, N. J. Manufacturer of automobile lamps. President, Charles Levy; secretary and treasurer, Frank V. Guarino.

AMERICAN BALL CHAIN WORKS.—12 Wooster St., New York, N. Y. Manufacturers of bead chains for pull sockets, etc. Business established 1888. Durbran & Hearne, proprietors.

AMERICAN BALL CO.—115 Clifford St., Providence, R. I. Manufacturer of ball bearings and ball end thrust bearings. Business established 1900. President, W. Penn Mather; vice-president, treasurer and general manager, Albert T. Sisson; secretary, M. F. Hughes.

AMERICAN BATTERY CO.—1134 Fulton St., Chicago, Ill. Manufacturer of storage batteries, battery-charging sets, farm lighting and power plants and rectifiers. Business established 1889.

AMERICAN BEARING & DIE CASTING CORP.—212 W. McCarty St., Indianapolis, Ind. Manufacturer of die cast bearings.

AMERICAN BEAUTY.—Trade name for electric heating and cooking appliances manufactured by the American Electrical Heater Co., Woodward, Burroughs & Cass Aves., Detroit, Mich.

AMERICAN BEAUTY.—Trade name for electric washing machines manufactured by the Thistle Mfg. Co., Chicago, Ill.

AMERICAN BELTING & TANNING CO.—135 Oliver St., Boston, Mass. Manufacturer of leather belting for motors and generators.

AMERICAN BLOWER CO.—Detroit, Mich. Manufacturer of fans, blowers, engines and air conditioning apparatus. President, James Inglis; vice-president and secretary, F. R. Still; vice-president and treasurer, J. F. G. Miller. Main office, Detroit, Mich. Factories, Detroit, Mich.; Troy, N. Y. Branch offices, Atlanta, Ga.; Boston, Mass.; Charlotte, N. C.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Dallas, Tex.; Denver, Colo.; Grand Rapids, Mich.; Hartford, Conn.; Indianapolis, Ind.; Kansas City, Mo.; Los Angeles, Cal.; Milwaukee, Wis.; Minneapolis, Minn.; Omaha, Neb.; Philadelphia, Pa.; Pittsburgh, Pa.; Providence, R. I.; Rochester, N. Y.; San Francisco, Cal.; Salt Lake City, Utah; St. Louis, Mo.; Seattle, Wash.; Washington, D. C.; 140 S. Dearborn St., Chicago, Ill.; 141 Broadway, New York, N. Y.

AMERICAN BOLT & SCREW CASE CO., THE.—Davies Bldg., Dayton, Ohio. Manufacturer of revolving cases for electrical stores. G. W. Chaffin, proprietor.

AMERICAN BOSCH MAGNETO CORP.—Springfield, Mass. Manufacturer of automobile ignition, lighting and starting equipment. Main office and factory, Springfield, Mass. Branch offices, 223 W. 46th St., New York, N. Y.; 3787 S. Michigan Ave., Chicago, Ill.; Detroit, Mich.; 1262 Post St., San Francisco, Cal.

AMERICAN BRAND.—Trade name for bare and insulated wire manufactured by the American Insulated Wire & Cable Co., 954 W. 21st St., Chicago, Ill.

AMERICAN BRASS & COPPER CO.—138 Lafayette St., New York, N. Y. Manufacturer of lighting fixtures and fixture fittings and parts.

AMERICAN BRASS CO., THE.—Waterbury, Conn. Manufacturer of brass, copper and nickel silver sheets, rolls, plates, wire and rods. President, John A. Coe; sales manager, F. E. Weaver; purchasing agent, H. T. Montague. Main office, Waterbury, Conn. Mills and factories, Ansonia Branch, Ansonia, Conn.; Buffalo Branch, Buffalo, N. Y.; Torrington Branch, Torrington, Conn.; Kenosha Branch, Kenosha, Wis.; Waterbury Branch, Waterbury, Conn. District offices, 195 Broadway, New York, N. Y.; 29 E. Madison St., Chicago, Ill.; 172 High St., Boston, Mass.; Book Bldg., Detroit, Mich.; 1401 Widener Bldg., Philadelphia, Pa.; 904 Union Bank Bldg., Pittsburgh, Pa.; Balfour Bldg., San Francisco, Cal.; 131 Dorrance St., Providence, R. I.; 707 Traction Bldg., Cincinnati, Ohio; 913 Citizens Bldg., Cleveland, Ohio.

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AMERICAN BRASS PRODUCTS CO.—105-15 S. Madison St., Pottstown, Pa. Manufacturer of brass, bronze, copper and monel metal specialties. Business established 1917. President and general manager, Holland M. Merrick; vice-president, William H. Worrilow; secretary and treasurer, Clarence E. Pyle.

AMERICAN BRIDGE CO.—New York, N. Y. Manufacturer of motor-driven escalators, transfer tables, air washers, A-frames, steel towers, catenary bridges, etc. President and general manager, August Ziesing; vice-president and sales manager, J. A. Hatfield; secretary, R. F. Ball; treasurer, F. E. Wiley. Main office, 30 Church St., New York, N. Y. Branch offices, Widener Bldg., Philadelphia, Pa.; John Hancock Bldg., Boston, Mass.; Continental Trust Bldg., Baltimore, Md.; Frick Bldg., Pittsburgh, Pa.; Marine National Bank Bldg., Buffalo, N. Y.; Union Trust Bldg., Cincinnati, Ohio.; Candler Bldg., Atlanta, Ga.; Guardian Bldg., Cleveland, Ohio; Beecher Ave. & M. C. R. R., Detroit, Mich.; 208 S. LaSalle St., Chicago, Ill.; 3rd National Bank Bldg., St. Louis, Mo.; 1st National Bank Bldg., Denver, Colo.; Walker Bank Bldg., Salt Lake City, Utah; Wolvin Bldg., Duluth, Minn.; 7th Ave. & 2nd St., S. E., Minneapolis, Minn. Sales representative, U. S. Steel Products Co., Rialto Bldg., San Francisco, Cal.; Selling Bldg., Portland, Ore.; 4th Ave. S., & Connecticut St., Seattle, Wash.

AMERICAN BRONZE CORP.—Berwyn, Pa. Manufacturer of bronze bearings for motors, generators, etc. Business established 1906. President and general manager, E. G. Anderson; vice-president and secretary, George D. Porter; treasurer, H. A. Smith. Main office and factory, Berwyn, Pa. Branch offices, 348 Tremont Bldg., Boston, Mass.; 340 Leader-News Bldg., Cleveland, Ohio; 464 Peoples Gas Bldg., Chicago, Ill.

AMERICAN BUREAU OF ENGINEERING, INC.—1601-1603 S. Michigan Ave., Chicago, Ill. Manufacturer of storage batteries and battery repair shop equipment. Business established 1915. President and general manager, C. J. Buckwalter; vice-president and sales manager, H. Edsall Olson; secretary, O. A. Witte; treasurer, A. W. Lemke. Sales representatives, Cochrane-Stephenson Co., Winnipeg, Man., Can.; W. L. Richey, Portland, Ore.; N. F. Andruss, San Francisco, Cal.

AMERICAN CAR & FOUNDRY CO.—New York, N. Y. Manufacturer of electric rivet heaters. President, W. H. Woodin; vice-presidents, W. C. Dickerman, J. M. Buick, H. W. Wolff, N. A. Doyle, W. F. Kingston; secretary, H. C. Wick; treasurer, S. S. DeLano. Main office, 165 Broadway, New York, N. Y. Branch offices, St. Louis, Mo.; 80 E. Jackson Blvd., Chicago, Ill.

AMERICAN CASTING & MFG. CORP.—30 Main St., Brooklyn, N. Y. Manufacturer of meter seals and sealing tools. President, H. L. C. Wenk, Jr.; secretary, N. B. Wenk.

AMERICAN CHAIN CO.—Bridgeport, Conn. Manufacturer of chains, jacks, etc.

AMERICAN CIRCULAR LOOM CO.—90 West St., New York, N. Y. Manufacturer of rigid steel conduit and nonmetallic tubing. Business established 1888. President, W. C. Robinson; vice-president, C. E. Corrigan; secretary, O. F. Felix; treasurer, H. H. Robinson; general manager, Oscar Hoppe. Factory, Kenilworth, N. J. Sales representatives, George Richards & Co., 557 W. Monroe St., Chicago, Ill.; R. B. Corey Co., 39 Cortlandt St., New York, N. Y.; C. Walter Jones, Boston, Mass.; W. A. McCombs, Pittsburgh, Pa.; R. B. Clapp, Los Angeles, Cal.; L. E. Sperry, San Francisco, Cal.

AMERICAN CLASSIC.—Trade name for electric washing machines manufactured by the Blackstone Mfg. Co., Jamestown, N. Y.

AMERICAN COPPER PRODUCTS CORP.—200 Broadway, New York, N. Y. Manufacturer of copper wire, cables, busbars and other copper products. Business established as Waclark Wire Co. in 1897; reorganized 1920. President, George E. Matthies; vice-presidents, F. S. Jerome, Wylie Brown; secretary, W. J. MacMillan; treasurer, B. H. Matthies; general manager, H. C. Carpenter; sales manager, William F. Heroy. Factory, Elizabeth, N. J.

AMERICAN CREOSOTING CO.—Louisville, Ky. Producer of creosoted poles, posts, ties and underground conduit. Main office, 401 W. Main St., Louisville, Ky. Branch office, Bogalusa, La. Plants, Manville, N. J.; Paterson, N. J.; Rome, N. Y.; Toledo, Ohio; Indianapolis, Ind.; Bloomington, Ind.; Russell, Ky.; Marion, Ill.; Kansas City, Mo.; Springfield, Mo.; Hugo, Okla.; Shreveport, La.; Deridder, La.; Bogalusa, La.; Brunswick, Ga.; Trenton, Ont., Can.

AMERICAN DI-ELECTRICS, LTD.—New York, N. Y. Manufacturer of insulating materials. President and general manager, John H. Barker. Main office, 71-75 Broadway, New York, N. Y. Factory, Long Island City, N. Y. Branch offices, Boston, Mass.; Philadelphia, Pa.; Pittsburgh, Pa.; St. Louis, Mo.; San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.

AMERICAN DIE & TOOL CO.—2nd and Buttonwood Sts., Reading, Pa. Manufacturer of gears for washing machines and motor speed reduction. Business established 1896. President, M. D. Sternbergh; secretary, treasurer and general manager, J. H. Sternbergh; sales manager, D. Sternbergh.

AMERICAN DISTRICT STEAM CO.—North Tonawanda, N. Y. Manufacturer of underground conduit systems for steam, etc., steam traps, valves, steam flow meters and other steam specialties. President, G. C. St. John; vice-president, treasurer and general manager, Robert Hall; secretary, H. C. Kimbrough. Main office, North Tonawanda, N. Y. Branch offices, 38 S. Dearborn St., Chicago, Ill.; Seattle, Wash.; New York, N. Y.

AMERICAN DRAFTING FURNITURE CO., INC.—103 Mill St., Rochester, N. Y. Manufacturer of drafting furniture. Business established 1898. President, G. N. Perkins; vice-president, S. F. Pratt; secretary, G. C. Perkins; treasurer and general manager, William R. Moyes; sales manager, J. L. O'Connor.

AMERICAN DUPLEX.—Trade name for electric key cutting machines manufactured by the American Sharpening Machine Co., Inc., 184 W. Washington St., Chicago, Ill.

AMERICAN ELECTRIC CO.—6401 S. State St., Chicago, Ill. Manufacturer of telephone apparatus and accessories. Business established 1898. President and treasurer, P. C. Burns; secretary and sales manager, E. L. Brown.

AMERICAN ELECTRIC CUTTING MACHINE CO.—149-151 Lafayette St., New York, N. Y. Manufacturer of small motors and electric cloth cutting machines. Business established 1893. President, E. M. Waring.

AMERICAN ELECTRIC MOTORS, INC.—Milwaukee, Wis. Manufacturer of a-c. motors. President, C. L. Daun; vice-president, H. B. Mortimer; secretary and treasurer, W. M. Sprinkman.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—An organization founded in 1882 to "establish and maintain a spirit of co-operation among members and encourage friendly relations between the companies and the public," and in particular, the consideration of matters concerning general welfare, public policy, fares, taxation, insurance and general policy. Its membership now aggregates 400 electric railway companies, 250 manufacturers of electric railway appliances, 2600 individual members and 2000 company section members.

The organization is composed of the American Electric Railway Association or parent body, and four affiliated associations—the American Electric Railway Accountants' Association, American Electric Railway Engineering Association, American Electric Railway Claims Association and American Electric Railway Transportation and Traffic Association.

The Accountants' Association considers questions relative to the standardization of accounts and reports and other matters relating to accounting for electric railways. The Engineering Association considers engineering questions covering construction and maintenance of electric railway equipment and apparatus, standardization, block signals and multiple-unit operation. The Claims Association considers the work for the prevention of accidents, the reduction of damage accounts, the maintenance of an index bureau service and other matters relating to the claim departments of electric railways. The Transportation and Traffic Association considers general operating methods in detail, rules, freight and express, time tables, the hiring and training of employees, block signals, multiple-unit operation and other matters relative to transportation and traffic operation.

Officers of the American Electric Railway Association for 1920-21 are: President, Philip H. Gadsden, president, Charleston Consolidated Railway & Lighting Co., Philadelphia, Pa. Vice-presidents, Robert I. Todd, Indianapolis, Ind.; Philip J. Kealy, Kansas City, Mo.; Britton I. Budd, Chicago, Ill.; C. D. Emmons, Baltimore, Md. Secretary-treasurer, E. B. Burritt, 8 West 40th St., New York, N. Y.

Officers of the Accountants' Association: President, John J. Landers, York, Pa. Vice-presidents, F. E. Webster, Haverhill, Mass.; W. G. Nicholson, Omaha, Neb.; W. A. Doty, Denver, Colo. Secretary-treasurer, F. J. Davis, Newark, N. J.

Officers of the Engineering Association: President, W. G. Gove, Brooklyn, N. Y. Vice-presidents, C. L. Cadle, New York, N. Y.; C. S. Kimball, Washington, D. C.; L. C. Datz, Birmingham, Ala. Secretary-treasurer, E. B. Burritt, New York, N. Y.

Officers of the Claims Association: President, J. J. Reynolds, Boston, Mass. Vice-presidents, C. G. Rice, Pittsburgh, Pa.; Wallace Muir, Lexington, Ky.; W. H. Hyland, Gloversville, N. Y. Secretary-treasurer, J. S. Kubu, Utica, N. Y.

Officers of the Transportation and Traffic Association: President, R. P. Stevens, New York, N. Y. Vice-presidents, L. H. Palmer, Baltimore, Md.; G. T. Seely, Youngstown, Ohio; J. K. Punderford, New Haven, Conn. Secretary-treasurer, E. B. Burritt, New York, N. Y.

The Association holds an annual convention in the fall, and an annual conference and dinner in the winter. "Aera," a monthly magazine devoted to the interests of the electric railway industry and the association, is published by the Association.

AMERICAN ELECTRICAL HEATER CO.—Woodward, Burroughs & Cass Aves., Detroit, Mich. Manufacturer of electric cooking and heating devices. Business established 1894. President, Robert H. Kuhn; vice-president, Frank Kuhn; secretary and treasurer, Guido Kuhn; general manager, Robert Kuhn; sales manager, W. A. Baker.

AMERICAN ELECTRICAL WORKS.—Phillipsdale, R. I. Manufacturers of wires and cables. Business established 1870. President, Frank N. Phillips; vice-president, Eugene R. Phillips; secretary, W. C. Ingerson; treasurer, G. E. Haywood; manager, C. H. Wagensell; general sales manager, E. H. Hammond. Main office and factory, Phillipsdale, R. I. Branch offices, 233 Broadway, New York, N. Y.; 112 W. Adams St., Chicago, Ill.; 176 Federal St., Boston, Mass.; Traction Bldg., Cincinnati, Ohio. Sales representatives, Garnet Young & Co., San Francisco, Cal.

AMERICAN ELECTROCHEMICAL SOCIETY.—Founded in Philadelphia, in 1902, with 355 charter members, it now numbers over 2500 members. It was preceded in Germany by the Deutsche Elektrochemische Gesellschaft (now Deutsche Bunsen Gesellschaft) and in England by the Faraday Society, but has surpassed both these taken together, in membership.

The object of the Society is to encourage the study and practice of electrochemistry. The membership is largely composed of chemists, metallurgists and electrical engineers, with a sprinkling of business men and lawyers connected with electrochemical industries. Anyone of good character is eligible to membership; annual dues are $5, entitling a member to pamphlet copies of all publications. Two meetings are held per year, at various places in America; the transactions of each meeting are issued, with complete discussions of papers, in a cloth bound volume; 36 volumes have been issued. The present officers, 1921-1922, are: President, Acheson Smith; secretary, Prof. Jos. W. Richards, Lehigh University, Bethlehem, Pa.; treasurer, P. G. Salom, Philadelphia; together with six vice-presidents and twelve managers.

The Committee on Public Relations, composed of the president and the past-presidents of the Society, is active in expressing the opinion of the Society on public questions, such as water-power concessions, special power rates for electrochemical purposes, conservation of fuels, licensing of technologists, relations of capital and labor. Various other committees of the Society busy themselves with the development of papers on various phases of electrochemistry. A division on Electrothermics has recently been formed to include all members interested in electric furnaces, electric steel, electric brass refractories, heat treating apparatus, etc.

AMERICAN ELEVATOR & MACHINE CO.—500 E. Main St., Louisville, Ky. Man-

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ufacturer of electric elevators. Business established 1898. President, E. Poschinger; vice-president, Charles F. Antz; secretary and sales manager, V. K. Ecker; treasurer and general manager, F. H. Poschinger.

AMERICAN ENAMEL CO.—Providence, R. I. Manufacturer of cord adjusters, socket attachments and wood handles for electrical purposes. Business established 1866. President and treasurer, James H. Dowd; sales manager, F. H. Humes. Main office and factory, Neville St., Providence, R. I. Branch office, 95 Madison Ave., New York, N. Y.

AMERICAN ENAMELED MAGNET WIRE CO.—Muskegon, Mich. Manufacturer of enameled magnet wire. President, E. C. Cronwall; secretary and treasurer, Charles H. Latimer.

AMERICAN ENGINE & FOUNDRY CO.—Charles City, Iowa. Manufacturer of farm lighting and power plants and gas engines. President, W. L. Joyce; vice-president, F. S. Pool; secretary and treasurer. C. C. Butler.

AMERICAN ENGINEERING CO.—Philadelphia, Pa. Manufacturer of electric hoists and automatic stokers. President, W. F. Sauter; vice-presidents, M. Alpern, W. V. Sauter; secretary and treasurer, C. L. Cushmore; general manager, M. Alpern; sales managers, (Stoker Division), H. N. Schofield; (Marine Division), P. E. Kriebel. Main office and factory, Aramingo Ave. & Cumberland St., Philadelphia, Pa. Branch offices, Boston, Mass.; Baltimore, Md.; Pittsburgh, Pa.; Cleveland, Ohio; Cincinnati, Ohio; Detroit, Mich.; New Orleans, La.; Denver, Colo.; Salt Lake City, Utah; 100 Broadway, New York, N. Y.; 140 S. Dearborn St., Chicago, Ill. Sales representative, Taylor Stoker Co., Ltd., Toronto, Ont., Can.

AMERICAN EQUIPMENT CO.—Norristown, Pa. Manufacturer of bolts, nuts and rods. Business established 1906. President, S. P. Mitchell; secretary, J. A. Longacre; treasurer, A. J. Major; sales manager, H. W. Magee.

AMERICAN EVER READY WORKS OF NATIONAL CARBON CO., INC.—Long Island City, N. Y. Manufacturer of storage batteries, flashlights and electrical measuring instruments. Business established 1898. Assistant general manager, E. K. Moore. Main office and factory, Thompson Ave. & Orton St., Long Island City, N. Y. Branch offices, 3711 S. Ashland Ave., Chicago, Ill.; 383 Whitehall St., Atlanta, Ga.

AMERICAN EXPANSION BOLT CO.—4077 Park Ave., New York, N. Y. Manufacturer of expansion bolts.

AMERICAN FARM EQUIPMENT CO.—Williamsport, Pa. Manufacturer of farm lighting and power plants. President, William J. Housel; secretary, Clarence Peaslee; treasurer, Charles A. Bair.

AMERICAN FIBER CONDUIT CORP.—New York, N. Y. Manufacturer of fiber conduit for underground construction. Business established 1898. President, John S. Cravens; vice-president, Gilbert Crossman; secretary, W. L. Percey; treasurer, E. M. Russell; general sales manager, J. M. Nelson, Jr. Main office, 103 Park Ave., New York, N. Y. Factory, Fulton, N. Y. Branch office, 330 Monadnock Block, Chicago, Ill. Western Electric Co., Inc., exclusive distributor in U. S.

AMERICAN FIRE PREVENTION BUREAU, INC.—1 Madison Ave., New York, N. Y. Manufacturer of fire alarm systems and accessories. Organized 1911. President, treasurer, general manager, John H. Derby; secretary, Jos. O. Hammitt.

AMERICAN FIXTURE CO.—Milwaukee, Wis. Manufacturer of adjustable lighting fixtures. A. C. Runkel and Ed. Kiesslich, partners.

AMERICAN FLOOR SURFACING MACHINE CO.—518 S. St. Clair St., Toledo, Ohio. Manufacturer of motor-driven floor surfacing machines. Business established 1903. President, William B. Frey; secretary and treasurer, H. H. Wolfe. Sales representative, J. H. Prugh, 4069 Ingalls St., San Diego, Cal.

AMERICAN FORGE & MFG. CO.—2433-41 W. 48th St., Chicago, Ill. Manufacturers of copper forgings. President, H. A. Jackwerth; secretary and treasurer, W. S. Cohn.

AMERICAN FOUNDRY CO., INC., THE.—Newark, N. J. Manufacturer of brass, bronze and aluminum castings. Secretary and general manager, R. B. Roberts, Jr. Main office and factory, Springfield Ave. & S. 11th St., Newark, N. J. Branch office, 2 Hudson St., New York, N. Y.

AMERICAN FROG & SWITCH CO., THE.—Hamilton, Ohio. Manufacturer of railway track equipment. Business established 1901. President, L. F. Phipps; secretary, Don Hoover; treasurer, E. S. Griffis. Main office and factory, Hamilton, Ohio. Branch offices, Diamond Bank Bldg., Pittsburgh, Pa.; Starks Bldg., Louisville, Ky.; Birmingham, Ala.; Mutual Bldg., Richmond, Va. Sales representatives, Handlan Buck Mfg. Co., St. Louis, Mo.; Miller Supply Co., Huntington, W. Va.

AMERICAN GALCO, INC.—Grand Central Palace, New York, N. Y. Manufacturer of regulators and oil cups. Business established 1919. President, G. A. Lindstedt; vice-president and general manager, Harry Carlson; secretary and treasurer, V. G. Lowe.

AMERICAN GAS MACHINE CO., INC.—Albert Lea, Minn. Manufacturer of electric washing machines. Business established 1896. President and general manager, H. C. Hanson; secretary, treasurer and sales manager, H. W. Jensen. Branch office, 78 Reade St., New York, N. Y.

AMERICAN GIANT.—Trade name for electroplating generator manufactured by the Connecticut Dynamo & Motor Co., Lyons Ave. & Coit St., Irvington, N. J.

AMERICAN GLASS SPECIALTY CO.—Monaca, Pa. Manufacturer of illuminating glassware.

AMERICAN HIGH SPEED CHAIN CO.—Indianapolis, Ind. Manufacturer of power transmission chains. H. G. Bates, sales manager. Main office, 401 S. Illinois St., Indianapolis, Ind. Branch offices, 332 S. Michigan Ave., Chicago, Ill.; 30 Church St., New York, N. Y.; The Bourse, Philadelphia, Pa.; 5086 Jenkins Arcade, Pittsburgh, Pa.; Associated Service Bldg., Buffalo, N. Y.

AMERICAN HOIST & DERRICK CO.—St. Paul, Minn. Manufacturer of electric hoists and derricks. Partnership, Oliver Crosby, W. O. Washburn, F. J. Johnson. Main office, St. Paul, Minn. Branch office, 343 S. Dearborn St., Chicago, Ill.

AMERICAN HUHN METALLIC PACKING CO.—Woolworth Bldg., New York, N. Y. Manufacturer of metallic packing for steam and air.

AMERICAN IDEAL.—Trade name for steam traps manufactured by the American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass.

AMERICAN INJECTOR CO.—175 14th Ave., Detroit, Mich. Manufacturer of injectors, grease and oil cups and other steam specialties. Business established 1883. President and general manager, John Trix; vice-president and sales manager, J. J. B. Trix; secretary and treasurer, Herbert B. Trix.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The national organization representing the electrical engineering profession. It was founded in 1884 and incorporated in 1896. The objects of the Institute are the advancement of the theory and practice of electrical engineering and of the allied arts and sciences, the maintenance of a high professional standing among its members, and the development of the individual engineer. The Institute has contributed largely toward the remarkable progress that has taken place in the electrical field during the last three decades, and has been an important factor in advancing the interests of its members and of the entire engineering profession.

The membership of the Institute consists of fellows, members, and associates. Election or transfer to a particular grade depends largely on the amount of experience the applicant has had. All branches of electrical engineering are represented in the membership, which includes consulting engineers, professors of electrical engineering, chief engineers, managers and other officers associated with electric lighting, railway, telephone, telegraph, power and manufacturing companies, and other persons interested in the advancement of the electrical profession. Total membership on Jan. 1, 1921, was 12,201.

Meetings of the Institute are usually held monthly, excepting during the summer, in cities where Institute Sections are located. An annual convention or general meeting is held outside New York City in June of each year, usually occupying about four days. A midwinter convention is held in New York City in February of each year. A Pacific Coast convention is held on the Pacific Coast, generally in September of each year. The annual business meeting of the Institute, at which officers are elected for the ensuing year, is held in New York on the third Friday in each May. Local meetings are also held monthly by the Sections and Student Branches.

The Institute is governed by a board of directors, elected by the membership, consisting of the two junior past-presidents, a president, six vice-presidents (ten commencing Aug. 1, 1921), twelve managers, and a treasurer. The terms of the officers are as follows: President, vice-presidents and treasurer, one year, (vice-presidents two years commencing Aug. 1, 1921); managers, four years. The present officers of the Institute are: President, A. W. Berresford, Milwaukee, Wis. Junior past-presidents, C. A. Adams, Cambridge, Mass., and Calvert Townley, New York. Vice-presidents, C. S. Ruffner, New York; C. Robbins, Pittsburgh, Pa.; L. T. Robinson, Schenectady, N. Y.; C. E. Magnusson, Seattle, Wash.; E. H. Martindale, Cleveland, Ohio; C. S. McDowell, U. S. Navy. Managers, W. A. Hall, Atlantic, Mass.; W. A. Del Mar, New York; W. Sykes, Chicago, Ill.; L. E. Imlay, New York; F. F. Fowle, Chicago, Ill.; L. F. Morehouse, New York; W. I. Slichter, New York; G. Faccioli, Pittsfield, Mass.; F. D. Newbury, Pittsburgh, Pa.; H. B. Smith, Worcester, Mass.; J. F. Lincoln, Cleveland, Ohio; E. B. Craft, New York. Treasurer, G. A. Hamilton, Elizabeth, N. J. Secretary, F. L. Hutchinson, New York. The past presidents of the Institute are as follows: *Norvin Green, 1884-5-6; *Franklin L. Pope, 1886-7; T. Commerford Martin, 1887-8; Edward Weston, 1888-9; Elihu Thomson, 1889-90; *William A. Anthony, 1890-91; Alexander Graham Bell, 1891-2; Frank Julian Sprague, 1892-3; *Edwin J. Houston, 1893-4-5; *Louis Duncan, 1895-6-7; Francis Bacon Crocker, 1897-8; A. E. Kennelly, 1898-1900; Carl Hering, 1900-1; Charles P. Steinmetz, 1901-02; Charles F. Scott, 1902-3; Bion J. Arnold, 1903-4; John W. Lieb, 1904-5; Schuyler Skaats Wheeler, 1905-6; *Samuel Sheldon, 1906-7; Henry G. Stott, 1907-8; Louis A. Ferguson, 1908-09; Lewis B. Stillwell, 1909-10; Dugald C. Jackson, 1910-11; Gano Dunn, 1911-12; Ralph B. Mershon, 1912-13; C. O. Mailloux, 1913-14; Paul M. Lincoln, 1914-15; John J. Carty, 1915-16; H. W. Buck, 1916-17; E. W. Rice, Jr., 1917-18; Comfort A. Adams, 1918-19; Calvert Townley, 1919-1920.

*Deceased.

Much of the important work of the Institute is accomplished through committees. Standing committees authorized under the constitution and by-laws are: Executive, Finance, Meetings and Papers, Publication, Co-ordination of Institute Activities, Safety Codes, Board of Examiners, Sections, Student Branches, Membership, Public Policy, Law, Headquarters, Standards, Edison Medal, Code of Principles of Professional Conduct and U. S. National Committee of the International Electrotechnical Commission. Special Committee: Super Power System.

Technical committees authorized under the by-laws are: Power Stations, Transmission and Distribution, Traction and Transportation, Industrial and Domestic Power, Lighting and Illumination, Economics of Electric Service, Protective Devices, Electrochemistry and Electrometallurgy, Electrophysics, Telegraphy and Telephony, Marine, Mines, Electrical Machinery, Instruments and Measurements, Iron and Steel Industry and Educational.

For the purpose of more effectively carrying out the aims of the Institute, and for the convenience of the members, the Institute has provided for the organization of Sections; 39 of these are now established in centers of electrical activity. To afford opportunity for the student to gain a proper perspective of engineering work, by enabling him to become acquainted with the personnel and the problems of present engineering work, the Institute provides for Branches and for student enrollment at a nominal fee; there are now 61 Student Branches at educational centers.

The Journal is a high-grade electrical engineering periodical issued to the entire membership without extra charge at the beginning of each calendar month and contains in full or in abstract engineering and theoretical papers and discussions as presented before meetings of the Institute and its Sections and Branches; descriptions of new developments characterized by notable advances, and items relating to the activities of the Institute and other organizations. The Transactions are published in one or more bound volumes each year, and consist of technical papers and discussions, reports, and other Institute matter deemed worthy of permanent record. The Institute also publishes a Year Book, Standardi-

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zation Rules and from time to time the reports and specifications of various committees.

An employment service is maintained for the purpose of assisting members in obtaining positions, and consists principally in acting as a medium for bringing together the employer and employee.

The Institute has its headquarters and executive offices on the tenth floor of the Engineering Societies Building, 33 West 39th St., New York. The Library, with which are combined the libraries of the societies of the civil, mechanical and mining engineers, is located in the building, consists of over 150,000 volumes and is conducted as a free public reference library. A Service Bureau makes it available to out-of-town members.

One of the most notable activities of the Institute, extending over many years, was the compilation of the A. I. E. E. Standardization Rules. In framing these rules, the chief purpose has been to define the terms and conditions which characterize the rating and behavior of electrical apparatus.

AMERICAN INSULATED WIRE & CABLE CO.—954 W. 21st St., Chicago, Ill. Manufacturer of bare and insulated wire. Business established 1899. President and general manager, Nathan T. Brenner; vice-president, L. G. Brenner; secretary and sales manager, M. B. Mervis; treasurer, Norman Brenner. Sales representatives, Davis-Cortell Co., 332 First Ave., Pittsburgh, Pa.; Foster Callahan, 237 Brown Marx Bldg., Birmingham, Ala.; Wood & Lane, 915 Olive St., St. Louis, Mo.

AMERICAN INSULATING MACHINERY CO.—Fairhill & Huntingdon Sts., Philadelphia, Pa. Manufacturer of wire drawing, insulation winding, braiding and taping, cabling, wire stranding, twisting machines and other insulating machinery. Business established 1855. President, Robert W. Withington; secretary and treasurer, Henry L. Benner.

AMERICAN INSULATION CO.—Roberts Ave. & Stokley St., Philadelphia, Pa. Manufacturer of asbestos tape, tubing, gloves and other asbestos products. President, John W. Latchum; vice-president and treasurer, Benjamin T. Conwell.

AMERICAN INSULATOR CORP.—New Freedom, Pa. Manufacturer of molded insulation, insulators, etc. Emile Hemming, president. Main office and factory, New Freedom, Pa. Branch offices, 30 Church St., New York, N. Y.; 44 Cherry St., Detroit, Mich.; Norwalk, Conn. Sales representative, Albert J. Cox Co., 564 W. Monroe St., Chicago, Ill.

AMERICAN IRONING MACHINE CO.—166 N. Michigan Ave., Chicago, Ill. Manufacturer of electric ironing machines. President, H. G. Gross; vice-president, E. C. Peter; secretary and treasurer, J. W. Taft.

AMERICAN JUNIOR.—Trade name for electric razor honing and safety blade sharpening machine manufactured by the American Sharpening Machine Co., Inc., 184 W. Washington St., Chicago, Ill.

AMERICAN LACE LEATHER CO., INC.—Richmond, Va. Manufacturer of belt lacing.

AMERICAN LADY.—Trade name for electric grill and toaster manufactured by the Union Electric Corp., 103 Mott St., New York, N. Y.

AMERICAN-LA FRANCE FIRE ENGINE CO.—Elmira, N. Y. Manufacturer of safety devices for electricians, welders, etc. Business established 1846. President and general manager, J. R. Clark; vice-president, August Heckscher; treasurer, A. E. Rhodes; sales manager, E. C. Keating. Main office, Elmira, N. Y. Factories, Elmira, N. Y., and Toronto, Ont., Can. Branch offices, Boston, Mass.; New York, N. Y.; Pittsburgh, Pa.; Chicago, Ill.; Denver, Colo.; Dallas, Tex.; Los Angeles, Cal.; San Francisco, Cal.; Portland, Ore.; Atlanta, Ga.; Washington, D. C.

AMERICAN LAMP.—Trade name for electric signs manufactured by American Sign Co., Cooley & Willard Sts., Kalamazoo, Mich.

AMERICAN LAVA CORP.—1429 William St., Chattanooga, Tenn. Manufacturer of lava for mechanical and electrical purposes. Business established 1902. President, P. J. Kruesi; vice-president and general manager, John Kruesi; secretary, H. R. Smartt; treasurer, W. A. Jeffords; sales manager, G. E. Richter, Jr.

AMERICAN LEATHER PRODUCTS CO., THE.—Indianapolis, Ind. Manufacturer of leather nail heads and other leather products. Business established 1911. President, M. Ross Masson; secretary and treasurer, E. L. Salvage.

AMERICAN LENS.—Trade name for electric signs manufactured by American Sign Co., Cooley & Willard Sts., Kalamazoo, Mich.

AMERICAN LINE MATERIALS CO.—Chicago, Ill. Manufacturer of underground conduit, crossarms and insulator pins. President, W. M. Carpenter; treasurer, Ernest S. Hough; general sales manager, A. F. Crosby. Main office, McCormick Bldg., Chicago, Ill. Branch offices, New York, N. Y.; Rutherford, N. J.; Norfolk, Va.; Hattiesburg, Miss.; Minnesota Transfer, Minn.; Centralia, Wash.; Tacoma, Wash.

AMERICAN LUMINOUS PRODUCTS CO.—Huntington Park, Cal. Manufacturer of luminous and radio-active substances. Established 1914. Proprietor and manager, Arthur H. Jackson.

AMERICAN MAID.—Trade name for electric washing machines manufactured by the American Appliance Products Co., 1231 W. Madison St., Chicago, Ill.

AMERICAN MANGANESE BRONZE CO.—Holmesburg Junction, Philadelphia, Pa. Manufacturer of brass and bronze products. President, James B. Curtis; vice-president and general manager, C. R. Spare; vice-president, treasurer and sales manager, T. H. Addie. Main office and factory, Holmesburg Junction, Philadelphia, Pa. Branch offices, 316 House Bldg., Pittsburgh, Pa.; 1646 Woodward Ave., Detroit, Mich.; 285 Beaver Hall Hill, Montreal, Que., Can.

AMERICAN MFG. CO.—Front & Walnut Sts., Wilmington, Del. Manufacturer of leather belting.

AMERICAN MASON SAFETY TREAD CO.—Lowell, Mass. Manufacturer of car steps and safety treads for car steps, stairways, etc. Established in 1895. President and general manager, Henry C. Delano; secretary-treasurer, J. L. Campbell. Main office and factory, 125 Perry St., Lowell, Mass. Branch offices, 480 Lexington Ave., New York, N. Y.; 900 Widener Bldg., Philadelphia, Pa.; 813 Old South Bldg., Boston, Mass.

AMERICAN METAL MOULDING CO.—141-145 New Jersey Railroad Ave., Newark, N. J. Manufacturer of armored cable and flexible metallic conduit. Business established 1914. President and treasurer, G. A. Johnson; secretary, A. H. Rosenkampff; general manager, C. J. Johnson.

AMERICAN MICA CO.—Newton Lower Falls, Mass. Manufacturer of mica and mica products. P. M. Morris, general manager.

AMERICAN MINE DOOR CO., THE.—Canton, Ohio. Manufacturer of cable splicing joints, sectionalizing insulators, trolley frogs, trolley wire splicing and wire sleeves, bond terminals and tools, etc. President, A. Vignos; secretary and treasurer, Alfred Vignos; general manager, N. K. Bowman.

AMERICAN MULTIGRAPH SALES CO., THE.—E. 40th St. & Kelly Ave., Cleveland, Ohio. Manufacturer of motor-driven printing and multigraph machines. Business established 1905. President and general manager, H. C. Osborn; vice-presidents, R. G. A. Phillips, R. G. Pack, W. C. Dunlap; secretary, H. S. Mansfield; treasurer, E. F. Koenig; sales manager, W. C. Dunlap.

AMERICAN NUT & BOLT FASTENER CO., THE.—Pittsburgh, Pa. Manufacturer of sheet metal stampings and washers. Vice-president and sales manager, G. A. Aiken; secretary and treasurer, Joseph R. Royston. Main office and factory, Ontario and Doerr Sts., Pittsburgh, Pa. Branch offices, Toledo, Ohio; Detroit, Mich.; Denver, Colo.; San Francisco, Cal.

AMERICAN OIL CORP.—Jackson, Mich. Manufacturer of lubricating oils and greases. Business established 1904. President and general manager, A. J. Callaghan; vice-president, A. H. Steele; secretary, W. E. Callaghan; treasurer, D. S. Fleming; sales manager, L. B. Stableford. Main office, 172 S. Water St., Jackson, Mich. Branch offices, New York, N. Y., and Detroit, Mich.

AMERICAN OVEN & MACHINE CO.—111 W. Washington St., Chicago, Ill. Manufacturer of motor-driven cake and dough mixers. President and general manager, S. J. Notz.

AMERICAN PERFORATOR CO.—617 W. Jackson Blvd., Chicago, Ill. Manufacturer of motor-driven perforating machines. Secretary, W. H. Lyman; sales manager, R. J. Hatton.

AMERICAN PIN CO., THE.—Waterbury, Conn. Manufacturer of fixture fittings and parts. President and treasurer, T. I. Driggs; vice-president, F. E. Bartlett; secretary, W. W. Bowers; sales manager (Gas and Electric Fixture Parts Dept.), L. F. Buechele. Main office and factory, Waterbury, Conn. Branch offices, 507 5th Ave., New York, N. Y.; 209 S. State St., Chicago, Ill.; 515 Washington St., Boston, Mass.; North American Bldg. Philadelphia, Pa.

AMERICAN PIPE BENDING MACHINE CO.—39 Pearl St., Boston, Mass. Manufacturer of pipe and conduit benders. President, Bennett Silverblatt; secretary, Edmund P. Blake; treasurer, A. J. Harris; general manager, E. P. Blake.

AMERICAN PLATINUM WORKS.—Newark, N. J. Refiners of platinum, gold and silver. Established, 1875. President and treasurer, Charles Engelhard; vice-president, Clarence B. Mitchell; secretary, Lyman E. Warren; general manager, Theodor Koch. Main office, 225-231 New Jersey Railroad Ave., Newark, N. J. Branch office, 30 Church St., New York, N. Y.

AMERICAN PORCELAIN CO., THE.—East Liverpool, Ohio. Manufacturer of porcelain insulators and other electrical porcelain. President, W. J. Curry; secretary, M. Batey; treasurer, W. A. Andrews.

AMERICAN PROJECTING CO., THE.—6231-33 Broadway, Chicago, Ill. Manufacturer of motion-picture machines and accessories. President, S. S. Hutchinson; general manager, J. H. Hutchinson.

AMERICAN PULLEY CO., THE.—Philadelphia, Pa. Manufacturer of car wheels, reels, pulleys, etc. Business established 1895. President, Charles E. Brinley; vice-president, secretary and sales manager, William R. Simpson; vice-president, G. C. Munoz; treasurer, John W. Muir. Main office, 4200 Wissahickon Ave., Philadelphia, Pa. Branch offices, 166 Pearl St., Boston, Mass.; 114 S. Clinton St., Chicago, Ill.; 536 1st Ave., S., Seattle, Wash.; 14 Natoma St., San Francisco, Cal.; 33 Greene St., New York, N. Y.

AMERICAN QUALITY.—Trade name for electric flat-iron manufactured by the American Electrical Heater Co., Woodward, Burroughs & Cass Aves., Detroit, Mich.

AMERICAN RADIATOR CO.—816-22 S. Michigan Ave., Chicago, Ill. Manufacturer of electric vacuum cleaners, steam radiators and boilers. Factory, Rockford, Ill. Manager (Vacuum Cleaner Division), J. E. Holland. Branch offices, Boston, Mass; Springfield, Mass.; Portland, Me.; Worcester, Mass.; Providence, R. I.; New Haven, Conn.; Albany, N. Y.; Newark, N. J.; Philadelphia, Pa.; Reading, Pa.; Harrisburg, Pa.; Wilkesbarre, Pa.; Baltimore, Md.; Washington, D. C.; Norfolk, Va.; Richmond, Va.; Syracuse, N. Y.; Rochester, N. Y.; Buffalo, N. Y.; Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Grand Rapids, Mich.; Cincinnati, Ohio; Dayton, Ohio; Columbus, Ohio; Louisville, Ky.; Atlanta, Ga.; Birmingham, Ala.; New Orleans, La.; Peoria, Ill.; Indianapolis, Ind.; St. Louis, Mo.; Des Moines, Iowa; Milwaukee, Wis.; Minneapolis, Minn.; St. Paul, Minn.; Duluth, Minn.; Omaha, Neb.; Kansas City, Mo.; Denver, Colo.; San Francisco, Cal.; Los Angeles, Cal.; Seattle, Wash.; Portland, Ore.; Spokane, Wash.; Brantford, N. Dak.; Toronto, Ont., Can.; 816-822 S. Michigan Ave., Chicago, Ill.; 104 W. 42nd St., New York, N. Y.

AMERICAN RADIO & RESEARCH CORP.—21 Park Row, New York, N. Y. Manufacturer of electrical laboratory instruments, radio apparatus and motors. Business established 1914. President, J. Axten; vice-president, treasurer and general manager, Harold J. Power; secretary, Havens Grant; sales manager, Charles W. Leber. Factory, Medford Hillside, Mass.

AMERICAN REFLECTOR & LIGHTING CO.—100-104 S. Jefferson St., Chicago, Ill. Manufacturer of lighting reflectors. President, A. J. Lawson; vice-president, Charles Landis; treasurer, Joseph Landis.

AMERICAN ROLLING MILL CO., THE.—Middletown, Ohio. Manufacturer of pure ingot iron and products thereof and sheet steel for electrical purposes. Business established 1900. President and general manager, George M. Verity; vice-presidents, J. H. Frantz, Charles R. Hook; secretary and treasurer, R. C. Phillips; sales manager, G. F. Ahlbrandt. Main

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office, Middletown, Ohio. Factories, Middletown, Zanesville and Columbus, Ohio. Branch offices, Pittsburgh, Pa.; Detroit, Mich.; St. Louis, Mo.; Cleveland, Ohio; Philadelphia, Pa.; Cincinnati, Ohio; Buffalo, N. Y.; Atlanta, Ga.; San Francisco, Cal.; 122 S. Michigan Ave., Chicago, Ill.; 50 Church St., New York, N. Y.; Toronto, Ont., Can.

AMERICAN ROUTER & MFG. CO.—P. O. Box 621, Pittsburgh, Pa. Manufacturer of patent hand and electric power stair routing machines. Established 1918. President, Samuel Hunter; vice-president and secretary, Frederick Forrester; treasurer, Otto Stickel; general manager, R. R. Jenkins. Factory, Connellsville, Pa. Sales representative, J. Fred Neubauer Co., Cleveland, Ohio.

AMERICAN RULE MFG. CO., INC.—127 Humboldt St., Brooklyn, N. Y. Manufacturer of folding rules.

AMERICAN SAW & MFG. CO.—Springfield, Mass. Manufacturer of hacksaws.

AMERICAN SCREW CO.—Providence, R. I. Manufacturer of machine and wood screws. President, Samuel M. Nicholson; treasurer, George W. Thurston; secretary, Albert M. Dunham.

AMERICAN SCRUBBING EQUIPMENT CO., INC.—Chicago, Ill. Manufacturer of motor-driven scrubbing machines. President and general manager, W. S. Finnell; vice-presidents, B. M. Schlicting and J. C. Helm; secretary, F. T. Muncie; treasurer, J. C. Helm; sales manager, J. W. Farris, Jr. Main office, 180 N. Wabash Ave., Chicago, Ill. Factory, Hannibal, Mo. Branch offices and warehouses, Boston, Mass.; Baltimore, Md.; Buffalo, N. Y.; Cleveland, Ohio; Denver, Colo.; Detroit, Mich.; Indianapolis, Ind.; Kansas City, Mo.; Louisville, Ky.; Milwaukee, Wis.; Minneapolis, Minn.; New Orleans, La.; Newark, N. J.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; St. Louis, Mo.; Los Angeles, Cal.

AMERICAN SHARPENING MACHINE CO., INC.—184 W. Washington St., Chicago, Ill. Manufacturer of electric razor sharpening and key cutting machines. Business established 1909. President, treasurer and general manager, R. S. Green; secretary, George B. Vance.

AMERICAN SHEARER MFG. CO.—Nashua, N. H. Manufacturer of electric horse clipping and grooming machines. Business established 1865. President, Joseph K. Priest; treasurer, Chester A. Priest. Sales representative, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.

AMERICAN SHEET & TIN PLATE CO—Pittsburgh, Pa. Manufacturer of sheet steel for electrical purposes. President, Eugene W. Pargny; vice-president, S. A. Davis; secretary and treasurer, H. B. Wheeler; sales manager, Jay I. Andrews. Main office, Frick Bldg., Pittsburgh, Pa. Sheet mill plants, Bridgeport, Ohio; Dover, Ohio; Gary, Ind.; Cambridge, Ohio; Hyde Park, Pa.; Leechburg, Pa.; Farrell, Pa.; New Philadelphia, Ohio; Scottdale, Pa.; Vandergrift, Pa.; Wellsville, Ohio; McKeesport, Pa. Branch offices, Continental and Commercial Bank Bldg., Chicago, Ill.; Union Trust Bldg., Cincinnati, Ohio; 1st National Bank Bldg., Denver, Colo.; Dime Bank Bldg., Detroit, Mich; Maison Blanche, New Orleans, La.; Hudson Terminal Bldg., New York, N. Y.; Widener Bldg., Philadelphia, Pa.; 3rd National Bank Bldg., St. Louis, Mo.

AMERICAN SIGN CO.—Cooley & Willard Sts., Kalamazoo, Mich. Manufacturer of electric signs. Established 1908. President and general manager, C. M. Davis; vice-president, G. P. Wigginton; secretary, Charles G. Bard; treasurer, William B. Milham.

AMERICAN SMELTERS SECURITIES CO.—San Francisco, Cal. Manufacturer of lead sheet, tubing, cable splicing sleeves, solder and electrolytic zinc. General manager, E. B. Braden. Main office, 201 1st St., San Francisco, Cal. Works, San Francisco and Selby, Cal.. Branch office, 84 Columbia St., Seattle, Wash.

AMERICAN SOLDER & FLUX CO.—2910 N. 16th St., Philadelphia, Pa. Manufacturer of solder and soldering compounds. General manager, F. D. McBride. Sales representative, E. G. Gooderham, Toronto, Ont., Can.

AMERICAN SPEED INDICATOR CO., THE.—New London, Conn. Manufacturer of marine indicators and speedometers. President and treasurer, Richard H. Pugh.

AMERICAN SPIRAL PIPE WORKS.—W. 14th & S. 48th Ave., Chicago, Ill. Manufacturers of power plant piping.

AMERICAN STAMPING CO.—Battle Creek, Mich. Manufacturer of oil and grease cups.

AMERICAN STEAM GAUGE & VALVE MFG. CO.—Boston, Mass. Manufacturer of feed water regulators, water filters, steam and vacuum traps and other power plant specialties. Main office, 208 Camden St., Boston, Mass. Branch offices, New York, N. Y.; 25 S. Jefferson St., Chicago, Ill.; Atlanta, Ga.; Pittsburgh, Pa.

AMERICAN STEEL & WIRE CO.—Chicago, Ill. Manufacturer of electrical wires and cables, wire rope, springs, rail bonds and bonding tools. President, William P. Palmer; vice-presidents, F. Baackes, J. S. Keefe, C. L. Miller; secretary, A. F. Allen; treasurer, J. R. Thomas; sales manager, F. Baackes. Main office, 208 S. La Salle St., Chicago, Ill. Sales offices, 30 Church St., New York, N. Y.; Western Reserve Bldg., Cleveland Ohio; 94 Grove St., Worcester, Mass.; 120 Franklin St., Boston, Mass.; Widener Bldg., Philadelphia, Pa.; Frick Bldg., Pittsburgh, Pa.; 337 Washington St., Buffalo, N. Y.; Foot of 1st St., Detroit, Mich.; Union Trust Bldg., Cincinnati, Ohio; 32 S. Charles St., Baltimore, Md.; Miners Bank Bldg., Wilkes Barre, Pa.; 3rd National Bank Bldg., St. Louis, Mo.; Pioneer Bldg., St. Paul, Minn.; 1st National Bank Bldg., Denver, Colo.; Brown-Marx Bldg., Birmingham, Ala.; Walker Bank Bldg., Salt Lake City, Utah. Warehouses, Baltimore, Md.; Buffalo, N. Y.; Birmingham, Ala.; Chicago, Ill.; Cleveland, Ohio; Denver, Colo.; Detroit, Mich.; Kansas City, Mo.; Los Angeles, Cal.; New Haven, Conn.; New Orleans, La.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa., Portland, Ore.; Salt Lake City, Utah; San Francisco, Cal.; Savannah, Ga.; Seattle, Wash.; St. Louis, Mo.; Trenton, N. J.; Worcester, Mass. Sales representative, U. S. Steel Products Co., San Francisco, Cal.; Los Angeles, Cal.; Portland, Ore.; Seattle, Wash.

AMERICAN STERILIZER CO.—Erie, Pa. Manufacturer of sterilizers and disinfectors. Business established 1894. President, J. E. Hall; vice-president, George R. Metcalf; treasurer-manager, George F. Hall; secretary, C. B. Hayes.

AMERICAN STOVE CO.—St. Louis, Mo. Manufacturer of blow torches for gasoline or oil.

AMERICAN SURGICAL SPECIALTY CO.—6 E. Lake St., Chicago, Ill. Manufacturer of electro-diagnostic and surgical instruments. W. J. Cameron, sole proprietor.

AMERICAN SWISS MAGNETO CO., THE.—Toledo, Ohio. Manufacturer of magneto generators and parts. Business established 1910. President and general manager, J. A. Bohannon; vice-president, J. B. Nordholt; secretary and treasurer, W. W. Knight. Main office, 1682 Fernwood Ave., Toledo, Ohio. Branch office, Los Angeles, Cal.

AMERICAN TAP & DIE CO.—Greenfield, Mass. Manufacturer of screw cutting tools. President and treasurer, Albert B. Allen; vice-president, Winthrop T. Noyes; secretary, Oliver B. Greene. Branch offices, 42 Murray St., New York, N. Y.; 504 Commerce, Chicago, Ill.; 508 Mission St., San Francisco, Cal.

AMERICAN THERMOPHONE CO.—114-116 Bedford St., Boston, Mass. Manufacturer of hearing devices for the deaf, telephone and radio receivers and telephones. Business established 1919. President, Louis Bacon; vice-chairman, Floris W. ter Meulen; secretary and treasurer, R. Richard Faokaberry; general manager, S. B. Ridge; sales manager, Warren Dyar.

AMERICAN THERMOSTAT CO.—226 Jelliff Ave., Newark, N. J. Manufacturer of electric thermostats and motors. Business established 1909. President, F. F. Aldridge; secretary and treasurer, A. S. Bevens.

AMERICAN 3 WAY-LUXFER PRISM CO.—Cicero, Ill. Manufacturer of prismatic glassware for electrical purposes. Business established 1920. President and general manager, C. H. Paschall; vice-president, C. P. Mills; secretary, Walter Cox; treasurer, J. J. Ohlis. Main office, 1309 S. 55th Court, Cicero, Ill. Factories, Cicero, Ill., and New York, N. Y. Branch offices, 139-141 Spring St., New York, N. Y.; Builders' Exchange, Minneapolis, Minn.; Penobscot Bldg., Detroit, Mich.; Grand Ave. Temple Bldg., Kansas City, Mo.

AMERICAN TRANSFORMER CO.—178-182 Emmett St., Newark, N. J. Manufacturer of transformers. Business established 1901. President, treasurer and general manager, W. F. Hubley; vice-president, M. H. Harrold.

AMERICAN UTILITIES CO.—St. Joseph, Mich. Manufacturer of electric water purifiers. President, Humphrey S. Gray; vice-president, M. V. Blake; secretary, treasurer and general manager, C. E. Blake.

AMERICAN VULCANIZED FIBRE CO.—Wilmington, Del. Manufacturer of fiber products. Business established 1873. Branch offices, 12 Pearl St., Boston, Mass.; 303 Oliver Bldg., Pittsburgh, Pa.; 1666 Woolworth Bldg., New York, N. Y.; 205 Kresge Bldg., Detroit, Mich.; 741 W. Van Buren St., Chicago, Ill.; 717 Engineers' Bldg., Cleveland, Ohio; 719 Widener Bldg., Philadelphia, Pa.

AMERICAN WATCHMAN'S CLOCK CO.—150 Nassau St., New York, N. Y. Manufacturer of electric time recorders, fire alarms and interior telephones. W. F. Pettes, proprietor.

AMERICAN WATCHMAN'S TIME DETECTOR CO.—3403 Perkins Ave., Cleveland, Ohio. Manufacturer of electric time recorders and detectors. Business established 1879. President, treasurer and general manager, Charles A. Keller; secretary, Maurice Greenwald.

AMERICAN WELDING CO.—Carbondale, Pa. Manufacturer of high-pressure tanks, boiler furnaces, etc. President, Charles L. Rowland; vice-president, Alex. McL. Rowland; secretary and treasurer, F. Orchard.

AMERICAN WELDING SOCIETY.—Organized in March, 1919. The objects are: "To advance the science and art of welding; to afford its members opportunities for the interchange of ideas with respect to the science and art of welding, and for the publication of the information thereon; to conduct researches into the science and art of welding, co-operating with other societies, associations and governmental departments for the benefit of industry in general."

The Society's activities embrace all classes of fusion welding (autogeneous welding). These classes are: (1) electric welding, including (a) electric arc welding (both with direct and alternating current, and with carbon and metallic electrodes), and (b) resistance welding, (butt, seam and spot welding); (2) gas welding (oxy-acetylene, etc.); (3) thermit welding. Forge welding will also be given proper attention by the Society should the occasion arise.

The headquarters of the Society are located in the Engineering Societies Building, 33 West 39th St., New York. It has local sections in Philadelphia, Chicago, Pittsburgh, Schenectady, Cleveland and New York. The total membership is about 550. There are five classes of membership: Class A, sustaining members; Class B, members; Class C, associate members with right to vote, but not hold office; Class D, associates without right to vote or hold office; Class E, association members.

In order to further its objects most effectively the Society has created an advisory committee on welding research and standardization, known as the American Bureau of Welding. The membership of the Bureau is made up of representatives of the American Welding Society, other interested societies and organizations, governmental departments and certain members at large chosen because of their special fitness. The American Bureau of Welding is also the advisory committee of the Division of Engineering of the National Research Council.

The officers for 1920-21 are: President, J. H. Deppeler; vice-presidents, D. B. Rushmore and J. W. Owens; treasurer, W. E. Symons; acting secretary, M. M. Kelly. The director of the American Bureau of Welding is Prof. Comfort A. Adams.

AMERICAN WELL WORKS, THE.—Aurora, Ill. Manufacturers of deep well, centrifugal and turbine pumps, well sinking and prospecting machinery. Business established 1868. President, M. T. Chapman; 1st vice-president and general manager, M. C. Chapman; 2nd vice-president, H. G. Chapman; secretary, H. W. Spiller; treasurer and sales manager, R. D. Mahaffey. Main office and factory, Aurora, Ill. Branch office, First National Bank Bldg., Chicago, Ill. Sales agencies, American Well Works, Dallas, Tex.; American Pump Co., Los Angeles, Cal.; California Hydraulic Engineering & Supply Co., San Francisco, Cal.; J. H. Dousman, 318 Reli-

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ance Bldg., Kansas City, Mo.; Farrar Pump & Machinery Co., St. Louis, Mo.; McNeal Machinery Co., Joplin, Mo.; M. J. O'Fallon Supply Co., Denver, Colo.; Reineke-Wagner Pump & Supply Co., Pittsburgh, Pa.; W. E. Gochenaur Mfg. Co., Philadelphia, Pa.; S. B. Whinery, 95 Liberty St., New York, N. Y.; Keiser-Geismer Engineering Co., Birmingham, Ala.; R. B. Whitacre & Co., St. Paul, Minn.; Green Machinery & Mfg. Co., Salt Lake City, Utah; Canadian-American Pump & Well Machinery Co., Chatham, Ont., Can.; Gorman, Clancey & Grindley, Ltd., Calgary, Alta., Edmonton, Alta., Can.; R. H. Buchanan & Co., Montreal, Que., Can.

AMERICAN WIRE GAGE.—The name of the system adopted as standard by the A. I. E. E. for expressing the size of solid wires used as conductors. This was formerly known as the Brown & Sharpe gage and is still widely designated as such. Nearly all copper and copper-clad wire, both bare and insulated, used in this country, is manufactured and sold in accordance with this gage. Stranded wires having an area less than 250,000 circular mils are also generally designated by means of this gage by being given the number of a solid wire having the same cross-sectional area. The abbreviation A. W. G. is commonly used.

The gage numbers are not arbitrarily chosen but follow a simple mathematical law, in which two diameters are specified and the intermediate diameters are found by a geometrical progression. Also see Gage, wire.

AMERICAN WIREMOLD CO.—Hartford, Conn. Manufacturer of metal raceways and other interior wiring specialties. Business established 1902. President, treasurer and general manager, D. H. Murphy, vice-president, H. B. Kirkland; secretary, G. M. Stewart; sales manager, C. W. Abbott. Main office, 81-88 Woodbine St., Hartford, Conn. Branch offices and warehouses, 1131 Race St., Philadelphia, Pa.; 29 Poplar St., Atlanta, Ga. District office, 1111 Keystone Bldg., Pittsburgh, Pa. Sales representatives, Thomas & Betts Co., 63 Vesey St., New York, N. Y.; M. B. Austin Co., 700 W. Jackson Blvd., Chicago, Ill.; Pacific States Electric Co., 575 Mission St., San Francisco, Cal., 256 S. Los Angeles St., Los Angeles, Cal.; G. H. Maynard, Commercial Bank Bldg., Washington, D. C., 61 N. 5th St., Portland, Ore., 570 1st Ave., Seattle, Wash.

AMERICO AND AMERICO JUNIOR.—Trade name for farm lighting and power plants manufactured by the American Engine & Foundry Co., Charles City, Iowa.

AMERICORE.—Trade name for rubber-covered wire manufactured by the American Steel & Wire Co., 208 S. La Salle St., Chicago, Ill.

AMERITE.—Trade name for rubber-covered and signal wire manufactured by the American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.

AMES & CO., W.—Jersey City, N. J. Manufacturers of tie rods, track tie spikes and track bolts. Business established 1859.

AMES & SONS CORP., OLIVER.—North Easton, Mass. Manufacturer of pole hole shovels and spoons. George E. Shepard, manager.

AMES CO., B. C.—Waltham, Mass. Manufacturer of micrometer dial gages.

AMMETER.—An ammeter is an instrument for measuring electric current. When connected into a circuit it gives a reading or indication proportional to some power of the actuating current. Ammeters are sometimes classed as d-c. and a-c. but many so-called a-c. ammeters may be used to measure direct currents. Another classification is according to the operating principle employed, giving the thermal, electromagnetic and electrodynamic types.

Hot-Wire Ammeters. The expansion of a wire with increase in temperature is the operating principle of the hot-wire ammeter. The current heats the wire and the resulting expansion moves a pointer over a scale which is graduated in terms of the current. These ammeters can be used for a-c. and d-c. measurements. For limitations see hot-wire instruments under Instruments, electrical measuring.

Electromagnetic Ammeters are of three main types. The so-called plunger type consists of a coil or solenoid into which is drawn an iron core by the magnetic action of the current in the coil. The controlling force is usually gravity. This type is suitable for rough measurements only and is relatively cheap and rugged.

Another type is the magnetic-vane instrument and the inclined-coil ammeter. The operating principle of the former is the repulsion between two vanes, one of which is fixed while the other is attached to the staff. The current flowing through a coil surrounding the vanes magnetizes them alike and the consequent repulsion moves the pointer over a scale. This form of ammeter may be used on both d-c. and a-c., but they are commonly used on a-c. circuits. The principle of operation of the inclined-coil ammeter is the reduction of the reluctance of a magnetic path by the introduction of soft iron. The instrument consists of a stationary coil whose plane makes an angle of 45° with the staff upon which is mounted a soft iron vane, also making an angle of 45° with it, but which normally is nearly in the plane of the coil. When current is passed through the coil the vane is magnetized and tends to set itself along the axis of the coil. This tendency causes the staff to rotate, moving the pointer over a scale. By this arrangement a long scale is obtained. These instruments may be used on a-c. and d-c. circuits. They are made with laminated magnetic shields and magnetic damping.

The movable-coil permanent-magnet ammeter consists of a permanent magnet of the horseshoe form within the air gap of which is pivoted a rectangular coil of fine wire. A fractional part of the current to be measured flows through this coil and the reaction between its magnetic field and that of the permanent magnet moves the pointer over the scale. The deflection depends upon the direction of current and hence such instruments are suitable for direct currents only. This type of ammeter is made in ranges from 300 microamperes for full scale deflection up to several thousand amperes. Induction ammeters are also of the electromagnetic type, but they are more commonly classed under the induction type.

Induction Ammeters. These are a-c. instruments solely and can not be used on d-c. circuits. The principle of operation is the production of shifting or rotating magnetic fields by alternating currents. In ammeters, the intensity of the magnetic field is proportional to the current, and as these fields cut or move across drums or disks of conducting material, the induced eddy currents are proportional to the actuating currents and hence the actuating force is proportional to the square of the flux, or roughly to the square of the main current. The controlling force is usually some form of spiral spring, hence the deflection is roughly proportional to the square of the current.

AMMETERS, AUTOMOBILE AND ELECTRIC VEHICLE.—These are small circular or fan-shaped indicating instruments of either the permanent-magnet movable-coil type or the soft-iron movable-vane type. The latter principle is used extensively in the lower priced instruments, but they are not as accurate as those of the D'Arsonval or former type which are used largely on higher priced cars. The zero of these instruments is usually in the center of the scale so that they will indicate both the charging and discharging current. Ammeters for this purpose must be particularly rugged to withstand the continual jarring incurred when mounted on the vehicle dashboard.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."

Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.

Ballman-Whitten Mfg. Co., 4060 Forest Park Blvd., St. Louis, Mo. "B-W."

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Clark Electric Meter Co., Oshkosh, Wis. "Semco."

Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.

Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Advance."

Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.

France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."

GENERAL ELECTRIC CO., Schenectady, N. Y. Type DM ammeters and voltmeters designed especially for small panels, battery-charging devices, automobile and motorboat applications. The construction is a novel application of the D'Arsonval permanent magnet type, and is an excellent example and a fine design of high-grade instrument work applied to a miniature element. Made self-contained up to 40 amp. with external shunts up to 150 amp. (Bulletin 46045.) See adv. pages 1203-1223.—Adv.

General Scientific Equipment Co., North Philadelphia, Pa.

Gray & Davis, Inc., Boston, Mass.

Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."

Nagel Electric Co., The W. G., 28-32 St. Clair St., Toledo, Ohio.

Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.

Otter Mfg. Co., Inc., 243-45 W. 17th St., New York, N. Y. "Individual Container."

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

Roller-Smith Co., 233 Broadway, New York, N. Y. "Universal."

Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, BATTERY AND POCKET.—Pocket ammeters for battery testing are frequently of the soft-iron movable-vane type, although the higher priced, more accurate instruments are of the D'Arsonval type. For testing dry cells instruments of the first type, often small enough to fit into a vest pocket, are used to measure the short-circuit current. A conical lug on one side of the instrument forms one terminal and a flexible conductor is attached to the other. The D'Arsonval type instruments are usually of a size that will fit into a coat pocket. They are used for charge and discharge measurements in connection with storage batteries.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."

Battery Appliance Corp., 3 E. 44th St., New York, N. Y. "Aelco."

Bunnell & Co., J. H., 32 Park Place, New York, N. Y.

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."

Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Eclipse," "Advance."

Etna Electric Works, 410 E. 15th St., New York, N. Y.

GENERAL ELECTRIC CO., Schenectady, N. Y. Pocket ammeters constructed on the Thomson inclined-coil principle with scales for reading 2 to 60 amp. for direct and alternating current. Sapphire jewel mounted moving elements reduce wear to a minimum, while an iron base mounting and cover plate protect the instrument from stray fields. A convenient feature is the long scale reading without the use of mechanical multiplying device. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.

Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.

Hoyt Electrical Instrument Works, Penacook, N. H. "Hoyt."

Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."

Kermel Apparatus Co., Cambridge, Mass.

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Elite."

Metric Appliance Corp., 299 Broadway, New York, N. Y. "Mac."

Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J.

National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."

Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

Readrite Meter Works, Bluffton, Ohio. "Readrite."

Roller-Smith Co., 233 Broadway, New York, N. Y.

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, MILLI, OR MILAMMETERS.—Instruments for measuring currents of a value less than one ampere are called milliammeters or milammeters, and their scales are calibrated to give the reading directly in milliamperes (thousandths of an ampere). They are made for both d-c. and a-c. measurements, the permanent-magnet moving-coil type being used almost entirely for d-c. instruments and the electrodynamometer the most widely used for a-c. instruments. These instruments are used largely for the accurate measurement of small current values in laboratory tests and are then of the portable type usually mounted in a hardwood box. Another useful form is an upright instrument having the zero point in the center of the scale. This type is used rather extensively in duplex and multiplex telegraphy for balancing circuits.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments made in one type, DP2, and five sizes ranging in capacity from 150 to 1500 milliamperes. Constructed on the D'Arsonval principle, combining the salient features of jewel mounted bearings, dustproof, cast iron cover, uniform scales, mirror-mounted index pointer and metal encased to protect from all stray magnetic fields with the indications rendered perfectly dead beat by the Foucault currents set up in the aluminum frame upon which the moving element is wound. Contained in a polished mahogany case. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
General Radio Co., 11 Windsor St., Cambridge, Mass. (Radio frequency.)
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
Sticht & Co., Herman H., 15 Park Row, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, PORTABLE, A-C.—Portable a-c. ammeters are usually self-contained instruments, enclosed in an iron case mounted on a wooden base or in a carrying case, and designed to be carried from place to place and used for general testing and laboratory work. They should always be used in the horizontal position to avoid errors due to unbalancing of the movable element. The principal types of these ammeters used are the soft-iron movable-vane type and the induction type. The first type has the advantages of low price, ruggedness and freedom from error due to ordinary frequency changes, while the induction type are more accurate and permit of an extremely long open scale. Induction type instruments are usually furnished with a curve for correction of frequency differences, and the frequency should be specified in purchasing an ammeter of this type.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments constructed on the Thomson inclined coil principle, and furnished in two types, and 12 sizes, ranging in capacity from 2 to 200 amp. For use on circuits of higher capacity, current transformers may be used, in which case the ammeter scale is marked in the actual capacity of the winding, thus enabling the use of the instrument without current transformer on circuits not exceeding capacity of the instrument. The moving elements, controlling force, damping device, and scales embody distinctive features of merit. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
General Radio Co., 11 Windsor St., Cambridge, Mass. (Radio frequency.)
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Reliance Instrument Co., Inc., 1135 W. Van Buren St., Chicago, Ill. "Reliance."
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, PORTABLE, A-C. AND D-C.—Self-contained instruments usually mounted on a hardwood base or in a carrying case, and designed to be used for general testing on either a-c. or d-c. circuits, or for miscellaneous laboratory work where a portable instrument is desired. While they may be of either the soft-iron movable vane, electrodynamometer or hot-wire types, the electrodynamometer is probably more generally used than the others. Their accuracy on a-c. and d-c. circuits is about the same, within certain limits of frequency, and is generally higher than that of either the soft-iron vane type or induction type of instrument. When calibrated on d-c., these instruments give correct effective values on a-c. circuits.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Self-contained instruments in capacities from 2 to 200 amp. Ammeters with double windings arranged for series multiple connections can be furnished in capacities up to and including 30/60 amp. These instruments may be used on circuits of any ordinary frequency, wave form or power-factor without appreciable error. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, PORTABLE, D-C.—These are almost invariably of the movable-coil permanent-magnet (D'Arsonval) type, and are standard instruments for all d.-c. measurements. They are constructed in such a way that the effects of stray magnetic fields are reduced to a minimum, and they are sometimes mounted in carrying cases or on wooden or sheet steel bases. The shunts for these ammeters are usually mounted within the case, although some of the larger range and multirange instruments are supplied with external shunts. The accuracy of this type of instrument is usually quite high, not infrequently 0.25% of full scale value.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Designed for secondary standards and general testing purposes. Constructed on the D'Arsonval principle, in capacities from 5 to 500 amp., self-contained up to 30 amp. To eliminate the undesirable feature of heating at higher capacities, a millivoltmeter is furnished, provided with 5-foot leads, all adjusted to have the same resistance in order that the instrument as well as the shunts may be fully interchangeable. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Pyroelectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Reliance Instrument Co., Inc., 1135 W. Van Buren St., Chicago, Ill. "Reliance."
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, PRECISION, CALIBRATING OR LABORATORY STANDARD.—Precision ammeters or secondary standards, as they are often called, are used in laboratories for calibrating instruments or for very accurate determinations of current values. These instruments represent the masterpieces of the instrument maker's art and probably operate with a higher degree of accuracy that any other direct indicating instruments used in any of the industries. There are several types of standards. For direct current, the D'Arsonval principle is applied to large instruments and very good results are obtained. Precision instruments for use on a.-c. circuits are usually divided into three groups: the first are suitable for a.-c. measurements only; another, called comparators, are used to compare the strength of two currents, usually a direct current with an alternating current; and the last, which are called transfer instruments. Among the latter class are the Siemens electrodynamometer, the Kelvin balance and the deflecting or indicating electrodynamometer. Modifications of these three types of instruments are generally used for a.-c. secondary standards and these instruments are commonly of a semiportable type. By means of special d.-c. shunts and a.-c. current transformers precision ammeters are given a wide variety of ranges. In all these instruments the scale is usually quite long so as to be read with great accuracy. Special precautions are taken to eliminate or compensate for errors due to frequency, wave form and temperature. Where this compensation is not complete correction factors are furnished by the manufacturer by which the readings can be readily corrected. A certificate is usually supplied by the manufacturer attesting the accuracy of each instrument.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Apparatus Co., 701 W. Washington Blvd., Chicago, Ill. "Milray."
GENERAL ELECTRIC CO., Schenectady, N. Y. Ammeters constructed on the D'Arsonval principle, very accurate and sensitive and designed especially for laboratory standards. Made in several types and capacities. (Bulletin 46048.) See adv. pages 1203-1223.—Adv.

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Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

AMMETERS, RECORDING OR CURVE DRAWING.—Recording ammeters are instruments which record graphically upon time charts, the values of the current they measure. They are made in both the switchboard and portable types and for measuring both alternating current and direct current. The d.-c. instruments are generally of the permanent-magnet movable-coil type and the a.-c. ammeters are made in several types, among them the electrodynamometer type which is widely used, the Kelvin balance type, solenoid type, etc. A pen or marking device is attached to the pointer and records the instantaneous values of the current on a chart, moved at a uniform speed by a clock mechanism. These charts are made of two forms: circular, ruled with concentric circles and curved radii; long strips, ruled with rectangular co-ordinates, although in some cases the current ordinates are also curved as the pen does not have a straight-line motion. Graphic meters are always provided with some form of damping device to prevent overshooting. The accuracy of these instruments is not as high as that of many other forms of ammeters. They serve admirably, however, in giving a practical record of the current fluctuations in a circuit. If the voltage is practically constant, these current fluctuations are substantially a measure of the load fluctuations.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn.
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ESTERLINE CO., THE., Lemcke Annex, Indianapolis, Ind. See Instruments, electrical, curve drawing, graphic recording or printing, miscel.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type C, made in eleven sizes, ranging from 5 to 200 amp. capacity. Extremely high torque is obtained by careful and correct proportioning of the various elements. Other features of special import described in Bulletin 46047. See adv. pages 1203-1223.—Adv.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

AMMETERS, SPECIAL AND MISCELLANEOUS. — Ammeters are sometimes made in special forms and having special ranges for such purposes as the measurement of pulsating currents supplied by induction coils or X-ray machines, high-potential current from static machines, rectified telephone currents, the plate current in electron or vacuum tubes, etc. Other instruments of the ordinary types are sometimes made to have special and very limited ranges giving accurate readings on just that portion of the scale most used. Hot-wire ammeters are also used for the measurement of high-frequency currents.

Manufacturers:

Coleman Lamp Co., 220-224 St. Francis Ave., Wichita, Kans. "Heil" foot-ampere meter.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

AMMETERS, SWITCHBOARD OR PANEL, A-C. — Ammeters for switchboard mounting, to measure alternating current, operate on several principles, but the electrodynamometer, induction and soft-iron movable-vane types are most generally used. The round type instruments arranged for rear connection are largely used as they present a neat and uniform appearance. Ammeters are sometimes made to measure the total current and have large ranges, but a more general and satisfactory method is to use a five-ampere instrument with a current transformer. The induction type ammeters which have an extremely long scale are probably used more than any of the other types.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave & Montgomery St., Jersey City, N. J.
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Midget."
Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Thomson horizontal, edgewise instruments, Type H2, have for years been recognized as standard for a-c. service and are undoubtedly the most accurate and attractive instruments used for switchboard work. While primarily designed for a-c. service, the voltmeters, ammeters and wattmeters can be used with good results on direct current. All are of uniform size, thus presenting a pleasing appearance. Also Type R round pattern instruments developed to meet the demand for compact, accurate and moderate-priced instruments for use on alternating current. They will also operate on direct current. For use up to 600 amp. Furnished with current transformers for voltages in excess of 2500 volts, or current greater than 600 amp. Type RF ammeters are also round pattern instruments with new features consisting of flush type case, an all glass front and air damping, which is very effective. Capacities up to 200 amp. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.
General Radio Co., 11 Windsor St., Cambridge, Mass. (Radio frequency.)
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
NORTON ELECTRICAL INSTRUMENT CO., THE, Manchester, Conn.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMETERS, SWITCHBOARD OR PANEL, D-C.—D-c. ammeters for switchboard or isolated panel mounting are essentially the same in principle and construction as the portable instruments, operating almost entirely on the D'Arsonval or permanent-magnet movable-coil principle. They differ from the portable instruments in that a full scale deflection is generally obtained with a 50 to 75-millivolt drop across the shunt, while the high-grade portable instruments have from 100 to 200 millivolts. Both round type and fan-shaped instruments are used and some of the latter are arranged with very long scales to be read at a distance. The dials on such instruments are often illuminated from behind. For crowded switchboards the edgewise type of instrument permits a very compact arrangement, although it cannot be read as accurately; in these instruments the axis of the moving coil is parallel to the board.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave & Montgomery St., Jersey City, N. J.
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Connecticut Dynamo & Motor Co., The, Lyons Ave. and Coit St., Irvington, N. J.
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Midget."
Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
GENERAL ELECTRIC CO., Schenectady, N. Y. This company has met the essential characteristics of instruments for d-c. switchboard service with a line of high-grade Thomson astatic ammeters and voltmeters. Made in illuminated dial and feeder-board patterns. Type D round-pattern instruments constructed on the D'Arsonval principle are neat in appearance, substantial, and unsurpassed in accuracy. They give excellent satisfaction on small switchboards for use in isolated plants, or, for marine work where a substantially made, high grade and compact d-c. instrument is required. Type DH3 horizontal, edgewise ammeters and voltmeters for d-c. service employ the same element in construction as the Type D. Ammeters built up to 60 amp. For larger measurements furnished with standard shunts. All types described in Bulletin 46045. See adv. pages 1203-1223.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
NORTON ELECTRICAL INSTRUMENT CO., THE, Box V, Manchester, Conn. Manufacturer of voltmeters and ammeters of both direct and alternating current in a variety of sizes for switchboard work.—Adv.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sholder-Excell Mfg. Co., The, Clyde, Ohio.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

AMMONIA.—NH_3; a colorless gas with a highly pungent odor; liquifies at —40°C., or can be liquefied at ordinary temperature by pressure. Its chief commercial uses are as a refrigerant and as a constituent of fertilizers (as ammonium nitrate or sulphate). It is of interest electrochemically, on the one hand, as a product of the treatment with steam of calcium cyanamid, an electrochemical product, and, on the other hand, as the raw material for the manufacture of nitric acid by an electrothermal process. It may also be produced electrothermally by the Haber process (which see). Also see Cyanamide and Nitric acid.

AMMONIUM CHLORIDE. — Ammonium chloride is used as an electrolyte in wet primary batteries of the Leclanche type and in the common form of dry cells. Its chemical formula is NH_4Cl. It is commercially known as "salammoniac," which is sold as a salt and is dissolved in water when ready to use. In the dry cells the ammonium chloride takes the form of a paste often combined with zinc chloride and is held by the capillary action of a porous mixture of crushed coke, manganese dioxide and graphite.

Manufacturers:

Barrett Co., The, 17 Battery Pl., New York, N. Y.
General Chemical Co., 25 Broad St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
L'Hommedieu & Sons Co., Charles F., 4521 Ogden Ave., Chicago, Ill.
Mallinckrodt Chemical Works, St. Louis, Mo.
Special Chemicals Co., Highland Park, Ill. "Speco."
VULCAN CHEMICAL CO., 1940 W. Taylor St., Chicago, Ill. "Vulcan."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

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AMMONIUM NITRATE.—See Nitrates.

oils and greases manufactured by the American Oil Corp., 172 S. Water St., Jackson, Mich.

AMOILCO.—Trade name for lubricating oils and greases manufactured by the American Oil Corp., 172 S. Water St., Jackson, Mich.

AMORTISSEUR WINDING.—This consists of grids of copper or other conducting material placed in the pole faces of synchronous machines. These grids are commonly made of copper bars put in slots parallel to the shaft and short-circuited at the end by other bars of conducting material which may extend entirely around the field structure, thus forming a "squirrel cage" similar to that of an induction-motor rotor.

Amortisseur windings are used to reduce hunting of synchronous motors and converters and of a-c. generators in parallel. They also serve to give a starting torque to synchronous motors and converters when these machines are started as polyphase induction motors.

AMP.—Abbreviation for ampere or amperes following numerical values in text or tables.

AMP-HR. — Abbreviation for ampere-hour.

AMPERE.—When a current of electricity is passed through an electrolyte, the quantity of the electrolyte decomposed is strictly proportional to the quantity of electricity that has passed. This is known as Faraday's first law and the definition of the practical unit of current, the ampere, is based on this experimental fact. The ampere is the unvarying electric current which, when passed through a standard solution of silver nitrate in water, deposits silver at the rate of 0.00111800 gram per second. An ampere is equal to one-tenth of the absolute electromagnetic unit of current.

AMPERE, ANDRE MARIE.—A French physicist and mathematician (born at Polemieux, near Lyons, in 1775, died at Marseilles, 1836) after whom the unit of electric current is named. About 1796 Ampere gave private lessons at Lyons in mathematics, chemistry and languages, and in 1801 he was appointed professor of physics in the Central School at Bourg. In 1805 he was called to Paris, where he served as teacher in the Polytechnic School, and in 1809 he was appointed professor of analysis. In 1814 he was elected a member of the Academy of Sciences and ten years later appointed professor of experimental physics in the College de France. Science is largely indebted to him for his electrodynamic theory and for his original views of the identity of electricity and magnetism. He was the inventor of the astatic needle, which made possible the astatic galvanometer. He was the first to show that two parallel conductors, carrying currents traveling in the same direction, attract each other, while if traveling in opposite directions they repel each other. He formulated the theory that there were currents of electricity circulating in the earth in the direction of its diurnal revolution which attracted the magnetic needle.

AMPERE-HOUR.—The ampere-hour is the common unit of electrical quantity used in storage-battery work and in electrolysis problems, such as electroplating and the like. The ampere-hour is the quantity of electricity conveyed or delivered by one ampere in one hour. The ampere-hour equals 3600 coulombs. It is sometimes abbreviated amp-hr.

AMPERE-HOUR METERS.—These are integrating meters which sum up the quantity of electricity that flows through them in any interval of time. The meter registers in ampere-hours. One type of these meters is electrolytic; it is of limited application. The operation of the ampere-hour meters most commonly employed is in every essential respect the same as that of a d-c. or electrodynamic watt-hour meter. In one of the most used types the operating current flows from one terminal through mercury to a pivoted copper disk which floats on the mercury. From the disk it flows through the mercury to a diametrically opposite terminal. This current reacts with the field of a permanent magnet, hence the torque and consequent speed is proportional to the current flowing. The counter torque is obtained by rotating an aluminum disk between poles of a permanent magnet.

Ampere-hour meters find extended application for integrating the charge and discharge of storage batteries, and in connection with electrolytic processes. In storage-battery work they show the state of charge or discharge and are usually reversible so that the index returns to zero after the battery has completed a cycle by being fully recharged. Since more ampere-hours must be returned on charge than were discharged, the charge reading of the meter is usually overcompensated (often adjustably) by 10 to 25%; that is, during the charge the meter reads slower so that the index does not return to zero until the proper overcharge has been effected. In many cases a contact is closed when the zero point is reached and the charge thus terminated. Ampere-hour meters are also made with other special features, such as duplex elements for submarine use, with recording attachments to give a graphic record of the ampere-hours used, etc.

Manufacturers:

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio. "Chargometer."

Automatic Transportation Co., 2933 Main St., New York, N. Y.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.

SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."

AMPERE METER.—An old name for ammeter.

AMPERE-TURN.—The practical unit of magnetomotive force is the ampere-turn. It is that magnetomotive force produced by one ampere in a coil of one turn; 1 ampere-turn = 0.4 π gilberts = 1.257 gilberts; 1 gilbert = 0.795 ampere-turns. In practical units the ampere-turn per inch is the unit of magnetizing force.

AMPHOTERIC ELECTROLYTE. — An electrolyte containing a chemical element which may on occasion act either as a base or an acid, i. e., either go to the cathode or to the anode. An example is lead nitrate, from which lead may be deposited on the cathode or lead peroxide on the anode, according to circumstances.

AMPINCO.—Trade name for fixture fittings and parts manufactured by the American Pin Co., Waterbury, Conn.

AMPLIFIER, TELEPHONIC.—This type of amplifier is commonly known as a telephone repeater, or that device which generates a new electric wave, much stronger than a weak wave which it receives.

AMPLIFIERS, RADIO.—The small amount of energy present in a receiving antenna makes necessary some sort of amplifying device in order that the incoming signals may be of sufficient magnitude for audibility. The three-element electron tube is most extensively used for this purpose. In an audio-frequency amplifier, the radio signals after detection are applied to the grid of an electron tube and the receiver or recorder connected to the plate circuit. If desired, the plate circuit of the first tube may be connected to the grid circuit of a second tube, thereby introducing two or more stages of amplification.

Transfer of energy from the plate circuit of one tube to the grid circuit of the next is generally accomplished by one of three ways. The two circuits may be coupled by having a resistance in common. A second method is to use a large inductance in place of the resistance. The most satisfactory method, however, is by the use of special transformers in the design of which account has been taken of the impedance of the electron tubes to be used.

Electron tubes may also be used for amplifying the radio frequency before detection. Radio-frequency amplifiers, although more difficult to design, possess many advantages, one of which is to lessen the effect of static. The same methods of transfer of energy may be used as in the audio-frequency amplifier, although the design of the parts is necessarily different.

Another type of audio-frequency amplifier makes use of the microphonic action of carbon. In this instrument a receiver diaphragm is connected directly to a carbon transmitter button which is in series with a local battery circuit. The motion of the diaphragm produces a fluctuating current in the local circuit which may be used to actuate another receiver.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."

American Radio & Research Corp., 21 Park Row, New York, N. Y.

Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill. "Amplifigon."

Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.

DeForest, Inc., Lee, 451 3rd St., San Francisco, Cal.

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.

Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.

General Radio Co., 11 Windsor St., Cambridge, Mass.

Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."

GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."

International Devices Co., 326 Broadway, New York, N. Y.

K. & G. Wireless Supply Co., 152 Chambers St., New York, N. Y.

Kennedy Co., The Colin B., 140 2nd St., San Francisco, Cal.

Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."

Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.

Magnavox Co., The, 2701-2765 E. 14th St., Oakland, Cal. "Telemegafone Junior."

Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y. "Meraco."

Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."

Radio Corp. of America, 233 Broadway, New York, N. Y.

Radio Electric Co., The, 3807-5th Ave., Pittsburgh, Pa.

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

Simon, Emil J., 217 Broadway, New York, N. Y.

Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.

Wireless Mfg. Co., 619 4th St., N. W., Canton, Ohio. "Wimco."

Wireless Specialty Apparatus Co., C. & Fargo Sts., Boston, Mass.

AMPLIFIGON.—Trade name for radio amplifier and detector manufactured by the Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.

AMPLIFONE.—Trade name for radio receivers manufactured by the F. M. Doolittle Co., 817 Chapel St., New Haven, Conn.

AM-PLUS STORAGE BATTERY CO.—741 Van Buren St., Chicago, Ill. Manufacturer of automobile lighting and starting storage batteries. Sales manager, A. J. Baracree.

AMRAD.—Trade name for radio equipment manufactured by the American Radio & Research Corp., 21 Park Row, New York, N. Y.

AMREVO ELECTRIC CO.—2309 Archer Ave., Chicago, Ill. Manufacturer of fixture fittings and bell-ringing transformers. Business established 1919. President, Seymour Stedman; vice-president, Adolph Holman; secretary, treasurer and general manager, Frederick E. Newman.

AMRONLITE.—Trade name for portable electric lamps manufactured by the Faries Mfg. Co., Decatur, Ill.

AMSLER.—Trade name for planimeters manufactured by the Crosby Steam Gage & Valve Co., Boston, Mass.

AMSLER-MORTON CO., THE.—Farmers Bank Bldg., Pittsburgh, Pa. Manufacturer of pulverized coal equipment. Business established 1903. W. O. Amsler, president.

AMUSEMENT DEVICES, ELECTRICAL OR ELECTRICAL EQUIPMENT FOR.—Amusement devices in summer gardens and the like very often include some electrical features or are driven by motors and utilize other electrical equipment. In some side shows there are various shocking machines and other electrical effects and motor-driven vibrators, blowers, rocking floors, turntables, etc. "Merry-go-rounds," "figure 8's," "loop-the-loops," various other rides and slides, etc., are often arranged to be operated by electric motors. They are also electrically lighted and sometimes

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provided with electric pianos, organs or other musical instruments. Also see Hazing stunts, electrical.

Manufacturers:

Parker, C. W., Leavenworth, Kans.
Thompson Scenic Railway Co., The L. A., 220 W. 42nd St., New York, N. Y.

ANACONDA COPPER MINING CO.—New York, N. Y. Manufacturer of crude and refined copper, lead, zinc and other metals. Business established (about) 1880. President, C. F. Kelley; vice-president, D. B. Thayer; secretary, D. B. Hennessey; treasurer, A. H. Melin; general manager, Fred Laist. Works, Anaconda and Great Falls, Mont.; Miami, Ariz.; Toole, Utah; East Chicago, Ind.; Perth Amboy, N. J. General sales office, United Metals Selling Co., 42 Broadway, New York, N. Y. Rolling Mills Dept. (H. D. Hawks, sales manager), 111 W. Washington St., Chicago, Ill.

ANACONDA ELECTRIC.—Trade name for zinc produced by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

ANCHOR.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

ANCHOR BOLTS OR SCREWS.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

ANCHOR ELECTRIC CO.—557 W. Jackson Blvd., Chicago, Ill. Manufacturer of automobile lamps, incandescent lamps, vacuum electrodes, etc. Business established 1915. President, treasurer and general manager, F. E. Caralun; vice-president, secretary and sales manager, A. H. Colbert.

ANCHOR PACKING CO.—Philadelphia, Pa. Manufacturer of packings, mechanical rubber goods and asbestos products. Business established 1911. President, Edward F. James; vice-president, W. R. Haggart; secretary and treasurer, Samuel Bennett; general manager, L. E. Adams. Main office, Lafayette Bldg., Philadelphia, Pa. Factories, Philadelphia, Pa.; Elkhart, Ind. Branch offices, 141 Milk St., Boston, Mass.; 190 N. State St., Chicago, Ill.; 139 Congress St., E., Detroit, Mich.; 72 Murray St., New York, N. Y.; 418 Common St., New Orleans, La.; 682 Howard St., San Francisco, Cal.; 713 Chestnut St., St. Louis, Mo.; 35 N. 7th St., Philadelphia, Pa.; 601 Manufacturers Bldg., Pittsburgh, Pa.; 418 St. James St., Montreal, Que., Can.

ANCHOR WEBBING CO.—300 Brook St., Pawtucket, R. I. Manufacturer of electrical tapes and sleeving. Business established 1905. President, J. Everett Hall; secretary, H. Hapgood; treasurer and general manager, Herbert M. Fillebrown. Sales representatives, Muellor Electric Co., Cleveland, Ohio; George J. Lambrecht, 115 Franklin St., New York, N. Y.; George W. Piekson, Railway Exchange Bldg., St. Louis, Mo.; Charles Farnham, I. W. Helman Bldg., Los Angeles, Cal.; Sperry & Bittner, 422 First Ave., Pittsburgh, Pa.; Woonsocket, R. I.; Pawtucket, R. I.; Valley Falls, R. I.; E. P. Bartlett & Co., 15 N. Jefferson St., Chicago, Ill.

ANCHORS, GUY.—Where guy cables can be carried down to the ground withqut interfering with traffic an anchor is set in the earth to which the cable is secured. This consists of an iron rod with an enlarged anchor piece set in the earth about 5 or 6 ft. Such anchors are of many types, quite a few of which are of patented design.

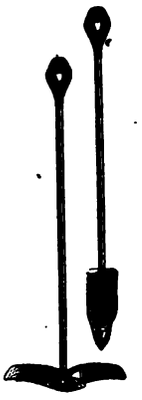
Manufacturers:

Chance Co., The, Centralia, Mo. "Never Creep."
CROUSE-HINDS CO., Syracuse, N. Y. "Harpoon" guy anchor is scientifically designed and thoroughly tested. Made of the best selected materials that withstand the action of the elements. They hold fast, having a holding power of over four tons, and are easily installed; it takes only one man and a sledge to do the installing. Copy of catalog sent upon request.—Adv.
Everstick Anchor Co., St. Louis, Mo. "Everstick."
Faultless Anchor & Mfg. Co., The, Centerburg, Ohio. "Faultless."
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gund Mfg. Co., LaCrosse, Wis. "Drive & Twist."
HALLETT IRON WORKS, Harvey, Ill. "Hallett," "Hiawatha." (See display advertisement on page 1254.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

IRON PRODUCTS CORP., La Crosse, Wis., makers of the "Red-Top" anchors. Drop forged from steel of high tensile strength. Rods are 6 ft. long, ⅞ in. thick. The sharp point makes driving easy and penetrates any obstacle in ground. One man can completely install a Red-Top anchor in one minute. It is driven in ground and opened by lifting about four inches. This is easily accomplished as it takes only 50 pounds of pull to open blades. Red-Top anchors can be used anywhere in any kind of soil. Send for our illustrated catalog containing complete information.—Adv.



Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. on page 1278.)
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Scrulix."
Miller Anchor Co., 20 Monroe St., Norwalk, Ohio.
Northern Pole & Lumber Co., Palladio Bldg., Duluth, Minn. (Cedar.)
St. Louis Malleable Casting Co., St. Louis, Mo. "O. K."
Specialty Device Co., The, 106 W. 3rd St., Cincinnati, Ohio. "Bierce."
Universal Cable Grip Co., Skaneateles, N. Y. "Red Top."
Wapak Hollow Ware Co., Wapakoneta, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse. (See display adv. on pages 1395-1402.)

ANDERSON.—Trade name for time switches manufactured by the Albert & J. M. Anderson Mfg. Co., Boston, Mass.

ANDERSON.—Trade name for electric railway brake adjusters manufactured by Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill.

ANDERSON.—Trade name for self-adjusting arms and lighting fixtures manufactured by the Localized Lighting Corp., 540 W. 58th St., New York, N. Y.

ANDERSON CO., THE V. D.—Cleveland, Ohio. Manufacturer of oil and steam separators, steam traps and oil filters. Business established 1885. President, C. O. Anderson; vice-president and sales manager, F. B. Anderson; secretary, treasurer and general manager, A. D. Anderson. Main office and factory, 1935 W. 96th St., Cleveland, Ohio. Branch offices, 537 Race St., Philadelphia, Pa.; 100 Pearl St., Boston, Mass.; Union Trust Bldg., Baltimore, Md.; 431 S. Dearborn St., Chicago, Ill.

ANDERSON ELECTRIC & EQUIPMENT CO.—154-160 Whiting St., Chicago, Ill. Manufacturer of automotive and surgical lighting specialties. President, E. G. K. Anderson; vice-president and general manager, B. G. Grisby; secretary, O. E. Grigsby; treasurer, J. A. Johnson; sales manager, O. Q. Hinds.

ANDERSON FOUNDRY & MACHINE CO.—Anderson, Ind. Manufacturer of oil engines. Business established 1872. President, W. N. Durbin; sales manaer, R. B. White. Branch offices and warehouses, Stuttgart, Ark.; Donaldsonville, La.

ANDERSON MFG. CO., ALBERT & J. M.—Boston, Mass. Manufacturers of electric railway, light and power specialties. President, J. M. Anderson; secretary, Andreas Anderson; treasurer and general manager, Alf E. Anderson; sales manager, George B. Crane. Main office, 289-305 A St., Boston, Mass. Branch offices, 135 Broadway, New York, N. Y.; 429 Real Estate Trust Bldg., Philadelphia, Pa.; 105 S. Dearborn St., Chicago, Ill.

ANDIS, O. M., MFG. CO.—1024 12th St., Racine, Wis. Manufacturer of electric hair clippers and cutters. Business established 1918. President, Matthew Andis; vice-president, Henry Meltzer; secretary and treasurer, John Oster.

ANDRAE & SONS CO., JULIUS.—Milwaukee, Wis. Manufacturer of farm lighting and power plants and motor-generators. Business established 1860. President, treasurer and general manager, Henry P. Andrae; vice-president and sales manager, J. C. Schmidtbauer; secretary, F. T. Andrae. Main office, Broadway & Michigan Sts., Milwaukee, Wis. Branch offices, 21 E. Michigan St., Duluth, Minn.; 311 1st St., S. E., Mason City, Iowa.

ANDRESSEN CO., JACOB.—258 3rd Ave., S., Minneapolis, Minn. Manufacturer of lighting fixtures and fixture fittings and parts. Business established 1902. President, Jacob Andresen; vice-president, Helga Andresen; secretary, Albert Russ; treasurer, F. W. Alban.

ANDREW.—Trade name for electric clocks manufactured by the Andrew Key Corp., 210 Olive St., St. Louis, Mo.

ANDREWS HEATING CO.—2529 University Ave., S. E., Minneapolis, Minn. Manufacturer of heat regulators. Business established (about) 1900. President, George C. Andrews; vice-president, secretary-treasurer and general manager, R. W. Otto; sales manager, M. A. Phillips.

ANDREWS STEEL CO., THE.—Newport, Ky. Manufacturer of alloy steel.

ANGELL BELT HOOK CO.—Providence, R. I. Manufacturer of belt fasteners.

ANGLDILE COMPUTING SCALE CO.—Elkhart, Ind. Manufacturer of electric coffee grinder.

ANGLE ADAPTERS.—See Adapters, reducers or extensions, socket.

ANGLE OF LEAD AND LAG.—If there is a phase difference between a sinusoidal alternating current and its e. m. f., the angle between them is the angle of lead with respect to the leading quantity, and the angle of lag with respect to the lagging quantity. The cosine of this angle is called the power-factor. See Lead and lag, also Phase difference.

ANGLES AND CHANNELS, BRASS, BRONZE AND COPPER.—Brass, bronze and copper are sometimes rolled, drawn or extruded into angles, channels and many other special and ornamental shapes. These are sometimes used for electrical purposes, especially the angles and channels which are used for busbars that require greater rigidity and strength than ordinary bars. These special shapes are also cut up into short lengths to make parts for electrical apparatus, this being a very economical way of making some of the special shaped conducting members.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.

ANGUERA LUMBER & TIE CO.—Chicago, Ill. Producer of insulating lumber and railway ties. Business established 1905. President and treasurer, F. de Anguera; vice-president, M. H. Clifton; secretary, A. Cattell. Main office, 1101 Conway Bldg., Chicago, Ill. Branch offices, St. Louis, Mo.; Cincinnati, Ohio.

ANGULAR VELOCITY.—A term applied to an alternating current and referring to the angular velocity of the rotating vector that may be used to represent the current. It is the product of 2π by the frequency in cycles per second. This product is expressed in radians per second and is given the symbol ω.

ANILINE.—$C_6H_5.NH_2$; an organic intermediate of considerable importance; m.p. —8° C.; b.p. 184° C. It is made by the electrolytic reduction of nitrobenzene.

ANIMATOGRAPH.—Trade name for motion picture machines manufactured by the Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa.

ANION.—That part of an electrolyte which is liberated, or tends to be liberated, by the action of an electric current at the anode. Sometimes erroneously applied to these parts of compounds before electrolysis is attempted, but the term has no meaning until an electrolyzing current is applied, since anions are brought into existence only by the electrolytic action of the current at the anode.

ANISOTROPIC CONDUCTORS OR DIELECTRICS.—These are conductors or dielectrics which exhibit different electrical qualities when measured in different directions, i. e., different conductance and resistance when measured with, along and across the grain stratification, plane of crystallization, etc.

ANNOUNCERS, TELEPHONIC, DEPOT, HOTEL, ETC.—These are telephones which are designed and arranged to speak

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loudly enough to be heard in a room without putting the receiver to the ear. They are used for paging people in a hotel, for calling employees in a factory or store, for announcing trains in a railroad station, for advertising goods displayed in a store window, and many other uses. The receiver is usually provided with a horn. By means of amplifiers as many as 50 to 100 reproducers may be operated by one transmitter, thus one person can make simultaneous announcements in many rooms or parts of an establishment.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
KLAXON CO., Newark, N. J.
Magnavox Co., The, 2701-2765 E. 14th St., Oakland, Cal.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."
Winkler-Reichmann Co., 4801 S. Morgan St., Chicago, Ill. "Still Small Voice," "Electric Page Boy."

ANNUNCIATORS, BURGLAR-ALARM.—These annunciators are similar to those used in offices, except that the drops indicate within certain limits the location of the attempted entry. This type is employed in connection with window and door contacts and their alarm circuits.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y. "Dixie."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."

ANNUNCIATORS, CARRIAGE CALL.—Carriage call annunciators are mounted outside of theaters, hotels, etc., to facilitate loading and avoid congestion. Each driver is given a number on arrival and when his passengers are ready to leave his number is displayed on the annunciator and he brings the carriage or car to the door. One annunciator of this type consists of a bank of lamps back of a glass bearing numbers. By pressing buttons, the circuits to certain lamps are closed and the driver's number displayed. Another type has two or three ribbons numbered from 0 to 9, which are rotated to give the desired combination and then the lights are turned on. A third type consists of three composite banks of lamps so arranged that combinations forming any number may be had. This type is not ordinarily known as an annunciator; for this type, see Calls, carriage, electric.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

ANNUNCIATORS, ELECTRICAL RESET.—After the indicator of an annunciator has been operated, a second button is pushed which sends a current through reset magnets, the armatures of which are attracted and this movement resets the indicators. The electrical reset is of special advantage where the annunciators are so located that mechanical reset would be difficult.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass. "Cotelco."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y. "Semaphore," "Dixie," "Arrow."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa. "Competition", "Guarantee," "Presto."
Spielman Electric Co., 1931 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."

ANNUNCIATORS, ELEVATOR.—An annunciator placed in the car of an elevator to indicate to the operator which floor wants service. There is a flexible cable which drops from the floor of the car to the side of the elevator shaft and carries the circuits to the push buttons (one or two at each floor) and to the source of current (battery or central-station current). The annunciator takes several forms, most of them using drops, targets or lamps. Often there are two push buttons at each floor, with two annunciator drops for each floor in the car. One indicates "up" and the other "down." When there are several elevators in a bank, it is customary to interlock the push buttons and announciators so that the first car to come down or up will pick up the passenger. These annunciators are a great convenience where there are only one or two elevators. Where there are three or more elevators in a bank a lamp signal system is usually preferable.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Elevator Signal Co., 116 West St., New York, N. Y.
Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J. "Locdrop."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass. "Ross," "Dandy."
Spielman Electric Co., 1931 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIATORS, FIRE-ALARM.—These annunciators are usually operated in connection with a sprinkler system. The opening of a sprinkler head causes the water to flow in a riser, the valve of which in opening closes the circuit of a relay in the annunciator indicating the location of the fire. This relay in turn closes the circuit of a set of batteries directly through fire-alarm bells in the building and may also send the alarm to the city system.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y. "18th Century."
Electric Materials Co., The, North East, Pa.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Spielman Electric Co., 1531 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIATORS, HOSPITAL.—These are designed to eliminate the noise of a bell or buzzer. If a patient pushes a button the action of a relay closes a circuit which lights a signal lamp, and a drop giving the number of the ward or room is also displayed on the annunciator. The lamp remains lighted until an attendant resets the annunciator. This system may be extended to include a lamp over the door of each room and a master annunciator in the superintendent's office to show when calls are answered.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Spielman Electric Co., 1931 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIATORS, HOTEL.—Annunciators of this type may be equipped with as many as 120 indicators per panel so wired that the pressing of a button registers at the office the number of the room from which the call is made and also sends a return call to a bell or buzzer in the room calling. These annunciators are used in hotels that have no private telephone system connected to each room.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
EDWARDS & CO., INC., 140th and Exterior Sts., New York, N. Y.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass. "Dandy," "Ross."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIATORS, LAMP TYPE.—Annunciators of this type, instead of having drops, have small lamps which are lighted to give the signal. In one type each lamp is mounted in a shell socket with an enclosing glass disk set flush with the surface of the annunciator. A number plate below the lamp indicates the origin of the call. Other types have numbers on a darkened glass shield and the call operates a lamp directly behind the corresponding number. In nearly all cases the signal sent in merely operates a relay controlling the lamp circuit. Annunciators of this type may have individual or group resets. They are applicable to almost any annunciator system, but are more frequently used on large installations where there are many call stations, as in hotels, etc., and on telephone switchboards.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

ANNUNCIATORS, MARINE.—Annunciators for marine service are made in substantial form with either a metallic or wooden case and consist essentially of electromagnetically operated shutters, arrows, drops or lamps and a bell or audible signal. On cargo vessels push-button stations are placed in the officers' quarters and the annunciator is usually located in the galley. On passenger vessels such a system is requisite to permit calls from passengers at all times for assistance, and push buttons are placed in each stateroom, often also in other parts of the ship. These are sometimes provided with a thermostatic attachment, if no general fire-alarm system is installed, and indicate on the annunciator the presence of fire. In these cases thermostatic control points are also located in various compartments of the steamer not accessible to the observation of the officers and crew.

The annunciators are usually designed so that an attendant is required to restore

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the drop and the bell continues to ring until this is done. Annunciators of special form are also provided for use with the general fire-alarm systems and are placed where an attendant or watch officer is constantly on duty.

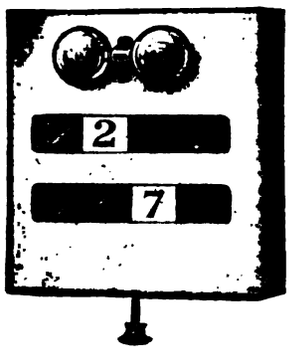
Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass. "Ross."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIATORS, MISCELLANEOUS.—Besides serving to indicate an ordinary call, annunciators for hotels are sometimes wired to permit the sending of a series of calls to each room every few seconds for several minutes, this signal serving as a fire alarm. Such annunciators are termed "return call and fire alarm." Car and steamer annunciators are designed with special reference to withstanding the shocks and injury liable to be met with on steamships. This classification also includes other special and miscellaneous types not otherwise listed.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
EDWARDS & CO., INC., New York, N. Y. Annunciators for residences, hotels, offices, industrial plants, etc. A large variety of types and styles for surface or flush mountings, also for desk use. The San-Fer-Ann, illustrated, is attractive and dependable and in keeping with the white tile kitchens in



The San-Fer-Ann Annunciator

modern homes. It has a steel case finished in white enamel. Annunciators with wood cases are supplied to match surroundings. Various types are made for hand reset or electric reset; also special designs for hotel offices, elevators, fire alarm systems. etc,—Adv.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Paxton & Vierling Iron Works, Omaha, Neb.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

ANNUNCIPHONE.—Trade name for telephones and switchboards manufactured by the Samson Electric Co., Canton, Mass.

ANODE.—Conventionally, the electrode by which current enters an electrolyte. The electrode connected outside the electrolytic cell to the positive (+) pole of a d-c. generator or discharging storage battery, or to the carbon pole of a primary battery, or its equivalent.

ANODE RAYS.—These are commonly called canal rays. They are found in the region behind a perforated anode in a vacuum tube through which there is an electrical discharge. They are positively charged particles having a mass practically that of a molecule of the gas in the tube and moving with a relatively small velocity. They produce fluorescence which is gray or bluish gray.

ANODE SLIMES.—The residue, usually spongy, muddy or slimy, remaining at the anode when the latter is composed of impure metal; the principal metal dissolv- while the undissolved constituents of the anode form the anode mud or slimes. It sometimes falls away continuously from the anode and settles to the bottom of the cell, or it may adhere to the residue of the anode as a thick mud which can be scraped off. In refining impure copper, tin or lead containing the precious metals, the slime is largely composed of silver, gold and platinum, and is carefully collected and treated for the recovery of these metals.

ANODES, ELECTROLYSIS AND ELECTROPLATING, MISCELLANEOUS.—For electrolytic processes the anodes are usually required to be quite pure. Graphite and lead are both used for this purpose in some of the commercial processes as they are not readily attacked by the electrolyte. Platinum anodes are used in laboratory work. For electroplating the anode must usually be of the same metal that is to be deposited. It is therefore silver, gold, nickel, copper, brass, zinc, tin or lead in some of the more common plating processes.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Bishop & Co. Platinum Works, J., Malvern, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Burns Supply Co., E. Reed, 21-27 Jackson St., Brooklyn, N. Y. (Electroplating.)
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill.
Fischer-Sweeny Bronze Co., Inc., 1301 Grand St., Hoboken, N. J.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Hagstoz & Son, T. B., 709 Sansom St., Philadelphia, Pa.
Handy & Harman, 59 Cedar St., New York, N. Y. (Silver.)
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Munning & Co., A. P., Church St., Matawan, N. J.
New Haven Copper Co., The, Seymour, Conn. (Copper.)
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Randolph-Clowes Co., The, Box 1012, Waterbury, Conn. (Brass and copper.)
U. S. Electro Galvanising Co., 32-34 Stockton St., Brooklyn, N. Y.
Universal Bearing Bronze Co., Winsted, Conn.

ANODES, INSOLUBLE.—Anodes which are not attacked, disintegrated, decomposed or dissolved when the electrolyzing current passes; permanent anodes. Platinum is used as such in the laboratory, but only rarely in commercial practice because of its high cost. Plates of cast magnetic iron oxide are used in sulphate solutions, but are rather brittle and easily broken. Sheet lead is semipermanent, i. e., is attacked only slowly in sulphate solutions. Graphite can be thus used as anode in many electrolytic processes, particularly in producing chlorine from salt solutions.

ANODION METAL CO., THE.—124 South St., Baltimore, Md. Manufacturer of lighting fixtures and portable electric lamps. Business established 1919. President, C. W. Harvey; secretary and sales manager, S. S. Murray; treasurer, J. C. Taliaferro. Sales representatives, C. G. Schlichter, 1526 Walnut St., Philadelphia, Pa.; S. S. Patrick, 606 Lyric Bldg., Vine St., Cincinnati, Ohio.

ANOLYTE.—That portion of the electrolyte in contact with the anode and which is kept from mixing freely with the catholyte by a porous partition or capillary tube or syphon. The anolyte is subjected to the adducing influence of the anode, but not to the reducing influence of the cathode.

ANSONIA.—Trade name for push buttons and annunciators manufactured by the Ansonia Electrical Co., Ansonia, Conn.

ANSONIA ELECTRICAL CO., THE.—Ansonia, Conn. Manufacturer of annunciators, bells, buzzers, push buttons and wire. Business established 1895. President, Thomas Wallace; secretary and treasurer, L. F. Anschutz; general manager, Thomas Wallace, 3rd; sales manager, W. J. Tonkin. Main office and factory, Ansonia, Conn. Branch office, 220 Broadway, New York, N. Y. Sales representatives, Monroe Brass & Wire Co., 801 Traction Bldg., Cincinnati, Ohio; B. K. Sweeney, 13th Ave. & Broadway, Denver, Colo.; George A. Gray & Co., 589 Mission St., San Francisco, Cal.; Electric Equipment Co., 9 S. Clinton St., Chicago, Ill.

ANSONIA NOVELTY CO., THE.—285 Main St., Ansonia, Conn. Manufacturer of toy motors, oilers and screw machine products.

ANSTICE & CO., INC., JOSIAH.—Rochester, N. Y. Manufacturer of labor-saving devices for hotels, restaurants, etc. Main office, Rochester, N. Y. Branch offices, 81 Walker St., New York, N. Y.; 56 E. Randolph St., Chicago, Ill.

ANTAKWA CO., THE.—212 N. Jefferson St., Chicago, Ill. Manufacturer of insulating paints. Business established 1917. President, R. H. Wagner; secretary, treasurer and general manager, H. J. Wagner.

ANTENNA, RADIO.—That portion of a radio station used for the radiation (transmission) or absorption (reception) of electromagnetic waves is called the antenna. In general the same antenna can be used for both purposes. The most common type of antenna consists of a system of elevated wires which may take one of several forms. Three common forms of this type are the T, the inverted L, and the umbrella antenna.

The loop or coil antenna has recently found much favor for receiving due to its static-eliminating and directional properties. The coil antenna receives best when placed so that the plane of the coil coincides with the direction of the incoming signals. (See Direction finding, radio.) It consists of a coil of wire of one or more turns having a diameter of from 2 to 100 ft., depending upon the wave length desired. The intensity of the signals received by such a receiving antenna is not as great as for the elevated type but the ratio of signal intensity to static intensity is greater.

Long wires buried in the earth or submerged in water are often used for receiving and possess certain advantageous properties. Combinations of the above mentioned antennas are sometimes used to obtain certain directive effects or to minimize the effect of static.

ANTENNA SUPPORTS, STEEL POLE.—Steel poles are sometimes used for the support of an antenna where the height is not great, as in amateur stations. The pole is often mounted on the roof of a house, garage or barn, as this permits a relatively high antenna without using a long pole or tower. Steel poles are usually made with a varying cross section, growing smaller in diameter near the top. Some improvised antenna supports for amateur stations are merely made of one or more lengths of gas pipe or conduit joined together. All antenna supports should be well guyed.

Manufacturers:

Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Radio Corp. of America, 233 Broadway, New York, N. Y.

ANTENNA SUPPORTS, TOWER TYPE.—See Towers, steel, radio antenna.

ANTENNA SUPPORTS, WOOD POLE OR MAST.—Wooden poles are often used for the support of small and comparatively low antennas. They are widely used by amateurs for mounting on top of a house or shed. The mast type supports afford greater height as they consist of several poles spliced together like a ship mast. Supports of this type require guying. For use with portable radio sets a single pole or a sectional mast may be used and by properly guying no foundation or rigid base is required. This type of support is used largely in the United States Army. A sectional mast which joins together like a fish pole, composed of about 10 sections, is

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also used with a truck as a base and gives a height of about 70 ft. Guy wires are used and the antenna is of the umbrella type which serves further to guy the top of the mast.

Manufacturers:

Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
DeForest, Inc., Lee, 451 3rd St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
KLAUS RADIO CO., Eureka, Ill.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

ANTENNA WIRE AND CORD.—See Wire, antenna, and antenna cord.

ANTHONY WAYNE.—Trade name for incandescent lamps manufactured by the Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind.

ANTHONY WAYNE LAMP CO.—1016 Savilla Ave., Ft. Wayne, Ind. Manufacturer of electric lamps. Business established 1921. A. C. Mannweiler, sole owner.

ANTHONY'S SURE-GRIP.—Trade name for conduit benders manufactured by Paul W. Herbst, 180 N. Dearborn St., Chicago, Ill.

ANTHRACENE.—$C_{14}H_{10}$; an important organic base in the dye industry. It can be oxidized electrochemically to anthraquinone, $C_{14}H_8O_2$, a prominent dye intermediate.

ANTI-BORAX COMPOUND CO.—Fort Wayne, Ind. Manufacturer of welding compounds. Henry J. Miller, proprietor.

ANTIHUMS.—A tightly stretched wire in the open air often hums more or less loudly, especially in winter. This is due to mechanical vibration. A telephone drop line taken from such a lead to the house of a subscriber will carry much of the noise to the house, where it is magnified by the wooden walls. It is worse if the drop line is attached first to the center of a side wall, which then acts like a large diaphragm. An antihum is a device cut into the drop line to stop the noise. It provides some soft material (like rubber) to bear the tension of the line, so as not to transmit the vibration. The electric current is carried around the device by a jumper.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

ANTI-INDUCTIVE.—A term applied to an electrical circuit or load (condensive load), in which the current leads the voltage across the load. The name comes from the fact that a condensive reactance tends to counteract an inductive reactance.

ANTIMONY.—A hard and brittle white metal with bluish luster. Symbol Sb; at.wt. 120.2; sp.gr. 6.7; m.p. 632°C.; b.p. 1600°C. The principal ore is stibnite, Sb_2S_3, from which it is obtained by smelting and refining in reverberatory furnaces, or sometimes by other methods. The principal producing country is China, though many other countries yield smaller amounts. The United States' production is very small. The world's production before the war was about 25,000 tons annually; in 1917 it was about 55,000 tons. Its principal use is as a component of various alloys, especially hard lead (in which form it is produced directly by blast-furnace smelting of lead ores containing antimony), type metal, Britannia metal, and bearing metals.

Small amounts of antimony have been produced electrolytically. The method of Demorest is based on leaching stibnite with an 8% solution of caustic soda, or a solution of sodium sulphide, and electrolyzing the solution using a current density of 7 amp. per sq. ft. at 2.7 volts, thus yielding a pure coherent deposit. The solution, however, must be purified after producing 1 lb. of antimony per lb. of caustic soda used, due to building up of sodium thiosulphate in the solution.

ANTI-NOISE.—Trade name for commercial, marine and aircraft telephones manufactured by the Magnavox Co., 2725 E. 14th St., Oakland, Cal.

ANTI-SPARK.—Trade name for commutator lubricating compound manufactured by the John F. Walsh Co., 170 North St., Pittsfield, Mass.

ANTI-SPLASH.—Trade name for electric sewage pumps manufactured by the Barnes Mfg. Co., N. Main St., Mansfield, Ohio.

ANYANGL.—Trade name for adjustable lighting fixtures manufactured by the Miller Saw-Trimmer Co., Penn & Water Sts., Pittsburgh, Pa.

ANYLITE.—Trade name for lamp socket dimmers and dimming sockets made by the Anylite Electric Co., Wall St., Fort Wayne, Ind.

ANYLITE ELECTRIC CO.—Fort Wayne, Ind. Manufacturer of lamp socket dimmers and dimming sockets. Business established 1918. President, G. A. Jacobs; vice-president, Leonard Sykes. Main office, Wall St., Fort Wayne, Ind. Branch office, 19 S. Wells St., Chicago, Ill. Sales representatives, A. Hall Berry, 73 Murray St., New York, N. Y.; Walter Wilson, 710 Polk St., San Francisco, Cal.; Dominion Battery Co., Ltd., 736 Dundes St., Toronto, Ont., Can.; B. F. Clark Co., 718 Cherry St., Philadelphia, Pa.; S. E. Wiedemer, 5822 Central St., Kansas City, Mo.; John Winkler, 141 E. 4th St., Cincinnati, Ohio.

ANYLITE TWIN.—Trade name for duplex sockets manufactured by the Anylite Electric Co., Ft. Wayne, Ind.

ANYWHEARE.—Trade name for adjustable lighting fixtures manufactured by S. Wetzler, 34 Union Sq., New York, N. Y.

AOSCO.—Trade name for mica insulating materials manufactured by the A. O. Schoonmaker Co., 88 Park Pl., New York, N. Y.

APEX.—Trade name for electric vacuum cleaners manufactured by the Apex Electrical Mfg. Co., 1067 E. 152nd St., Cleveland, Ohio. Exclusive distributor, Apex Electrical Distributing Co., 1089 E. 152nd St., Cleveland, Ohio.

APEX.—Trade name for friction tape manufactured by Elkhart Rubber Works, Elkhart, Ind.

APEX.—Trade name for rail joints manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

APEX.—Trade name for power transmission belting manufactured by N. Palmer & Co., Bridgeport, Conn.

APEX APPLIANCE CO.—3223 W. 30th St., Chicago, Ill. Manufacturer of electric labor-saving devices. President, C. W. Swanson; vice-president, Edwin C. Goldbeck; secretary, O. H. Erhardt; treasurer, A. F. Anderson.

APEX ELECTRICAL MFG. CO., THE.—Cleveland, Ohio. Manufacturer of electric vacuum cleaners and washing machines. Business established 1913. President, C. A. Kolp; vice-president, W. A. Frantz; treasurer and general manager, C. G. Frantz; sales manager, R. J. Strittmatter. Main office and factory, 1067 E. 152nd St., Cleveland, Ohio. Branch offices, Kansas City, Mo.; St. Louis, Mo.; Minneapolis, Minn. Exclusive distributor, Apex Electrical Distributing Co., 1089 E. 152nd St., Cleveland, Ohio.

APEX ELECTRICAL MFG. CO., LTD.—102-104 Atlantic Ave., Toronto, Ont., Can. Manufacturer of electric vacuum cleaners and washing machines.

APEX ELECTRICAL SPECIALTY CO.—79 Orange St., Newark, N. J. Manufacturer of incandescent lamps.

APFEL'S.—Trade name for electric heating and cooking devices manufactured by the Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash.

APOLLO.—Trade name for lighting unit manufactured by the Holophane Glass Co., Inc., 340 Madison Ave., New York, N. Y.

APOLLO.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

APOLLO.—Trade name for electrotherapeutic apparatus manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

APOLLO MAGNETO CORP.—Kingston, N. Y. Manufacturer of magneto ignition equipment. President and general manager, J. K. Leucke; vice-president, Richard M. Atwater, Jr.; secretary, Jesse Myers; treasurer, Paul Stamm. Main office, 85 Grand St., Kingston, N. Y. Factories, Kingston, N. Y.; Brooklyn, N. Y. Branch office and warehouse, Magneto Winding Co., 1723 8th Ave., Brooklyn, N. Y.

APOLLO METAL WORKS.—LaSalle, Ill. Manufacturers of zinc sheets, etc.

APOLLO-NICKELZINC.—Trade name for zinc manufactured by the Apollo Metal Works, LaSalle, Ill.

APOLLO SPECIAL.—Trade name for sheet steel for electrical purposes manufactured by the American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa.

APPARENT POWER.—The product of the r.m.s. or effective values of the current and voltage of a circuit; apparent power is expressed in volt-amperes or kv-a. Also see Power, a-c.

APPLETON ELECTRIC CO.—Chicago, Ill. Manufacturer of conduit fittings. Business established 1900. President, treasurer and general manager, A. I. Appleton; vice-president, F. H. Merrill; secretary, J. V. Painter; sales manager, R. P. Tillotson. Main office and factory, 1703 Wellington Ave., Chicago, Ill. Branch office and warehouse, 55 Barclay St., New York, N. Y. District office, 917 Pine St., St. Louis, Mo. Sales representative, Keeler, White Co., 509 Mission St., San Francisco, Cal.

APRONS, ACIDPROOF. — Acidproof aprons are generally made of heavy rubber or rubber-coated cloth, and are worn by storage-battery attendants, electroplaters, chemists, etc., to protect the clothing from damage by sulphuric, hydrochloric or other destructive acids. They are generally made with a bib and are from 46 to 48 ins. long.

Manufacturers:

Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill. "Besco."
BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J.
Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Defiance Welding Co., The, 700 Phelps Ave., Defiance, Ohio. "Invincible."
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo. "Lion."
Hanson & Van Winkle, Newark, N. J.

AQUA.—Trade name for electric water heaters manufactured by the Aqua Electric Heater Co., 250 W. 54th St., New York N. Y.

AQUA ELECTRIC HEATER CO.—250 W. 54th St., New York, N. Y. Manufacturer of electric water heaters. Business established 1920. President and general manager, H. Bobker; vice-president and sales manager, H. Barroll; secretary and treasurer, H. Dineson. Factory, Bridgeport, Conn.

ARALCO.—Trade name for showcase and show window lighting reflectors manufactured by the American Reflector & Lighting Co., 100-104 S. Jefferson St., Chicago, Ill.

ARBORLUX.—Trade name for Christmas tree lighting outfits manufactured by the General Electric Co., Schenectady, N. Y.

ARC, ELECTRIC.—When an electric current jumps across an opening or break in a circuit a stream of vapor, producing intense heat and light, is formed by the evaporation of the terminal conductors, or electrodes, and the vapor continues to carry the current across the gap. The vapor stream will not ordinarily pass in a straight line but follows a curved path or arc from which it takes its name. The arc was first produced on a large scale in 1806 by Sir Humphrey Davy, who by using a battery of 2,000 voltaic cells and charcoal pencils produced an arc 4 ins. long.

The term electric arc is ordinarily restricted to such arcs as are intentionally maintained to secure very high heat or light, and to arcs incidentally formed when circuits of high current or voltage are broken or closed but which are not intentionally maintained. The former are highly useful; the latter are usually an unavoidable nuisance the destructive effects of which must be carefully guarded against. Arcs formed when the latter type of circuit is intentionally opened or closed (usually periodically) and usefully employed are more commonly referred to as "sparks," such as in the case of spark plugs and spark gaps.

To sustain an arc the current it carries must be sufficient to produce continuous evaporation of the electrodes. These electrodes may be of carbon or metal, or composite, containing both. If the arc is supplied from a constant-voltage circuit, its length gradually increases with evaporation of the electrodes and the voltage across the arc increases while its current decreases; to maintain the arc constant the electrodes must be fed together, this being done by hand or automatically by electrically controlled mechanism.

Highly inductive circuits produce long

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arcs when broken. Such arcs are usefully employed in such equipment as spark plugs and spark coils. In large-capacity or high-tension switches, circuit breakers, contactors, controllers, etc., this arcing is objectionable and causes serious burning of the contacts unless overcome. To destroy such arcs use is made of a magnetic blowout coil, a horn gap or an air blast to lengthen the arc so that it breaks, because as it lengthens its resistance increases and its current decreases ultimately to the point that it can no longer vaporize the electrode material. A magnetic field deflects and lengthens an arc; in the magnetic blowout an electromagnet coil is used to lengthen the arc to the breaking point. In a horn gap the heated vapor rises between the diverging arms, lengthening and finally breaking. An air blast both cools the vapor stream and displaces it by relatively nonconducting air thus also lengthening it, both actions helping to break the arc.

Arcs may be maintained by either direct or alternating current. In the d-c. arc between carbon electrodes the positive electrode forms into a hollow or crater in which the carbon seems to boil. This crater gives the highest temperature attainable by any known means, this temperature being estimated at about 4,000° C. (7,230° F.). Applications of the heat of the arc are made commercially in electric furnaces and electric welding. See Furnaces, electric arc; Welding, electric, review and status of; also Welders, electric arc.

An arc is always accompanied by considerable light, the luminosity and color of which depends on the electrode materials and the current used. Commercial applications of the arc for lighting are made in arc lamps and searchlights. See Lamps, arc; Searchlights; Spotlights, stage.

ARC FURNACE.—An electric furnace in which the principal source of heat is a gap across which the current jumps or arcs, passing through the gas or vapor between the terminals. See Furnaces, electric.

ARC LAMPS.—See Lamps, arc.

ARC PROCESSES.—Those processes in which a high-tension arc discharge is utilized in the fixation of atmospheric nitrogen. (See Nitric acid).

ARCA.—Trade name for regulators manufactured by the American Galco, Inc., Grand Central Palace, New York, N. Y.

ARCHBOLD-BRADY CO.—Syracuse, N. Y. Manufacturer of steel transmission structures and catenary bridges.

ARCHER.—Trade name for commercial lighting unit manufactured by George Ainsworth, New Liggett Bldg., New York, N. Y.

ARCMASTER.—Trade name for solenoid switches manufactured by the Jeffrey Mfg. Co., 1st Ave & 4th St., Columbus, Ohio.

ARCO WAND.—Trade name for electric vacuum cleaners made by the American Radiator Co., 816-22 S. Michigan Ave., Chicago, Ill.

ARCOVER.—Trade name for insulators, insulated connectors, knobs, handles, etc., manufactured by the Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y.

ARCS, RADIO.—The voltage across an electric arc decreases with increasing current. This property known as "negative resistance," makes possible the use of an arc as a source of radio-frequency oscillations. The negative resistance of the arc maintains continuous oscillations in a circuit composed of an aerial and a tuning inductance. Telegraph signals are transmitted either by short-circuiting a few turns of the inductance, thereby changing the wave length of the transmitted wave, or by switching the energy from a non-radiating circuit to the aerial. Arc generators usually contain copper and carbon electrodes in an air-tight water-cooled chamber. The arc burns in an atmosphere of hydrogen or hydrocarbon vapor. A strong magnetic field is also applied to the arc.

Up to the present, arc radio-frequency generators have been the most satisfactory source of continuous oscillations. They are used exclusively by the United States Navy, for high-power work. Arc stations of 500 and 1,000 kw. have been built. (See Radio stations, high-power.)

ARCTIC.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

ARCTIC.—Trade name for journal boxes manufactured by the More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.

ARCWALL.—Trade name for electric coal cutting machines manufactured by the Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.

ARGOLITE.—Trade name for incandescent gas lamps manufactured by the Independent Lamp & Wire Co., 1737 Broadway, New York, N. Y.

ARGOLUX.—Trade name for commercial lighting unit manufactured by the Wagner-Woodruff Co., 830 S. Olive St., Los Angeles, Cal.

ARGON.—Trade name for tungsten incandescent lamps manufactured by the Lyhtan Electric Lamp Co., 591 Central Ave., Jersey City, N. J.

ARGUS.—Trade name for lightning arresters for telephone and telegraph instruments manufactured by Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.

ARGUS AISLE-LITE.—Trade name for aisle lights manufactured by the Argus Enterprises, Inc., 815-823 Prospect Ave., Cleveland, Ohio.

ARGUS ENTERPRISES, INC., THE.—Cleveland, Ohio. Manufacturer of projecting lamp adapters and aisle lights. H. H. Cudmore, president. Main office, 815-823 Prospect Ave., Cleveland, Ohio. Branch offices, New York, N. Y.; Chicago, Ill.; Boston, Mass.; Buffalo, N. Y.; Denver, Colo.; Los Angeles, Cal.; Omaha, Neb.; Salt Lake City, Utah; Des Moines, Iowa.

ARGUS-GE MAZDA.—Trade name for projecting lamp adapters manufactured by the Argus Enterprises, Inc., 815-823 Prospect Ave., Cleveland, Ohio.

ARION MFG. CO.—250 Devonshire St., Boston, Mass. Manufacturer of electrically operated phonographs. General manager, R. R. Sheldon.

ARIONOLA.—Trade name for electrically operated phonograph manufactured by the Arion Mfg. Co., 250 Devonshire St., Boston, Mass.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION.—President, E. M. Emerson, England, Ark.; secretary-treasurer, Thos. Stahl, Siloam Springs, Ark.

ARKANSAS UTILITIES ASSOCIATION.—President, C. J. Griffith, manager, Little Rock Railway & Electric Co., Little Rock, Ark.; secretary, S. E. Dillon, Hot Springs.

ARKLESS.—Trade name for nonrenewable cartridge fuses manufactured by the Economy Fuse & Mfg. Co., 2717 Greenview Ave., Chicago, Ill.

ARM & HAMMER.—Trade name for leather belting manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

ARMATURE.—In dynamoelectric machines, the armature is that part of a generator from which electrical energy is given out, or that part of a motor to which the electric energy to be converted to mechanical energy is supplied. It usually consists of a laminated iron core, forming a part of the magnetic circuit of the machine, upon which are placed the electric conductors through which the energy transformation takes place. The armature is made to rotate in most d-c. machines, synchronous converters and a-c. commutator motors. It is more commonly stationary in a-c. generator, synchronous motors, and squirrel-cage and slip-ring induction motors. For listing of armature manufacturers see Armatures, complete.

With magnets, an armature is a piece of iron joining the poles. With permanent magnets it may serve to retain the magnetism, in which case it is called a "keeper"; with electromagnets it may hold a load or move a part, for example, to open or close an electric circuit.

ARMATURE.—Trade name for friction tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

ARMATURE BALANCING MACHINES.—A class of special machines used in balancing rotating armatures, or other rotating parts, so that vibration is reduced to a minimum when such parts are rapidly rotated. There are two degrees of balance necessary for this condition, viz., static balance and dynamic balance.

Static balance exists if there is no resultant moment about the axis of rotation when that axis is horizontal and the rotatable part is stationary in any angular position. Static balance can be determined with a moderate degree of sensitiveness without a machine by resting the shaft of the armature (or other rotatable part) on horizontal, parallel ways. An unbalance will be indicated by the rolling of the armature on the ways until the heavier side is below the shaft. A counterweight on the lighter side or the removal of weight from the heavier side may eliminate the tendency to roll, in which case the armature is statically balanced as nearly as it can be by this method. A more sensitive way of determining static balance consists in rotating the armature with both bearings rigidly attached to a spring-mounted support, in which case a static unbalance causes vibration of the support. This is prevented by properly adjusting a counterweight.

Dynamic balance exists when a statically balanced armature or other rotatable part is rotated and there is no tendency to vibrate. This condition may be determined by rotating a statically balanced armature with one bearing rigidly mounted and the other flexibly mounted so that it may move slightly in an axial plane against a spring. If there is dynamic unbalance, the flexibly mounted bearing will vibrate. This vibration may be eliminated by the proper placing of a counterweight or the removal of weight without disturbing the static balance.

Both static balance and dynamic balance are especially desirable in high-speed machines.

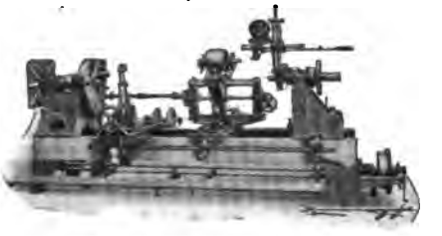
Manufacturers:

Bowsher Co., The N. P., South Bend, Ind. "Bowsher's Balancing Ways."
Lippincott-Carwen Corp., Erie Ave. & Richmond St., Philadelphia, Pa.
Olsen Testing Machine Co., Tinius, 500 N. 12th St., Philadelphia, Pa.

ARMATURE BANDING MACHINES.—Machines used in placing binding wires about armatures. These are laid in groups or bands and serve to hold the conductors in place on the armature cores. They are used only on machines where armature slot wedges or pegs are not used and where there is danger of the coils becoming loosened by vibration and centrifugal force. The machines in some cases are a special form of lathe or spring winding machine, and draw the binding wire, which has a very high tensile strength, tightly around the armature.

Manufacturers:

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.



Peerless Heavy Duty Machine

Practically every repair necessary on electric railway or large industrial armatures can be made on the heavy-duty Peerless machine, illustrated above. It consists of a banding machine, commutator slotting and commutator grinding machine and field coil winding plate. It saves time and labor and does better work than primitive methods. The complete Peerless line, which is completely cataloged, also includes smaller tools for use in cases where the different operations are to be carried on separately.—Adv.

ARMATURE CHARACTERISTIC. — A curve showing the relation between the exciting current and load current for constant speed and constant terminal voltage of a d-c. generator armature.

ARMATURE COIL EQUIPMENT CO.—3203 Scranton Rd., Cleveland, Ohio. Manufacturer of coil forming and winding machines. Sole owner and manager, A. Fathauer.

ARMATURE COIL-FORMING MACHINES.—Machines that form previously wound armature coils into the shape which they must have to fit properly into the slots of the armature core. They are usually machines operating like a press with adjustable members so that coils of various shapes and sizes may be formed on them. They give the correct spacing between sides of the coil, so they will fit into the slots, and the proper bend and twist at the coil ends. This insures a neat job and makes the coils uniform, which is a difficult and time-consuming operation when done by hand.

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Manufacturers:

Armature Coil Equipment Co., 3203 Scranton Rd., Cleveland, Ohio. "Improved."

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago Ill. "Segur."

ARMATURE COIL-TAPING MACHINES.—Machines for applying insulating tape around the conductors forming an armature coil. Such taping not only serves for insulation but also assists in holding the conductors of the coil together and in the proper cross-sectional form before they are placed in the armature slots. The taping machines often consist of a bobbin on a split circular guide ring. The bobbin carries sufficient tape to finish one or more coils and the coil is placed so that it interlinks the circular guide ring. The bobbin thus makes a complete revolution around the side of the coil. These machines reduce the cost of coil taping very much, as they are great time and labor savers.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Chattanooga Armature Works, 1-3 Duncan Ave., Chattanooga, Tenn.

Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Segur."

ARMATURE COIL-WINDING MACHINES.—Machines holding forms on which conductors for armature coils are wound. These forms may or may not give the coil its final desired shape. If they do not, the coils are bent to the proper shape in an armature coil-forming machine, which see. The forms are usually hinged or so made that after the coil is wound, the form may be withdrawn without disturbing the shape of the coil. In many cases the coils are merely wound in circular form by means of a machine and are taped before being formed into the final shape desired.

ARMATURE CORES OR DISKS.—The iron core of an armature made of sheet iron or steel rings or disks. (See Armature punchings; also see Core, armature.)

ARMATURE DISK-NOTCHING MACHINES.—Machines for cutting the notches in armature disks, these notches combining to form the armature slots when the disks are assembled in the armature core. These machines are always a form of punch press, in some cases (as for very small motors) a standard punch press being used and the entire disk cut and notched in one operation. For larger core disks or sections thereof only one slot may be cut at a time and then the machine must be equipped with a dividing head that will permit accurate spacing of the slots. This head must also permit of adjustment to cut varying numbers of slots. In the case of very large motors and generators, instead of using complete circular disks, only sections or segments of the disk are used and these are all joined together later, being overlapped in assembling.

Manufacturers:

Bliss Co., E. W., Adams & Plymouth Sts., Brooklyn, N. Y.

Standard Machinery Co., Auburn, R. I. (P. O. address, Elmwood Station, Providence, R. I.)

ARMATURE PUNCHINGS.—Thin sheets of electrical iron or steel that have been punched in a press or disk-notching machine into the desired circular or ring form for use in armature cores. In small machines a single punching in disk or ring form may embrace the whole circumference of the armature; in larger machines only a section of the circumference is included in each punching, the several sections when placed end to end forming a complete ring. The punchings are assembled into the completed armature core. (For further details see Core, armature.)

Manufacturers:

Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Bissell Co., The F., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio.

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.

Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."

Liberty Electric Corp., Port Chester, N. Y.

Worcester Stamped Metal Co., Worcester, Mass.

ARMATURE RACKS.—Frames for holding partially or completely assembled armatures. Where the armatures are merely held or stored until ready to be used, a wooden inclined frame is used having notches in the framework for the armature shafts to rest in. Fairly large armatures sometimes have a special rack resembling a sawhorse, in which the armature is held while being worked on or tested as well as when storing. Metal racks are also used, especially to support the armatures during the impregnating and baking processes.

Manufacturers:

Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.

Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

ARMATURE REACTION.—This is the effect of the current in the armature of an electric generator or motor upon the magnitude and distribution of the flux set up by the current in its field winding. With d-c. machines, this effect varies with the magnitude of the current and with the position of the brushes on the commutator. If the brushes are so set that connections to the armature windings are made at the middle of the interpolar space, then the armature current produces a cross-magnetizing action, increasing the flux density at the trailing pole tip in generators and at the entering pole tip in motors, with little or no change in the total number of lines of force per pole. If the brushes of a generator are shifted in the direction of rotation, or those of a motor oppositely, the armature current also produces a demagnetizing action, lessening the flux per pole and correspondingly reducing the voltage of generators and increasing the speed of motors.

With synchronous a-c. machines, the armature reaction gives cross magnetizing action when the current is in phase with the generated voltage of the armature, demagnetizing or magnetizing action when the current lags or leads, respectively, the generated voltage by a quarter of a period, and a combination of cross magnetizing action with demagnetizing or magnetizing action when the current lags or leads less than a quarter of a period. The effect with synchronous generators and motors is to reduce the generated voltage when the current lags behind this voltage and to increase it when the current leads.

ARMATURE TESTING MACHINES AND OUTFITS.—Machines or devices for determining the presence or absence of short circuits, open circuits and grounds in armature windings. If these faults are present the testing machine may show the approximate location of them. In the simplest form these outfits consist of a source of energy with a lamp in series with two testing terminals. For more accurate work and special testing this may take the form of a testing transformer, which see.

Manufacturers:

American Bureau of Engineering, Inc., 1601-03 S. Michigan Ave., Chicago, Ill. "Ambu."

Century Electrical Co., 102 Randall Ave., Syracuse, N. Y. "Century."

Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.

Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.

Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

Roller-Smith Co., 233 Broadway, New York, N. Y.

Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ARMATURE WINDING.—The conductors that are placed on the armature core and connected in any one of a number of ways to form the desired electrical circuits are called the armature winding. This term is also applied to the process of winding an armature.

Armature windings are sometimes classified according to the shape of the core and the arrangement of the windings thereon into disk, ring and drum windings. The drum type is about the only one now used, and has the conductors placed on the outside of revolving armature cores and on the inside of stationary armature cores.

Armature windings are also classified according to the character of the circuits through them into open-coil and closed-coil windings. The open-coil winding is one which forms an open circuit when no outside connections are brought to the armature; a closed-coil winding is one which forms a closed circuit on the armature without any outside connections. Open-coil windings are largely used on a-c. machines, while closed-coil windings are used on d-c. and on some a-c. machines.

Closed-coil armatures of the drum type for d-c. machines may have either parallel or series windings. In parallel windings, the number of circuits through the armature from one machine terminal to the other is equal to or a multiple of the number of poles and there must be as many brush sets as there are poles. In series windings the number of circuits is two or a multiple of two, independent of the number of poles. Two brush sets—one positive and one negative—may be used, or the number may be the same as the number of poles. From the appearance of parallel and series windings, they are often called lap and wave windings, respectively. Either kind of winding may be increased in number on a given armature core so that there may be a winding which is duplex, triplex, etc., and has double, treble, etc., the number of circuits possessed by a single or simplex winding. Lap windings are commonly used on large d-c. machines and on small machines for low voltage. Wave windings are often used on small multipolar machines.

The pitch of an armature winding is the span covered in passing from one active conductor through the end connections to the next conductor in series with it. The pitch is commonly measured by the number of conductors passed over, but is also expressed as a percentage of the pole span, the distance from a point on a north pole to the corresponding point on an adjacent south pole being taken as 100 per cent.

ARMATURE WINDING MACHINES.—Machines designed for winding the armatures of small electric machines, generally fractional-horsepower motors. They are applied only to small motors, as the larger sizes always have the coils wound separately and then placed on the armature. (Also see Armature coil-winding machines.)

Manufacturers:

Armature Coil Equipment Co., 3203 Scranton Rd., Cleveland, Ohio. "Handy."

Chapman, P. E., 10th and Walnut Sts., St. Louis, Mo.

Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Chapman."

Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

ARMATURES, COMPLETE.—A complete armature is one completely wound and assembled and ready to place into a generator or motor. Such armatures are occasionally supplied to some manufacturers of small motors who do not have adequate facilities for armature winding. Motor repair shops and the electrical maintenance departments of electric railways and large industrial plants frequently carry in reserve a stock of complete armatures of standardized motors so that in cases of armature burnout or other trouble the machine may be placed in service again with minimum delay.

Manufacturers:

Air-Way Electric Appliance Co., Toledo, Ohio.

Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.

Bissell Co., The F., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio.

Boston Armature Works, 77 Washington St., N., Boston, Mass.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Central Armature Works, 417 S. Racine Ave., Chicago, Ill.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

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Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
Jantz & Leist Electric Co., Western Ave. and York St., Cincinnati, Ohio.
Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., W., Toronto, Ont., Can.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Kurz & Root, Appleton, Wis.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Leacock Co., A. M., 291-295 Cortlandt St., Belleville, N. J.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Munning & Co., A. P., Church St., Matawan, N. J.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ARMCO.—Trade name for pure ingot iron and products thereof and sheet metal for electrical purposes manufactured by the American Rolling Mill Co., Middletown, Ohio.

ARMORPLATE.—Trade name for electric mine locomotives manufactured by the Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.

ARMS.—See Bayonet arms; Breakarms; Crossarms; Flexible arms for portable lamps; Mastarms.

ARMSTRONG.—Trade name for gas and kerosene engines manufactured by the American Engine & Foundry Co., Charles City, Iowa.

ARMSTRONG.—Trade name for household electric cooking appliances manufactured by the Standard Stamping Co., 1st St. & 7th Ave., Huntington, W. Va.

ARMSTRONG & WHITE.—Renshaw Bldg., Pittsburgh, Pa. Manufacturers of sockets.

ARMSTRONG MACHINE WORKS.—Three Rivers, Mich. Manufacturer of steam traps. Business established 1907. President and general manager, A. E. Armstrong; vice-president, M. F. Armstrong; secretary, A. L. Jones; treasurer and sales manager, L. D. Goff.

ARMSTRONG MACHINERY CO.—3201-3219 E. Riverside Ave., Spokane, Wash. Manufacturer of motor-driven ice-making and refrigerating machinery. President, L. B. Armstrong; secretary, treasurer and manager, Stanley Mayall.

ARMSTRONG MFG. CO., THE.—Bridgeport, Conn. Manufacturer of conduit and pipe threading dies, stocks and vises.

ARMYDUCT.—Trade name for rigid metallic interior conduit manufactured by the National Enameling & Mfg. Co., Renshaw Blvd., Pittsburgh, Pa.

ARNESSEN ELECTRIC CO.—New York, N. Y. Manufacturer of marine fittings. Main office, 109 Broad St., New York, N. Y. Branch offices, 142 S. 3rd St., Philadelphia, Pa.; 11-13 S. Gay St., Baltimore, Md.; 113 Hamilton Ave., Brooklyn, N. Y.; 426 Common St., New Orleans, La.

ARNOLD.—Trade name for motors and electric labor-saving devices manufactured by the Arnold Electric Co., Racine, Wis.

ARNOLD.—Trade name for electric milk sterilizers manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

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ARNOLD ELECTRIC CO.—Racine, Wis. Manufacturer of motors and electric labor-saving devices. Business established 1905. President, G. C. Schmitz; secretary and treasurer, J. A. Schmitz. Branch office, 140 S. Dearborn St., Chicago, Ill.

ARNOLD ELECTRIC TOOL CO., INC.—New London, Conn. Manufacturer of electric tools. Business established 1918. President and general manager, F. N. Lapointe; vice-president, G. A. Arnold; secretary and treasurer, R. P. Saltsman. Main office, Fort Trumbull Bldg., New London, Conn. Branch offices and warehouses, 114 Liberty St., New York, N. Y.; 924 Marquette Bldg., Chicago, Ill.

ARORA CO., INC.—46 E. 41st St., New York, N. Y. Manufacturer of electric washing machines.

ARORA QUALITY.—Trade name for washing machines manufactured by the Arora Co., Inc., 46 E. 41st St., New York, N. Y.

ARRESTERS, LIGHTNING, APPLICATION AND FUNCTION OF.—Lightning arresters are used on overhead lines to provide a path for the discharge of static electricity to ground. Such static charges accumulate during electrical storms for the most part and the arrester is therefore called a lightning arrester.

The arrester is so constructed that it will stop the flow of power after the static discharge has jumped across the air gaps to ground. This is accomplished by resistors in series or by electrolytic means. The arresters are connected from the line wires to ground and are placed as near as practicable to the transformers, cables, or other equipment which they are intended to protect. The size and cost of arresters increases as the line voltage is higher.

The principal types of lightning arresters are described below. For telephone and other signaling circuits the arrester is often combined with other protective devices and called a lightning protector; see Protectors, lightning. Also see Lightning.

ARRESTERS, LIGHTNING, ELECTROLYTIC.—On lines operating at voltages above 10,000 and where the value of the equipment protected is great, it is desirable to have a type of arrester having a large discharge capacity, such as is possible with the electrolytic type. It consists of a stack of superposed aluminum cones containing an electrolyte which permits the lightning discharge to pass through the stack to ground but does not permit the reverse wave of alternating current to follow. The film of oxide which produces the choking effect must be maintained by momentarily closing the spark gap, thus "charging" the arrester. Charging must be done every day or two.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."
GENERAL ELECTRIC CO., Schenectady, N. Y. Aluminum Cell Arresters for the protection of important generating and transforming a-c. apparatus of large stations of any voltage. On account of their high speed of discharge and enormous discharge capacity, they are capable of quickly and thoroughly relieving lines of dangerous surges. The aluminum cone stacks are immersed in oil in steel tanks. Gap mechanism is mounted on pipe framework, all parts of which are thoroughly weatherproofed by galvanizing or sherardizing. Several types are made, ranging from 1,000 volts up to 155,000 volts. (Bulletin 45601A.) See adv. pages 1203-1223. —Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." .(See display adv. pages 1395-1402.)

ARRESTERS, LIGHTNING, EXPULSION.—Expulsion lightning arresters are those in which the gases produced by the discharge develop a very high pressure in a special chamber and are violently expelled, thus blowing out the arc formed. In one form of this arrester the two electrodes are on opposite sides of a block which has a series of grooves filled with resistance material between them. Another series of grooves at right angles to the first set provide an escape for the gases formed and as they are at right angles the arc formed in each groove is immediately broken. In another type of expulsion arrester a series of discharge gaps are placed in a special chamber sealed at the upper end. When a discharge passes these gaps and an arc is established across a final discharge point, the rapid expansion of the air in the chamber forces it out past the discharge point and the arc is broken.

Arresters of this type are used on both a-c. and d-c. lines. They are not made for a high voltage in one unit, but by connecting two or more in series may be used on circuits up to about 10,000 volts.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.



Expulsion Type



Circuit Breaker Type

Keystone expulsion type lightning arresters, illustrated on left, are used generally for the protection of transformers and other electrical apparatus. They are made with casing of heavy porcelain, are self-contained and easy to install directly on crossarms or other supporting means. They are an inexpensive arrester and offer very efficient protection. Garton-Daniels lightning arresters, illustrated on right, are of circuit-breaker type. They have remained unchanged in principle for 28 years and render extraordinary service in protecting electrical apparatus of all kinds. This company is prepared to supply lightning protective apparatus to meet practically every condition and because of its long experience in manufacturing and selling protective apparatus it is fitted to make recommendations for complete lightning protection. Its complete line of protective apparatus includes lightning arresters and broad lines of choke coils, disconnecting switches, ground fittings and other allied material. A very complete bulletin on this lightning protective apparatus is issued annually.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ARRESTERS, LIGHTNING, GAS-PRESSURE LIQUID TYPE.—Lightning arresters of this type depend upon the heating of an electrolyte to generate a gas that will rupture the discharge arc that caused the heating. These arresters are adjustable to close values of the voltage at which the discharge will occur by changing the height of the liquid and electrolyte.

Manufacturers:

SCHWEITZER & CONRAD, INC., 4431-39 Ravenswood Ave., Chicago, Ill. The S & C gas pressure liquid type lightning, or surge arrester, consists essentially of an electrolyte and a discharge terminal enclosed in a container. At a pre-determined voltage, the discharge occurs between the terminal and the surface of the electrolyte. The amount of current flowing depends upon the resistance of the electrolyte, which is adjusted for the rated voltage. The heat of the discharge arc and the flow of current through the electrolyte, transforms the liquid into a gas which accumulates and exerts pressure on the surface of the liquid, forcing some of the liquid into a reservoir. This lowers the surface of the liquid, and, consequently lengthens the arc until it breaks. When the gas and liquid cools, the liquid returns to its original level and the arrester is ready for the next discharge. Schweitzer & Conrad, Inc., own patents which fully cover the method of interrupting the flow of current in a liquid conductor, which comprises vaporizing a part of the liquid conductor by the heat of the current flow, then causing the vapor so generated to be accumulated, and to exert a pressure upon the free surface of the liquid conductor to move the same down and out of the conducting relation. The S & C liquid arrester can be furnished for all voltages.—Adv.

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ARRESTERS, LIGHTNING, HORNGAP.—Where arresters are installed on a pole top or other location having ample headroom, the spark gap for the discharge is arranged in the form of a letter V, or pair or diverging horns, hence the name horngap. The bottom of the V is not closed and makes the spark gap. When an arc is formed it is carried upward along the two horns of the V until it is attenuated to the breaking point. This type of arrester is cheap and with various modifications is used to protect farm lines and other installations. It is also much used in conjunction with other types of arresters, such as the electrolytic.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.

ELECTRIC POWER EQUIPMENT CO., Philadelphia, Pa. See display adv. page 1261.

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

GENERAL ELECTRIC CO., Schenectady, N. Y. Horn type arresters (for series lighting circuits only) for indoor use having the resistances and horn gaps mounted on porcelain bases which in turn are insulated, with wooden supports. The supports, except those for the lowest voltages, have asbestos barriers and back to eliminate all liability of damage from the arc of discharge. For outdoor use the resistances are enclosed in metal cap porcelain tubes, which are mounted directly on one of the insulators supporting the horns, giving a most compact and economical assembly of the arrester element. (Bulletin 45602.) See adv. pages 1203-1223.—Adv.

Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."

HI-VOLTAGE EQUIPMENT CO., Cleveland, Ohio. Manufacturers of air break switches, lightning arresters, choke coils, high voltage fuses, disconnecting switches, outdoor bus supports, steel sub-station structures, crossarms. The Hi-Voltage Arrester is designed for outdoor mounting. It is extremely sensitive, that is, it acts with a minimum of delay in arresting any surge that might damage line or apparatus. It is built to discharge the surge energy at a rate that will prevent the voltage building up on the line to a point that is dangerous to apparatus. The arrester cuts off the power current after a discharge quickly. There are three (3) distinct causes of discharge across arresters. Static, high-frequency surges or impulses, and switching surges. Static on which many ungrounded neutral systems account for a large percentage of arrester discharges will drain across the flash rod of the Hi-Voltage arrester and the gap to ground, but the line current or voltage will not flow to ground. The danger to apparatus from high frequency or disturbances of steep wave front is more serious than the voltage of the surge would indicate, because the entire voltage of the discharge may be distributed over only a few feet of the conductor and there is danger of the entire voltage of the surge piling up between the first few turns of a transformer winding. The Hi-Voltage arrester is particularly sensitive to high frequency—discharging high frequency at a lower voltage than at normal frequency. This is accomplished by the characteristics of the flash rod. In discharging a surge in which there is any appreciable energy the arc breaks across the flash rod and across the gap to ground through the resistance. The arc across the flash rod is immediately taken by the horns and broken usually in a fraction of a second. These horns at their closest points are further apart than the tops of the horns on most arresters. The arc formed between horns so widely spaced breaks very quickly. It is not necessary for the arc to climb the horns—it merely flashes up and extinguishes itself so that the duration of a power arc across the arrester is very short.—Adv.

HUBBARD & CO., Pittsburgh, Pa. "Peirce" universal lightning arresters may be used on all voltages, both a-c. and d-c., up to and including 7,500 volts. They are mounted on the conductor, and provide a direct and easy path to ground, free from frail and undependable resistances. There are three elements essential to the success of an arrester combined in the Peirce universal: (1) the choke coil, which



Peirce Universal Lightning Arrester

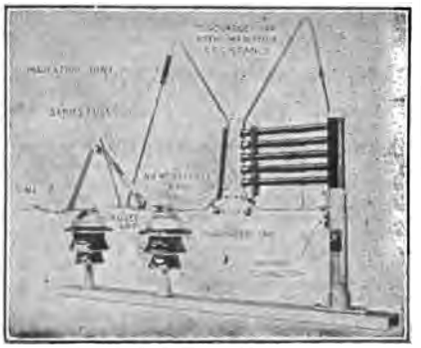
strains out all foreign current of abnormal frequency, without causing appreciable impedance of line current and sectionalized disturbances; (2) the air gap, which, placed near the choke coil between the line and the ground, passes off all excess voltage and foreign current; (3) the horn air gap, which breaks the arc and prevents the escape of line current after the foreign current has been spilled off the line. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.

LINE MATERIAL CO., So. Milwaukee, Wis. (See display adv. page 1278.)

Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.

Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."

SCHWEITZER & CONRAD, INC., 4431-39 Ravenswood Ave., Chicago, Ill. The S & C graded resistance arrester consists essentially of a horn gap and a number of resistance units enclosed in weather proof Bakelite tubes. They are all in one vertical plane, inserted one above the other in a round insulating column of Bakelite about 2½ ins. in diameter. They are connected in series by means of flat copper jumpers, and at the last or bottom unit, a connection is made direct to ground. Brass discs are provided at the end of each resistance rod to take the arc. These discs are so mounted that they may be adjusted to present a new



The S & C Type H Arrester

or clean surface at the points between the resistance units. They are provided at the lowest, or no resistance step, with sphere gaps, consisting of hemispheres 2½ ins. in diameter. The S & C type H arrester automatically adjusts its resistance to the capacity of the potential disturbance. With any potential rise on the lines the arc will start across the smallest gap, at which point all the resistance is in the circuit to ground. If the potential rise is of low energy capacity, the current flowing through this gap and on through the total resistance to ground, may be sufficient to keep the voltage down to approximately normal. If the current flowing through this gap and resistance is insufficient to keep the voltage down, the arc will then break across at the next lower resistance step and a larger current will flow through to ground. If this current is still insufficient to keep the voltage down to a safe value, then the arc will break across the next lower step until the step is reached where sufficient current will flow to dissipate the potential rise. At this point, the voltage will be reduced to its normal value and then the arc will tend to rise along the converging part of the horns, being driven upward by both the heated air current and by the electro-magnetic effect. Operating in the reverse manner to that outlined above, the resistance in the circuit then increases, and the strength of the arc is weakened accordingly until the diverging portion of the horns is reached, when it will rise still higher and lengthen until it breaks. The resistance is automatically cut into the circuit step by step without any moving parts, and the current is gradually cut down so that it will break easily and without any potential rise. The gap at the upper or high resistance step is smaller than the gap at the last or lower resistance step. This decrease in the length of the gap is gradual, and materially assists the arc to rise over the resistance portion of the arrester.—Adv.

Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.

Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. on pages 1395-1402.)

ARRESTERS, LIGHTNING, MAGNETIC BLOWOUT.—On d-c. lines, such as trolley circuits, the flow of power following a discharge of lightning may be stopped by the use of a solenoid so placed that the magnetic field is brought to bear on the arc, thus blowing it out. The blowout type of arrester has been used quite extensively for the protection of trolley lines.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. A magnetic blowout arrester which for average conditions will give the desired protection when placed on the cars and along the line at intervals of at least four per mile. Where lightning disturbances are especially severe, the use of a d-c. aluminum arrester is advisable. These are built to withstand the rigors of service on railway cars. They combine the advantages of a condenser and the safety-valve effect of the aluminum cell. Having no gap in series, the aluminum arrester operates upon the slightest rise in potential. (Bulletin 44712.) See adv. pages 1203-1223.—Adv.

Shaw Insulator Co., 5-7 Kirk Pl., Newark, N. J. "Multi-Vapo-Gap."

ARRESTERS, LIGHTNING, MISCELLANEOUS.—Various schemes other than those listed above have been devised for lightning protection which are rather limited in their application. Some of these use the compression principle, for instance, by having air in a sealed chamber expand due to the discharge, thus creating a sudden pressure at the air gaps; or by depending on the vaporization of a small part of the water in a tube, the steam pressure generated being used to drive the water out and open the circuit. Another arrester for use on d-c. lines consists of a condenser that is charged to normal voltage, but when any static surges appear the voltage is increased sufficiently to discharge to ground.

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Manufacturers:

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Garton-Daniels."

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

Electro Service Co., Marietta, Ga. ("Bennett" surge.)

GENERAL ELECTRIC CO., Schenectady, N. Y. In addition to the G-E arresters described elsewhere, there are two lines of limited but important use. One of these is for the protection of telephone circuits used near power distribution lines. Two types are made,—one a horn arrester, which is placed across the telephone circuits to keep down the voltage on the latter in case of a cross with the power line; the other is a combined fuse, switch and arrester, which provides a means for manually disconnecting the telephone circuit for inspection and repairs, for automatically disconnecting it in case of excessive foreign currents as might be caused by induction and an arrester for keeping the potential between lines, and between lines and ground to a low value during lightning disturbances. The other line consists of the by-pass arresters, which are used without connection to ground, across an inductive circuit as a current transformer or regulator coil, to by-pass a high frequency disturbance so that it will not damage the apparatus but will be passed on to where it can be discharged to ground through a lightning arrester. See adv. pages 1203-1223.—Adv.

Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."

Hall Switch & Signal Co., Garwood, N. J.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."

Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."

Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."

ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."

Southern Electrical Equipment Co., Charlotte, N. C.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. on pages 1395-1402.)

ARRESTERS, LIGHTNING, MULTIGAP.—On circuits operating at 10,000 volts or below, the lightning protection is usually obtained by the use of the necessary number of spark gaps in series with a suitable resistance. This general class is often called the multigap type. Some types have a single series circuit through the arrester and others have two or three paths in multiple. The multipath type provides better protection as it can be adjusted for the various kinds of discharge in the system. One type of gap arrester has a solenoid circuit opener which increases the resistance to the flow of line power to ground.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."

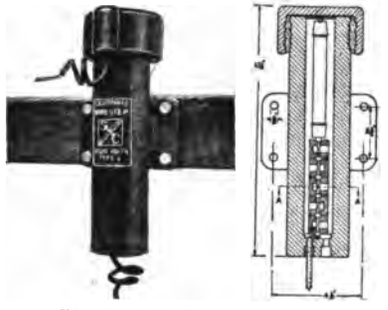
GENERAL ELECTRIC CO., Schenectady, N. Y. A Graded Shunt Resistance Multi-gap Arrester suitable for indoor or outdoor installation on circuits up to 15,000 volts. For installation in stations and substations and on feeders for the protection of motors and transformers, and on lines for protecting transformers. Essential feature is the metal cylinders, spaced with small air gap between them and connected between line and ground, which act as condensers and give arrester sensitiveness causing it to discharge at much lower voltage than would an arrester having only a single gap of length equal to sum of small gaps. (Bulletin 45603A.) The G-E Compression Chamber Multigap Arrester for the protection of distribution transformers is designed to meet the demands for an arrester which would give good protection and of such a cost that it could be placed at the terminals of even the smallest transformers. It consists of multi-gaps and resistances mounted in a porcelain tube. Its construction and the materials used are such that the arrester is not only light and compact, but also water-proof and fire-proof, features which make inspection unnecessary. (Bulletin 45603A.) See adv. pages 1203-1223.—Adv.



G-E Lightning Arresters

LINE MATERIAL CO., So. Milwaukee, Wis. (See display adv. page 1228.)

SCHWEITZER & CONRAD, INC., 4431-39 Ravenswood Ave., Chicago, Ill. The S & C Type "L" Multi Chamber lightning arrester is suitable for use on alternating current circuits not exceeding 3,000 volts to ground. It consists of a porcelain housing entirely closed at the upper end, and closed, with the exception of a small venting hole, at the lower end. Mounted inside of the housing is a resistance connected in series with a number of discharge gaps. Separate cylindrical chambers open at one end only are formed in blocks of insulating material of very high heat resisting qualities. The gaps are located in each of the chambers near the back or closed end. When a discharge passes through this arrester, the heated air back of each gap in the closed end of the respective chambers blows the arc out toward the open end. This blowout action is very effective in extinguishing the arc and rupturing the dynamic current, which tends to follow the high voltage discharge. The insulating blocks are so assembled that the chamber openings are diametrically opposite each other. This arrangement prevents bridging the gaps by the arc or arc vapor.—Adv.



The S. & C. Type L Arrester

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ARRESTERS, LIGHTNING, OXIDE FILM.—The necessity for frequent charging of electrolytic arresters led to the development of the oxide film type, in which the electrolytic medium is a pressed powder which does not freeze and requires no charging. This type of arrester is therefore desirable for use at unattended substations or large transformer installations which cannot be charged daily, except at great inconvenience and expense.

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E Oxide Film Arresters are in service in all parts of the United States, some since 1915. They are made for all a-c. circuits above 1,000 volts, and are suitable for use where the highest degree of protection is desired The insulation used is unusually high with respect to the maximum rating of the arresters. All iron or steel parts are either sherardized or galvanized. Sheet metal parts are painted in addition. The simplicity of design, ease of erection, inspection and repairs and the small space requirement are features of importance in arrester selection. (Bulletin Y-1441.) See adv. pages 1203-1223.—Adv.

ARRESTERS, LIGHTNING, TELEPHONE AND TELEGRAPH.—A device for diverting lightning and all high-potential current to ground instead of through the telephone or telegraph instruments. It usually consists of an air gap between two carbon blocks, although metal is sometimes used. Some arresters have the gap filled with a perforated or slotted sheet of thin mica, or in some cases one of the carbon blocks is recessed and filled with fusible metal, which melts and permanently grounds the line under heavy discharge. A recent development in the vacuum arrester, which consists of a spark gap situated in a partial vacuum or vacuum tube. This type has a number of advantages, such as wide gap, larger electrodes, absence of fusing and grounding, and sensitiveness to high-frequency discharges. A lightning arrester made of two or more metal plates whose adjacent edges are cut like a saw, called a saw-tooth arrester is rather widely used. These various types of arresters are also used on fire alarm, railway signaling and other signaling circuits. Also see Protectors, telephone.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Arrow Conductor & Mfg. Co., 1536 W. Adams St., Chicago, Ill. "Arrow."

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell," "Union." "Triangle."

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Chance Co., The, Centralia, Mo. "Sky-Rocket."

Cook Electric Co., 900-910 W. Van Buren St., Chicago, Ill. "Cook."

Cox Arrester Co., C. E., Eaton, Ohio.

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

Ericsson Mfg. Co., Buffalo, N. Y.

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.

Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "Argus."

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill.

Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."

Michigan Electric Specialty Co., Muskegon, Mich. "Vac-M."

Minnesota Electric Co., 309 2nd Ave., S., Minneapolis, Minn. "Chapman."

Monarch Telephone Mfg. Co., Fort Dodge, Iowa.

National Electric Specialty Co., The, Toledo, Ohio. "Vac-M."

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

ARRESTERS, SPARK, ARC LAMP, ETC.—When open arc lamps are used for interior lighting in places where readily inflammable material is in the vicinity, they are provided with spark arresters to prevent the escape of sparks or hot carbon or melted copper. These are very seldom used now, as the old open arc lamps are practically obsolete. Arc lamps used in such places now have electrodes completely enclosed in tight-fitting globe and spark arresters are then not required.

Manufacturers:

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C.G.E."

ARROLOCK.—Trade name for locking socket manufactured by the Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.

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ARROTYPE.—Trade name for plug fuses manufactured by the Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.

ARROW.—Trade name for bell-ringing transformers manufactured by the Air-Way Electric Appliance Corp., Toledo, Ohio.

ARROW.—Trade name for leather belting manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

ARROW.—Trade name for lightning arresters manufactured by the Arrow Conductor & Mfg. Co., 1536 W. Adams St., Chicago, Ill.

ARROW.—Trade name for wiring specialties manufactured by the Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.

ARROW.—Trade name for annunciators manufactured by Edwards & Co., Inc., 140th & Exterior Sts., New York, N. Y.

ARROW CONDUCTOR & MFG. CO.—1536 W. Adams St., Chicago, Ill. Manufacturer of lightning protective equipment. Business established 1908. President, R. C. Glanke; treasurer and general manager, A. A. Glanke.

ARROW ELECTRIC CO.—Hartford, Conn. Manufacturer of electrical wiring specialties. Business established 1908. President and treasurer, C. G. Perkins; vice-president and general manager, Edward R. Grier; secretary, B. C. Perkins; sales manager, H. C. Pond. Main office and factory, 103 Hawthorne St., Hartford, Conn. Branch offices and warehouses, 579 Howard St., San Francisco, Cal.; 297 Franklin St., Boston, Mass.; 560 W. Monroe St., Chicago, Ill. District offices, 253 Broadway, New York, N. Y.; Seitz Bldg., Syracuse, N. Y.; Chamber of Commerce Bldg., Pittsburgh, Pa.

ARROW FLEXIBLE CONDUIT CO.—210-12 Canal St., New York, N. Y. Manufacturer of flexible steel conduit and armored cable. Business established 1919. President and sales manager, Albert Rappaport; secretary and general manager, Henry Ginsburg; treasurer, Morris Janiger.

ARROW GRIP MFG. CO., INC.—Glens Falls, N. Y. Manufacturer of automobile and other jacks.

ARROW MACHINE CO.—4334 Hudson Blvd., West Hoboken, N. J. Manufacturer of incandescent lamp making machinery. Business established 1912. John Baach, proprietor. Branch office, Commercial Electric Lamp Engineering Co., 507 Hackensack Plank Rd., West Hoboken, N. J.

ARROW REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-3086 W. 106th St., Cleveland, Ohio.

ARSEM FURNACE.—A type of laboratory electric furnace specially devised for heating in a vacuum.

ART CRAFT FIXTURE CO.—85 Academy St., Newark, N. J. Manufacturer of lighting fixtures and portable lamps. Business established 1912. President and general manager, C. M. Hickman; vice-president, E. A. Walker; secretary, A. F. Schwarze; treasurer, F. J. Holmberg.

ART LAMP MFG. CO.—521 S. Wabash Ave., Chicago, Ill. Manufacturer of portable lamps, shades and torchiers. Sole owner, E. C. Ruttenberg.

ART METAL MFG. CO., THE.—Cleveland, Ohio. Manufacturer of lighting fixtures. President, W. E. Cochran. Main office and factory, Cleveland, Ohio. Branch offices, 88 Park Pl., New York, N. Y.; Pittsburgh, Pa.; 327 W. 2nd St., Los Angeles, Cal.; 1010 Garrick Bldg., Chicago, Ill.; 1614 Harvey St., Omaha, Neb.; Royal Bank Bldg., Toronto, Ont., Can.

ART METAL WORKS, THE.—Newark, N. J. Manufacturers of portable electric lamps. President, Louis V. Aronson; secretary, treasurer and general manager, Alexander Harris; sales manager, F. W. Osgood. Main office and factory, Aronson Sq., Newark, N. J. Branch offices, Palmer House, Chicago, Ill.; 698 Arcade Bldg., St. Louis, Mo.; 347 5th Ave., New York, N. Y. Sales representatives, C. F. Mallet, 46 Kearney St., San Francisco, Cal.; H. Gill, 323 Charles Bldg., Denver, Colo.

ART NOVELTY PRODUCTION CO.—1375 W. Grand Ave., Chicago, Ill. Manufacturer of lamp bases. John Domincall, sole owner.

ART SHADE CO.—224 N. Desplaines St., Chicago, Ill. Manufacturer of lamp shades and glass bowls. President and treasurer, E. P. Vanderwicken; secretary, B. Ross.

ART SPECIALTY CO.—805 S. 11th St., Philadelphia, Pa. Manufacturer of portable electric lamps.

ARTCRAFT METAL STAMPING CORP.—1022-24 Myrtle Ave., Brooklyn, N. Y. Manufacturer of lighting fixtures, sockets and lighting specialties. Business established 1919. President, David Shapiro; vice-president and general manager, Charles Thoma; secretary, Solomon Shapiro; treasurer and sales manager, Joseph Shapiro.

ARTFIBRE.—Trade name for lighting fixtures manufactured by Fibreduro, Inc., 396 Broadway, New York, N. Y.

ARTHUR & FOWLER CO.—119½ N. Browne St., Spokane, Wash. Manufacturer of electric heating devices and battery charging panels. Business established 1917. President and general manager, Guy Arthur; vice-president, P. L. Fowler; secretary, C. W. Rathbun; treasurer, C. S. Bennett. Sales representatives, Montana Electric Co., Butte, Mont., Great Falls, Mont.; Washington Electric Supply Co., Spokane, Wash.

ARTIFICIAL DAYLIGHTING CO., INC.—227 W. 17th St., New York, N. Y. Manufacturer of color identification and daylight lamps. Established 1916. President and general manager, Norman Macbeth; secretary and sales manager, H. G. Bailey.

ARTIFICIAL LINE.—In land line telegraphs, submarine cable working, composite telephony, and printing telegraph systems, where duplex operation is maintained, an artificial line is made a part of terminal apparatus. In resistance and capacity the artificial line is made to equal the same factors of the real line in use.

ARTISTIC BEAUTY.—Trade name for lighting fixtures manufactured by the Clinton Metal Lamp Co., 55 Chrystie St., New York, N. Y.

ARTISTIC LIGHTING FIXTURE CORP.—21-25 E. Houston St., New York, N. Y. Manufacturer of electric lighting fixtures. Business established 1916. President, treasurer and general manager, S. H. Shiminsky; secretary, J. Trichlinger.

ARTS ELECTRICAL CO.—25 Grand St., Troy, N. Y. Manufacturer of frosting compounds for lamps. Business established 1907. President and general manager, John L. Arts, Jr.

ASBESTO-METALLIC.—Trade name for friction blocks and clutch facings manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

ASBESTO-SPONGE.—Trade name for asbestos sheets manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

ASBESTOCEL.—Trade name for asbestos paper manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

ASBESTOL.—Trade name for linemen's leather gloves manufactured by the Eisendroth Glove Co., Armitage & Elston Aves., Chicago, Ill.

ASBESTOS.—Asbestos is a mineral fiber formed in incandescent rock at the time the earth's crust was formed. It is composed of hydrous silicate of magnesia. Acids and alkalies do not affect it and in its pure state, free from metallic oxides, it is a good electrical insulator, its resistivity being about 160,000 ohm-cm., and its disruptive voltage from 250 to 400 volts per mm. It is very difficult to find asbestos free from iron or other impurities and for this reason it is a better thermal insulator than electrical. Frequently it is mixed with other fibers or binding materials to increase its mechanical strength and to improve the insulation properties, and it is then fabricated into paper or sheets, boards, tape, cloth, etc. It is used as an insulation for wires and cables exposed to high temperatures. In the form of cloth it is used for gloves, garments, etc., used by furnace attendants, welders and other operatives that are compelled to work in the vicinity of dangerously high temperatures.

ASBESTOS BOARDS, LININGS, LUMBER, SHEET, ETC.—Due to their fire-resistive qualities these types of building material are made in the forms noted. In general they are composed of a mixture o asbestos fiber and Portland or other cement, and rolled under pressure into slabs and sheets varying in thickness from ¼ to 1 inch and of various sizes. It is used for lining cutout cabinets, panelboards, switch boxes and in other locations where resistance to fire is desired. This material can be worked with suitable tools and, if thin, even with ordinary tools.

Manufacturers:

American Insulation Co., Roberts Ave. and Stokley St., Philadelphia, Pa.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
Dagnall Asbestos & Insulation Co., 316 Lagauchetiere St., W., Montreal, Que., Canada.
Dominion Asbestos & Rubber Corp., 154 Naussau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Eastern Asbestos Co., 503 Turks Head Bldg., Providence, R. I. "Easco."
Franklin Mfg. Co., The, Franklin, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display advertisement on page 1251.)
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y. "Asbestocel" board, "Asbesto-Metallic," "Non-Burn" linings, "Vitribestos," "Fire-Felt," "Thermo Fire-Felt," "Vitro Fire-Felt," "Asbesto-Sponge" sheets, "Transite" wood.
Keasbey & Mattison Co., Ambler, Pa. "Ambler."
Kramig & Co., R. E., 8th St. and Eggleston Ave., Cincinnati, Ohio. "Coal Savers."
Mikesell Bros. Co., 156 N. La Salle St., Chicago, Ill. "Mibroco."
National Asbestos Mfg. Co., 163-193 Henderson St., Jersey City, N. J.
Standard Asbestos Co., 69 Beekman St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

ASBESTOS-COVERED WIRE. — See Wire, asbestos-covered.

ASBESTOS DIAPHRAGMS.—Asbestos is used as the base for many types of electrolytic diaphragms, as cloth, board in various forms, both plain and impregnated with powders and with melted surphur. Asbestos is particularly suited for a diaphragm material in alkaline solutions. (See Diaphragms.)

ASBESTOS FIBRE SPINNING CO.—North Wales, Pa. Manufacturer of asbestos cloth, tape, tubing and other insulating products. Business established 1899. President, Christopher Huber; vice-president and general manager, George Schafenacker, Jr.; secretary, treasurer and sales manager, W. H. Huber. Branch office, 1113 Chestnut St., Philadelphia, Pa.

ASBESTOS GLOVES, PAPER, WIRE.—See Gloves, asbestos; Paper, asbestos; Wire, asbestos-covered; Wire, magnet, asbestos-covered.

ASBESTOS PAPER.—See Paper, asbestos.

ASBESTOS TUBING, TWINE, YARN, ETC.—Asbestos is a fibrous mineral which in pure form resembles cotton. It is combed out and spun into loose strands and may then be woven into tape, twine, cord, yarn, sleeving, cloth, etc., or may be wound directly onto bare wire. In the woven forms it is employed more as a fireproof insulation than electrical. It is used frequently for protecting armature windings, and on arc-lamp, furnace and oven leads and heating-device cords. When wound directly on the wire it is first impregnated with a cement, which greatly increases its utility; in this form it is used extensively in certain electromagnet windings or any other place where high temperatures are encountered. (Also see Tape, asbestos.)

Manufacturers:

Advance Packing & Supply Co., 64 E. Lake St., Chicago, Ill.
American Asbestos Co., Norristown, Pa. (Tape, yarn.)
American Insulation Co., Roberts Ave. and Stokley St., Philadelphia, Pa.
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Asbestos Fibre Spinning Co., North Wales, Pa.
Atlantic Asbestos Co., Butler and Sepvira Sts., Philadelphia, Pa.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (Tubing.) (See display advertisement on page 1320.)
Dagnall Asbestos & Insulation Co., 316 Lagauchetiere St., W., Montreal, Que., Canada.
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT B., 7 S. 17th St., Philadelphia, Pa.
Eastern Asbestos Co., 503 Turks Head Bldg., Providence, R. I. "Easco."

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General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C. "Garco."
GENERAL ELECTRIC CO., Schenectady, N. Y., (See display adv. pages 1203-1223.)
Goetzke Gasket & Packing Co., Georges Rd., New Brunswick, N. J. (Packing and gaskets.) "Elastic."
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa. "Ambler."
Kramig & Co., R. E., 8th St. and Eggleston Ave., Cincinnati, Ohio.
Mikesell Bros. Co., 156 N. La Salle St., Chicago, Ill. "Mibroco."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
ROCKBESTOS PRODUCTS CORP., P.O. Drawer 1102, New Haven, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ASH HANDLING, POWER-PLANT.—Ash disposal, like coal handling, assumes many forms, depending upon the quantity of ash to be disposed of, the distance and elevation involved and the mode of receiving or delivering the ashes for final removal. Ashes are extremely corrosive as well as abrasive, so that apparatus with minimum moving parts exposed to the ash should be used.

The largest plants dump their ashes from the ash hoppers immediately beneath the boiler furnaces into railroad or ash cars hauled by machine or animal along a track laid below the boiler-room floor. The smaller plants, with up to 200 tons of ash per day, use ash conveyors of the steam jet, bucket and belt types and scrapers. Which type is the best depends upon the tonnage involved, station layout, etc.

Hand shoveling, hand car and wheelbarrow should be abolished on the score of cost almost everywhere and mechanical apparatus used instead. The steam jet and the hoist can almost invariably be used when the clamshell and other more bulky equipment is not feasible.

Many plants adopt mechanical stokers but fail to save labor costs by handling their coal and ashes mechanically. The mechanical coal and ash-handling equipments are the complement of the mechanical stoker.

ASHBROOK ELECTRIC CO.—4111 Ravenswood Ave., Chicago, Ill. Manufacturer of farm lighting and power plants, storage batteries and battery charging and battery repair shop equipment.

ASCHROFT MFG. CO.—New York, N. Y. Manufacturer of steam gages. Main office, 119 W. 40th St., New York, N. Y. Branch office, 27 N. Jefferson St., Chicago, Ill.

ASHCROFT PROCESS.—An electrolytic process for the production of metallic sodium. Fused salt is electrolyzed in one compartment with a carbon anode and a lead cathode, the fused lead-sodium alloy being led into a second compartment in which the alloy serves as anode in a bath of fused caustic soda. Metallic sodium is then deposited on an iron cathode, the deposition being much more efficient at the lower temperature of the fused caustic soda than if carried out directly from the fused salt, which is at a much higher temperature.

ASHEVILLE MICA CO.—Biltmore, N. C. Manufacturers of mica and mica products. Business established 1899. Partnership of W. Vance Brown and S. Herbert Brown. Main office and factory, Biltmore, N. C. Branch offices, 212 W. Austin Ave., Chicago, Ill.; 217 Centre St., New York, N. Y.

ASHTON MFG. CO.—184 Emmet St., Newark, N. J. Manufacturer of gasoline and kerosene torches and fire pots. Business established 1909. President, E. B. Kerr; vice-president, C. J. Kerr; secretary, treasurer and general manager, J. B. Kerr.

ASHTON VALVE CO.—Boston, Mass. Manufacturer of gages and valves. President, O. C. Keckley; vice-president, L. A. Urdan; secretary and treasurer, J. S. White. Main office, Boston, Mass. Branch offices, 137 Liberty St., New York, N. Y.; 318 W. Washington St., Chicago, Ill.; 503 Mission St., San Francisco, Cal.; St. Louis, Mo.; Milwaukee, Wis.

ASPHALT, INSULATING.—A natural pitch of bituminous character, composed of a mixture of hydrocarbons. Asphalt is generally black in color. At ordinary temperatures it is hard, but when heated it becomes viscous at about 70°C. and melts at about 100°C. It has a dielectric strength of about 1100 volts per mm. and is used in the manufacture of insulating varnishes and impregnating and sealing compounds, especially those for sealing cable joints and potheads, and storage and dry batteries. It is practically unaffected by water, ordinary acids or alkalies.

Manufacturers:

American Insulation Co., Roberts Ave. & Stokley St., Philadelphia, Pa.
Barber Asphalt Paving Co., The, Land Title Bldg., Philadelphia, Pa. "Genasco."
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
INTERNATIONAL PAINT CORP., 915 Olive St., St. Louis, Mo. "Inco Insulite." (See display advertisement on page 1320.)
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B."
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."

ASPHALTIC JAPAN.—(See Japans, asphaltic, etc.)

ASPIRATORS, ELECTRIC.—Electrically operated apparatus for creating a partial vacuum in chemical laboratory or other similar processes, or for producing a movement of gases or liquids by the suction principle, as with an exhaust fan.

ASSOCIATED ENGINEERS CO.—180 N. Dearborn St., Chicago, Ill. Manufacturer of lighting fixtures, cable racks, disconnect switches, soldering irons and controller release devices. President, W. L. Abbott; vice-president, C. A. Keller; secretary, H. A. Fife; treasurer, G. E. McKana.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES.—This is an association of corporations, firms or individuals actively engaged in the manufacture of electrical supplies or of electrical construction materials. It was organized in 1915 for the purpose of "advancing and protecting the interests of the manufacturers of electrical supplies and of the manufacturers of materials entering into electrical construction, in manufacturing, engineering, safety and other problems, to promote the standardization of electrical material, to collect and disseminate information and to promote co-operation among the members."

General matters affecting the Association policies and management are under the direct jurisdiction of the Board of Governors and officers, acting under advice of a general counsel. Effective work for the individual manufacturer is accomplished through the formation of sections, each section covering some particular and special line of devices embraced in the broad term "electrical supplies." Sections are subdivided into committees or groups, each of which is a complete organization in itself, thus enabling the individual manufacturer to take part in the particular line of work in which he is interested, and to suggest activities which may be considered.

The following sections have been organized: Air Circuit Breaker, Armored Conductor and Flexible Conduit, Attachment Plug, Carbon, Electrical Porcelain, Fan Motor, Fuse, Heating Appliance, Industrial Lighting, Insulating Materials, Interior Lighting Fixture, Knife Switch, Lamp Receptacle and Socket, Line Material, Molded or Formed Insulation, Nonmetallic Conduit, Metal Molding, Outlet Box, Panelboard and Switchboard, Rigid Conduit, Signaling Apparatus, Snap Switch, and Wire and Cable.

The Association has attained remarkable results in the line of standardization, with an immense saving to the manufacturers and a great convenience to the consumers. It has co-operated with the Underwriters' Laboratories in standardizing products and having them listed by the Underwriters. The Federal Trade Commission has been co-operated with in segregating statistical information as to the various products of the electrical industry, with a view to the adoption of the best business methods applicable to the requirements of each branch of the industry. The Association is a member of the Merchants Association of New York, the Chamber of Commerce of the United States, the Electrical Manufacturers' Council, and has a representative on the Electrical Committee of the National Fire Protection Association and therefore has a voice in preparing the National Electrical Code.

Many important subjects have been considered by the sections, to improve manufacturing, shipping, accounting, selling, collection and similar features of the business, also to determine the current and probable future demands and market conditions, etc.

General offices are in the Carbide and Carbon Bldg., 30 E. 42nd St., New York City. The officers for 1921-22 are: President, Shiras Morris, Hart & Hegeman Mfg. Co., Hartford, Conn.; vice president, W. H. Thornly; treasurer, J. W. Perry; general secretary, Charles E. Dustin.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—Organized in 1885. An association of central-station companies licensed under the Edison patents. The object of the association is "the development of the service to the public of electricity for light, heat and power and the promotion of co-operation among its members in dealing with the scientific, engineering and commercial problems involved." There are now 71 member companies, and 4 honorary members, the latter being the General Electric Co., Thomas A. Edison, R. R. Bowker, and Wilson S. Howell. The annual convention is usually held in September. The minutes of the meetings are distributed among member companies, but are not published. Officers for 1920-21 are: President, Walter H. Johnson; vice-president, M. S. Sloan; treasurer, E. A. Edkins; secretary, P. S. Miller, 80th St. and East End Ave., New York, N. Y.

The technical work of the Association is divided among the following committees: Lamp, Rates, Utilities Publications, Steam Turbines and Generators, Electricity Distribution and Use, Metering and Service Methods, Street Lighting, Standards, and Fuel.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS.—An international organization founded in 1907 for the "advancement of the application of electricity to the iron and steel and allied industry," and whose ultimate aim is the complete electrification of this industry. Its membership aggregates 1,200 and is composed of electrical engineers, electrical superintendents, chief engineers, combustion engineers and master mechanics (active members), and designers, manufacturers and distributors (associate members). Thirty-two of the largest steel companies in the United States, Canada and France are firm members. The Safety-First movement was originated within this organization and the National Safety Council was organized by this society in 1912. The Association was appointed as sponsor for the preparation of specifications covering overhead electric traveling cranes by the American Engineering Standards Committee.

Officers for 1920-21 are: President, B. W. Gilson, Carnegie Steel Co., Youngstown, Ohio; vice-presidents, E. S. Jefferies, Hamilton, Ont., Can., and F. A. Wiley, Chicago, Ill.; treasurer, James Farrington, Steubenville, Ohio; secretary, J. F. Kelly, Empire Bldg., Pittsburgh, Pa. The board of directors includes the above named officers, two past-presidents, D. M. Petty, and C. A. Menk, and four directors, W. S. Hall, R. F. Gale, J. E. Fries, and C. E. Bedell.

The Association has five active branches at Pittsburgh, Cleveland, Birmingham, Philadelphia and Chicago, each of which meets monthly. An annual meeting is held with all sections participating. Over 400 technical papers pertaining to the practical operation of steel-mill electrical apparatus have been presented before the various branches of this society. The most important committees of the Association are: Standardization, Electrical Development, Safety, Educational, and Electric Furnace. These committees collaborate all the data obtainable with regard to the advancement of the electrical art, presenting the information they have obtained in the form of a paper at the annual convention. An Association Journal is issued monthly, and the Proceedings are published yearly.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO.—President, O. H. Scott, Belleville, Ont., Can.; secretary, S. R. A. Clement, 190 University Ave., Toronto, Ont., Can.

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ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—A national organization, founded in 1908, for the advancement of knowledge pertaining to the principles, design, construction, maintenance and operation of railway electrical appliances, by discussion, investigation and reports of the experiences of its members, and to provide a means of exchange of ideas, to the end that railway electrical equipment may be systematized and improved. Its membership aggregates about 400 and consists of electrical engineers of steam railways as senior active members, subordinate employees of electrical departments as junior active members, and associate members representing the electrical industries dealing with steam railroads.

In the earlier days, the Association devoted its activities principally to the study of electric car lighting and later to the illumination of railway shops and buildings, standardization of electrical equipment, light and power as applied to steam railroads and power-plant organization and equipment. The officers for 1920-21 are: President, L. S. Billau, B. & O. R. R.; vice-presidents, L. C. Hensel, Frisco Lines, and E. S. M. Macnab, C. P. R. R.; secretary-treasurer, Jos. A. Andreucetti, Room 411, C. & N. W. Terminal Station, Chicago, Illinois.

ASSOCIATIONS AND SOCIETIES, ELECTRICAL.—The electrical industry is rich in its organizations, which have contributed very substantially to its rapid progress and expansion through the dissemination of knowledge, interchange of ideas and coordination of effort. There are over thirty national associations, societies and institutes among the various branches of the electrical industry in the United States and Canada. The two largest are the American Institute of Electrical Engineers and the National Electric Light Association. A sketch of each of these, and of some thirty other national organizations that are distinctively or predominantly electrical, will be found under the name of each organization. There is a larger number of state or geographic electrical associations which are entered under their respective names, together with the name and address of the secretary and in some cases also of other officers.

ASSURANCE, FACTOR OF.—The factor of assurance of a wire or cable insulation is the ratio of the voltage at which it is tested to that at which it is used.

ASTATIC INSTRUMENTS.—To eliminate the influence of external or stray magnetic fields, the movable elements of many electrical instruments are so constructed that the stray field tends to deflect one part of the movable element in one direction and an identical part in the opposite direction. The net deflection is zero. Such instruments are called astatic.

ASYNCHRONOUS.—Not having the same frequency—the opposite of synchronous. Sometimes used to describe alternating-current machines in which the frequency is fixed by outside conditions and the speed changes with load, voltage, etc., as in the case of induction motors. (Also see Synchronous.)

ASYNCHRONOUS MACHINE.—An a-c. generator or motor in which the ratio of the frequency to the speed changes with the load, as an induction generator or an induction motor.

AT LAST.—Trade name for electric washing machines manufactured by the At Last Washer Co., Perry, Iowa.

AT LAST WASHER CO.—Perry, Iowa. Manufacturer of electric washing machines. A. S. Kibby, manager.

ATERITE CO., INC.—New York, N. Y. Manufacturer of noncorrosive metallic alloy. President, James C. Smith; vice-presidents, Henry P. Hallock and Foster Milliken, Sr.; secretary, Henry S. Leach; treasurer, Charles E. Fox. Main office and factory, John and William Sts., New York, N. Y. Branch offices, Conway Bldg., Chicago, Ill.; Beatty Bldg., Houston, Tex.

ATHOL MACHINE CO.—Athol, Mass. Manufacturer of vises, pliers, levels and other electricians' tools. Business established 1868. President and treasurer, L. S. Starrett; vice-president, W. G. Nims; secretary, F. E. Wing; general manager, H. R. Linton. Main office and factory, Athol, Mass. Branch offices, 90 W. Broadway, New York, N. Y.; 17 N. Jefferson St., Chicago, Ill.

ATKINS & CO., E. C.—Indianapolis, Ind. Manufacturers of saws, tools, etc. Business established 1857. President, H. C. Atkins; vice-president and sales manager, N. A. Gladding; secretary, M. A. Potter; treasurer, F. C. Gardner. Main office, 402 S. Illinois St., Indianapolis, Ind. Factories Lancaster, N. Y.; Indianapolis, Ind.; Hamilton, Ont., Can. Branch offices and warehouses, 56 Reade St., New York, N. Y.; 64 E. South Water St., Chicago, Ill.; Atlanta, Ga.; Memphis, Tenn.; New Oleans, La.; Minneapolis, Minn.; San Francisco, Cal.; Portland, Ore.; Seattle, Wash.; Vancouver, B. C., Can.

ATLANTIC.—Trade name for electric trucks manufactured by the Atlantic Electric Vehicle Co., 893 Freylinghuysen Ave., Newark, N. J.

ATLANTIC.—Trade name for rubber belting manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pennsylvania.

ATLANTIC.—Trade name for electric water system pump manufactured by the Rumsey Pump Co., Ltd., Seneca Falls, N. Y.

ATLANTIC.—Trade name for leather belting manufactured by the Schwartz Belting Co., 74-76 Murray St., New York, New York.

ATLANTIC ASBESTOS CO.—Butler and Sepvira Sts., Philadelphia, Pa. Manufacturer of asbestos tape, tubing and other products. Business established 1916. President and general manager, H. V. Everham; secretary, F. P. Sher; treasurer, Clement Restrin.

ATLANTIC CLOCK CO.—45 India St., Boston, Mass. Manufacturer of electric clocks. Partnership, Fred S. Atkinson, James W. Gregg.

ATLANTIC CREOSOTING & WOOD PRESERVING WORKS.—Norfolk, Va. Producers of creosoted poles, crossarms and railway ties.

ATLANTIC ELECTRIC VEHICLE CO.—893 Freylinghuysen Ave., Newark, N. J. Manufacturer of electric trucks.

ATLANTIC INSULATED WIRE & CABLE CO.—52 Vanderbilt Ave., New York, N. Y. Manufacturer of insulated wire and cable. Business established 1902. President, Edward Sawyer; vice-president, E. H. Johnson; secretary, J. M. Woolsey; treasurer, C. A. Kane. Factory, Stamford, Conn. Sales representatives, Electrical Sales Co., 2 E. Redwood St., Baltimore, Md.; George Richards & Co., 557 W. Monroe St., Chicago, Ill.; A. D. Stein, 156 Purchase St., Boston, Mass.; T. C. Coleman & Son, Starks Bldg., Louisville, Ky.; W. A. McCombs & Co., Union Arcade Bldg., Pittsburgh, Pa.; Rank & Goodell, 906 Merchants Bank Bldg., St. Paul, Minn.

ATLANTIC TUBING CO.—1756 Cranston St., Providence, R. I. Manufacturer of conduit and cable connectors and rubber tubing. President and treasurer, Harry L. Lippitt; secretary and sales manager, J. G. Schonfarber.

ATLAS.—Trade name for storage batteries manufactured by the Atlas Electric Storage Battery Co., Greenville, Mich.

ATLAS.—Trade name for boiler covering cement manufactured by the Atlas Mineral Products Co., Mertztown, Pa.

ATLAS.—Trade name for rail joints and braces, tie plates, etc., manufactured by the Atlas Railway Supply Co., 1526 Manhattan Bldg., Chicago, Ill.

ATLAS.—Trade name for wet batteries manufactured by the Eastern Signal & Supply Co., 50 Church St., New York, N. Y.

ATLAS.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

ATLAS.—Trade name for rail grinder manufactured by the Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pennsylvania.

ATLAS.—Trade name for lubricants manufactured by the Swan & Finch Co., 522 5th Ave., New York, N. Y.

ATLAS BOLT & SCREW CO., THE.—1100-44 Ivanhoe Rd., Cleveland, Ohio. Manufacturer of bolts, screws and nuts.

ATLAS CAR & MFG. CO., THE.—Cleveland, Ohio. Manufacturer of storage battery locomotives, industrial cars and other industrial railway equipment. Main office, Cleveland, Ohio. Branch offices, Woolworth Bldg., New York, N. Y.; 529 Marquette Bldg., Chicago, Ill.

ATLAS ELECTRIC DEVICES CO.—360 W. Superior St., Chicago, Ill. Manufacturer of color testing outfits. President, John E. Thompson; vice-president, Renfrew H. Kuehmsted; secretary, Harold J. Zonne; treasurer, Clarence W. Jameson.

ATLAS ELECTRIC STORAGE BATTERY CO.—Greenville, Mich. Manufacturer of storage batteries for automobile lighting and starting. Business established 1918. President, H. G. Baker; vice-president and sales manager, Z. C. Bohrer; secretary, treasurer and general manager, H. P. Belknap.

ATLAS FOUR IN ONE.—Trade name for renewable multiple cartridge fuse manufactured by the Multiple Electric Products Co., Inc., 450 4th Ave., New York, N. Y.

ATLAS IRON, WIRE & GENERAL METAL WORKS.—815-817 Queen St., W., Toronto, Ont., Can. Manufacturers of motor-driven dishwashers, steel transmission line structures; wire guards, frames for lamp shades and other wire and metal products. Business established 1910. President, M. Daney; general manager, W. A. Marshall.

ATLAS MINERAL PRODUCTS CO.—Mertztown, Pa. Manufacturer of insulating compounds and protective paints. President, M. F. Wirtz; secretary and manager, George L. Wirtz. Main office, Mertztown, Pa. Factories, Mertztown, Pa., and Albany, Pa. Branch office, 127 N. Dearborn St., Chicago, Ill.

ATLAS POWDER CO.—Philadelphia, Pa. Manufacturer of electric blasting apparatus. President, W. J. Webster; vice-president, J. F. Van Lear; secretary and treasurer, Leland Lyon; general manager, W. A. Layfield; sales manager, J. W. Mathews. Branch offices, Oliver Bldg., Pittsburgh, Pa.; Arcade Bldg., St. Louis, Mo.; Holston National Bank Bldg., Knoxville, Tenn; Masonic Bldg., Houghton, Mich.; Joplin, Mo.

ATLAS RAILWAY SUPPLY CO.—1526 Manhattan Bldg., Chicago, Ill. Manufacturer of tie plates, rail joints and braces. G. M. Huber, manager.

ATMOSPHERE.—The whole mass of air surrounding the earth, or the gaseous envelope surrounding any celestial orb or other body. In physics, it is the pressure of the air at sea level used as a unit. It is the pressure that will cause the mercury in a barometer to stand at 760 mm. It is equivalent to about 14.7 lbs. per sq. in.

ATMOSPHERIC CONDITIONING CORP.—Philadelphia, Pa. Manufacturer of air conditioning apparatus. Business established 1917. President, John F. Hale; vice-president, Samuel C. Bloom; secretary and treasurer, H. A. Terrell. Main Office, 920 Lafayette Bldg., Philadelphia, Pa. Factory, Camden, N. J. Branch office, 1301 Monadnock Block, Chicago, Ill.

ATMOSPHERIC NITROGEN, FIXATION OF.—The electrical process of removing the nitrogen present in the atmosphere and utilizing it in the production of useful products. See Nitrogen, fixation of; also Birkeland-Eyde process; also Pauling process and Schoenherr-Hessberger process.

ATMOSPHERICS.—See Radio communication interference.

ATOMIC WEIGHT.—The relative weight of the atom of any element, referred to some element taken as a standard. Hydrogen was formerly used as this standard but most chemists now prefer to use oxygen as a basis, its atomic weight being 16.0.

ATTACHALL.—Trade name for heating device plug manufactured by the Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.

ATTACHMENT PLUGS.—See Plugs, attachment.

ATTACHMENTS, ELECTRIC, FOR GAS FIXTURES.—Attachments have sometimes been applied to gas fixtures which make it possible to light the gas by an electric spark rather than with a match. They consisted essentially of a spark gap which could be attached to any kind of a burner and connected by wires to a spark coil and battery. They are not used much now because of the very general use of electric lighting, which has replaced gas lighting to a large extent. (Also see Lighters, gas, electric.)

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y.

American Brass & Copper Co., 138 Lafayette St., New York, N. Y. "Leviton."

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Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "Glocator."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hole's Lighthouse, 6911 Jeffery Ave., Chicago, Ill.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

ATTACHMENTS, LOCKING, FOR SWITCHES.—Fittings designed to replace the knobs or handles of surface or flush type snap switches and provided with slots or holes of special form which are fitted by keys used only by authorized persons in operating the switches. They are used in public hallways, lobbies, waiting rooms, schools, asylums, etc., to prevent unauthorized persons from tampering with the lights where ordinary switches have been installed.

Heavy current-carrying disconnecting switches are often provided with locking attachments or "safety catches", magnetic locks, etc., to prevent opening on abnormal load.

Many motor and line switches are provided with padlocks or other locks to prevent anyone closing or opening them, especially when work is being done on the circuit controlled.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y., (See display adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.
Mendell Mfg. Co., Mattapoisett, Mass.

ATTACHMENTS, LUMINOUS, FOR SWITCH BUTTONS, ETC.—Luminous attachments for switches generally consist of a small, thin disk or button upon which a phosphorescent compound is spread. The button or disk is then applied to the switch button and usually protected by a glass or other transparent covering. At night a glow is given off by the compound which enables the switch to be found readily.

Manufacturers:

American Luminous Products Co., Huntington Park, Cal.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Cold Light Mfg. Co., 18th and Blake Sts., Denver, Colo.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Ingersoll & Bro., Robert H., 37 S. Wabash Ave., Chicago, Ill. "Ingersollite."
Leonard Watch Co., 10 S. Wabash Ave., Chicago, Ill. "Lumalite."
Lightfinder Sales Corp., Inc., 14 W. 17th St., New York, N. Y. "Litefinder."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
O'Hara Waltham Dial Co., Inc., Waltham, Mass. "Pointlite," "Pointswitch."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill. "Eradium Luminous."
Plaut & Co., L., 484 E. 23rd St., New York, N. Y.
Radium Luminous Material Corp., 58 Pine St., New York, N. Y. "Undark."
Smith & Co., T. C., 1531 Cherry St., Philadelphia, Pa. "Seelite."
Starlite Mfg. Co., 2 Columbus Circle, New York, N. Y. "Starlite."

ATTACHMENTS, OVERLOAD AND OTHER TRIPPING OR CLOSING, FOR SWITCHES AND CIRCUIT BREAKERS.—Most switches are not provided for automatic opening or closing, nor for remote control. Certain types of manually operated switches can be arranged for such automatic operation or remote control by the addition of special attachments. The most common is the overload attachment or tripping device, which converts the switch into an overload circuit breaker. Other attachments are undervoltage or novoltage; reverse current, power or phase; shunt trip, interlocking or special remote control; electromagnetic or motor-operated closing devices. Many of these attachments are controlled through relays. Similar attachments are also available for circuit breakers, in which, as a rule, they provide an additinal protective, interlocking or operating device.

Manufacturers:

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa.
Miller Anchor Co., 20 Monroe St., Norwalk, Ohio.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

ATTACHMENTS, PULL CHAIN.—These attachments are devices for extending the pull chain out from the socket, allowing it to hang free of the fixture so that it does not bear against glassware or metal reflector of large diameter and cause the glass or shade holder to be strainod when the cord is pulled. The devices used are mostly of two types: one is a brass tube fastened to the socket to act as a guide for the chain; another type has a long-armed lever, the pendent cord being fastened to the long arm and the socket chain to the short arm. The lever type also clamps to the socket. These devices prevent loosening of the glass or other reflector which may result in its falling; they also avoid shearing stresses that may crack the glass.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Cold Light Mfg. Co., 18th and Blake Sts., Denver, Colo.
GENERAL ELECTRIC CO., Schenectady, N. Y., (See display adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display advertisement on page 1327.)

ATTACHMENTS, SOCKET.—Some miscellaneous socket auxiliaries are made by manufacturers and listed merely as socket attachments; they are used largely on pull sockets. Among these are chain guides, extenders or lever attachments which extend out from the socket and beyond the reflector and permit the chain or cord to be pulled without rubbing against the reflector, globe or shade and causing it to swing; these are commonly called pull-chain attachments (see Attachments, pull chain). Other so-called attachments are made which permit a socket to be mounted on an oil lamp base; these are more properly called adapters. (See Adapters, lamp.)

Manufacturers:

Adsit Laboratories, The., 825 Hennepin Ave., Minneapolis, Minn.
American Enamel Co., Neville St., Providence, R. I.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Cold Light Mfg. Co., 18th and Blake Sts., Denver, Colo.
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)
Elbee Electric Sales Co., 180 N. Dearborn St., Chicago, Ill. "Mincer."
Faries Mfg. Co., Decatur, Ill.
GENERAL ELECTRIC CO., Schenectady N. Y., (See display adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn. "Economy."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Flexo."
Rittenhouse Co., A. E., Honeoye Falls, N. Y. "Easylite."
Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
United Electric Supply Co., Boston, Mass. "Straight Pull."

ATTACHMENTS, VACUUM CLEANER.—(See Vacuum cleaner attachments.)

ATTACHO.—Trade name for attachment plug manufactured by the Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio.

ATTENUATION.—The progressive weakening suffered by alternating current as it passes along a line which has resistance and capacitance, or resistance and leakage. It is worse in telephone cables. It affects some frequencies in telephone current more than others and this renders speech indistinct. It is corrected by "loading," which see.

ATWATER KENT.—Trade name for automobile lighting and ignition equipment manufactured by the Atwater Kent Mfg. Co., 4937 Stenton Ave., Philadelphia, Pa.

ATWOOD.—Trade name for electric vacuum cleaners manufactured by the Atwood Vacuum Machine Co., 128-130 N. Water St., Rockford, Ill.

ATWOOD VACUUM MACHINE CO.—128-130 N. Water St., Rockford, Ill. Manufacturer of electric vacuum cleaners. Business established 1909. President, J. T. Atwood; secretary and treasurer, Seth B. Atwood. Sales representative, Atwood-Stewart Vacuum Machine Co., Insurance Exchange Bldg., Chicago, Ill.

AT. WT.—Abbreviation for atomic weight.

AU.—Symbol for the element gold. It is derived from the Latin word "aurum", meaning gold.

AUBURN.—Trade name for spark plugs manufactured by the New York Mica & Mfg. Co., Auburn, N. Y.

AUBURN BALL BEARING CO.—28 Industrial St., Rochester, N. Y. Manufacturer of ball bearings. Business established 1893. F. A. Collins, Jr., sales manager.

AUBURN BUTTON WORKS, INC.—Auburn, N. Y. Manufacturer of Bakelite, Condensite and other molded insulation products. President, J. H. Woodruff; vice-president, C. H. Woodruff; secretary W. S. Ewll; treasurer, Douglas Woodruff. Main office and factory, 40-46 Washington St., Auburn, N. Y. Sales office, 19-25 E. 24th St., New York, N. Y.

AUBURN LEATHER GOODS CO.—Auburn, N. Y. Manufacturer of leather washers, felt gaskets, cushions, etc. F. G. Ten Eyck, sole owner.

AUDIBLE.—Trade name for desk stand telephones manufactured by the Audible Telephone Mfg. Co., 3037-39 N. Clark St., Chicago, Ill.

AUDIBLE TELEPHONE MFG. CO.—3037-39 N. Clark St., Chicago, Ill. Manufacturer of desk stand telephones. R. A. Cavanaugh, president.

AUDIFFREN-SINGRUN.—Trade name for motor-driven refrigerating machines manufactured by Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.

AUDION.—Trade name for electron tubes manufactured by the De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

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AUDIPHONES.—Term used by U. S. Patent Office for class of microphonic hearing devices used by deaf persons. (See Hearing devices for the deaf.)

AUDIOTRON MFG. CO.—35 Montgomery St., San Francisco, Cal. Manufacturer of amateur radio equipment. E. T. Cunningham, owner.

AUGERS, EARTH, POLE OR POST HOLE.—The excavation of pole holes is facilitated by the use of an auger where the soil conditions make it practical to use it. Hand power augers cannot be used for pole holes in a hard soil, such as clay, but in sandy loam they are found useful. For the smaller post holes for right-of-way fences they are nearly always serviceable. Pole-hole digging machines driven by suitable power are found economical in clay as well as sandy soil and are being adopted by companies having large numbers of poles to erect; for this type see Boring machines, earth.

Manufacturers:

Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Iwan Bros., South Bend, Ind.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Specialty Device Co., The, 106 W. 3rd St., Cincinnati, Ohio. "Standard."

AURAND.—Trade name for commutator slotters manufactured by the Green Equipment Corp., Monadnock Block, Chicago, Ill.

AURENE.—Trade name for glass shades manufactured by the Steuben Glass Works, Corning, N. Y.

AURISTOPHONE.—Trade name for hearing device for the deaf manufactured by the Evolution Phone Co., Inc., 48 Greenwich Ave., New York, N. Y.

AURORA.—Trade name for lubricating oils and greases manufactured by the Pigot, Sayre Co., 17 Battery Pl., New York, N. Y.

AURORA.—Trade name for electric blueprinting machines manufactured by Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

AURORA STEEL PRODUCTS CO.—Aurora, Ill. Manufacturer of steel cabinets and boxes for electrical purposes. President, A. Nelson; vice-president, P. R. Sparks; treasurer, A. R. Carlson; secretary, D. R. Furnas.

AURORALITE.—Trade name for electric flashing sign manufactured by the Smith-Hecht Co., Century Bldg., Indianapolis, Ind.

AUSTIN CO., THE M. B.—108-116 S. Desplaines St., Chicago, Ill. Manufacturer of conduit fittings and wiring devices. Business established 1894. President, Merritt B. Austin; secretary and treasurer, William A. Browne; sales manager, Arnold H. Friend. Sales representatives, S. B. Condit Jr. & Co., Boston, Mass.; V. C. Gilpin Co., 50 Columbia Heights, Brooklyn, N. Y.; W. A. Leiser & Co., 1607 Sansom St., Philadelphia, Pa.; H. C. Biglian, 41 Airlie St., Atlanta, Ga.; Wood & Lane Co., 915 Olive St., St. Louis, Mo.; Lloyd A. Woolley, 83 Ellicott St., Buffalo, N. Y.; C. B. Price, 584 Union Arcade, Pittsburgh, Pa.; Robert Thorne, 124 Commonwealth Ave., Detroit, Mich.; J. G. Pomeroy, 833 San Fernando Bldg., Los Angeles, Cal.; O. T. Jenkins, 414 Dallas County State Bank Bldg., Dallas, Tex.; George A. Gray Co., 589 Mission St., San Francisco, Cal.

AUTEX.—Trade name for automatic extension reels made by the Cincinnati Specialty Mfg. Co., Inc., 1907-21 Powers St., Cincinnati, Ohio.

AUTH ELECTRICAL SPECIALTY CO.—422 E. 53rd St., New York, N. Y. Manufacturer of low-tension signaling apparatus. Established 1916. President and treasurer, Charles Auth; vice-president and secretary, A. H. Stuhl; sales manager, John Smith.

AUTO BRASSFLEX.—Trade name for brass conduit for automobile wiring manufaotured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

AUTOCALL CO., THE.—Shelby, Ohio. Manufacturer of industrial fire alarm and special signaling systems. Business established 1907. President, W. W. Van Horn; vice-president and general manager, Howard Seltzer; secretary, C. C. Skiles; treasurer, Roy Van Wagner; sales manager J. H. Warden. Main office and factory, Shelby, Ohio. Branch offices, 39 Cortlandt St., New York, N. Y.; 417 S. Dearborn St., Chicago, Ill.; 505 Ellicott Sq., Buffalo, N. Y.; 1631 Real Estate Trust Bldg., Philadelphia, Pa.; Rose Bldg., Cleveland, Ohio; 502 Pontiac Bldg., St. Louis, Mo.; 320 Market St., San Francisco, Cal.; 6 Beacon St., Boston, Mass.

AUTO-CIRCULATOR.—Trade name for electric automobile heaters manufaotured by the Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash.

AU-TO COMPRESSOR CO., THE.—233 Mulberry St., Wilmington, Ohio. Manufacturer of automobile accessories. Business established 1905. President and general manager, J. W. Lawhead; vice-president, E. J. Hiatt; secretary, R. L. Owens; treasurer, M. R. Denver; sales manager, E. S. Lee, Jr.

AUTO-DALITE.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa.

AUTO FARM-LIGHT CO., INC., THE.—1002 Kentucky Ave., Indianapolis, Ind. Manufacturer of farm lighting plants.

AUTOFLAG.—Trade name for railway signals and alarms manufactured by the Bryant Zinc Co., 600 Orleans St., Chicago, Ill.

AUTO FLEXTUBE.—Trade name for nonmetallic conduit for automobile wiring manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

AUTO GEOPHONE.—Trade name for telephonic detectors for machinery noises, made by the Globe Phone Mfg. Co., Reading, Mass.

AUTO-GRILL.—Trade name for eleotric broiler for hotels, restaurants and soda fountains made by the H. G. Weeks Mfg. Co., Hamilton, Ohio.

AUTO-GUIDE.—Trade name for auto direction indicator manufactured by the Automatic Electrical Devices Co., 120-122 W. 3rd St., Cincinnati, Ohio.

AUTOITE.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., Philadelphia, Pa.

AUTOMAPHONE.—Trade name for automatic signaling magneto telephone manufactured by the Leich Electric Co., Genoa, Ill.

AUTOMATIC.—Trade name for eleotric washing machines manufactured by the Automatic Electric Washer Co., Inc., Newton, Iowa.

AUTOMATIC.—Trade name for electric arc welders manufactured by the Automatic Electrical Devices Co., 120-122 W. 3rd St., Cincinnati, Ohio.

AUTOMATIC.—Trade name for refrigerating machinery manufaotured by the Automatic Refrigerating Co., 618 Capitol Ave., Hartford, Conn.

AUTOMATIC.—Trade name for electric time stamps and registers manufactured by the Automatic Time Stamp Co., 160 Congress St., Boston, Mass.

AUTOMATIC.—Trade name for storage battery industrial trucks, tractors and engines manufactured by the Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.

AUTOMATIC.—Trade name for fire extinguishers manufactured by the G. W. Diener Mfg. Co., 400 Monticello Ave., Chicago, Ill.

AUTOMATIC.—Trade name for electrically operated phonographs manufactured by the Electric Phonograph Co., Kalamazoo, Mich.

AUTOMATIC.—Trade name for battery fillers manufaotured by the Luthy Products Corp., 1170 Broadway, New York, N. Y.

AUTOMATIC CARBONIC MACHINE CO.—308 N. Michigan Blvd., Chicago, Ill. Manufacturer of refrigerating and air conditioning apparatus. Business established 1919. President and general manager, Seymour Woolfner; vice-president, Ira Woolfner; secretary and treasurer, J. R. Foosman; sales manager, Major Hosberg. Factory, Peoria, Ill.

AUTOMATIC CONTROLLER & MFG. CO.—246 Washington Ave., Ogden, Utah. Manufacturer of electric spot welders. Business established 1917. President and general manager, Cleveland Redfield; vice-president, C. A. Redfield; secretary, M. S. Stone; treasurer, F. W. Redfield; sales manager, George E. Prine.

AUTOMATIC ELECTRIC CO.—Chicago, Ill. Manufacturer of automatic telephone equipment and signaling devices. Business established 1891. President, A. F. Adams; vice-presidents, H. L. Gary, H. A. Harris, A. E. Keith, Grant Pelton; secretary, W. I. Patton; treasurer, H. L. Gary; general manager, H. A. Harris; sales manager, C. E. Blomeyer. Main office and factory, 1001 W. Van Buren St., Chicago, Ill. Branch offices, Ft. Wayne, Ind.; Kansas City, Mo.; Detroit, Mich.; Pittsburgh, Pa.; Cleveland, Ohio; Rochester, N. Y.; Philadelphia, Pa.; Boston, Mass.; 21 E. 40th St., New York, N. Y. Sales representative, Direct Line Telephone Co., San Francisco, Cal.

AUTOMATIC ELECTRIC HEATER CO.—Warren, Pa. Manufacturer of electric controllers and heating devices. Business established 1920. President, R. M. Baily; vice-president, G. S. Milner; secretary and treasurer, J. P. Rogers; general manager, W. F. Clark.

AUTOMATIC ELECTRIC MFG. CO., THE.—126 E. Walnut St., Mankato, Minn. Manufacturer of remote control and time switches. Business established 1920. President and general manager, J. F. Krost; vice-president, R. J. Krost; secretary and treasurer, V. J. Steffey; sales manager, Ray Duchene. Sales representative, Daniel Fager, Cincinnati, Ohio.

AUTOMATIC ELECTRIC WASHER CO., INC.—Newton, Iowa. Manufacturer of electric washing machines. Business established 1908. President, H. L. Ogg; vice-president, John Nelson; secretary, H. E. Nelson; sales manager, H. M. Vaughan. Main office, Newton, Iowa. Branch office and warehouse, 1931½ Main St., Dallas, Tex.

AUTOMATIC ELECTRICAL DEVICES CO.—120-122 W. 3rd St., Cincinnati, Ohio. Manufacturer of farm lighting and power plants, controllers, cranes, rheostats, welders and battery charging equipment. Business established 1917. President, Clarence E. Ogden; vice-president and sales manager, Bertram Smith; secretary, Arthur H. Ewald; treasurer, W. H. Ewald; general manager, C. E. Ogden. Sales representatives, O. P. Smith Co., 205 W. Harrison St., Chicago, Ill.; Autolectric Devices Corp., 1966 Broadway, New York, N. Y.; Industrial Transportation Machinery Co., 1009 N. Broadway, St. Louis, Mo.; Robert Notvest, 4002 Permanent Bldg., Cleveland, Ohio; Powley & Townsley, Excelsior Life Bldg., Toronto, Ont., Can.; Transportation Engineering Corp., 200 5th Ave., New York, N. Y.

AUTOMATIC EVERCOLD.—Trade name for refrigerating apparatus manufactured by the Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill.

AUTOMATIC FUEL SAVING CO.—Philadelphia, Pa. Manufacturer of stokers, damper regulators and other boiler room equipment. Main office, 1061 Bulletin Bldg., Philadelphia, Pa. Branch offices, 350 Machinery Hall, Chicago, Ill.; Cleveland, Ohio.

AUTOMATIC FURNACE CO., THE.—Dayton, Ohio. Manufacturer of boiler furnaces, grates, steam engines and chain-grate stokers. President, O. D. Cotton; vice-president, E. J. Landor; secretary and treasurer, O. M. Cotton; general manager, H. M. Cotton. Main office and factory, 1st & Harshman Sts., Dayton, Ohio. Branch offices, 231 Insurance Exchange Bldg., Chicago, Ill.; 39 Cortlandt St., New York, N. Y.; 205 S. Robert St., St. Paul, Minn.

AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE.—Columbus, Ohio. Manufacturer of automatic circuit breakers, relays, switches and accessories therefor. Business established 1913. President, J. T. Wolfley; vice-president and general manager, A. R. Anderson; secretary, E. C. Raney; treasurer, O. M. Spielman; sales manager, C. M. Hickle. Branch office, 498 Union Arcade, Pittsburgh, Pa. Sales representatives, Ambler, Ott & Riter, Salt Lake City, Utah; Eicher & Bratt, Seattle, Wash.; W. D. Hamer Co., Indianapolis, Ind.; C. F. Anderson, San Francisco, Cal.; McClary-Jemison Machinery Co., Birmingham, Ala.; Mine Service Co., Hazard, Ky.; Minerallac Electric Co., 1045 Washington Blvd., Chicago, Ill.; J. B. Noros Co., Scranton, Pa.; J. P. Rockwood, 95 Liberty St., New York, N. Y.

AUTOMATIC REFRIGERATING CO., THE.—Hartford, Conn. Manufacturer of motor-driven refrigerating machinery. Business established 1905. President and treasurer, J. K. Hamilton, Jr.; secretary and general manager, M. F. Owens; sales manager, L. M. Church. Main office and factory, 618 Capitol Ave., Hartford, Conn.

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Branch offices, Atlanta, Ga.; Boston, Mass.; Cleveland, Ohio; Los Angeles, Cal.; Louisville, Ky.; New Orleans, La.; Rochester, N. Y.; San Francisco, Cal.; Seattle, Wash.; Washington, D. C.; 53 W. Jackson Blvd., Chicago, Ill.; 50 E. 42nd St., New York, N. Y. Sales representatives, Aumen Machinery Co., 107 E. Lombard St., Baltimore, Md.; Termant-Lovegrove Co., Union National Bank Bldg., Houston, Tex.

AUTOMATIC STRAIGHT AIR BRAKE CO.—210 11th Ave., New York, N. Y. Manufacturer of air brakes.

AUTOMATIC SWITCH CO.—154 Grand St., New York, N. Y. Manufacturer of controllers, starters, rheostats, switches, etc. Business established 1888. President and general manager, David H. Darrin; vice-president, C. E. Thornall; secretary and treasurer, F. W. Davey; sales manager, W. F. Hulburt.

AUTOMATIC TELEPHONES AND AUTOMATIC TELEPHONY.—See Telephones, automatic; Telephony, automatic.

AUTOMATIC TIME STAMP CO., THE.—Boston, Mass. Manufacturer of electric time stamps and recorders. Business established 1880. President, W. H. Stickney; treasurer, Clarence Blakely; manager, Frank D. Brannan. Main office, 160 Congress St., Boston, Mass. Branch offices, 108 Fulton St., New York, N. Y.; 74 W. Washington St., Chicago, Ill.

AUTOMATIC TRANSPORTATION CO.—2933 Main St., Buffalo, N. Y. Manufacturer of storage battery trucks, tractors and engines. Business established 1904. President, William C. Carr; vice-president and sales manager, Edgar L. Kleindinst; secretary and treasurer, Joel H. Prescott. Sales representatives, Bartlett Factory Equipment Co., Philadelphia, Pa.; Chadwick Bros. Co., Milwaukee, Wis.; A. B. Clark, San Francisco, Cal.; J. D. Collins, Atlanta, Ga.; J. C. Dolan, Denver, Colo.; Donahue Steel Products Co., Chicago, Ill.; E. S. Goodloe, Washington, D. C.; R. Craig Gordon, Minneapolis, Minn.; Gulf Motor Truck Co., New Orleans, La.; Haralson Sales Co., Inc., Birmingham, Ala.; Industrial Transportation Machinery Co., St. Louis, Mo.; L. H. Long, Boston, Mass.; McCreery Machine Co., Seattle, Wash.; W. H. Mims, New York, N. Y.; C. E. Ogden, Cincinnati, Ohio; Pittsburgh Mining Machine Co., Pittsburgh, Pa.; Powley & Townsley, Ltd., Toronto, Ont., Can.; Stimpson Equipment Co., Salt Lake City, Utah; Transportation Engineering Corp., New York, N. Y.; Sornborger & Goddsel, Buffalo, N. Y.; Wehle Equipment Co., Louisville, Ky.; Industrial Transportation Machinery Co., Kansas City, Mo.; Frank Z. Sherer & Co., Indianapolis, Ind.

AUTOMATIC TROLLEY GUARD CO.—61-69 Carroll St., Buffalo, N. Y. Manufacturer of trolley wheel guards. Partnership, H. R. Hoffeld and William Maier.

AUTOMOBILE ELECTRICAL ACCESSORIES.—See Coils, ignition or spark; Fuses, automobile; Generators, automobile lighting and starting; Generators, magneto, ignition; Headlights, electric, automobile; Heaters, electric, automobile; Ignition outfits, complete, for automobiles, etc.; Lamps, automobile; Plugs, spark; Signals, automobile; Sockets, automobile; Spotlights, automobile; Starters, automobile, electric; Switches, automobile; Telephones, automobile or limousine; Wire, automobile.

AUTOMOBILE IGNITION, LIGHTING AND STARTING WIRE.—See Wire, automobile ignition; Wire, automobile lighting and starting.

AUTOMOBILES, ELECTRIC.—These are more commonly called electric vehicles. See Vehicles, electric; also Trucks, electric.

AUTOPHONE.—Trade name for automatic private telephone system manufactured by the S. H. Couch Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

AUTO-PILER.—Trade name for electrically operated, self-propelled stacking machine made by the Brown Portable Conveying Machinery Co., 10 S. LaSalle St., Chicago, Ill.

AUTOREELITE.—Trade name for automobile spotlights manufactured by the Anderson Electric & Equipment Co., 154-160 Whiting St., Chicago, Ill.

AUTOSAN.—Trade name for electric dishwashing machine manufactured by the Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. Exclusive distributors, Couch & Dean, 1480 Broadway, New York, N. Y.

AUTOSTARTERS OR AUTOTRANSFORMER STARTERS.—An autotransformer starter is a motor starter having an autotransformer to furnish a reduced voltage for starting. The device includes the necessary switching mechanism, and is frequently called an autostarter or compensator. A two-coil transformer is used on two-phase circuits. On three-phase either a two-coil transformer connected open-delta or a three-coil transformer Y-connected is used. The starting voltage is usually 50% or 67% of line voltage. This type of starter is used in connection with squirrel-cage motors starting light. The current drawn from the line is less than the motor current, depending on the ratio of transformation of the transformer.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myles Sts., Hamilton, Ont., Can. "Westinghouse."

CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis. C-H Auto Transformer Starter, Bulletin 9141, is used for starting polyphase squirrel-cage motors. Both low-voltage and inverse-time-limit overload protection are provided. Standard starters are arranged to supply 65% of line voltage for starting, but two other taps are provided at 50 and 80% of line voltage for unusual load conditions. The commutating mechanism is oil-immersed at the bottom of the case below the transformers. This plan provides better cooling and makes examination and renewal of contacts much easier than other arrangements. The stationary contacts are standard drum type fingers. The moving contacts are simple pieces of copper which can be reversed to give double the usual amount of wear. The entire commutating mechanism is made of steel and no flexible moving leads are used. A double break is interposed in each motor line in the "off" position. The sliding contacts keep clean and smooth. The design of the starter insures a high head of oil over the contactors. Raising the hinged cover gives easy access to the transformers, the overload and low-voltage devices and the motor and line terminals. The handle may be locked in the "off" position. Remote control of stopping may be obtained by using a push-button type master switch in the low-voltage coil circuit. See display adv. pages 1225-1230.—Adv.



9141 Auto-Transformer or Compensator Starter

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

INDUSTRIAL CONTROLLER CO., Milwaukee, Wis. The I-C automatic compensator may be used wherever a hand operated auto starter or compensator is ordinarily employed. This automatic compensator can be mounted near the motor, or in any convenient location, and the small control wires carried down to a start and stop control station located at the most accessible point or points. Its outstanding features are (1) Safety to attendant, who operates only by push button. (2) Protection to the motor and machinery, as the correct time interval is automatically secured regardless of carelessness or incompetency. (3) The motor is started and stopped at the most convenient and efficient point or points. (4) It is economic to install, as there is a saving of material which often allows it to be installed as moderately as a hand compensator. Hand operated compensators can also be supplied for all purposes.—Adv.



Automatic Compensator

Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.

Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."

PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh." (See description under Transformers, medium voltage, miscellaneous.)

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

AUTO STEELFLEX.—Trade name for steel conduit and fittings for automobile wiring manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

AUTOTRANSFORMER.—This is a transformer with but one coil or winding, which performs the functions of both primary and secondary. When used to step the voltage down, the two ends of the coil are connected to the primary circuit. The number of turns of the coil included between the secondary terminals depends upon the voltage to be supplied or upon the ratio of transformation. Thus, if the ratio is 2 to 1, one-half of the turns will be included between the secondary terminals. In the part of the winding included in both primary and secondary circuits, the two currents are opposed. Thus the actual current here is the difference between the secondary and the primary amperes. The area of the conductors being determined by the current, there results a saving of copper which is large in the case of low transformation-ratios; one-half the copper is saved in the case of a 2 to 1 ratio.

Since the primary and the secondary circuits are combined, there may exist between a wire of the secondary system and the ground the full primary voltage. This fact, together with the lesser saving of copper, largely prevents the use of these transformers on systems transforming from a dangerous to a safe voltage, as for instance, from 1100 to 110 volts. An exception to this is the case of grounded circuits such as a-c. railways. Special uses of autotransformers are as balancing coils in obtaining three-wire systems from two-wire, and as autostarters for induction motors; they are also used as compensa-

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tors for both incandescent lamps and projecting arc lamps. Also see Autostarters, motor; Autotransformers, miscellaneous; Compensators, incandescent lamp; Compensators, projecting arc lamp.

AUTOTRANSFORMERS, MISCELLANEOUS.—Autotransformers are often applied for various miscellaneous purposes other than those mentioned above, one of the principal applications being as a boosting transformer. They are also used on lighting circuits to obtain 110-volt circuits from 220-volt or 440-volt supplies; a similar use is as so-called balance coils to secure three-wire distribution from two-wire 220-volt supply. Three-phase autotransformers are rather commonly used for interlinking two systems of different voltages. Single-phase and occasionally three-phase autotransformers are also used to produce a proper division of load between transformers operating in parallel which are of different makes and have unequal impedances.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B. & B."
Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Autotransformers for 50-140 cycle 220-110 volt service are made and carried in stock in sizes ranging from 1 to 15 kw. inclusive. Excepting the 15 kw. which is oil cooled, they are air cooled and all suitable for either indoor or outdoor installation. Special auto-transformers manufactured for all requirements. See adv. pages 1203-1223.—Adv.
International Devices Co., 326 Broadway, New York, N. Y.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Liberty Electric Corp., Port Chester, N. Y.
MOLONEY ELECTRIC CO., 7th & Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. "Westinghouse. See display adv. pages 1395-1402.

AUTOVENT.—Trade name for motor-driven ventilating fans manufactured by the Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill.

AUTOWATER SYSTEM.—Trade name for electric pumping system manufactured by the Goulds Mfg. Co., Seneca Falls, N. Y.

AVAILABLE OUTPUT.—The load which any electrical machine is capable of carrying for a specified time (or continuously) without exceeding in any respect its temperature rating. It is the general expression for the load capacity of electrical machinery.

AVERAGE VALUE.—The average value of an alternating current or e.m.f. is the arithmetical mean of the instantaneous values for half a cycle, or for a complete cycle if both halves are considered positive. For a simple sine-wave the average value equals 0.636 times the maximum value.

$I_{av}=0.636\ I_m$ and $E_{av}=0.636\ E_m$.

AVERAGES.—Averages may be divided into four principal classes: arithmetical, algebraic, true or weighted, and geometric. Each of these kinds of averages is much used in commercial and technical calculations. Unfortunately, many persons do not know the difference between these different kinds of averages and are likely to use the simple arithmetical average when they should use the weighted or in some cases algebraic and weighted average. The following explains the difference between these types of averages and the method of deriving each one.

Arithmetical. The arithmetical average is simply the mean value of a sum of comparable quantities, that is, the summation of the quantities divided by the number of quantities. Example: Find the mean or average wattage of five lamps on a circuit, these being, respectively, 40, 50, 60, 75 and 100 watts. Their sum is 325 and their average is 325÷5=65 watts.

Algebraic. The algebraic mean is the same as the arithmetic but takes into account the algebraic sign of the quantities. Example: To find the average temperature where six readings were taken, the readings being 10°, 5°, 1°, 0°, —1°, —3°. The mean is their algebraic or net sum (+12) divided by the number of readings (6) or a mean of +2°.

Weighted. The true or weighted average is a modification of the arithmetical average and is used where the mean of related quantities must be obtained but their relative weight or importance to the whole is not equal for each quantity. This is done by multiplying each quantity by its weight, finding the sum of the products, and dividing that sum by the sum of the weights. The quotient is the weighted average. Example: A central station divides its customers into four classes according to their monthly bills. To find the average income per customer per month when Class A (representing 2% of all customers) has an average bill of $6.00; Class B (10% of customers) with average bill of $4.50; Class C (50% of customers) with average bill of $2.50; Class D (38% of customers) with average bill of $1.00. The relative importance or weight of each class determined by its relative number is then:

Class	Relative Weight	Weighted Product
A	1	$ 6.00
B	5	22.50
C	25	62.50
D	19	19.00
Total	50	$110.00

Mean income per customer per month=$110÷50=$2.20, which is the weighted average.

Geometric. The problem in the case of an arithmetic mean is to find a uniform number, which, when substituted for each of the given numbers, leaves the total sum unchanged. The problem in finding the geometric mean is to find a number which, when substituted for each of the given numbers, leaves the product of all the numbers unchanged. Example: The average daily load of a generating station for each year from 1915 to 1920, expressed as a percent of that of the preceding year was as follows: (assuming 100% for the 1915 load): 105, 118, 109, 102, 115. The percent increase from 1915 to 1920 is obtained by multiplying together the five percents which is approximately 1.58. What uniform percent of increase year by year will give the same percent of increase of 1920 over 1915?

Let (1+r) be the constant multiplier or percent.

Then $(1+r)^5=(1.05\times1.18\times1.09\times1.02\times1.15)=1.58415$.

Then $(1+r)=\sqrt[5]{1.58415}$.

$=1.096$, the geometric mean.

Each of the unequal increases in the series may therefore be replaced by 109.6% and still give the same product. In computing geometric means for all but the simplest problems it will be necessary to use logarithms.

Root Mean Square. A special case of averages much used in electrical engineering is the root-mean-square value, commonly designated as the r.m.s. value of a current or e.m.f. This is a special case of averages combining the arithmetic and geometric principles. The r.m.s. value is found by squaring the individual values, finding the arithmetical average square and extracting the square root thereof. Also see Effective value.

Average Ordinate of a Curve. While this may be found by adding all of the various ordinates and dividing by their number, this is a very tedious process and is usually done very much more readily by finding the area of the curve within the limits considered and dividing this area by the abscissa or the length of the base of that portion of the curve. This gives the height of an equivalent rectangle and therefore the true average value of the ordinates.

AVERILL.—Trade name for insulating varnish manufactured by the California Paint Co., 11th, 12th & Pine Sts., Oakland, Cal.

AVIAPHONE.—Trade name for aviator's telephone manufactured by the Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.

AVOGADRO'S LAW.—A relation discovered by Avogadro in 1811, that the densities of gases at like pressures and temperatures are proportional to their molecular weights; whence is drawn the conclusion that equal volumes of gases contain equal numbers of molecules. This law is used in chemistry to determine the molecular weights of gases from observations of their densities.

A. W.—Trade name for current regulators manufactured by the Packard Electric Co., Warren, Ohio.

AWEBCO.—Trade name for electrical tapes and sleeving manufactured by the Anchor Webbing Co., 300 Brook St., Pawtucket, R. I.

A. W. G.—Abbreviation for American Wire Gage.

AXCESS.—Trade name for lighting fixtures manufactured by the Sampson Axcess System, Inc., 434 Union St., Lynn, Mass.

AXES, LINEMEN'S.—Linemen's axes are of two general forms, a chopping ax and a hand or broad ax. The chopping axes weigh from 4 to 6 lbs., while the hand axes are from 2 to 3 lbs., and make a cut from 4½ to 6 ins. wide. They are part of every lineman's equipment and are very useful in the construction of practically all overhead electric lines.

Manufacturers:

Black Co., Inc., John B., 43 W. 2nd St., Chester, Pa.
Warren Axe & Tool Co., Warren, Pa. "Sager," "Warren."
White Co., The L. & I. J., 143 Perry St., Buffalo, N. Y.

AXIOM.—Trade name for leather belting manufactured by the Schwartz Belting Co., 74-76 Murray St., New York, N. Y.

AXIS, NEUTRAL.—An axis of symmetry, commonly used to designate a straight line through the center of the shaft of a d-c. armature and perpendicular to it, and approximately perpendicular to the direction of the magnetic flux, about which the flux is symmetrically distributed.

AXIS OF COMMUTATION.—A line in a d-c. armature passing through the shaft at right angles to it and through the side of a coil in its midcommutating position. In d-c. machines without interpoles, the axis of commutation is often shifted from the neutral axis in the direction of rotation in generators and the opposite in motors for the purpose of placing the coil undergoing commutation in a commutating field.

AXLES, ELECTRIC CAR AND LOCOMOTIVE.—One of the principal parts of a truck on which the car wheels are mounted and which carries near its end and by means of the journal boxes the weight of the car or locomotive and transmits it through the wheels to the track. Wheels are almost universally mounted solidly on the axles and the latter turn in suitable bearings contained in the journal or oil boxes. Axles are universally of cylindrical cross section throughout and of varying diameter. Modern axles are forged and turned from the best grades of steel and frequently are heat-treated to better withstand the hard service to which they are subjected.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Laclede Steel Co., Arcade Bldg., St. Louis, Mo.
Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.
St. Louis Car Co., 8000 Broadway, St. Louis, Mo.
Standard Forgings Co., The, Railway Exchange Bldg., Chicago, Ill.

AXLES, ELECTRIC VEHICLE AND TRUCK.—This definition relates particularly to the driving axle which is generally the rear. An axle for an electric vehicle differs from that used on any other form of automobile principally in the means adopted to carry the motor or motors.

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The motor may be mounted on the body and the power transmitted to the axle by means of chains or propeller shafts, on a cradle attached to the axle, or it may be bolted directly to the axle housing and drive through a worm gear.

Where only one motor is used the power is transmitted through a chain to a sprocket attached to the differential or compensating gear, or through a bevel pinion meshing with the bevel "ring gear" mounted on the differential gear. Where two motors are used the power is generally transmitted through a chain from each motor to each driving wheel, the use of a differential then becoming unnecessary.

When the balanced drive is used the motor, differential and transmission members are all parts of the rear axle and wheel assembly. The motor shaft is parallel to the axle housing and the power is transmitted through drive shafts to floating pinions within each wheel, thence through intermediate spur gears, housed within disk wheels, which mesh with internal gear rings that form the interior of the wheel rims.

Manufacturers:

Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.

Laclede Steel Co., Arcade Bldg., St. Louis, Mo.

Standard Forgings Co., The, Railway Exchange Bldg., Chicago, Ill.

Walker Axle Co., 72 W. Adams St., Chicago, Ill.

AXLES, TROLLEY-WHEEL.—The axles on which trolley wheels run are mounted in the trolley harp. They are sometimes made of bronze as a solid axle and in many cases are made hollow with a few holes drilled in the surface and one in the end. This small cylinder is packed with grease and lubricates the bearing for about one week. To prevent pitting of the axles by heavy current passing through them special contact springs are provided which rub on the wheel and connect to the harp, thus shunting the axle.

Manufacturers:

East Hampton Bell Co., The, East Hampton, Conn.

B

B.—Symbol for magnetic flux density. Chemical symbol for the element boron. The small letter b is also the symbol for susceptance, whose unit is the mho. In illumination and photometry b is the symbol for brightness.

BABBITT METAL.—Babbitt metal is an alloy used for bearings in many electrical machines, such as motors, generators, converters and in fact all rotating machinery. It is made in a number of grades depending upon the proportion of the main constituents, which are tin, antimony, copper, lead and zinc. These are combined into two general classes which are called tin-base or lead-base metal having over 50% of tin or of lead.

Tin-base metals are divided into three classes, the first of which contains tin, antimony and copper. In these the tin varies from 83 to 91%, antimony from 4.5 to 8½% and copper from 3.7 to 8½%. Lead is sometimes added to give the second class of babbitts, which have a lower melting point. In these, the tin is over 50%, antimony not less than 12%, and copper not less than 3%. The third class is composed of tin, copper, and zinc.

Lead-base babbitts are also divided into three classes containing lead and antimony; lead, antimony and tin; and lead, antimony, tin and copper. The lead content in these may run as high as 90%.

Manufacturers:

American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal.

Bronze Metal Co., 30 Church St., New York, N. Y. "B. M. Co. Special."

Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.

Eagle Smelting & Refining Works, Ltd., 41-45 Prince St., Montreal, Que., Can.

Graham & Co., James, 293 Wooster St., New Haven, Conn.

Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa. "Lumeco Genuine," "Queen Bee."

Lumen Bearing Co., Buffalo, N. Y.

Magnolia Metal Co., 113-115 Bank St., New York, N. Y.

More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo. "Hoo Hoo."

Muzzy-Lyon Co., Detroit, Mich. "Duro," "Mogul."

National Lead Co., 111 Broadway, New York, N. Y. "Dutch Boy."

New Era Mfg. Co., 730 Cobb Ave., Kalamazoo, Mich.

North American Smelting Co., 9th & Thompson Sts., Philadelphia, Pa.

Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."

Pittsburgh White Metal Co., 3116 Penn Ave., Pittsburgh, Pa. "Rinehart."

BABCOCK & WILCOX CO., THE.—New York, N. Y. Manufacturer of water-tube boilers. Business established 1881. President, W. D. Hoxie; vice-president, A. G. Pratt; secretary, J. E. Eustis; treasurer, J. G. Ward. Main office, 85 Liberty St., New York, N. Y. Factories, Bayonne, N. J., and Barberton, Ohio. Branch offices, 49 Federal St., Boston, Mass.; North American Bldg., Philadelphia, Pa.; Farmers Deposit Bank Bldg., Pittsburgh, Pa.; Traction Bldg., Cincinnati, Ohio; Candler Bldg., Atlanta, Ga.; 533 Baronne St., New Orleans, La.; Southern Pacific Bldg., Houston, Tex.; Santa Rita Hotel Bldg., Tucson, Ariz.; Marquette Bldg., Chicago, Ill.; 435 17th St., Denver, Colo.; 705 Kearns Bldg., Salt Lake City, Utah; Mutual Life Bldg., Seattle, Wash.; Sheldon Bldg., San Francisco, Cal.; I. N. Van Nuys Bldg., Los Angeles, Cal.; Fort Worth, Tex.

BABCOCK PRINTING PRESS MFG. CO., THE.—New London, Conn. Manufacturer of motor-driven printing machinery. Business established 1882. President, James E. Bennet; secretary, Wilfred D. Wells; treasurer, Mrs. George P. Fenner; sales manager, Charles W. Britcher. Main office and factory, 38 Pequot Ave., New London, Conn. Branch office, 38 Park Row, New York, N. Y. Sales representatives, Barnhart Bros. & Spindler, 32 Throop St., Chicago, Ill.; Kansas City, Mo.; Washington, D. C.; Seattle, Wash.; St. Louis, Mo.; St. Paul, Minn.; Omaha, Neb.

BABSON.—Trade name for electric milk sterilizers manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

BABY.—Trade name for sign receptacle manufactured by the Solar Electric Co., 124 W. Lake St., Chicago, Ill.

BABY DENZAR.—Trade name for lighting unit manufactured by the Beardslee Chandelier Mfg. Co., 216 S. Jefferson St., Chicago, Ill.

BABY GRAND.—Trade name for toy motors manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

BABY HOGAN SILENT.—Trade name for high-frequency transformers manufactured by the McIntosh Battery & Optical Co., 217-223 N. Desplaines St., Chicago, Ill.

BABY INVINCIBLE.—Trade name for electric vacuum cleaners manufactured by the Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.

BABY LIGHT.—Trade name for portable lamp manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Missouri.

BABY REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-3086 W. 106th St., Cleveland, Ohio.

BABY SPOT.—Trade name for stage spotlight manufactured by the Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.

BABY VIOLETTA.—Trade name for electrotherapeutic violet-ray high-frequency apparatus manufactured by the Bleadon-Dun Co., 213 S. Peoria St., Chicago, Ill.

BABY VIXEN.—Trade name for automobile wrench manufactured by the Bonney Vise & Tool Works, Inc., Allentown, Pa.

BACHARACH INDUSTRIAL INSTRUMENT CO.—7000-6 Bennett St., Pittsburgh, Pa. Manufacturer of meters, indicators, etc. H. Bacharach, president. Sales representative, Herman H. Sticht & Co., 15 Park Row, New York, N. Y.

BACHELET MEDICAL APPLIANCE CO., INC.—32 E. Strand St., Kingston, N. Y. Manufacturer of electrotherapeutic apparatus. Business established 1919. President, John Schühle; vice-president, Schuyler C. Schultz; secretary, treasurer and general manager, Charles J. Dampf.

BACHELET WAVE.—Trade name for medical batteries manufactured by the Bachelet Medical Appliance Co., Inc., 32 E. Strand St., Kingston, N. Y.

BACK AMPERE-TURNS.—Part of the winding on the armature of a generator or motor sets up a magnetic field opposed to the main field set up by the field magnets. This back magnetic flux is measured or determined by the back ampere-turns. (See Armature reaction.)

BACK LASH.—The distance or space through which a piece of machinery, such as a screw, wheel, armature, piston, etc., may be moved without affecting the associated parts. It is applied to much electrical apparatus to measure of limit the looseness or play in a piece. In relays it is an important adjustment, and refers to the distance between the armature contact and the back contact, or the distance the armature may move without opening the back contact.

BACK PITCH.—A term used in armature winding referring to a left-handed pitch or progression of the armature winding as seen from the commutator end. It is also used in certain windings to designate any pitch or distance between slots on the end away from the commutator, as distinguished from the front pitch which may have a different value. (Also see Pitch, winding.)

BACK STOP.—A metal stop usually, on which a relay armature rests when the coils are not energized. It is also applied to certain keys such as a telegraph key, in which the key rests against the stop when released.

BACKING METAL, ELECTROTYPE.—A soft metal (practically the same as type metal) used to back up the thin copper shell of an electrotype. It serves to strengthen the shell and when placed on a wooden block builds it up to the standard thickness of printing types and engravings. (Also see Electrotype.)

BACO.—Trade name for track drills, foundry products, etc., manufactured by the Bird-Archer Co., 90 West St., New York, N. Y.

BACO ELECTRIC CO., THE.—Bode, Iowa. Manufacturer of electric soldering irons.

BACO SODERWAND.—Trade name for electric soldering iron manufactured by the Baco Electric Co., Bode, Iowa.

BACON FELT CO.—Winchester, Mass. Manufacturer of felt wicks for motors, etc. Business established 1825.

BACON VULCANIZER MFG. CO.—4065 Hollis St., Oakland, Cal. Manufacturer of electric vulcanizers and heating devices. Business established 1908. President and general manager, Thomas P. Bacon; sales manager, W. E. Dugdell.

BADENHAUSEN, PHILLIPS.—1425 Chestnut St., Philadelphia, Pa. Manufacturer of water-tube boilers and superheaters.

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BADGER.—Trade name for air washers, cooling ponds and expansion joints manufactured by E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass.

BADGER & SONS CO., E. B.—Boston, Mass. Manufacturer of expansion joints, air washers and cooling ponds. Business established 1841. President, Daniel B. Badger; secretary, J. W. Spring; treasurer, Arthur C. Badger; general manager, Erastus B. Badger; sales manager, Harold W. Coombs. Main office and factory, 75 Pitts St., Boston, Mass. Branch offices, 101 Park Ave., New York, N. Y.; 616 S. Michigan Ave., Chicago, Ill.

BADGER MALLEABLE & MFG. CO.—South Milwaukee, Wis. Manufacturer of malleable iron castings. President and manager, A. J. Ricker; secretary and treasurer, H. M. Lewis.

BAEHKER, F.—2531 Milwaukee Ave., Chicago, Ill. Manufacturer of lighting fixtures. Proprietor, F. Baehker.

BAEKELAND, LEO HENDRIX.—An American chemist, electrochemist and inventor, born at Ghent, Belgium, 1863. He graduated from the University of Ghent in 1882. Later he studied electrochemistry at the Polytechnicum, Charlottenburg, Germany. He taught for several years at the University of Ghent and at the Normal School of Science of Bruges. He came to the United States in 1889 and in 1893 founded the Nepera Chemical Co. for the manufacture of photographic papers. One of these was "Velox," which Dr. Baekeland perfected and afterwards sold to the Eastman Kodak Co. He then turned his attention to electrochemistry and organic chemistry. His best known invention is what has come to be known as Bakelite, a chemical synthetic compound formed from carbolic acid and formaldehyde, which is widely used as a molded electrical insulator and as a substitute for hard rubber and amber. He has also patented many inventions on the subject of organic chemistry, electrical insulations, synthetic resins, plastics, lacquers and varnishes. Dr. Baekeland, as consulting chemist, assisted in the development of the Townsend electrolytic cell for the Hooker Electrochemical Co. of Niagara Falls, N. Y., in 1903. He received the Nicholls medal in 1909 and the Willard Gibbs medal in 1913 from the American Chemical Society. In 1910 he was awarded the John Scott medal by the Franklin Institute; in 1914 the Chandler medal (first award) by Columbia University, and in 1916 the Perkin medal for industrial chemical research by the affiliated Chemical and Electrochemical societies. He was president of the American Electrochemical Society in 1909; president of the American Institute of Chemical Engineers in 1912; president of the Section of Plastics, International Congress of Applied Chemistry, New York, in 1912, and president of the Inventors' Guild in 1914.

BAETZ BROS. SPECIALTY CO., LTD.—21 Gaukel St., Kitchener, Ont., Can. Manufacturer of portable electric lamps and lamp shades. President, C. J. Baetz; vice-president and treasurer, J. H. Baetz; secretary, W. J. Fleischauer.

BAFFLES.—Baffles are plates or walls made of steel, common brick or fire brick, used to deflect, alter and control the course of gases, etc. They are used in a furnace and as a part of boiler settings, and are designed so that the hot gases have a course around the boiler tubes of such length that the maximum amount of heat is taken from them before they pass on to the stack or chimney.

BAGS. ELECTRICIANS' AND LINEMEN'S TOOL.—These are usually strong canvas or duck bags used by linemen and electricians for carrying their tools. They are very seldom made entirely of leather, but are nearly always reinforced on the bottom and sides with sole leather or bag leather, and provided with steel studs. Steel frames are used at the top and the canvas is clinched between the frame and an interior piece or is riveted to the frame. Leather carrying handles are provided and sometimes reinforcing straps passing completely around the bag are added.

Manufacturers:

BUHRKE CO., THE R. H., 1240 Fullerton Ave., Chicago, Ill. Buhrke tool bag, shown in cut below, is made in lengths from 12 to 24 ins. It has double steel frame riveted to body of bag, steel studs in bottom, and is sewed on lockstitch machines. It is made of one-piece No. 6 (24 oz.) white duck, reinforced for 3½ ins. from bottom by



Buhrke White Duck Tool Bag

heavy bag leather, also in one piece. Can be furnished with socket for padlock or with shoulder straps. The all leather bag shown below is made of first grade harness leather. As can be seen from cut, the bag is sewed from the outside with lock stitch waxed



Buhrke All Leather Tool Bag

linen thread without a leather welt. It is made in lengths from 14 to 24 ins. by 7 by 8 ins. Buhrke Co. also manufacture bags of all descriptions made to customers' specifications.—Adv.

Fulton Bag & Cotton Mills, Atlanta, Ga.

Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa.

Industrial Products Co., 1001 Chestnut St., Philadelphia, Pa. (Collapsible canvas bucket). "Ipco."

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill., manufacturers of inspectors' black leather tool bags, made of heavy oak-tanned harness leather, stitched with waxed linen thread. Bottom, three-ply and studded with steel studs, arranged with shoulder straps and retaining straps that pass clear around the bag. We also manufacture linemen's canvas tool bags with heavy leather bottom, stitched with waxed linen thread, steel frame and leather handles. Write for complete catalog covering construction tools for further information about this and other Klein products. See also adv. Page 1259.—Adv.

BAGS, LAMP TRIMMERS'.—Lamp trimmers' bags are little used at present because of the decrease in the use of arc lamps. The arcs still widely used for street lighting are magnetite lamps and they require less trimming than the carbon arcs. Lamp trimmers carry an oval-shaped or rectangular bag made of heavy harness leather provided with a shoulder strap, in which extra carbons or magnetite electrodes are kept. Street lamp tenders now carry chiefly cleaning equipment and this is usually kept in a wagon or automobile, together with some globes and extra lamps to replace broken or burned out units.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa.

BAILEY CO., GEORGE D.—4505 Ravenswood Ave., Chicago, Ill. Manufacturer of roller bearings. President, George D. Bailey; vice-president, C. F. Ferguson; secretary and treasurer, E. H. Ferguson.

BAILEY MFG. CO., THE.—Union City, Ind. Manufacturer of adjustable magneto couplings. Business established 1920. President, P. I. Turner; vice-president, H. D. Willcutts; secretary, treasurer and general manager, W. E. Price.

BAILEY METER CO.—2015 E. 46th St., Cleveland, Ohio. Manufacturer of boiler-room and other power plant instruments and meters. President, E. G. Bailey; treasurer, R. S. Coffin.

BAILEY-REYNOLDS CHANDELIER CO., THE.—913-915 Grand Ave., Kansas City, Mo. Manufacturer of electric lighting fixtures. Business established 1903. President, J. S. Bailey; vice-president, Carrie W. Reynolds; secretary and treasurer, J. D. Reynolds.

BAILY.—Trade name for electric furnaces made by the Electric Furnace Co., Alliance, Ohio.

BAIN, ALEXANDER.—A Scottish electrician and inventor; born 1810, died 1877. His name is chiefly associated with an automatic chemical telegraph, which was tried out in the United States about 1850. He also perfected several other inventions, among which were electrically operated clocks, and ship's progress recorders.

BAIRD MACHINE CO., THE.—Bridgeport, Conn. Manufacturer of machines for making electrical parts. Business established 1870. President, treasurer and general manager, C. L. Warner; vice-president, A. J. Lewis; secretary, B. C. Warner; sales manager, Albert Pott.

BAIRD MOTION PICTURE MACHINE CO.—24 E. 23rd St., New York, N. Y. Manufacturer of motor-driven motion-picture machines.

BAJOHR LIGHTNING CONDUCTOR CO., CARL.—4055 Keokuk St., St. Louis, Mo. Manufacturer of lightning conductors. Business established 1883. President, general manager and sales manager, William Bajohr; vice-president, Anna J. Bajohr; secretary and treasurer, Clara T. Bajohr.

BAKELITE.—Trade name for insulating material manufactured by the General Bakelite Co., 2 Rector St., New York, N. Y.

BAKELITE AND BAKELITE PRODUCTS.—Bakelite is a synthetic condensation product of phenol invented by Dr. L. H. Baekeland. It was one of the first of the chemically produced or artificial insulating compounds and is typical of those that have been produced since. In its final state it is a hard, nonresinous, infusible solid resembling hard rubber or amber. It is colored by organic dyes or mineral pigments and may be made red, black, yellow, brown, colorless and transparent, or opaque. The material is sold in dissolved, liquid or solid condition, and may be used for lacquer or varnishes, enamel, impregnation, adhesive cement, molding compositions and molded articles. It can be molded into almost any shape by casting, or forming in a hot press and will hold metal inserts securely. When in its final state it can be machined, finished and worked with about the same ease as hard rubber or amber. Bakelite is not hygroscopic and is not affected by steam, hot water and many acids, but will not withstand strong alkaline solutions, hot sulphuric acid, nitric acid, or bromine. Its dielectric strength alone is 22,000 volts per mm. and in combination with other products is as high as 44,500 volts per mm. Bakelite products comprise a very extensive line. Bakelite is used as a base for varnishes, enamels, lacquers and cements, all of which are highly dielectric and are used as coverings for metal parts or in the case of cements for bonding glass, metal, porcelain, etc. Molded products may be very accurately formed from Bakelite and it is commonly used for small insulating parts, ignition system parts, telephone transmitters, and receivers, terminal blocks, caps, buttons, tubes, rods and many other parts. It is also used for molding commutators and for impregnating armature or other windings.

Manufacturers:

Alden-Napier Co., 54 Willow St., Springeld, Mass. "Na-ald."

Auburn Button Works, Inc., 40-46 Washington St., Auburn, N. Y.

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

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Boonton Rubber Mfg. Co., Boonton, N. J.
Braun Gear Works, 1321-25 Gates Ave., Brooklyn, N. Y.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Chelsea Radio Co., 15 5th St., Chelsea, Mass.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display advertisement on page 1320.)
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
General Bakelite Co., 2 Rector St., New York, N. Y. "Bakelite."
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Hall Switch & Signal Co., Garwood, N. J.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Mack Molding Co., Little Falls, N. J.
Nagel Electric Co., The W. G., 28-32 St. Clair St., Toledo, Ohio.
Parkin Mfg. Co., San Rafael, Cal.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See adv. pages 1395-1402.)

BAKELITE-DILECTO.—Trade name for molded insulation manufactured by the Continental Fibre Co., Newark, Del.

BAKELITE-MICARTA.—A trade name for an insulating material sometimes called Bakelized paper. It is made in various grades in plates, tubes, rods, etc. It is a hard, homogeneous material considerably stronger than hard fiber, cannot be molded and can be punched only in thin sheets, but can be drilled, tapped, and otherwise worked with sharp tools. It withstands temperatures of 150°C. continuously, and for short periods will withstand 260°C. Its resistivity is about 2.13×10^{13} ohm-cm., and its dielectric strength about 19,500 to 39,000 volts per mm. It is nonhygroscopic and insoluble in weak acids and alkalies, hot water and oils.

BAKELITE MOLDING MACHINES.—See Molding machines, insulation.

BAKER & CO., INC.—Newark, N. J. Refiners and workers of platinum, gold and silver for chemical, electrical and other technical uses. President, Charles W. Baker, vice-president, C. B. Mitchell; secretary and treasurer, Charles Engelhard; sales manager, Alvin M. Williams. Main office, 54 Austin St., Newark, N. J. Branch offices and warehouses, 30 Church St., New York City and 5 S. Wabash Ave., Chicago, Ill.

BAKER R & L CO., THE.—Cleveland, Ohio. Manufacturer of electric cranes, hoists, industrial trucks and tractors. Business established 1915. President, F. W. Treadway; vice-president and general manager, E. J. Bartlett; vice-president, E. J. Stahl; secretary, W. P. Southard; treasurer, W. C. Fischer; sales manager, M. A. Watterson. Main office and factory, Cleveland, Ohio. Branch office, 17 Central Park West, New York, N. Y.

BAKERS, HOT PACKS AND OTHER BODY-HEATING APPARATUS. — Electrically heated apparatus made in special forms to be adapted to various parts of the human body and to permit an application of heat without affecting adjacent parts. The heating is accomplished by metallic heating elements enclosed in a protecting chamber or insulating medium, or by the use of a number of special incandescent lamps. These frequently take the form of a solid or adjustable arch which may be placed over the body. Some bakers, especially those having metallic heating elements, are made in cylindrical form resembling an electric muffle oven and are used to enclose an arm, leg, etc., for treatment. Also see Baths, electric light.

Manufacturers:

BURDICK CABINET CO., Milton, Wis. "Radio-Vitant."
Edmands, Walter S., 21-27 Pearl St., Boston, Mass.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Pelton," "Radio."
Sanitarium Equipment Co., Battle Creek, Mich. "Universal Radiantor."
Solidarch Electric Hotpack Co., 1225 Cottman St., Fox Chase, Philadelphia.

BAKING, ELECTRIC.—See Cooking (cookery), electric; Ovens, electric, bake, hotel, restaurant, etc.; Ovens, electric, baking and roasting, portable.

BALANCE-FACTOR.—The balance-factor of a polyphase system is the ratio of the minimum value to the maximum value of power in the power pulsation due to an unbalanced load. Its maximum value is 1.

BALANCED CIRCUITS.—This term is applied to three-wire d-c. and single-phase circuits and to any polyphase circuits. When applied to three-wire circuits it means that both sides are loaded equally. When the branches of polyphase systems are equally loaded, they are also balanced. When this condition is attained, the total power of the system is constant. Hence, constant power is the characteristic of a balanced polyphase system. Also see Unbalanced circuits.

BALANCER SETS.—Commonly two identical d-c. machines which serve primarily to maintain approximately equal voltages between the outside wires and the neutral of a three-wire distributing system when the corresponding loads are unequal and the system is supplied by two-wire generators. The armatures of a balancer set are coupled together mechanically and connected in series electrically between the armatures. A lighter load on one side of the system tends to raise the voltage on that side, and the part of the balancer set on the same side functions as a motor and drives the other part as a generator. Power is thus transferred from the more lightly to the more heavily loaded side, tending to equalize the total loading and maintain approximately equal voltages.

Balancer sets may be used in systems having more than three wires, in which case the number of machines coupled together is one less than the number of wires, but such systems are quite rare.

Balancer sets are not needed when a three-wire system is supplied by a three-wire generator or by two generators in series or by a synchronous converter, if, in this latter case, the neutral of the three-wire system is connected to the neutral of the transformers supplying the converter.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Sets made in standard sizes ranging from 28 to 4,000 amp. Machines are rated by current carried in the neutral and not by the per cent. of unbalancing or kw. capacity. By compounding the machine it is possible to equalize the voltages on both sides within 2 per cent, even under conditions of maximum unbalancing. (Bulletin 42552A). See adv. pages 1203-1223.—Adv.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BALANCES, CHEMICAL AND OTHER LABORATORY.—These are very sensitive balances used in chemical, electrochemical and other laboratories for routine and commercial testing, for assay work, etc., and also in school and college laboratories. They are very accurately constructed and consist essentially of a structural beam supported on an agate knife edge, with an indicating pointer swinging over a scale. A glass case encloses the balance to exclude air currents. The weights are placed in a pan suspended from one end of the beam and the material to be weighed in the other pan. The final adjustment is by means of a rider that is moved along the beam. Balances of this form are made with sensitivities as high as 0.01 milligram.

Manufacturers:

Bausch & Lomb Optical Co., Rochester, N. Y.
Eimer & Amend, 211 3rd Ave., New York, N. Y.
Heil Chemical Co., Henry, St. Louis, Mo.
Thompson Balance Co., Denver, Colo.
Torsion Balance Co., 92 Reade St., New York, N. Y. "Torsion."
Troemner, Henry, 911 Arch St., Philadelphia, Pa.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.

BALATA.—A gum found in Venezuela, which is quite similar to gutta-percha. It is used somewhat for insulating purposes. See Gutta-percha; also rubber.

BALATA.—Trade name for rubber-covered wires and cables manufactured by the Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y.

BALBACH-THUM PROCESS.—A modification of the Moebius process, which see, for parting gold and silver electrolytically, yielding pure silver and slimes from which the gold is readily recovered. In the Balbach-Thum method the cathodes are slabs lying on the bottom of shallow glazed-earthenware tanks. The anodes of dore bullion or similar material rest in canvas trays, in the electrolyte near the surface and are left in until entirely consumed, new ones being added to keep up the anode surface. The canvas retains the gold slimes, while the silver goes into solution and is deposited on the cathodes in the form of nonadherent crystals of pure silver, which are scooped out every few hours, melted and cast into bars.

BALCH ROENTGENOSCOPIC SCREEN CO.—Salem, Mass. Manufacturer of x-ray fluoroscopes.

BALDOR ELECTRIC CO.—4351-55 Duncan Ave., St. Louis, Mo. Manufacturer of repulsion-induction motors. Business established 1920. President and general manager, E. Ballman; vice-president, J. F. Gerleman; secretary and sales manager, O. A. Baumann; treasurer, E. Doerr.

BALDWIN.—Trade name for cash and parcel carrier systems manufactured by the James L. Baldwin & Co., 358 W. Madison St., Chicago, Ill.

BALDWIN & CO., JAMES L.—358 W. Madison St., Chicago, Ill. Manufacturers of cash and parcel carrier systems. James L. Baldwin, sole owner.

BALDWIN CHAIN & MFG. CO., THE.—Worcester, Mass. Manufacturer of power transmission chains and sprockets. President, George T. Dewey; vice-presidents, William F. Cole and James H. Kendall; treasurer, William H. Gates; general manager, William A. Rockenfield.

BALDWIN, NATHANIEL.—3414 S. 23rd St., East, Salt Lake City, Utah. Manufacturer of radio and telephone receivers. Business established 1912. Sales representative, John Firth, 18 Broadway, New York, N. Y.

BALLARD.—Trade name for motor-driven cloth cutting machines manufactured by the Wildman Mfg. Co., Norristown, Pa.

BALLISTIC GALVANOMETER.—See under Galvanometer.

BALLMAN-WHITTEN MFG. CO.—4060 Forest Park Blvd., St. Louis, Mo. Manufacturer of automobile coil testers and ammeters. Business established 1914. President, treasurer and general manager, S. A. Whitten; vice-president, E. Ballman; secretary, Charles Vanek, Jr.

BALSA REFRIGERATOR CORP.—50 E. 42nd St., New York, N. Y. Manufacturer of electric household refrigerators. President, R. B. Sheridan; secretary, Gordon C. Carson; factory manager, T. A. Gamon. Factory, Long Island City, N. Y.

BALTIMORE BATTERY SEPARATOR CO.—5145 Reisterstown Rd., Arlington, Baltimore, Md. Manufacturer of battery boxes and separators. Business established 1920. President, James T. Jenkins; vice-president, treasurer and general manager, E. A. Garlock; sales manager, W. C. Arnold.

BALTIMORE OIL ENGINE CO.—Baltimore, Md. Manufacturer of oil engines.

BAMBOO FILAMENT.—Of historical interest as one of the earliest commercial forms of filament for incandescent lamps. It was devised by Edison and consisted of a fiber of bamboo which had been sujected to a carbonizing process.

B & B.—Trade name for electrical specialties manufactured by the Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

B & L.—Trade name for lighting fixtures, and illuminating glassware manufactured by Bauman & Loeb, Inc., 138 Bowery, New York, N. Y.

B. & M.—Trade name for electrolytic copper produced by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

B. & S. OR B. & S. G.—Abbreviations for Brown & Sharpe Gage.

BANDS OR COLLARS, POLE.—These are bands of forged steel placed on tubular iron or steel poles for attaching trolley

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span wires or guy wires. They are made either of two semicircular pieces bolted together or of a single split ring clamped on the pole by bolts. A lug is provided for attaching the span or guy wire.

Manufacturers:

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display advertisement on page 1254.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. on page 1278.)
Strieby & Foote Co., Newark, N. J.
Threadless Pipe Fittings Corp., Newark, N. J. (Exclusive distributors, Rubino & Liebstein, Newark, N. J.)

B & W.—Trade name for water-tube boilers manufactured by the Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.

B. & W.—Trade name for cord connectors and candlesticks manufactured by the B. & W. Specialty Mfg. Co., 100 Boyleston St., Boston, Mass.

B. & W. SPECIALTY MFG. CO.—100 Boylston St., Boston, Mass. Manufacturer of candelabra fixtures and cord connectors. Business established 1920. President, Samuel T. MacQuarrie; secretary and general manager, George H. Bowen; treasurer and sales manager, H. E. Bowen. Sales representatives, Southern Sales Co., Mobile, Ala.; Electrical Specialty Co., Baltimore, Md.; Henry J. Vieth, Jr., New Orleans, La.

BANFIELD & SONS, LTD., W. H.—370-86 Pope Ave., Toronto, Ont., Can. Manufacturer of lighting fixtures, portable lamps, outlet boxes, etc.

BANGOR FIDELITY SLATE CO.—Bangor, Pa. Manufacturer of slate for electrical purposes. President, B. F. Dilliard; treasurer, Oliver Labar; secretary, J. I. Weiss.

BANGOR STRUCTURAL SLATE CO.—Bangor, Pa. Manufacturer of structural slate for electrical purposes. President, G. D. Shimer; secretary, A. Bonney; treasurer, K. S. Shimer.

BANK.—Apparatus used in automatic and semiautomatic telephone systems consisting of several tiers of contact terminals over which the wipers or fingers of an automatic switch move to engage the trunks or lines connected to the terminals. Banks are either flat or semicylindrical in shape. One important bank is known as the "line bank." This is the part of an automatic switch which carries the line terminals either of trunk lines or of subscriber lines. A "private bank" is the bank in an automatic switch which has on it the release trunks for protecting the trunks when busy.

BANNER.—Trade name for incandescent lamps manufactured by the Banner Electric Division, National Lamp Works of General Electric Co., Youngstown, Ohio.

BANNER.—Trade name for welding compound manufactured by the Cortland Specialty Co., 176 Railroad St., Cortland, N. Y.

BANNER.—Trade name for measuring tapes manufactured by the Lufkin Rule Co., Saginaw, Mich.

BANNER.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

BANNER ELECTRIC DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Youngstown, Ohio. Manufacturer of incandescent lamps. General manager, N. L. Norris.

BANTAM.—Trade name for electric vacuum cleaners manufactured by the Tyler Mfg. Co., Boston, Mass.

BANTAM BALL BEARING CO., THE.—Bantam, Conn. Manufacturer of thrust bearings. Business established 1905. President, Nellie M. Scott; vice-president and general manager, Henry H. Edwards; secretary, Chauncey B. Heath; treasurer, Helen Schoonmaker; sales manager, L. G. Robinson. Main office and factory, Bantam, Conn. Branch office, Detroit, Mich. Sales representative, Frank M. Cobbledick Co., 193 Mission St., San Francisco, Cal.

BAR MAGNET.—A permanent magnet in the form of a rather short straight bar.

BAR-NUN.—Trade name for electric grinder for cereals, grains, etc., manufactured by the B. F. Gump Co., 431-437 S. Clinton St., Chicago, Ill.

BARBER.—Trade name for gasoline engines and manhole pumps manufactured by King Bros., 439 E. Water St., Syracuse, N. Y.

BARBER & SONS, CHARLES.—Meaford, Ont., Can. Manufacturers of hydraulic turbines. Business established 1867.

BARBER ASPHALT PAVING CO., THE.—Philadelphia, Pa. Manufacturer of asphalt, insulating compounds, cements, paints, etc. President, Arthur W. Sewall; vice-presidents, C. W. Bayliss, A. L. Robinson, Frank Seamans; secretary, E. R. Riter; treasurer, Ira Atkinson. Main office, Land Title Bldg., Philadelphia, Pa. Factories, Maurer, N. J.; Madison, Ill. Branch offices, St. Louis, Mo.; Kansas City, Mo.; Pittsburgh, Pa.; Atlanta, Ga.; 233 Broadway, New York, N. Y.; 7 S. Dearborn St., Chicago, Ill.

BARBER ELECTRIC MFG. CO.—North Attleboro, Mass. Manufacturer of switchboards, panelboards and switches.

BARBER-GREENE CO.—Aurora, Ill. Manufacturer of electric portable conveyors. Business established 1916. President, H. H. Barber; vice-president and treasurer, W. B. Green; secretary, D. G. McIlwraith; sales manager, W. A. Buell. Main office, Aurora, Ill. Branch offices, 340 Leader-News Bldg., Cleveland, Ohio; 141 Centre St., New York City; 1010 Penn Square Bldg., Philadelphia, Pa.; 11 S. LaSalle St., Chicago, Ill.; 605 Arrott Bldg., Pittsburgh, Pa.; Third National Bank Bldg., St. Louis, Mo.; Century Bldg., Hartford, Conn.; Merchants Bank Bldg., Indianapolis, Ind.; Martin Bldg., Utica, N. Y. Sales representatives, General Utilities Co., Bankers Trust Bldg., Norfolk, Va.; Chadwick Bros., First Wisconsin National Bank Bldg., Milwaukee, Wis.; R. W. Wood Co., 327 Jefferson Ave., East, Detroit, Mich.; Lucke Sales & Engr. Co., 501 Washington Ave., Minneapolis, Minn.; Bowman Machinery Co., 1207 Howard St., Omaha, Neb.; H. P. Wilson & Co., 1626 Blake St., Denver, Colo.; F. C. Stannard Co., 315 Dooly Block, Salt Lake City, Utah; Smith-Booth-Usher Co., 326 Central Ave., Los Angeles, Cal.; Clyde Equipment Co., 18th & Upshur Sts., Portland, Ore.

BARBERS' ELECTRIC SPECIALTY CO., THE.—4204 Troost Ave., Kansas City, Mo. Manufacturer of electric hair cutting machines, vibrators and hair driers.

BARBERS' POLES, ILLUMINATED AND REVOLVING.—Translucent cylinders of glass or special porcelain having the characteristic red, white and blue spiral stripes, and so set vertically in holders at top and bottom as to be revolved by an electric motor installed in the metal base. Some poles have incandescent lamps installed within the cylinder, while others are illuminated at the top by globe-enclosed electric lamp. These poles attract more attention than a stationary or unlighted pole.

Manufacturers:

Kochs Co., Theodore A., 659 Wells St., Chicago, Ill.
Schunck & Ogg, 235 Canal St., New York, N. Y.

BARCALO MFG. CO.—Buffalo, N. Y. Manufacturer of pliers and wrenches. President and treasurer, Edward J. Barcalo; vice-president, Bryant Glenny; secretary, Alban W. Kirton; sales manager, Frank Anderson.

BARCY & NICHOLSON.—Detroit, Mich. Manufacturers of battery connectors.

BARKELEW ELECTRIC MFG. CO.—Middletown, Ohio. Manufacturer of switchboards, switches and other electrical specialties. President and treasurer, C. W. Denny; vice-president, W. O. Barnitz; secretary, G. E. Denny. Main office, Middletown, Ohio. Branch offices, 15 S. Clinton St., Chicago, Ill.; 525 Market St., San Francisco, Cal.

BARLOW ELECTRICAL SPECIALTIES CO.—Yonkers, N. Y. Manufacturer of projecting arc lamp compensators.

BARLOW & SEELIG MFG. CO.—Ripon, Wis. Manufacturer of vacuum-type electric washing machines. Business established 1908. President, J. B. Barlow; vice-president, F. W. Suszycki; secretary, treasurer and general manager, J. G. Seelig.

BARNARD & CO., B. S.—31 Union Sq., New York, N. Y. Manufacturers of underground construction tools and specialties. Business established 1905. President, B. S. Barnard; vice-president, W. H. Barnard; secretary, treasurer and general manager, H. P. McElearney.

BARNES'.—Trade name for electric water purifier manufactured by the American Utilities Co., St. Joseph, Mich.

BARNES CO., THE WALLACE.—Bristol, Conn. Manufacturer of springs and screw machine products. Business established 1857. President, C. F. Barnes; secretary, H. C. Barnes; treasurer and general manager, F. F. Barnes; sales manager, Brown Joyce. Main office and factory, Bristol, Conn. Branch office, Book Bldg., Detroit, Mich.

BARNES-LINDSLEY MFG. CO.—503 Couch Bldg., Portland, Ore. Manufacturer of wood crossarms. President, E. L. Barnes; vice-president, C. P. Lindsley; secretary, M. H. Barnes.

BARNES-MADE.—Trade name for screw machine products, spring steel, wire, stampings, etc., manufactured by the Wallace Barnes Co., Bristol, Conn.

BARNES MFG. CO., THE.—N. Main St., Mansfield, Ohio. Manufacturer of electric pumps. Business established 1895. President, C. H. Voegele; vice-president, William Dow; secretary and general manager, T. R. Barnes; treasurer, E. J. Gilbert; sales manager, A. C. Saxe.

BARNETT FOUNDRY & MACHINE CO.—Lyons Ave. & Colt St., Irvington, N. J. Manufacturer of electric ironing machines. Business established 1845. President, Thomas Hannah; vice-president, Frank E. Mann; secretary and treasurer, Gerald Hannay.

BARNEY VENTILATING FAN WORKS.—25-27 Haverhill St., Boston, Mass. Manufacturers of motor-driven ventilating fans. Albert B. Franklin, Inc., proprietor.

BARNHART BROS. & SPINDLER.—Monroe & Throop Sts., Chicago, Ill. Manufacturers of die castings. Business established 1868. President, W. H. French; vice-president, treasurer and general manager, Charles R. Murray; secretary, E. W. Conable; sales manager, L. R. Brink.

BARNSTEAD STILL & STERILIZER CO.—Boston, Mass. Manufacturer of electric stills and sterilizers. Business established 1878. President and treasurer, Alonzo J. Shadman; vice-president, W. G. Shadman; secretary, George L. Ellsworth. Main office, 2 Lanesville Terrace, Forest Hills, Boston, Mass. Branch office, 189 W. Madison St., Chicago, Ill.

BAROMETERS.—Instruments for determining the weight or pressure of the atmosphere. In their simplest form they consist of a long graduated glass tube filled with mercury and then inverted in a cup of mercury. They are used in connection with power plants and electrical testing work to forecast possible weather changes, measure the atmospheric pressure prevailing and also to determine the greatest degree of vacuum obtainable in connection with condensing equipment. The normal barometric reading corresponding to an atmospheric pressure of 15 lbs. per sq. in. is 30 ins. or 760 mm. of mercury.

Manufacturers:

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
General Scientific Equipment Co., North Philadelphia, Pa.
Green, Henry J., 1191 Bedford Ave., Brooklyn, N. Y.
Hearn & Harrison, 418 Netre Dame St., West, Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y. "Nautico."
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y. "Tycos."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

BARRETER.—A measuring instrument of the bridge type, in which the change in resistance with the passage of current in a high-temperature-coefficient wire is utilized to measure telephone currents or similar currents of that frequency.

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BARRETT.—Trade name for jacks manufactured by the Duff Mfg. Co., Preble Ave., Pittsburgh, Pa.

BARRETT & CO., M. L.—233 W. Lake St., Chicago, Ill. Manufacturers of lamp coloring compounds, lacquers and insulating varnish. President, M. L. Barrett; vice-president, J. P. Barrett; secretary, W. H. Shellman. Factory, Cicero, Ill.

BARRETT CO., THE.—New York, N. Y. Manufacturer of creosote oil, paving material, protective paints, battery chemicals, etc. President, T. M. Rianhard; vice-president, J. C. Runkle; vice-president and assistant general manager, R. P. Perry; secretary and treasurer, E. J. Steer. Main office, 17 Battery Pl., New York, N. Y. Branch offices, Atlanta, Ga.; Baltimore, Md.; Bangor, Me.; Berkeley, Cal.; Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Dallas, Tex.; Detroit, Mich.; Denver, Colo.; Duluth, Minn.; Houston, Tex.; Jacksonville, Fla.; Kansas City, Mo.; Medina, N. Y.; Milwaukee, Wis.; Minneapolis, Minn.; Nashville, Tenn.; New Orleans, La.; New York, N. Y.; Omaha, Neb.; Peoria, Ill.; Philadelphia, Pa.; Pittsburgh, Pa.; Richmond, Va.; St. Louis, Mo.; Salt Lake City, Utah; Seattle, Wash.; Toledo, Ohio; Washington, D. C.; Youngstown, Ohio.

BARRETT SALES CO.—568 W. Washington Blvd., Chicago, Ill. Manufacturer of toggle bolts, hammer and spring drills, expansion bolts, screws, shields, etc. Business established 1912. President, treasurer and general manager, A. C. Barrett; vice-president, J. A. Barrett; secretary and sales manager, W. F. Syring.

BARRIER.—A partition, plate, slab or wall of insulating material placed between the poles of a switch, circuit breaker, lightning arrester or other medium or high-tension apparatus or between individual busbars of a set; also between adjacent switches, etc., of different circuits. Such barriers serve to prevent accidental short-circuits between adjoining poles or buses; to prevent arcing from pole to pole on opening a switch or circuit breaker; to prevent grounds or other difficulties occurring on one pole or bus from being communicated to the other sides of the circuit, and to prevent short-circuits or other serious troubles in the switch, circuit breaker, buses, etc., from spreading to other circuits.

BARRIER SWITCHES.—Usually knife switches with barriers of porcelain, slate or other insulating material between the poles.

BARRIER, TRANSFORMER INSULATION.—A heavy continuous insulating sheet or cylinder between the high-voltage and low-voltage windings of a transformer, designed to insure that the high-voltage shall not break through to the low-voltage system.

BARRIERS, BUS, CIRCUIT BREAKER, SWITCH, ETC.—Barriers for busbars, circuit breakers, switches, lightning arresters, etc., are commonly made of asbestos lumber, slate or soapstone slabs. These are listed under separate headings. In addition such barriers are often constructed of brick, concrete, sandstone, various artificial stones, etc. The first two are usually constructed on the job while building the switch cells or bus compartments, while sandstone, artificial slate and similar materials are furnished in slabs. Barriers between switches or circuit breakers on the front of a switchboard are generally slabs of slate, marble or other material to match the board.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
GARFIELD MFG. CO., Garfield, N. J.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y. "Transite."
Mendell Mfg. Co., Mattapoisett, Mass.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Ohio Quarries Co., The, Citizens Bldg., Cleveland, Ohio. "Buckeye Gray."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BARS, COMMUTATOR.—The separate bars or conducting pieces that are built together to form the commutator. Commutator bars are practically always made of hard-drawn copper and in the usual form taper in thickness toward their inner edges, so that when assembled the outside or contact surface of the commutator is that of a cylinder. In radial or disk commutators the bars also taper toward the inner edges, but their length is radial and their contact surface is a plane at right angles to the shaft. Commutator bars are often called commutator segments, but the latter term is not so definite because it is also sometimes applied to the mica plate insulation between the copper bars; such plate insulation is properly called commutator insulating segments.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Buckeye Tempered Copper & Brass Co., Mansfield, Ohio.
Cameron Electrical Mfg. Co., The, 205 Main St., Ansonia, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Commutator Co., 125 1st St., N., Minneapolis, Minn.
Electric Materials Co., The, North East, Pa.
Eureka Co., North East, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ROME BRASS & COPPER CO., Rome, N. Y. (See display advertisement on page 1312.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BARS, POLE OR POST HOLE, TAMPING.—In backfilling the earth about poles it is important that the soil be well tamped in order that the pole shall stand straight after the strain of the wires has been placed upon it. A suitable tamping bar greatly facilitates this work. Such bars have the lower end so shaped as to pack the earth solidly.

Manufacturers:

Dicke Tool Co., The, Downers Grove, Ill.
HERBST, PAUL W., Chicago, Ill. We manufacture a full line of steel crow diggers and tamping bars; also an electric spud, wood handle iron shoe and electric tamping tool. We are also exclusive distributors of the "Loy" digging tool. See display advertisement on page 1258.—Adv.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Iwan Bros., 1503 Prairie Ave., South Bend, Ind. "Iwan."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.
Oliver Iron & Steel Co., 10th and Muriel Sts., Pittsburgh, Pa.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display advertisement on page 1253.)

BARS, TIE TAMPING.—A bar or rod used for forcing the ballast material under the ties in a track. Such bars generally have a blunted and enlarged end which is bent at such an angle to the bar that when the bar is brought down it will exert the maximum force in pushing the ballast under the tie. Hand tamping bars vary somewhat in length and weight, but a bar about 5½ ft. long and weighing about 13 lbs. is quite frequently used. Machine tamping bars are of various weights and designs, depending largely upon the machine with which they are to be used.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Imperial."

BARTLETT & SNOW CO., THE C. O.—Cleveland, Ohio. Manufacturer of elevating and conveying machinery. President, C. O. Bartlett; vice-president, E. J. Neville; secretary and treasurer, W. S. Lister; general manager, H. S. Hersey.

BARTLETT, INC., H. N.—19 Park Pl., New York, N. Y. Manufacturer of electrical insulating materials. Business established 1916. President, H. N. Bartlett; treasurer, D. F. Burnett.

BARTLETT NOSHADO LITE.—Trade name for operating room lighting fixtures manufactured by the Scanlan-Morris Co., Madison, Wis.

BARTON, F. C.—New York, N. Y. Manufacturer of narrow fabrics. Business established 1895. Main office, 65 Worth St., New York, N. Y. Factories, Bridgeport, Conn., and Philadelphia, Pa. Branch office, 223 W. Jackson Blvd., Chicago, Ill.

BARWOOD MFG. CO., L. J.—Stoneham Branch, Boston 80, Mass. Manufacturer of washers, gaskets, packing, etc. Business established 1900. Sole owner, Leon J. Barwood; general manager, Victor H. Barwood.

BASCO.—Trade name for battery-charging sets, circuit breakers, automobile lamps, relays, switches and other electrical specialties manufactured by the Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis.

BASE FRAMES OR SUBBASES, WOOD, MOTOR AND GENERATOR.—A timber frame or subbase placed under small or medium-sized generators or motors to locate them in the proper position and at the proper height so that they may be coupled to the driving or driven machinery. Such base frames are occasionally used to insulate the frame of the machine from ground, where grounding of the frame is impracticable or not required. Sometimes the base frame is used as a belt-tightening base; for this type see Bases, belt-tightening, motor and generator.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASE RAILS.—See Bases, belt-tightening, motor and generator.

BASE SPEED, ADJUSTABLE-SPEED MOTOR.—The base speed of an adjustable-speed motor is the speed attained with full field strength under full load and with no resistor inserted in the armature circuit.

BASES AND PEDESTALS, OR STANDARDS, FLOOR LAMP, METAL.—Metal is not much used as a material for floor lamp standards, except for the very massive candelabra outfits or torchiers, and for reading or smokers' and lodge lamps. These latter types are commonly made of brass tubing, generally telescopic, with leaded base, or of ornamental iron.

Manufacturers:

BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind. (For operating room.)
Biddle-Gaumer Co., 3846-3856 Lancaster Ave., Philadelphia, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. (Composition) "Compolux."
Champion Brass Works, Coldwater, Mich.
Empire Lamp & Brass Mfg. Co., 663 W. Washington St., Chicago, Ill.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Newman Mfg. Co., 717-721 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.
Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y.
Smyser-Royer Co., York, Pa.
Vester Sons, Inc., Alfred, 5 Mason St., Providence, R. I.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

BASES AND PEDESTALS, OR STANDARDS, FLOOR LAMP, REED OR WOOD.—Wood is now the most popular material for floor lamp bases and pedestals. The ease with which it can be turned or carved and the various natural and special color finishes that it can be given have led to the production of an almost endless variety of designs utilizing this material. Woven reed or wicker standards are made to be used with furniture of like material, such as is used on porches or other semioutdoor places and in hotel lobbies and rest rooms.

Manufacturers:

Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Brown Co., The W. B., Bluffton, Ind.

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Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."
Daison Mfg. Co., Inc., 916 Chestnut St., Philadelphia, Pa.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y.
Highlands Mfg. Co., Muncie, Ind.
Lamb Bros. & Greene, Nappanee, Ind.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.
Novelty Turning Co., 34 Main St., Norway, Me. (Wood.)
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Ypsilanti Reed Furniture Co., Ionia, Mich.

BASES AND STANDS, TABLE LAMP, METAL.—Metal bases for table lamps are largely used for reading lamps with glass shades (metal being also used to form the framework of the shade) and for decorative boudoir lamps. The stands are generally of cast brass, though other metals are sometimes used. The metals are given a variety of finishes, enamel finishes being generally employed on metals other than brass.

Manufacturers:

American Art Co., 114 E. Grand Ave., Chicago, Ill.
Art Novelty Production Co., 1875 W. Grand Ave., Chicago, Ill.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Biddle-Gaumer Co., 3846-3856 Lancaster Ave., Philadelphia, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Calgary Iron Works, Ltd., The, 410-416 9th Ave., E., Calgary, Alta., Can.
Consolidated Lamp & Glass Co., Coraopolis, Pa.
Empire Lamp & Brass Mfg. Co., 663 W. Washington St., Chicago, Ill.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Lamb Bros. & Greene, Nappanee, Ind.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Newman Mfg. Co., 717-721 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.
Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.
Parisienne Lamp & Shade Co., 1220 W. 6th St., Cleveland, Ohio. "Parisienne."
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Young & Co., William B., 1733 N. 6th St., Philadelphia, Pa.

BASES AND STANDS, TABLE LAMP, POTTERY, GLASS, ETC.—Pottery table lamp stands are generally in the form of a vase and made up in the almost endless variety of decorative finishes which pottery may be given. Glass, terra cotta, porcelain, etc., are also used for lamps of odd design, often using figures for the lamp stand.

Manufacturers:

Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y. (Glass.)
Consolidated Lamp & Glass Co., Coraopolis, Pa.
Daison Mfg. Co., Inc., 916 Chestnut St., Philadelphia, Pa.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Highlands Mfg. Co., Muncie, Ind.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Parisienne Lamp & Shade Co., 1220 W. 6th St., Cleveland, Ohio. "Parisienne."
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
Van Briggle Tile & Pottery Co., The, Colorado Springs, Colo. (Pottery.)
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.
Weller, S. A., Zanesville, Ohio. (Pottery.)

BASES AND STANDS, TABLE LAMP, REED OR WOOD.—Wood is one of the commonest materials for table lamp stands. The base and stick, though generally turned separately, are usually made up as a unit. However, a separate base of suitable form for pottery stands, made of teak or imitation teak wood, is sometimes used. Reed bases for table lamps are made to correspond to similar ones for floor lamps.

Manufacturers:

Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Brown Co., The W. B., Bluffton, Ind.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polychrome Art Works, 2700 Diversey Ave., Chicago, Ill.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill. (Reed.)
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (Reed.) (See display advertisement on page 1308.)
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. (Wood.) "Hasco."
Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.
Ypsilanti Reed Furniture Co., Ionia, Mich. (Reed.)

BASES, BELT-TIGHTENING, MOTOR AND GENERATOR.—A stationary sub-base used with motors or generators that drive or are driven by belts, sometimes carrying a set of rails which fit into grooves on the main machine base and permit the machine to be moved on the sub-base so as to adjust the tension of the belt. This is sometimes changed by having the machine base carry the rails and the sub-base is then grooved. A screw or other arrangement to permit moving and adjusting of the machine and clamping it in position on the base is usually provided. In other forms there are slots in the sub-base for bolts, by means of which the machine may be bolted in place after it has been moved to the desired position.

Manufacturers:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASES, CUTOUT, FOR CARTRIDGE FUSES.—Porcelain, slate, marble or composition blocks upon which are mounted either ferrule or knife-blade contacts into which the cartridge fuses designed for the rating of the base are inserted. The dimensions must conform to the standard dimensions of the fuses with which the bases are to be used.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."

CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill.—Union cutout bases, or enclosed fuse cutouts, are made to N. E. Code Standard for 250 and 600 volt circuits, with carrying capacities up to and including 1,000 amperes. Single, double, and triple pole, main line with porcelain or slate bases. Two or three wire, single or double branch, with por-



No. 2010



No. 2021

celain bases, double or triple pole outouts for 250 volts, and capacities of 0-30 or 31-60 amperes as required. Single pole, main line, fuse cutouts from



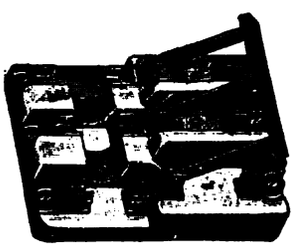
No. 2030

61 to 1000 amps. for both 250 and 600-volts, furnished with slate bases. 1500 and 2500 volt cutouts, 0 to 100 amps., for single pole, main line, are fitted with clips spaced for old code fuses.



No. 2006

Union combination switch cutouts can be supplied for double or triple pole top or bottom entrance, 125-250 volt, 0-30 or 31-60 amps. capacity. If desired switches can be fitted with per-



No. 804

manent connecting strap in place of one of the fuses, as required by Underwriters' for grounded circuits. All bases are equipped with firm gripping clips of standard design.—Adv.

Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Fuses, cartridge, nonrenewable.)
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Heineman Electric Co., 5th St. & Girard Ave., Philadelphia, Pa.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mendell Mfg. Co., Mattapoisett, Mass.

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Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display advertisement on page 1285.)
Paiste Co., H. T. Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display advertisement on pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASES, CUTOUT, FOR OPEN LINK FUSES.—A newly added rule of the National Electrical Code requires that the base or block, upon which link fuses in an electrical circuit are mounted, be of slate or marble and enclosed in an iron box or cabinet. The bases must also conform to certain standard spacing distances. Also see Fuses, link.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASES, CUTOUT, FOR PLUG FUSES.—A block, usually of porcelain, having a right or left-handed screw shell and center contact molded in for each plug fuse the cutout is designed to carry. Right-handed screw shell cutout bases are designed for use on circuits of 125 volts and 30 amperes capacity. Left-handed screw shell cutout bases are designed for 250 volts under certain limitations.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Molded composition panelboard bases, strong, fireproof, of high dielectric strength, and not affected by heat, moisture, oils or acids. 4, 6, 8 and 10 circuit units with 2 and 3 wire main lugs and concealed base bars. Cheaper to install and better appearing than porcelain block work. This type of panelboard is particularly adapted to residences and apartments. For further information write for panelboard catalog.—Adv.



Panel Board Base

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
DANBURY ELECTRIC MFG. CO., Danbury, Conn.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Fuses, cartridge, nonrenewable.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Heineman Electric Co., 5th St. & Girard Ave., Philadelphia, Pa.
Hemco Electric Mfg. Co., Inc., 344 E. 40th St., New York, N. Y. "Hemco." (Exclusive distributor, George Richards & Co., 557 W. Monroe St., Chicago, Ill.)
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
King-Craymer Electric Mfg. Co., 32 Haviland St., South Norwalk, Conn. "K-C."
Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."
Lewis Electric Co., Inc., The, Canton, Ohio.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J. "F.C.M."
Paiste Co., H. T. Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J. "Tecco."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display advertisement on pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASES, INCANDESCENT LAMP.—The base is that portion of the incandescent lamp which fits into the socket and to which the bulb and filament supports and terminals are attached.

The most common standard base in use in the United States for many years, for lamps of medium size, is that known as the medium Edison screw base. Previously several different types of sockets and lamp bases were used, but these have largely disappeared and the few old sockets of other than the Edison type remaining in use have been fitted with adapters to take Edison screw base lamps.

The lamp bases now regularly turned out on lamps for the American market are the following: (1) Regular Edison medium screw base, just mentioned, as used on the majority of lamps of from 10 to 300 watts. (2) Mogul screw base, for multiple lamps of 300 to 1,000 watts, and series street lighting lamps of all sizes. (3) Candelabra screw base, for small lamps for candelabra or imitation candle type fixtures. (4) Miniature screw base, for the still smaller lamps used in flashlights. (5) Bayonet candelabra base, employing the bayonet catch principle, used for automobile lamps where the jar tends to loosen screw base lamps; bayonet candelabra bases are again divided into two classes, as follows: (a) bayonet catch with double contacts, one contact on the tip of the base for each lamp terminal; (b) bayonet catch with single contact, in which one lamp terminal is brought to a single center contact on the tip of the base and the other is brought to the metal shell of the base, and the circuit is completed through the metal shell of the socket and through the metal frame of the automobile.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
National Marine Lamp Co., The, Forestville, Conn.
Providence Base Works of General Electric Co., 586 Atwells St., Providence, R. I.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

BASES, SNAP SWITCH.—Circular bases of porcelain at least ½ inch thick, upon which snap switches are mounted. These "sub-bases," as they are also called, are made in types for knob and tube work and for end runs, through runs and angle runs of moldings or raceway.

Manufacturers:

AMERICAN INSULATOR CORP., New Freedom, Pa. (Molded).
American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-1304.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PARKER & SON, INC., J. H., Parkersburg, W. Va. Sub switch bases of moulding, concealed, and cleat and concealed types.—Adv.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
Woodley Slate Co., Bangor, Pa. (Exclusive distributor, The Structural Slate Co., Pen Argyl, Pa.)

BASES, TROLLEY (CAR ROOF).—A pivoting device placed on the roof of an electric railway car to which is attached the trolley pole carrying the harp and wheel which is arranged to turn in a horizontal plane, so that the trolley wheel will follow the trolley wire over curved track and so the pole may be swung around for reverse running. It is provided with springs so attached as to maintain practically a uniform upward pressure of the trolley wheel against the trolley wire at all operating heights of the latter.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Bayonet Trolley Harp Co., 404 Mitchell Bldg., Springfield, Ohio. "Bayonet."
Holland Trolley Supply Co., The, 1623 E. 43rd St., Cleveland, Ohio. "Holland."
Nuttall Co., R. D., Pittsburgh, Pa.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B trolley base, roller bearing, with renewable bushings for all wearing parts.—Adv.
Trolley Supply Co., The, Massillon, Ohio. "Simplex."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BASHLIN CO., THE.—Warren, Pa. Manufacturer of pipe fittings, valves, etc. Business established 1901. President, E. H. Bashlin; vice-president, F. C. Tochterman; secretary, T. E. Cook; treasurer and general manager, J. E. Hazeltine. Factory, North Warren, Pa. Sales representatives, W. J. Hyland Mfg. Co., Springfield, Mass.; Tomlinson Steam Specialty Co., Cleveland, Ohio; Bell & Gossett Co., 609 W. 30th St., Chicago, Ill.; Manuel Specialties Co., Empire Hotel, Syracuse, N. Y.; John A. McDowell, 2010 Railway Exchange Bldg., St. Louis, Mo.; W. R. Lonsdale, 2275 Elm St., Denver, Colo.; George H. Trask, 76 Sacramento St., San Francisco, Cal.

BASTIAN AUTO ENGINEERING WORKS.—134 W. Tabor Rd., Olney, Philadelphia, Pa. Manufacturers of motor-driven air compressors for garages. M. L. Bastian, proprietor.

BATES.—Trade name for automobile signals made by the Ryan Corp., Phoenix, N. Y.

BATES EXPANDED STEEL TRUSS CO.—208 S. LaSalle St., Chicago, Ill. Manufacturer of steel transmission towers, poles, pole-line hardware, etc. Business established 1914. President, W. J. Chalmers; vice-president, Charles A. Brewer; secretary and general manager, A. J. Bates; treasurer, Walter A. Bates; sales manager, E. F. Holt. Factory, East Chicago, Ind.

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BATHS, ELECTRIC LIGHT.—Electric light baths are cabinets, usually metallic, in which a number of incandescent lamps are properly located so that a patient may sit on a chair or stool in the cabinet and have the light rays penetrate all the tissues of the body except the head. The rays of light and radiant heat penetrate the surface of the skin until all the radiant energy absorbed is transformed into heat energy and produces copious perspiration. The metal cabinets are lined with nonabsorbing or reflecting material, such as glass, with the lamps placed on the walls and in the floor and far enough from the patient to prevent irritation. The top of the cabinet or bath contains a flexible collar which fits closely around the neck of the patient and prevents the escape of heat and light.

Various kinds of lamps may be used to give different results, as the radiant effects depend upon the spectrum of the light source. Tungsten gas-filled lamps giving a nearly white light are generally used, as the effect of this light is similar to that of daylight. A still closer approach to daylight or sunlight effect is obtained by using special blue-bulb gas-filled tungsten lamps.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind. "Carlsbad."

Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.

BURDICK CABINET CO., Milton, Wis. Burdick ventilated light baths are of all-steel construction and equipped with ventilating system, ruby-glow foot warmers, sanitary adjustable collarette, and observation window. Arrangement of lamps obtains a central point of radiation, insuring absolute comfort and producing an active, eliminative sweat in the shortest possible time. Finished in super-baked, hand-rubbed white enamels, with nickel trimmings. —Adv.



Burdick Electric Bath Cabinet

Edmands, Walter S., 21-27 Pearl St., Boston, Mass.

Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."

Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Manhattan," "Queens," "Richmond."

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."

McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill. "Hydrosine."

METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.

Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.

Sanitarium Equipment Co., Battle Creek, Mich. "Battle Creek."

Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.

Solidarch Electric Hotpack Co., 1225 Cottman St., Fox Chase, Philadelphia, Pa.

BATHS, ELECTRICALLY HEATED WATER, FOR LABORATORIES.—Water baths are used in laboratories for evaporating liquids at a uniform rate or for maintaining solutions, cultures or products at a constant temperature not exceeding 212°F. The electrically heated baths have a heating unit immersed in the bottom of a tank, generally of tinned copper, and connected to a heater switch and control thermostat. A quantity of water is kept in the tank and heated to the desired temperature. The solution or material to be heated is placed in a test tube or other vessel and suspended in the water or mounted on a supporting rack. The thermostat makes it possible to maintain a very constant temperature.

Manufacturers:

Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

Thermo Electric Instrument Co., The, 8 Johnson St., Newark, N. J. "Freas," "Thelco."

Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md. "Alsops."

BATOCO.—Trade name for battery tools manufactured by the Battery Tools Co., 29-A N. Willow St., Montclair, N. J.

BATTERIES.—Electric batteries are electrochemical cells used as sources of electrical energy; they are generally connected in groups and used collectively. Although the word battery should properly be restricted to a group of such cells, it is quite commonly applied even when the battery consists of a single cell.

The distinctive feature of a battery is that it develops electrical energy as the result of a chemical reaction between its essential elements, which consist of a positive and a negative electrode and an electrolyte. If this reaction so changes these elements, or a part of them, as to make it virtually impossible to restore them to original condition, then the battery is called a nonreversible or primary battery, since it serves as a primary source of electrical energy. If the chemical reaction may be reversed by sending an electric current through the cell in the opposite direction, thus restoring the elements to their original condition, then the battery is called a reversible, secondary, or storage battery. It is called a secondary battery because some primary source of electrical energy, such as a generator, must be used first to "charge" the cell or put it into condition to act as a battery and when it so acts it serves as a secondary source. It is most commonly called a storage battery because it stores energy, first converting it from electrical to chemical and, on discharge, reconverting it back to electrical energy. A simple distinction between primary and secondary, or storage, batteries is that primary batteries may in many cases be recharged by adding fresh chemicals to replace those used up in service, while storage batteries are recharged by means of an electric current.

Development. The first electric battery was invented by Volta in 1800. Ever since then invention of new or improved batteries has been a fascinating field for inventors. Until the perfection of the generator (about 1870 to 1880) into a commercial machine, primary batteries were the only practical sources of electric current available. A large number of metals have been used in primary cells, also nonmetals and even gases being tried with various electrolytes and depolarizers. Among the almost countless primary cells that have been developed the following types were probably the best known: Bunsen, Daniell, gravity, Grove, Lalande, Leclanché, Poggendorff and dry cells, all but the last being wet cells with plentiful liquid electrolyte. Of these the gravity, Lalande, Leclanché and dry cells are almost the only ones that have survived. The chief reason for this is that the introduction of electric generators and central-station electric service has restricted the field for batteries to those uses discussed below under applications, and for these applications only those types of batteries are in use as are most free from the limitations of and objections to all batteries. Of the primary types remaining in service, dry cells constitute by far the greatest number because of their marked convenience, compactness and availability in various sizes.

The first storage battery was developed by Planté in 1860. His process was very slow, expensive and produced cells of limited capacity. In 1881 Faure developed the process of making pasted plates which in improved form is very generally used for practically all lead type storage cells. The great weight of the lead type cell led many other inventors to produce cells employing other metals for both, or at least one of, the electrodes. The number of electrolytic processes that are effectively reversible is very small, however, and only one (aside from the lead peroxide-sulphuric acid-lead type, commonly known as the lead storage battery) has survived on a commercial scale; this is the nickel-alkali-iron cell of which the Edison storage battery is the best known and most used type. Most other types that have been tried suffered from local action on open circuit or dissolving of at least one of the electrodes in the electrolyte from which it could not ordinarily be recovered by the recharging current.

Applications. The uses for batteries, both primary and storage, are almost countless. They can, however, be grouped into three principal classes, each of which may be further subdivided into numerous subclasses. These principal classes of service are: (1) Service where a portable, self-contained and simple source of energy is desired; (2) starting, peak load, night load, reserve, standby or emergency service; (3) service where a low-voltage d-c. source or a constant-voltage d-c. source is needed.

The first class includes any portable use for which a complete generating set would be impracticable or undesirable, such as pocket or hand lamps (flashlights, portable lanterns, miners' safety lamps, etc.); propulsion of electric vehicles, trucks, tractors, locomotives, launches, submerged submarines, etc.; ignition and lighting of many gasoline automobiles; miscellaneous portable uses.

The second class includes services for which the battery is only an auxiliary, such as for starting gasoline automobiles and other internal-combustion engines; carrying part of the peak load and all the night load or other small load of a generating plant so as to improve the load-factor of the generating set and eliminate attendance at night, usually of small plants such as farm lighting and other isolated plants; serving as an emergency or reserve source in d-c. substations, for generator excitation, for emergency lighting in theaters, on ships, etc., for ship radio service, etc.

The third class includes much signaling and other apparatus for which low-voltage direct currents are needed, such as in telephony, telegraphy, radio, fire alarms, house bells, annunciators, etc., these being cases in which a motor-generator set would be inexpedient; also where a very constant d-c. source is necessary as in much laboratory and other testing.

There are many applications that fall in more than one of these main classes, and a great many others that cannot be suitably included in any of them. However, the general field of usefulness of all batteries is where generator current is either not available or can not be conveniently adapted to the requirements of the circuit in question. Where batteries are used, they are likely to be dry cells for small sizes and where electrical recharging facilities are not at hand; where these facilities exist and always where the battery must be capable of furnishing large currents, storage batteries are employed. The field of the primary wet cells is gradually being taken over by primary dry cells and storage cells.

Production. The production of primary dry cells in 1899 was reported as 1,946,688, valued at $316,013; in 1914 it had risen to 71,092,438, valued at $8,719,164; for 1920 it was estimated at about 70,000,000. Primary wet cells in 1899 amounted to 708,077, valued at $571,370; in 1914, 306,351, valued at $802,525. The output of storage batteries and parts in 1899 was valued at $2,559,600; in 1914 at $13,080,964; for 1920 the output has been estimated at about $100,000,000, of which over one-half was in gasoline automobile ignition, lighting and starting batteries.

BATTERIES, MEDICAL.—This is partly a misnomer, as some of these outfits contain no batteries whatever. See Medical batteries.

BATTERIES, PRIMARY, DRY.—These are very compact and convenient forms of primary battery, generally a modification or outgrowth of the Leclanché cell. Dry batteries first appeared in this country about 1890, but it was several years before they were actually placed on the market. Their principal advantages are simplicity and ease of connection, ability to be placed in any position and handled without much care, and the service given for a considerable period of time without any attention being required.

Dry cells are divided into four general classes according to their construction: large size cells of the Leclanché type containing an absorbent paper lining; small cells of Leclanché type with bag construction, used principally for flashlights; desiccated cells, to which water must be added before using; silver chloride cells used in medical apparatus, testing sets, etc.

The Leclanché type of cells is generally made with a cylindrical zinc container or can which serves as the negative electrode. The positive electrode is a carbon rod which is placed axially within the container and surrounded with a depolarizing agent, manganese dioxide, which is mixed with crushed coke and graphite and tamped about the rod. The electrolyte is ammonium chloride (salammoniac) with zinc chloride added to reduce corrosion. The electrolyte is held by capillary action in a porous medium which separates the zinc from the carbon and also in the pores of the carbon and depolarizer. The top of the battery is flooded and sealed with an asphaltum compound.

A great many sizes of dry batteries have

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been made, some differing only minutely from the sizes of other manufacturers. Much work has been done to standardize sizes as much as possible and reduce this number so that batteries of different manufacturers will be interchangeable in flashlights, etc. In the larger sized dry batteries which are characterized by the use of an absorbent paper or porous medium placed all around the interior of the zinc container, three sizes have been called standard. It is the custom of many manufacturers to number the battery to express the height of the zinc can in inches. Thus Nos. 4, 6 and 8, which are standard, are in cans of these heights and have diameters of 1½, 2½ and 3½ ins., respectively.

The small or miniature cells, which are used for flashlights, pocket batteries, testing sets, etc., are not numbered in this manner. They are made in 15 sizes, of which six are standard. The standard sizes have diameters of ⅝, ¾, 1⅛, 1, 1¼ and 1¼ ins. with heights of 1⅞, 2⅛, 1⅛, 2⅞, 2¼ and 2⅞ ins., respectively. These batteries are generally made of the bag construction, having a small muslin or fabric sack enclosing the carbon electrode and containing the carbon and depolarizer.

Desiccated cells are generally of the large size. They are made with the electrolyte in dry form and water must be added several hours before using. Their advantage is that they do not deteriorate when not in use, as the other types do to a marked degree while carried in stock before being sold.

Silver chloride cells are small cells having zinc and silver as electrodes, depolarized by a mass of silver chloride around the silver electrode. They are made in sizes of 2⅜ by ¾ in. or smaller. When used for feeble currents they give quite constant e.m.f.

Dry batteries depreciate with age when not in use, and should not be purchased unless recently made. Even the better grade batteries are almost worthless after 12 or 14 months on open circuit. This is due principally to local action within the cell, which is affected considerably by the temperature. Temperatures above 77°F (25°C) tend to increase the local chemical action and thus shorten the life of the batteries. They should always be stored in a cool place.

The open-circuit voltage of a new battery is about 1.5 volts. With age this continues to drop, whether the battery is used or not. On closed circuit the voltage drops to about 1 volt, the greater part of the drop being due to polarization. About 70,000,000 dry cells are produced annually in the United States.

BATTERIES, PRIMARY, DRY, FLASHLIGHT.—These are the smaller size dry cells which are commonly of the bag type of construction. (See Batteries, primary, dry.) Batteries for flashlights and other small apparatus, such as some medical batteries, portable testing sets, radio apparatus, etc., generally consist of several individual cells combined into one battery. Various forms and sizes are thus obtained, depending on the voltage or capacity desired, but all are very compact.

These batteries are very seldom made with binding posts. For flashlight use they are often piled two or three on top of each other, the terminal of the carbon coming into contact with a polished central spot on the bottom of the zinc container of the next cell, etc. This gives a series connection, which is the most used. Parallel connections are obtained by soldered connectors usually. Small size batteries are subject to more rapid deterioration than larger batteries when on open circuit even before they are used. Preference should be given, in buying, to stock that is fresh and has not reposed on the dealer's shelves many months. A tremendous increase in the number of batteries made of this size occurred during the recent war, as very large numbers of flashlights were used by both the army and navy, especially by soldiers in the trenches.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Bright Star Battery Co., 310 Hudson St., New York, N. Y. "Mars-Bright."
Burgess Battery Co., Madison, Wis.
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass. "Add Water."
Canadian General Electric Co., Ltd., 212 King St. W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."
Carbon Products Co., The, Lancaster, Ohio. "C.P.C."
Comet Battery Co., The, 1362 E. 3rd St., Cleveland, Ohio.
Delta Electric Co., Marion, Ind. "Giant."
Diamond Electric Specialties Corp., 101-103 S. Orange Ave., Newark, N. J. "Diamond."
Doe Electrical Device Co., Kent, Ohio (in preparation).
Enterprise Electric Novelty Co., Inc., 603 W. 130th St., New York, N. Y. "Super-Enco."
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y. "Mono-cell."
French Battery & Carbon Co., Madison, Wis. "Ray-O-Lite."
Hipwell Mfg. Co., Pittsburgh, Pa. "Hipco."
International Battery Co., Inc., 453-455 Broome St., New York, N. Y. "Three Star."
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "American," "Columbia."
Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y. "Niagara."
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Stackpole Carbon Co., St. Marys, Pa.
Stuart Products Corp., 665 Washington Blvd., Chicago, Ill. "Make-Ur-Own."
TRIANGLE ELECTRO TRADING CO., 79 Chambers St., New York, N. Y. "Triangle" batteries constitute a high quality product made under a guarantee protecting both dealer and consumer. They are furnished for all standard types of cases. Purest chemical materials scientifically combined to give greatest possible endurance. See also page 1298, display section.—Adv.
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill. "Universal."
Usona Mfg. Co., Inc., The, 1 Hudson St., New York, N. Y. "Kwik-Lite."
Winchester Repeating Arms Co., New Haven, Conn. "Winchester."
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

BATTERIES, PRIMARY, DRY, IGNITION, TELEPHONE, ETC.—These are the larger size dry cells made with the absorbent paper lining. (See Batteries, dry.) While there are three standard sizes, the No. 6 battery is by far the most widely used. The batteries are classified according to the service they are designed for, as follows: Gas-engine and automotive ignition or heavy service, intermediate cells for general service, and telephone or light service. While any of these cells may be used for the other services with quite good results, those cells which are designed for a particular service will give longer life on that service than any of the other types. It is a general custom in the United States to judge a battery by the short-circuit current. A No. 6 cell made of good material and in good condition should give from 18 to 25 amperes on short-circuit. The average capacity of a battery of this type when connected in a circuit of 16 ohms resistance is 25 ampere-hours before the terminal voltage falls to 0.5 volt. The terminal resistance which is sometimes used to indicate the condition of the battery, depends somewhat upon the absorbent medium and principally upon the fineness of the depolarizer and the degree of tamping; it is about 0.1 ohm when new and increases to several times that value when old.

Instead of binding-post terminals some types of dry cells have screw-type terminals like an Edison incandescent lamp base. The upper half-inch or so of the zinc case is threaded to fit into a correspondingly threaded screw shell battery receptacle or holder; the carbon terminal is polished and fits against a central contact in the receptacle. This type of terminal connections facilitates replacing and connecting of the cells, especially by an inexperienced person. Also see Holders, battery.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "Four B."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "Jove."
Burgess Battery Co., Madison, Wis.
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass. "Add Water."
Canada Dry Cells, Ltd., Winnipeg, Man., Can. "North Star."
Canadian General Electric Co., Ltd., 212 King St., W. Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."
Carbon Products Co., The, Lancaster, Ohio. "C. P. C."
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. "Champion."
Delta Electric Co., Marion, Ind. "Giant."
Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. (For Audiphone).
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
French Battery & Carbon Co., Madison, Wis. "Fleur-De-Lis," "Ray-O-Spark."
Globe Phone Mfg. Co., Reading, Mass. (For portable microphones.)
Hi-Po Waterproof Battery Corp., South Norwalk, Conn. "Hi-Po" for automobile ignition, lighting and starting.
Hipwell Mfg. Co., Pittsburgh, Pa. "Hipco."
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Red Seal," "Hi-Up," "Blue Seal," "Mesco," "Red Seal Sparker."
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia Hot Shot," "Columbia," "Ignitor."
Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y. "Niagara."
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
Stackpole Carbon Co., St. Marys, Pa.
Stuart Products Corp., 665 Washington Blvd., Chicago, Ill.
Twin Dry Cell Battery Co., The, 2108 Superior Ave., W. Cleveland, Ohio. "Twin."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill. "Universal."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BATTERIES, PRIMARY, DRY, MISCELLANEOUS.—These are silver chloride batteries and desiccated batteries (described under Batteries, primary, dry) and any other special type of dry battery that may be made. The silver chloride batteries have the advantages of negligible temperature coefficient and are practically nonpolarizable and free from local action. For these reasons they are used in some high-grade testing sets. Desiccated cells have the advantage of a long shelf life before use. They were used considerably during the recent war. They cannot be handled as freely as ordinary dry cells after they have been filled with water but they give good results. Some of the better batteries of this type give about 20 amperes on short-circuit test and have an open-circuit voltage of about 1.5 volts.

Manufacturers:

Chloride of Silver Dry Cell Battery Co., 407-409 N. Paca St., Baltimore, Md.

BATTERIES, PRIMARY, WET.—A type of primary batteries in which the electrolyte is a liquid. There are numerous forms of wet batteries that have been used for various purposes, as they are the oldest type of battery and were the main source of electrical energy used for experimental purposes and early development in the electrical field until the introduction of dynamoelectric machines. The increased use of storage batteries and dry batteries and of low-voltage transformers has greatly reduced their field of application so that today there are only two or three types used commercially.

Wet batteries are divided primarily into two classes, depending upon the circuits they are to be used for, either open circuit or closed circuit. Their use now is confined chiefly to laboratory work, some forms of track signaling, for operating door bells, etc., and certain forms of fire and burglar-alarm systems. All types of wet batteries should be installed in places where the electrolyte will not freeze, nor evaporate rapidly, nor be exposed to deleterious gases or other injurious agencies. Pure water must occasionally be added to replace evaporation. As the zinc electrode is used up and the electrolyte weakened they must be renewed. Wet cells require more care than dry cells, which is one of the chief reasons why the latter have replaced them in many cases.

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BATTERIES, PRIMARY, WET, CLOSED-CIRCUIT. — Closed-circuit primary batteries are those designed to be used in a circuit that is normally closed and in which the battery furnishes a small current continuously. The types now most used are the gravity battery and the Edison-Lalande battery. The gravity battery or Daniell cell, of which it is a modification, makes use of gravity to separate the electrolyte and maintain the heavier copper sulphate on the bottom and the zinc sulphate solution on the top. In the common form, the zinc or negative electrode is cast in the form of a "crowfoot" and is hung over the edge of a glass jar. The positive electrode is made of three or four pieces of sheet copper riveted together, spread out and placed edgewise on the bottom of the jar. To set up the battery copper sulphate crystals, also called blue vitriol or bluestone, are placed in the bottom together with the copper electrode and covered with water or a weak solution of copper sulphate. If zinc sulphate is then poured in carefully to cover the zinc electrode the battery is ready for use. When zinc sulphate is not added, sufficient water is added to cover the zinc and the cell short-circuited for several hours while the zinc sulphate solution forms. These batteries must be kept on closed circuit. The Edison-Lalande battery may be used on either open or closed-circuit and is described under the open-circuit wet batteries.

There are several other forms of wet batteries used on closed circuits. The principal forms are modifications of the copper oxide-sodium hydroxide-zinc combination of which the Edison-Lalande is the best known form.

Manufacturers:

Beattie Zinc Works, Reading, Mass.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Eastern Signal & Supply Co., 50 Church St., New York, N. Y. "Atlas."
Edison, Inc., Thomas A., Belmont Ave., Bloomfield, N. J. "Edison," "BSCO."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Duplex," "Trojan," "Klondike," "Columbia," "National."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Ray Battery Co., Huron St., North, Ypsilanti, Mich.
Waterbury Battery Co., The, 30 Church St., New York, N. Y. "Waterbury," "Gordon."

BATTERIES, PRIMARY, WET, OPEN-CIRCUIT.—The open-circuit wet batteries are represented by two principal types, the Leclanché and the Edison-Lalande batteries. The Leclanché cell was widely used for intermittent service, but has been largely replaced by its dry form or dry battery. In the forms now most used, manganese dioxide and carbon are molded with a binder into a cylindrical form which is suspended in a glass jar; this is the positive electrode. The negative electrode is a rod of zinc which is placed at one side of or suspended within the carbon cylinder. A solution of ammonium chloride (salammoniac) is used as the electrolyte. These batteries have an e.m.f. of about 1.5 volts, but this drops rapidly if heavy currents are drawn. They are used for open-circuit work only. Modified forms of the Leclanché cell are available under various trade names.

The Edison-Lalande cell is usually made of two ribbed zinc plates with a plate of compressed copper oxide between them. The ribs serve to hold the plate together until it is worn out. A very thin layer of metallic copper is placed on the copper oxide electrode to improve its conductivity. Sodium hydroxide (caustic soda) solution is used for the electrolyte and a layer of mineral oil is usually added on top to prevent evaporation, also the formation of sodium carbonate by absorption of and combination with carbon dioxide in the air. These cells have an e.m.f. of about 0.95 volt and are adapted for both open or closed-circuit work. Other types of cell using caustic soda, copper oxide and zinc in other forms are obtainable under different trade names.

Manufacturers:

Blau Service, Inc., 682 Montgomery St., Jersey City, N. J.
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Klondike," "LeClanche," "Fuller."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
Ray Battery Co., Huron St., North, Ypsilanti, Mich.
SAMSON ELECTRIC CO., Canton, Mass.
Waterbury Battery Co., The, 30 Church St., New York, N. Y. "Waterbury," "Gordon."

BATTERIES, STORAGE.—Of all the electrode combinations that have been tried out for storage batteries, the one first used by Planté in 1860 remains today the most widely used, although now quite differently applied. Planté placed lead plates in dilute sulphuric acid and slowly but repeatedly charged and discharged them in opposite directions. The capacity gradually increased as the process was continued and after about a year a considerable thickness of lead peroxide (PbO_2) was formed on and from the surface of the positive plates, while the negative plate surface was converted into spongy or porous lead (Pb). Many years later this process of electrochemical formation was accelerated by adding dilute nitric acid or some other agent to the electrolyte during the forming to attack the lead plates quite rapidly, these having been first prepared by sawing, scoring or other means to increase their superficial surface; thus the formation could be completed in a few days.

Before this accelerated process came into vogue, Faure had in 1881 developed a process of using skeleton lead plates or grids on which a paste of lead oxides (prepared from litharge or red lead and dilute sulphuric acid) was applied. After a few charges and discharges these oxides were converted into lead peroxide and spongy lead, thus quickly giving a large mass of "active material." This process was applied first in batteries for portable service, where large capacity and light weight were desirable. The pasted plates made in this way were cheaper and lighter than plates made by the Planté process of modifications thereof. In recent years the process of making pasted plates has been so improved that they are practically as durable as Planté plates; therefore they have almost entirely replaced the latter.

During the discharge of a lead battery the lead peroxide and also the spongy lead combine with part of the sulphuric acid to form lead sulphate; on charge the lead sulphate is reconverted into the peroxide and spongy lead and the sulphuric acid returned to the electrolyte. The chemical reaction is represented by the following equation:

$$PbO_2 + 2H_2SO_4 + Pb = 2PbSO_4 + 2H_2O$$

read from left to right it represents discharge; from right to left it represents charge. During charge the counter e.m.f of the cell rises to 2.5 to 2.6 volts, depending on the charging rate, electrolyte density and temperature; the specific gravity also rises. On open circuit the e.m.f is about 2.0 to 2.1 volts. During normal discharge it gradually drops from 2.0 or a little over to 1.8 or even 1.7, depending on the discharge rate, electrolyte density and temperature; the discharge should not be continued below 1.75 volts; during discharge the specific gravity falls. Lead type storage batteries should not be left in a discharged condition, but recharged as soon as possible. Charging may begin at a high rate, but should preferably taper down to one-half of the normal charging rate or less at the end of charge; charging at constant current is common, but produces excessive and injurious gassing near the end unless the current is then reduced.

Lead cells are assembled with the positive and negative plates alternating and kept apart by separators, which are either thin treated wood boards, perforated hard rubber sheets, or glass tubes. There is one more negative than there are positive plates and the negatives form the outer plates when there are more than two. The positives and negatives are joined into corresponding groups by having the plate lugs burned into a connecting strap (or busbar in large cells) to which the terminal post is burned or of which it forms a part. The assembled element (plates and separators) is placed in a hard rubber or glass jar for small or medium size cells and lead-lined wooden tanks for very large cells. Rubber jars are used for all portable cells, glass for stationary ones. In rubber jars the plates rest on narrow bridges raised up across the bottom to prevent short-circuiting due to collection of material gradually dropped from the plates; in glass jars and in tanks the plates have extra supporting lugs to hang from the sides of the jar or rest on glass plates set along the sides of the lead-lined tanks.

Aside from lead storage batteries, the only other type that is much used on a commercial scale is the nickel-iron or alkaline battery, generally known as the Edison storage battery. In its present form this was introduced in 1909. Its positive active material is nickel peroxide and the negative is finely divided iron; the electrolyte is a solution of potassium hydroxide of about 21% concentration. During discharge the iron is oxidized and the nickel peroxide reduced to a lower oxide; during charge the iron is again reduced and the nickel reoxidized to the higher nickel peroxide; the electrolyte seems to play only a passive or catalytic part in the reactions, whose exact nature is not definitely known.

The construction of the Edison battery plates and the entire cell is an ingenious combination of electrical, chemical and mechanical skill. The positive plate is a nickel-plated steel frame or strong grid; tubular and perforated pockets of similar metal are filled with nickel hydrate and nickel flakes in alternate layers under pressure and these pockets are pressed into the spaces in the frame or grid. The negative plate consists of a similar grid but with rectangular openings, into which are pressed nickel-steel pockets filled with finely divided iron and some mercury. Each plate is subjected to high pressure to practically weld the pockets to the grid and in the negative to also corrugate the pocket surfaces. The plates are separated by means of hard rubber washers and spacers and are joined into the respective positive and negative groups by being bolted together on a steel stud carrying the terminal post. The jar is of corrugated nickel-plated sheet steel, and the cell cover also; the latter has a vent for the gas liberated on charge and for adding water. All connections are bolted, not burned. A narrow space is left around the cells to aid in keeping them cool.

On charge, the Edison cell voltage rises from about 1.55 to 1.8; during discharge it falls from about 1.45 to 0.9, the average e.m.f. being about 1.2 volts. The electrolyte density does not change appreciably. The cell temperature rises during charge and should not exceed 115° F. under any conditions. If the cell temperature is very low, the capacity is greatly diminished, although the cell is not damaged thereby. In very cold weather the battery should be kept at a temperature above 40° F. The cells are very rugged, can be charged and discharged at various rates (within the critical temperature limits) and may stand discharged for some time. Their capacity is higher for the same weight, but their efficiency slightly lower than that of lead storage cells. The discharge voltage being lower, a larger number of cells must be used to make a battery of any desired voltage.

The principal classes of service for storage batteries are given in the following articles and listings.

BATTERIES, STORAGE, AUTOMOTIVE IGNITION, LIGHTING AND STARTING.—Considering a battery to be a set of cells, more storage batteries are produced and sold annually for use on gasoline automobiles than for any other single type of service. They are usually standardized for 6 or 12 volts, consisting of 3 or 6 cells, respectively, in the case of lead batteries; for starting service 16, 18, 24, and 30 volts are also used occasionally. The cells are connected in series and placed in a box whose dimensions depend on the space set apart for it on each particular make of car. Some effort has been made to standardize these dimensions, but there is still a wide divergence among them. If the battery is used for ignition service alone, or lighting alone, or for ignition and lighting, it is not called on to carry any large load at one time; it should have ample capacity, however, to carry the load for a long time, as there may be long intervals between charges. For starting service the battery has to carry a heavy load with most engine starts, especially in cold weather. It should have a high discharge-current rating and ample reserve capacity for cases where special difficulty is experienced in starting

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the engine or where the engine has to be started frequently with the probability that the battery may not have been adequately charged during the short times that the engine was running and driving the generator at charging speed. These considerations are usually taken care of in the design and construction of starting batteries, and their success is shown by the rapid increase in the installation of electric starting equipment on automobiles. Since the starting load is the most important one of starting batteries, their ignition and lighting load is a minor or incidental feature. The same types of batteries that are used for automobile ignition, lighting and starting are also used for similar automotive services on motorboats, airplanes, tractors, stationary gas, oil or gasoline engines, etc.

Manufacturers:

Acme Storage Battery Corp., 19 Main St., Poughkeepsie, N. Y. "Acme."
Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C."
American Bureau of Engineering, Inc., 1601-03 S. Michigan Ave., Chicago, Ill. "Ambu."
American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. and Orton St., Long Island City, N. Y. "Eveready."
Am-Plus Storage Battery Co., 741 Van Buren St., Chicago, Ill. "Am-Plus."
Ashbrook Electric Co., 4111 Ravenswood Ave., Chicago, Ill. "Ashbrook."
Atlas Electric Storage Battery Co., Greenville, Mich. "Atlas."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Campbell Electric Co., 1529 Wyandotte St., Kansas City, Mo.
Calumet Storage Battery Co., 10113 Indianapolis Ave., Chicago, Ill. "Epoch."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hart Accumulator Co., Ltd., Drummond Bldg., Montreal, Que., Can.
Carbon Products Co., The, Lancaster, Ohio. "C. P. C."
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y. "Champion."
Cincinnati Storage Battery Co., The, Moormann Ave., near Madison Rd., Cincinnati, Ohio, "Cincinnati."
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill. "Cole," "Realive."
Cooper Storage Battery Co., Dunbar St. and B. & O. R. R., Cincinnati, Ohio. "Cooper."
Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.
Croftan Storage Battery Co., 423-425 W. Queen St., Toronto, Ont., Can. "Vulcan."
Dealers Electric Lighting Co., 500 E. 40th St., Chicago, Ill. "Perfection."
Dixie Battery & Mfg. Co., Pine Bluff, Ark. "Dixie." (Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.)
Dixie Storage Battery Co., 1412-19 Lafayette Ave., Baltimore, Md. "Dixie."
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
EDISON STORAGE BATTERY CO., Orange, N. J. (Automobile ignition and lighting only.) For the construction, characteristics and uses of the Edison Storage Battery, see this company's statement under Batteries, storage, electric car, locomotive, etc. Also see page 1313.—Adv.
Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia, Pa. "Exide."
Endurance Battery Corp., 580 Hudson St., New York, N. Y. "Endurance."
Ermet Mfg. Co., 16th St. and Sherman Drive, Indianapolis, Ind.
Eureka Battery Co., 1254 Addison St., Chicago, Ill.
Ex-Cel Battery Works, Inc., 1502 S. Wabash Ave., Chicago, Ill. "X L."
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C., "Federal."
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y. "Powerpaks."
Fritchle Electric Co., The, 1544 Clarkson St., Denver, Colo.
General Lead Batteries Co., Chapel St. and Lister Ave., Newark, N. J. "Titan."
General Storage Battery Co., 2005 Locust St., St. Louis, Mo. "General."
Gold Seal Storage Battery Co., Green Bay, Wis. "Gold Seal."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo. "Lion."
Heissler Storage Battery Co., 2506-10 Cottage Grove Ave., Chicago, Ill.
Hinsdill Electric Co., 225 River St., Troy, N. Y. "Lincoln."
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
KLAUS RADIO CO., Eureka, Ill.
Lyons Storage Battery Co., Inc., Stephen Girard Bldg., Philadelphia, Pa. "Lyons."
Mac-Lar Battery Co., Inc., 146 3rd St., Detroit, Mich. "Master."
Marko & Co., Inc., Paul M., 1402-12 Atlantic Ave., Brooklyn, N. Y.
Milwaukee Auto Specialty Mfg. Co., Inc., 711 Chestnut St., Milwaukee, Wis. "Masco," "Radium."
Minimax Electric & Mfg. Co., Ltd., The, Maissonneuve, Montreal, Que., Can. "High Power."
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Multiple Storage Battery Co., Van Wyck Ave. and L. I. R. R., Jamaica, L. I., N. Y. "Multiple."
National Carbon Co., Inc., Highland and Madison Aves., Cleveland, Ohio. "Columbia."
North American Storage Battery Co., 40-44 W. North St., Indianapolis, Ind.
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection."
Philadelphia Storage Battery Co., Ontario and C Sts., Philadelphia, Pa. "Philco Retainer," "Philco," "Diamond Grid."
Pioneer Storage Battery Co., 1415 Race St., Philadelphia, Pa. "Pioneer."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind. "Prest-O-Lite."
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can. "Prest-O-Lite."
Ray Battery Co., Huron St., N., Ypsilanti, Mich.
Rochester Storage Battery Co., Inc., 28-30 Scio St., Rochester, N. Y. "Rochester."
Samson Battery Mfg. Co., 230-300 E. 4th St., Fort Wayne, Ind. "Samson."
Smith Battery Co., F. V. L., 10½ Auburn Ave., Atlanta, Ga. "Dixie."
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex. "Standard," "Captive Force."
Star Storage Battery Co., 309-313 N. Jefferson St., Muncie, Ind. "Star."
Storage Battery & Appliance Corp., The, Philadelphia, Pa. "Eureka."
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Universal Battery Co., 3410-3434 S. LaSalle St., Chicago, Ill. "Universal."
Utility Battery Co., 123 W. Madison St., Chicago, Ill. "Utility."
Vesta Battery Corp., 2100 Indiana Ave., Chicago, Ill.
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."
Westinghouse Union Battery Co., Swissvale, Pa.
Willard Storage Battery Co., 246-286 E. 131st St., Cleveland, Ohio. "Willard."
WITHERBEE STORAGE BATTERY CO., INC., 643-655 W. 43rd St., New York, N. Y. "Witherbee."
Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky. "Red Cap."

BATTERIES, STORAGE, CENTRAL STATION.—The value of the storage battery as an instantaneously available reserve in case of a system disturbance of a central station has long been recognized. In the central parts of large cities where d-c. service is supplied and where continuity of this service is of great importance, battery capacity is provided at great cost to maintain the system pressure when there is an interruption of the power supply. Such batteries are usually of the lead type and are of large capacity. They are usually mounted in lead-lined tanks in separate battery rooms. They are used mostly in substations, also in generating stations as a reserve source of excitation current, station lighting current and sometimes of switch control current. Central-station batteries usually "float" on the line, that is, operate in parallel with the bus voltage without much charge or discharge, but ready for immediate discharge if the bus or line voltage fails. Electric railway systems also use this type of battery for similar purposes.

Manufacturers:

Canadian Hart Accumulator Co., Ltd., Drummond Bldg., Montreal, Quebec, Canada.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia, Pa. "Exide."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Universal Battery Co., 3410 S. LaSalle St., Chicago, Ill. "Universal."
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."

BATTERIES, STORAGE, ELECTRIC CAR, LOCOMOTIVE, VEHICLE, TRACTOR AND TRUCK.—Compactness and as light weight per ampere-hour of capacity as is consistent with rugged construction are predominating requirements of storage batteries for use in propelling vehicles and conveyances of any sort, including mining and some switching locomotives, street cars, omnibuses, electric pleasure vehicles, commercial vehicles and heavy trucks, industrial tractors and trucks, electric launches, etc. Both the nickel-iron and thin-plate lead types of battery are used very largely for this service. The lead cells are invariably in rubber jars. In any case the cells are grouped in trays holding various numbers of cells depending on the space available in the battery compartments of the vehicles. The size of the cells depends on the load and the number of hours they are to carry it before recharge, plus a reserve allowance. For most purposes such a number of cells is used in one battery as will permit most economical charge on standard 110 to 120-volt d-c. circuits, that is, with as little resistance in the charging circuit as possible and yet permit current adjustment. For lead batteries 40 to 44 cells are most common for vehicle and heavy truck service. For tractors and industrial trucks, smaller numbers of cells are often used because of the lack of space. Wherever it is possible to give a boosting charge during one or more intervals in the regular daily service of the locomotive, vehicle or conveyance, such charges serve to improve the battery condition and permit a somewhat smaller capacity to suffice.

Manufacturers:

"Ads-it" Battery Mfg. Co., 825 Hennepin Ave., Minneapolis, Minn. "Ads-It."
Campbell Electric Co., 1529 Wyandotte St., Kansas City, Mo.
Canadian Hart Accumulator Co., Ltd., Drummond Bldg., Montreal, Que., Can.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Champion Storage Battery Corp., Poughkeepsie, N. Y. "Champion."
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill. "Cole." "Realive."
Croftan Storage Battery Co., 423-425 W. Queen St., Toronto, Ont., Can. "Vulcan."
Dixie Battery & Mfg. Co., Pine Bluff, Ark. "Dixie." (Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.)
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
EDISON STORAGE BATTERY CO., Orange, N. J. In the late nineties, realizing the importance of improvement in electrical accumulators or storage batteries, Thomas A. Edison undertook a thorough study of the problem and by years of intensive work developed the nickel - iron - alkaline storage battery which today bears his name. The Edison storage battery employs a principle differing radically from that of all other storage batteries having commercial importance at the present time. It is the only storage battery having iron or steel in its construction. Instead of lead grids, its grids are of steel. Instead of rubber or glass jars, its container is of steel. Instead of acid electrolyte, it employs an alkaline solution. Its active materials are compounds of nickel and iron instead of compounds of lead. This gives the Edison battery a wonderful permanence of structure, of capacity and of endurance. The chemical reactions do not destroy the mechanical strength of the battery—rather the alkaline solution is a preservative of the iron and steel members. Many exclusive advantages result from its distinctive characteristics. It is light in weight. The steel container is unbreak-

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able. It suffers small loss of charge when idle. No frequent hydrometer readings are necessary. The tray assembly and cell connections are simple. Severe vibration and concussion have no effect upon it. It steadily increases in capacity for the first eight or twelve months. Temperature of electrolyte may rise to 115° F. without harm. Sulphation and kindred "diseases," like buckling or growing of plates, are impossible. It may be boosted at high rates, several times normal rate being safely recommended for short periods. It is hermetically sealed except for the single filler opening; no plate renewals, no wood separator renewals or other repairs are needed. It may be left standing idle, either charged or discharged, for months at a time without injury and with absolutely no attention. It gives off no noxious fumes and can be placed in any environment without fear of corroding near-by metal or injuring persons in the neighborhood. It can be put on charge at any time, regardless of how little or how much of the previous charge has been used and, similarly, it may be taken off charge at any time and used, whether fully charged or not. The Edison cell-to-cell connectors are made of copper and are practically unbreakable. There are no lead straps to burn out with subsequent delay and expense incident to their repair. Accidents that are bound to occur occasionally, as for example short circuits, continued overcharges, charges in the reverse direction, excessive "boosting," or charging at too low rate have no permanent effect upon its life. The many applications that furnish proof of the reliability, strength, long life and low maintenance cost of the Edison battery include electric street trucks, storage-battery locomotives, storage-battery industrial trucks and tractors, railway car lighting and signal operations, multiple-unit control, railway storage-battery cars, electric safety mine lamps, marine lighting and ignition, radio service, gasoline truck lighting and ignition, meter testing, etc. The number of ways in which an Edison Battery can be used is not limited. Although it has been on the market since 1908, new applications are being found continually. Bulletins descriptive of the Edison battery in many and varying applications (including those mentioned above) may be obtained by addressing the Edison Storage Battery Co., Orange, N. J. (See also page 1313.)—Adv.

Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia, Pa. "Exide."
Ermet Mfg. Co., 16th St. and Sherman Drive, Indianapolis, Ind.
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
General Lead Batteries Co., Chapel St. and Lister Ave., Newark, N. J. "Titan."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
Heissler Storage Battery Co., 2506-2510 Cottage Grove Ave., Chicago, Ill.
K. W. Battery Co., 1532-1534 S. Michigan Ave., Chicago, Ill. "K.W."
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Multiple Storage Battery Co., Van Wyck Ave. and L. I. R. R., Jamaica, L. I., N. Y. "Multiple."
North American Storage Battery Co., 40-44 W. North St., Indianapolis, Ind.
Philadelphia Storage Battery Co., Ontario and C Sts., Philadelphia, Pa. "Philco Retainer." "Philco," "Diamond Grid."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind. "Prest-O-Lite."
Prest-O-Lite Co. of Canada, Ltd., Hillcrest park, Toronto, Ont., Can. "Prest-O-Lite."
Smith Battery Co., F. V. L., 10½ Auburn Ave., Atlanta, Ga.
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Universal Battery Co., 3410-3424 S. LaSalle St., Chicago, Ill. "Universal."
Volkcar Storage Battery Co., 220-222 E. 25th St., Chicago, Ill. "Volkcar."
Westinghouse Union Battery Co., Swissvale, Pa.
Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky. "Red Cap."

BATTERIES, STORAGE, HOUSE LIGHTING.—These batteries are used chiefly with farm lighting plants and for similar isolated plant service, such as for country clubs, summer resorts, etc., remote from the lines of electric light and power companies. The generating set in such plants is usually a gasoline-engine driven outfit, whose operation at night would be inconvenient and noisy. Provision of a storage battery which carries the load at night and in other times of light load permits shutting down the engine at those times. A relatively small number of fair sized cells is preferable to a large number of small cells; for this reason 16 cells, giving a nominal discharge potential of 32 volts (with lead batteries), constitute the standard battery. Occasionally 110-volt service is given for which a lead battery of 55 to 62 cells may be installed. The size or rated capacity of the cells will depend on the maximum amount of load and the length of time the battery is expected to carry it. A minimum of 50 amp-hr. should be provided; in a large installation in which the battery is to carry the load for possibly two days in an emergency the battery capacity may have to be ten times as large, though this is very exceptional. Both glass-jar and rubber-jar batteries are used. Where there is available an airy room with suitable shelving, glass jars are preferable as they permit ready and frequent inspection of the cells. In some cases auxiliary "end" cells are provided to permit maintaining more constant voltage during discharge and also to permit having constant voltage on any load circuits supplied during charge. The latter type of cells are simpler and easier to take care of: they consist merely of skeleton grids without active material and are called counter e. m. f. cells. Also see Farm lighting plants.

Manufacturers:

A-C Electrical Mfg. Co., 4th St. U. B. Bldg., Dayton, Ohio. "Dayton."
Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C."
Campbell Electric Co., 1529 Wyandotte St., Kansas City, Mo.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Dealers Electric Lighting Co., 500 E. 40th St., Chicago, Ill. "Perfection."
EDISON STORAGE BATTERY CO., Orange, N. J. For the construction, characteristics and uses of the Edison Storage Battery, see this company's statement under Batteries, storage, electric car, locomotive, etc. Also see page 1313.—Adv.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa. "Exide."
Eureka Battery Co., 1254 Addison St., Chicago, Ill.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C. "Federal."
General Lead Batteries Co., Chapel St. & Lister Ave., Newark, N. J. "Titan."
Globe Electric Co., Milwaukee, Wis. "Globe."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
Guaranteed Battery Co., 2017-2025 Lucas Ave., St. Louis, Mo. "Lion."
Minnesota Storage Battery Co., 206-210 N. 4th St., Minneapolis, Minn.
North American Storage Battery Co., 40-44 W. North St., Indianapolis, Ind.
Perfection Storage Battery Co., 500-508 E. 40th St., Chicago, Ill. "Perfection."
Samson Battery Mfg. Co., 230-300 E. 4th St., Fort Wayne, Ind. "Samson."
Universal Battery Co., 3410-3424 S. La Salle St., Chicago, Ill. "Universal."
Western Cable & Light Co., Baldwin, Wis.
Westinghouse Union Battery Co., Swissvale, Pa.
Willard Storage Battery Co., 246-286 E. 131st St., Cleveland, Ohio. "Willard."
Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky. "Red Cap."

BATTERIES, STORAGE, MISCELLANEOUS.—Aside from the six main classes of service specifically listed herewith, storage batteries find extensive use for a great many other purposes. Among these is their frequent use for miners' safety lamps, a compact and light-weight battery being carried on the miner's back and connected to the lamp on his cap. Firemen sometimes use similar lamps and also portable electric lanterns containing a compact storage battery; for this service such batteries give steadier and more dependable light for several hours steady than dry-cell outfits can give. Storage batteries are also used for other miscellaneous portable uses, such as in laboratories where a constant d-c. voltage is often needed in special tests, for temporary lighting of a Christmas tree or operation of a fan in a sick room where standard electricity service is not available, etc. Stationary batteries are also installed in many laboratories, for general testing, in theaters for emergency lighting, likewise in hospitals and other institutions. On shipboard storage batteries are frequently used, especially on naval vessels; on submarines they constitute the sole source of power and lighting while the vessel is submerged; on battleships they are used for much emergency lighting, signaling and control; on all vessels carrying 50 passengers or more it is required that an emergency source of electrical energy be provided for the radio equipment which in most cases is a storage battery. Among other uses is the operation of certain types of multiple-unit railway control systems, operation of oil switches in power houses and important substations, operation of circuit breakers and other equipment under the control of relays, etc. The number of all such miscellaneous uses is so large that it calls for various numbers of cells, cell sizes, types, methods of assembling and mounting that are best suited to the requirements of each individual case.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C."
American Battery Co., 1134 Fulton St., Chicago, Ill. "American."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Hart Accumulator Co., Ltd., Drummond Bldg., Montreal, Que., Can.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Cincinnati Storage Battery Co., The, Moormann Ave. near Madison Rd., Cincinnati, Ohio. "Cincinnati."
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill. "Cole," "Realive."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Croftan Storage Battery Co., 423-5 W. Queen St., Toronto, Ont., Can. "Vulcan."
Dixie Battery & Mfg. Co., Pine Bluff, Ark. "Dixie." (Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.)
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
EDISON STORAGE BATTERY CO., Orange, N. J. For multiple-unit control; oil switch control; emergency lighting and radio in marine service; with the Edison Safety Mine Lamps, which are used in thousands of gaseous mines, principally in the bituminous coal industry, but also in the anthracite and the metal mine. For the construction, characteristics and uses of the Edison Storage Battery, see this company's statement under Batteries, storage, electric car, locomotive, etc. Also see page 1313.—Adv.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa. "Exide."
Endurance Battery Corp., 580 Hudson St., New York, N. Y. "Endurance."
Ermet Mfg. Co., 16th St. & Sherman Drive, Indianapolis, Ind.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C. "Federal."
FEDERAL ELECTRIC CO., 84th & State Sts., Chicago, Ill. (See display advertisement on page 1291.)
Fritchle Electric Co., The, 1544 Clarkson St., Denver, Colo.
Gem Storage Battery Co., 1332 W. 21st St., Chicago, Ill. "Gem."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y. (Wireless and submarine.)
Heissler Storage Battery Co., 2506-10 Cottage Grove Ave., Chicago, Ill.
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
MacRae, Hector C., 314 St. Paul St., Baltimore, Md. "Champion Accumulator."
Marcuson, E., 70 Cortlandt St., New York, N. Y.
Marko & Co., Inc., Paul M., 1402-12 Atlantic Ave., Brooklyn, N. Y.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Multiple Storage Battery Co., Van Wyck Ave. & L. I. R. R., Jamaica, L. I., N. Y. "Multiple."
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection."
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa. "Philco Retainer," "Philco," "Diamond Grid."

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Pioneer Storage Battery Co., 1415 Race St., Philadelphia, Pa. "Pioneer."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind. "Prest-O-Lite."
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can. "Prest-O-Lite."
Ray Battery Co., Huron St., North, Ypsilanti, Mich.
Smith Battery Co., F. V. L., 10½ Auburn Ave., Atlanta, Ga. "Dixie."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."
WITHERBEE STORAGE BATTERY CO., INC., New York City. Witherbee storage batteries have been synonymous since 1903 with utmost dependability and longest life. Every part is made in the Witherbee factories to insure its meeting with the rigid standards of this company. Plates, separators, jars, case, are all of latest approved design and foremost construction.—Adv.

BATTERIES, STORAGE, RAILROAD CAR LIGHTING.—When either the straight storage system or the axle-driven generating system is provided for the lighting of steam-railroad sleeping, parlor, dining or other passenger cars, a storage battery is installed on each car. For this service 32 volts has been practically standardized and is provided by 16 cells, if lead batteries are used. Special care is taken in the construction of batteries for this service. The plates, separators, connections and jars are of rugged design to withstand constant vibration and other severe treatment. These batteries usually conform to the specifications of the Association of Railway Electrical Engineers. The cells are placed in substantial trays that are set in a box hung below the car floor. For the straight storage system the battery must have sufficient capacity to carry the load for an entire night run; for the axle system the battery need be of capacity merely to carry the load while the train is standing or running at low speed and also while the car is detached from the train. (Also see Car lighting equipments, railway.)

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. and Orton St., Long Island City, N. Y. "Ever Ready."
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Dixie Battery & Mfg. Co., Pine Bluff, Ark. "Dixie." (Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.)
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
EDISON STORAGE BATTERY CO., Orange, N. J. For the construction, characteristics and uses of the Edison Storage Battery, see this company's statement under Batteries, storage, electric car, locomotive, etc. Also see page 1313.—Adv.
Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia Pa. "Exide."
Ermet Mfg. Co., 16th St. and Sherman Drive, Indianapolis, Ind.
General Lead Batteries Co., Chapel St. and Lister Ave., Newark, N. J. "Titan."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Multiple Storage Battery Co., Van Wyck Ave. and L. R. R. R., Jamaica, L. I., N. Y. "Multiple."
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection."
Ray Battery Co., Huron St., N., Ypsilanti, Mich.
Smith Battery Co., F. V. L., 10½ Auburn Ave., Atlanta, Ga. "Dixie."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Willard Storage Battery Co., 246-286 E. 131st St., Cleveland, Ohio. "Willard."
Westinghouse Union Battery Co., Swissvale, Pa.
Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky. "Red Cap."

BATTERIES, STORAGE, TELEGRAPH, TELEPHONE AND OTHER SIGNALING.—For telephone exchanges, telegraph exchanges and important stations, railway signaling systems employing direct current, fire-alarm and sometimes also burglar-alarm systems, auxiliary batteries for radio stations, and other signaling and communication service, storage batteries have come into extensive use. They have replaced primary batteries for such service to a very large extent, because they can be made of any desired capacity and give more dependable service since their operation and maintenance are quite simple and must be made systematic. These batteries are almost invariably stationary and are usually of the glass-jar type, except for large telephone or telegraph exchanges in which lead-lined tanks are used, and in some radio batteries for which rubber-jar sets, made up like automobile starting or lighting batteries, are employed. For small batteries in glass jars couples are frequently used; these have only one positive and one negative plate in each cell, the positive plate of one cell being permanently burned to the lead strap of the negative plate of the next cell, thus giving a series connection without use of intermediate connecting bolts or other battery connectors.

Manufacturers:

American Battery Co., 1134 Fulton St., Chicago, Ill. "American."
American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Cincinnati Storage Battery Co., The, Moormann Ave. near Madison Rd., Cincinnati, Ohio. "Cincinnati."
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill. "Cole," "Realive."
Croftan Storage Battery Co., 423-5 W. Queen St., Toronto, Ont., Can. "Vulcan."
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
EDISON STORAGE BATTERY CO., Orange, N. J. For the construction, characteristics and uses of the Edison Storage Battery, see this company's statement under Batteries, storage, electric car, locomotive, etc. Also see page 1313.—Adv.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa. "Exide."
Endurance Storage Battery Corp., 580 Hudson St., New York, N. Y. "Endurance."
Ermet Mfg. Co., 16th St. & Sherman Drive, Indianapolis, Ind.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C. "Federal."
Gem Storage Battery Co., 1332 W. 21st St., Chicago, Ill. ("Gem" radio.)
General Lead Batteries Co., Chapel St. & Lister Ave., Newark, N. J. "Titan."
Gould Storage Battery Co., 30 E. 42nd St., New York, N. Y.
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
Heissler Storage Battery Co., 2506-10 Cottage Grove Ave., Chicago, Ill.
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
KLAUS RADIO CO., Eureka, Ill.
Marcuson, E., 70 Cortlandt St., New York, N. Y.
Marko & Co., Inc., Paul M., 1402-12 Atlantic Ave., Brooklyn, N. Y.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Multiple Storage Battery Co., Van Wyck Ave. & L. I. R. R., Jamaica, L. I., N. Y. "Multiple."
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection."
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa. "Philco Retainer." "Philco." "Diamond Grid."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind. "Prest-O-Lite."
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can. "Prest-O-Lite."
Radio Corp. of America, 233 Broadway, New York, N. Y.
Ray Battery Co., Huron St., North, Ypsilanti, Mich.
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Universal Battery Co., 3410-3424 S. La Salle St., Chicago, Ill. "Universal."
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."
Westinghouse Union Battery Co., Swissvale, Pa.
Willard Storage Battery Co., 246-286 E. 131st St., Cleveland, Ohio. "Willard."
Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky. "Red Cap."

BATTERMAN-TRUITT CO. — Chicago, Ill. Manufacturer of motor-driven blowers and ventilating fans. Business established 1916. President and sales manager, J. E. Truitt; vice-president, E. Ackerman; secretary and treasurer, Theodore F. Le Jeune. Main office and factory, 736 W. Monroe St., Chicago, Ill. Branch offices, 1018 Majestic Bldg., Milwaukee, Wis.; 110 State St., Boston, Mass.; 2002½ Live Oak St., Dallas, Tex.; 950 Ellicott Sq., Buffalo, N. Y.; Equitable Bldg., Baltimore, Md.; 1924 Grand Ave., Kansas City, Mo.; 1710 Glenarm St., Denver, Colo.; 28 Woodbridge St., East, Detroit, Mich.; 1125 W. 32nd St., Indianapolis, Ind.; 230 5th Ave., Pittsburgh, Pa.; 534 Bienville St., New Orleans, La.; 122 N. 7th St., St. Louis, Mo.; 919 Ulmer Bldg., Cleveland, Ohio; 922 Sansom St., Philadelphia, Pa.; 23 W. 3rd St., Cincinnati, Ohio. Sales representatives, Northwestern Electric Equipment Co., 174 E. 6th St., St. Paul, Minn.; McCrum & Gillem, 1011 Empire Bldg., Birmingham, Ala.; C. O. Hall, 147 W. 35th St., New York, N. Y.; Walker-Lilly Electric Co., 912 Lincoln Bank Bldg., Louisville, Ky.

BATTERSEA.—Trade name for flexible connectors for brushes, contacts, etc., manufactured by the Morganite Brush Co., Inc., 518 W. 38th St., New York, N. Y.

BATTERY APPLIANCE CORP.—3 E. 44th St., New York, N. Y. Manufacturer of battery ammeters and battery-charging rheostats.

BATTERY-CHARGING EQUIPMENT.—See Cable, battery-charging; Motor-generators for battery charging; Panels, battery-charging; Plugs, battery-charging; Receptacles, battery-charging; Rectifiers, battery-charging; Rheostats, battery-charging; Switchboards, battery-charging.

BATTERY-CHARGING SETS, COMPLETE.—This classification includes complete outfits used for the charging of storage batteries, usually consisting of a motor-generator, synchronous converter, rectifier or engine-driven generator, together with the necessary rheostats or control apparatus, instruments and protective devices, all of which is mounted on a single base or frame, or otherwise constructed as a unit. These are usually small sets for use in gasoline-vehicle garages, or small private electric garages, telephone exchanges, fire-alarm central stations, etc.

Manufacturers:

Acme Electric & Mfg. Co., The, 1444 Hamilton Ave., Cleveland, Ohio. "Acme."
Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Alamo Farm Light Co., 703 Tower Bldg., Chicago, Ill.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
American Battery Co., 1134 Fulton St., Chicago, Ill. (rectifier sets). "American."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRICAL DEVICES CO., THE, 120 W. Third St., Cincinnati, Ohio. Manufacturers of automatic battery charging devices for charging all types of storage battery vehicles. Each Uni-panel section is a complete stand-



Battery Charging Set

ardized charging unit. All of the various type Uni-panel charging and meter sections are of the same size and are interchangeable. These sections can be furnished equipped with a discharge switch if desired, and initial installation may consist of but one panel. One Uni-panel instrument section will read any reasonable number of charging circuits, and additional sections may be added as desired. All connections are made at a common point

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on the rear of each unit. Adjustable resistance grids, nickel plated to prevent rust and make better contact, are used exclusively, and can be quickly removed individually, without disturbing remainder. Slate panel does not carry weight of grids or frame. Uni-panels are arranged for automatic charging, where an electric chargometer is used and charges battery at normal and boost rates. These panels can be used for charging two similar sets of Edison batteries in series. Uni-panel construction provides the most flexible, compact and efficient charging equipment available. They are built in two principal types, type W, for charging lead and Edison batteries, and type WM, for charging two similar sets of Edison batteries. The latter, for industrial vehicles only, is of the series type and is particularly economical.—Adv.

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Blau Service, Inc., 682 Montgomery St., Jersey City, N. J.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Duplex Storage Battery Co., Beaver Dam, Wis. "Duplex."
Electric Products Co., The, Cleveland, Ohio. "Wotton."
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
GENERAL ELECTRIC CO., Schenectady, N. Y. Self-contained motor generator sets with panels, larger sets for multiple battery charging with battery charging switchboards, rectifiers of mercury arc and ionized gas or Tungar types, rheostats, plugs, etc. See descriptions under separate items and adv. pages 1203-1223.—Adv.
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
Hertner Electric Co., The, 1905 W. 114th St., Cleveland, Ohio.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Leich Electric Co., Genoa, Ill.
Litscher Lite Corp., 1138-40 Monroe Ave., Grand Rapids, Mich.
Main Electric Co., Cleveland, Ohio. "Main."
Marble-Card Electric Co., Gladstone, Mich.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Munning & Co., A. P., Church St., Matawan, N. J.
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio.
Ross Engineering Co., J. J., 1006 E. Larned St., Detroit, Mich. "Ross Junior."
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U. S. E. M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv., pages 1395-1402.)

BATTERY CHEMICALS AND ELECTRODES.—See Ammonium chloride; Carbons, battery; Copper sulphate; Coppers, battery; Electrolyte, storage battery; Electrolyte, miscellaneous; Manganese dioxide; Sulphuric acid; Zincs, battery; Chemicals, battery, miscellaneous.

BATTERY EQUIPMENT & SUPPLY CO.—1400 S. Michigan Ave., Chicago, Ill. Manufacturer of battery repair shop equipment. President, A. Gershman; vice-president, H. Block; secretary and treasurer, R. Block.

BATTERY, FLOATING.—See Floating battery.

BATTERY INSTRUMENTS.—See Ammeters, battery and pocket; Hydrometers; Testers, battery; Voltammeters, battery and pocket; Voltmeters, battery and pocket.

BATTERY PARTS AND ACCESSORIES.—See Boxes, battery; Cabinets, battery; Compounds, battery sealing; Connectors, battery; Covers, battery jar; Enamels, storage battery; Holders, battery; Jars, battery; Plates, battery; Separators, storage battery; Siphons, acid; Switches, battery; Switches, end cell; Syringes, acid; Tanks, lead-lined, for large storage batteries; Trays, storage battery; Wells, railway signal battery.

BATTERY REPAIR-SHOP EQUIPMENT.—The repair and maintenance of storage batteries requires some special tools and equipment. A few of the most important items, such as lead-burning outfits and tools, hydrometers, rubber aprons and gloves, carboy rockers, ammeters, voltmeters, testers, rheostats, water stills, etc., are listed separately. In addition to these it is necessary that the proper vises, battery turntables, burning racks, etc., be provided for handling the battery while repairing it. Post builders for the various round and square terminal posts are required and burning collars of several shapes are also used. To soften the sealing compound battery steamers or ovens are used. Removing the elements from the battery jar also requires special tools, such as plate and lug pullers. For handling the acid, special syringes, funnels, pitchers, gloves, sleeves, etc., are often provided. Miscellaneous tools, such as punches, shave hooks, battery knives, lead rasps, wire brushes, lead cutters, etc., are also included in this class.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Ashbrook Electric Co., 4111 Ravenswood Ave., Chicago, Ill. "Ashbrook."
Battery Equipment & Supply Co., The, 1400 S. Michigan Ave., Chicago, Ill. "Besco."
BATTERY TOOLS CO., 29 A. N. Willow St., Montclair, N. J. (battery steamer). "Batoco."
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Illinois Battery Steamer Co., 607 Spencer St., Peoria, Ill. (Battery steamers and stills.) "Ibsco."
Orum, S. R. M., North Philadelphia, Pa. "Super Six."
Reliable Mfg. Co., The, Cleveland, Ohio. ("Reliable" battery filler.)
Service Station Supply Co., 30-32 Larned St., Detroit, Mich. "Hyrate."
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
Thompson Mfg. Co., Meadville, Pa. ("Press-Sure" terminal tongs, terminal reamers, etc.)
Xander, J. G., 824 Court St., Reading, Pa. ("Universal" cleaners for battery terminals.)

BATTERY SYSTEMS, TELEPHONE.—Telephone systems make use of several methods of connection for their batteries, which are usually storage batteries in the modern systems.

Local Battery. What is commonly known as the "local-battery" system is the older arrangement of apparatus in a telephone which placed an electric battery (usually of dry cells) in each telephone to supply current to its transmitter. It usually has a magneto generator to signal others and is sometimes called the "magneto system."

Common Battery. The more modern arrangement, "common battery," is an arrangement of telephone apparatus which supplies all the transmitters connected to a central office with direct current from one storage battery at the office. It makes the telephone instrument simpler and the signals more positive than the magneto or local-battery system.

Common-battery systems are divided into three general types known as the Stone, Hayes and impedance-condenser systems. The first is an arrangement of common battery for feeding direct current to telephones which places the battery in a bridge across the line, with one or two impedance coils in series with the battery. The battery current divides, part going to one telephone and part to the other. It is not much used any more, because the shorter of two subscriber lines robs the longer one of current.

The Hayes common-battery system is the common-battery feed which uses a repeating coil to join together the two subscriber lines. The repeating coil has four sections or windings. The battery is in the center and feeds current through two windings to one subscriber and through the other two windings to the other subscriber. Each line gets all the current which its resistance permits. The battery must be very quiet, for all the talking current goes through it, and any disturbance in the battery makes the telephone connection noisy.

The impedance-condenser system is a common-battery feed which has one impedance coil (of two windings) for each subscriber line, and connects the two subscriber lines by condensers. The impedance coils permit the battery current to flow, but prevent much of the alternating talking current from passing across from one wire to the other of the line. The condensers keep the battery feeds separate, but permit the alternating talking current to flow between the telephones. The battery does not need to be very quiet, because the talking current does not go through it and the impedances keep the battery noise out. Each telephone line gets all the current which its resistance permits.

One pole of the battery, usually the positive, is connected to earth or ground. This is then referred to as a "ground battery." A supervised battery is a battery feed wire for a group of apparatus, so called when it contains a low-resistance relay to give supervision if too much current is drawn, or if the usual amount be drawn for too long a time.

BATTERY-TEST-O-METER. — Trade name for storage battery testing set manufactured by A. E. Moeller, 261-3-5 Sumpter St., Brooklyn, N. Y.

BATTERY TOOLS CO.—29 A. N. Willow St., Montclair, N. J. Manufacturer of battery tools. C. R. Wickham, sole owner.

BATTLE CREEK.—Trade name for electric light baths manufactured by the Sanitarium Equipment Co., Battle Creek, Mich.

BAUDETTE CEDAR CO.—Box 615, Baudette, Minn. Producer of cedar poles and railway ties. Business established 1914. George D. Arnold, manager.

BAU.—Trade name for conduit box manufactured by the Pratt-Chuck Co., Frankfort, N. Y.

BAUER.—Trade name for electric washing machines manufactured by the Vulcan Mfg. Co., 1511 Cypress Ave., Kansas City, Mo.

BAUER BROS. CO., THE.—Springfield, Ohio. Manufacturer of electric feed grinders. President, Charles L. Bauer; vice-president, L. E. Bauer; secretary, W. E. Copenhaver.

BAUER ELECTRIC.—Trade name for electric washing machines manufactured by the Vulcan Mfg. Co., 1511 Cypress St., Kansas City, Mo.

BAUER, INC., H. A.—Lansdowne, Pa. Manufacturer of lighting fixtures.

BAUER, K. C.—Trade name for oil engine and oil and gasoline tanks manufactured by the Bauer Machine Co., 113 W. 18th St., Kansas City, Mo.

BAUER MACHINE CO., THE.—113 W. 18th St., Kansas City, Mo. Manufacturer of oil engines, oil and gasoline tanks, etc. President, E. G. Hawkins.

BAUM.—Trade name for disconnecting switches manufactured by the Pacific Electric & Mfg. Co., 827 Folsom St., San Francisco, Cal.

BAUMAN & LOEB, INC.—138 Bowery, New York, N. Y. Manufacturer of lighting fixtures and illuminating glassware. President and treasurer, O. Bauman; secretary, H. B. Bauman.

BAUSCH & LOMB OPTICAL CO.—Rochester, N. Y. Manufacturer of automobile lamp lenses, searchlight mirrors, and other optical equipment and apparatus.

BAUXITE.—A hydrated oxide of aluminum, found native in large quantities, particularly in Arkansas and southern France, and used as the raw material for manufacture of aluminum. As taken from the ground it contains 25 to 30% of aluminum. Its chief impurities are silica, iron oxide and titanium oxide, which must be

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removed before the aluminum oxide can be reduced to commercially pure (99%) aluminum. See Bayer process.

BAWDEN MACHINE CO., LTD.—163-75 Sterling Road, Toronto, Ont., Can. Manufacturer of electric pumps, air compressors, steam engines and friction clutches. President, F. M. Bawden; secretary, G. T. Clarkson; sales manager, A. G. Hill. Sales representative, S. Searce, 606 Shaughnessey Bldg., Montreal, Que., Can.

BAY DE NOQUET CO.—817 Railway Exchange, Chicago, Ill. Producer of cedar poles. Business established 1881. President and general manager, George J. Farnsworth; vice-president, John C. Durgin; secretary, George W. Ellis; treasurer, Fred W. Good; sales manager, M. Mac Leod. Yards, Nahma, Mich.

BAY STATE INSULATED WIRE & CABLE CO.—Hyde Park, Mass. Manufacturer of wires and cables. Business established 1906. President, treasurer and general manager. J. H. H. McNamee; vice-president and sales manager, H. E. McNamee.

BAY STATE STAMPING CO.—380 Chandler St., Worcester, Mass. Manufacturer of oil and grease cups, grinding wheel dressers, sheet metal stampings, etc.

BAYER FOUNDRIES CO.—St. Louis, Mo. Manufacturer of brass, bronze and aluminum castings. President and general manager, Leo. J. Bayer; vice-president, Louis Boeger; secretary, August V. Bayer; treasurer, Frank X. Bayer. Main office and factory, 4057 Park Ave., St. Louis, Mo. Branch offices, 11 John St., New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Baltimore, Ohio; Pittsburgh, Pa.; Cincinnati, Ohio; Atlanta, Ga.; New Orleans, La.; Dallas, Tex.; San Francisco, Cal.

BAYER PROCESS.—A process for the preparation of pure alumina from bauxite. The bauxite is roasted to oxidize the iron and then digested with caustic soda under pressure, dissolving the alumina. The solution is diluted and filtered to remove ferric hydroxide, then treated with aluminum hydroxide, causing 70% of the alumina present in the supersaturated solution to be precipitated. This is washed and dried, while the solution is concentrated and utilized for treating more bauxite. See Alumina.

BAYER STEAM SOOT BLOWER CO.—St. Louis, Mo. Manufacturer of soot blowers. President and general manager, Leo. J. Bayer; vice-president, Louis Boeger; secretary, August V. Bayer; treasurer, Frank X. Bayer. Main office and factory, 4057 Park Ave., St. Louis, Mo. Branch offices, 11 John St., New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Baltimore, Md.; Pittsburgh, Pa.; Cincinnati, Ohio; Atlanta, Ga.; New Orleans, La.; Dallas, Tex.; San Francisco, Cal.

BAYER VALVE CO.—St. Louis, Mo. Manufacturer of brass globe, angle and check valves. President and general manager, Leo. J. Bayer; vice-president, Louis Boeger; secretary, August V. Bayer; treasurer, Frank X. Bayer. Main office and factory, 4057 Park Ave., St. Louis, Mo. Branch offices, 11 John St., New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Baltimore, Md.; Pittsburgh, Pa.; Cincinnati, Ohio; Atlanta, Ga.; New Orleans, La.; Dallas, Tex.; San Francisco, Cal.

BAYLEY & SONS, INC.—105 Vanderveer St., Brooklyn, N. Y. Manufacturer of lighting fixtures and illuminating glassware. Business established 1914. President and treasurer, George W. Bayley; vice-president and sales manager, William F. Andrews; secretary, Robert W. Bayley; general manager, H. Heath. Branch office, 101 Park Ave., New York, N. Y.

BAYLIS CO., THE.—Nelson St., Bloomfield, N. J. Manufacturer of carbon brushes and brush holders. Business established 1897.

BAYONET.—Trade name for trolley base, harp, wheels and sleet cutter manufactured by the Bayonet Trolley Harp Co., 404 Mitchell Bldg., Springfield, Ohio.

BAYONET ARMS.—A wire is sometimes carried at the top of a pole on a steel extension rod to which is attached the line insulator and conductor. This extension arm bears a resemblance to a bayonet, whence the name bayonet arm.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

BAYONET TROLLEY HARP CO.—404 Mitchell Bldg., Springfield, Ohio. Manufacturer of trolley bases, harps, wheels and sleet cutters. Business established 1903. President, J. M. Olinger; treasurer, R. A. Garlough.

BAYONNE BOLT & NUT CO.—Bayonne, N. J. Manufacturer of bolts, nuts and washers. Business established 1910. President, J. R. Steers; vice-presidents, Henry Steers and E. L. Rupf; secretary, A. J. Wehrmann; general manager, E. L. Rupf; sales manager, A. D. Morris.

BAYONNE STEEL CASTING CO.—Bayonne, N. J. Manufacturer of steel castings. President and treasurer, W. D. Sargent; vice-president and general manager, A. H. Jameson.

BB.—Abbreviation for Best Best iron wire, which see.

B. B.—Trade name for automobile testers, commutator and other brushes manufactured by Becker Bros., 25 N. Jefferson St., Chicago, Ill.

B-B.—Trade name for carbon brushes manufactured by the Boxill-Bruel Carbon Brush Co., 1022 S. Michigan St., Indianapolis, Ind.

B BATTERY.—In electron tube work the battery which maintains the plate at a positive potential with respect to the filament is commonly called the B battery.

B-BRAND.—Trade name for spark plugs manufactured by the Charles H. Buettner Co., 1924-1926 W. 8th St., Cincinnati, Ohio.

B.E.—Trade name for electric house pumps manufactured by the Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

BEACH-RUSS CO.—New York, N. Y. Manufacturer of electric vacuum pumps and blowers, etc. President, A. T. Beach; vice-president, C. A. Beach; secretary and treasurer, H. C. Russ. Main office, 220 Broadway, New York, N. Y. Factory, Brooklyn, N. Y. Branch offices, Weidner Bldg., Philadelphia, Pa.; Conway Bldg., Chicago, Ill.

BEACON.—Trade name for electric signs manufactured by the Beacon Mfg. & Sales Co., Inc., Freeport, N. Y.

BEACON ELECTRIC WORKS OF NATIONAL CARBON CO., INC.—Long Island City, N. Y. Manufacturer of flashlights. Branch offices, 383 Whitehall St., Atlanta, Ga.; 3711 S. Ashland Ave., Chicago, Ill.

BEACON LIGHT.—Trade name for farm lighting plant manufactured by the Beaudette & Graham Co., Boston, Mass.

BEACON MFG. & SALES CO., INC.—Freeport, N. Y. Manufacturer of electric signs and advertising specialties.

BEADS, GLASS, INSULATION.—Glass beads have been used in various places for insulating purposes. One use was on arc lamps where the high temperature was destructive to most insulation. The beads are strung onto the wire and provide a thick but flexible insulation of a rather mechanical nature. They have also been used in various forms of radio equipment.

BEADS, GLASS, FOR LAMP SHADES.—Glass beads of various colors were formerly extensively used in strings to form a sort of fringe around the edge of a lamp shade. These have largely been replaced by the use of silk and parchment shades with silk fringes or no fringes. On glass domes glass beads are occasionally used.

Manufacturers:

Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y.

Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.

BEAN SPRAY PUMP CO.—San José, Cal. Manufacturer of electric pumps. President, D. C. Crummey; vice-president, E. N. Richmond; secretary, H. L. Austin. Main office, San José, Cal. Factories, San José, Cal.; Lansing, Mich. Branch offices, Fresno, Cal.; Los Angeles, Cal.

BEARDMORE BELTING CO., LTD.—Toronto, Ont., Can. Manufacturer of leather belting. W. G. McLeod, manager. Main office, 37 Front St., East, Toronto, Ont. Tannery, Acton West, Ont. Branch office, 59 St. Peter St., Montreal, Que., Can.

BEARDSLEE CHANDELIER MFG. CO.—216 S. Jefferson St., Chicago, Ill. Manufacturer of lighting fixtures and portable lamps. President and general manager, F. R. Farmer; vice-president, C. G. Ricklefs; secretary, R. C. White; treasurer, Benjamin P. George.

BEARDSLEY.—Trade name for insulator pins, brackets and breakarms manufactured by the Eastern Malleable Iron Co., Naugatuck, Conn.

BEARING BRACKETS. — Supports of open construction for the bearings of machines that are attached to the frame supporting the stationary element, which may be either the field structure or the armature core in the case of electrical machines. The bearing bracket proper does not include parts of the bearing, however. What is called the assembled bearing bracket includes the bracket with its bearing and all associated parts.

BEARING PEDESTALS.—Upright supports for the bearings of horizontal-shaft machines independent of the body frame of the machine. These pedestals are mounted on or constructed as a part of the base plate. They do not include the bearing itself or any part of it. What is called the assembled bearing pedestal consists of the pedestal with its bearing and all accessory parts.

BEARINGS, BABBITT.—A type of plain bearing that is provided with a lining of babbitt metal (an alloy of low coefficient of friction) on its cylindrical contact surfaces. After the babbitt lining becomes worn the bearing is usually rebabbitted or relined with fresh babbitt. Babbitt bearings are among the most common in use for motors, generators and other electrical machinery of the smaller and medium sizes.

Manufacturers:

American Bearing & Die Casting Corp., 212 W. McCarty St., Indianapolis, Ind. "American."

Bunting Brass & Bronze Co., The, Toledo, Ohio.

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.

Canadian S. K. F. Co., Ltd., 83 King St., W., Toronto, Ont., Can.

Doehler Die-Casting Co., Court & Huntington Sts., Brooklyn, N. Y.

Franklin Die-Casting Corp., Magnolia & Gifford Sts., Syracuse, N. Y.

Hodgkins Co., J. F., Box 447, Gardiner, Me.

Muzzy-Lyon Co., Detroit, Mich. "Mogul."

Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill. "Glyco."

S. K. F. Industries, Inc., 165 Broadway, New York, N. Y. "S. K. F."

BEACH.—Trade name for drill chucks manufactured by the Morse Twist Drill & Machine Co., New Bedford, Mass.

BEACON.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

BEAD CHAIN MFG. CO., THE.—Mt. Grove & State Sts., Bridgeport, Conn. Manufacturer of bead chains for pull sockets, etc. Business established 1914. President, treasurer and general manager, W. Gerald Bryant; vice-presidents, Waldo C. Bryant, Gilbert W. Goodridge; secretary, David S. Day.

BEARINGS, BALL.—Bearings in which friction is greatly reduced by having balls rolling in guides called races, between the moving and stationary parts. The balls are often spaced by separators or cages. These bearings are so constructed that the balls will roll with very little sliding, hence rolling friction is about the only kind of friction that exists in such bearings. The use of ball bearings in electrical machinery is increasing, particularly for motors, as this type of bearing allows considerable reduction in the length of the armature shaft, an important feature in adapting a motor for direct drive of a machine where the space available for the motor is very cramped. The increased cost of the ball bearings is sometimes justified by the higher efficiency due to the reduced friction losses regardless of other advantages.

Manufacturers:

Abbott Ball Co., The, Hartford, Conn.

American Ball Co., 115 Clifford St., Providence, R. I. "American."

Auburn Ball Bearing Co., 28 Industrial St., Rochester, N. Y. "Auburn."

Bantam Ball Bearing Co., The, Bantam, Conn.

Bearings Co. of America, The, Harrisburg & College Aves., Lancaster, Pa.

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Canadian S. K. F. Co., Ltd., 83 King St., W., Toronto, Ont., Can.
Fafnir Bearing Co., The, New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y. "Universal."
G. A. Ball Bearing Mfg. Co., 123-141 Albany Ave., Chicago, Ill.
Gurney Ball Bearing Co., Jamestown, N. Y.
Holden & White Inc., 343 S. Dearborn St., Chicago, Ill. "Perry Hartman."
Langhaar Ball Bearing Co., The, Aurora, Ind. "LSA."
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
New Departure Mfg. Co., The, Bristol, Conn. "New Departure," "Radax."
New York Bearings Co., Inc., 311 W. 59th St., New York, N. Y.
Norma Co. of America, The, Anable Ave., Long Island City, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Schatz Mfg. Co., Poughkeepsie, N. Y. "Commercial."
S. K. F. Industries, Inc., 165 Broadway, New York, N. Y. "S. K. F."
Standard Machinery Co., Auburn, R. I. (P. O. address, Elmwood Station, Providence, R. I.)
Standard Steel & Bearings, Inc., 5001 Lancaster Ave., Philadelphia, Pa. "S. R. B."

BEARINGS, BRONZE.—Bronze bearings are much used on medium-sized and large motors and generators, where there is considerable pressure on the bearing and for which a plain babbitt bearing would prove too soft. For the smaller machines of this group there is often provided a bronze casing to hold some softer white metal lining, such as babbitt. In this case the bearing metal surface is generally very thin and the bronze casing has the additional advantage that even if the soft metal should be worn off the bronze still furnishes a quite acceptable bearing.

Manufacturers:

American Bearing & Die Casting Corp., 212 W. McCarty St., Indianapolis, Ind. "American."
American Bronze Corp., Berwyn, Pa. "Non Gran."
Bronze Metal Co., 30 Church St., New York, N. Y. "Vim Metal."
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Doehler Die-Casting Co., Court & Huntington Sts., Brooklyn, N. Y. (Babbitt-lined) "Do-Lite."
Doubleday-Hill Electric Co., 719-21 Liberty Ave., Pittsburgh, Pa.
Legler-Eilerman Co., The, Dayton, Ohio.
Lumen Bearing Co., Buffalo, N. Y.
Massachusetts Oilless Bearings Co., 518 Main St., Worcester, Mass. "C.G.M." metal oilless, "P-L" wood oilless bearings.
Milwaukee Die Casting Co., 297 4th St., Milwaukee, Wis.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo. "Tiger."
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
North American Smelting Co., 9th & Thompson Sts., Philadelphia, Pa.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Stewart Mfg. Corp., 4538 Fullerton Ave., Chicago, Ill.
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BEARINGS CO. OF AMERICA, THE.—Lancaster, Pa. Manufacturer of thrust ball bearings and ball retainers. Business established 1897. President and general manager, Jack L. Straub; vice-president, J. S. Bretz; secretary and treasurer, John Hertzler; sales manager, A. G. Hertzler.

BEARINGS, JEWEL, FOR ELECTRICAL INSTRUMENTS.—Jewel bearings are used in nearly all electrical indicating, recording and integrating instruments, to insure a long wearing bearing with very little friction. Sapphire is the most common bearing jewel, and it is made up either as a point or as a cup in which a hardened steel ball or spindle rotates. Agate, ruby and diamond have also been used, but they are harder than sapphire and thus more liable to crack. Where vibration and rather rough usage are encountered sapphire is the best material for this purpose.

Manufacturers:

Bird, Richard H., 11 Gifford Ave., Waltham, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Diamond Cupped Bearing Co., 130 Manhattan St., New York, N. Y.
Eastern Specialty Co., 3551 N. 5th St., Philadelphia, Pa.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Fisher & Vinal Jewel Works, 15 Crescent St., Waltham, Mass.
Worley Jewel Co., John, Lane St., Waltham, Mass.

BEARINGS, JOURNAL, ELECTRIC RAILWAY TRUCK.—That wearing and renewable part of the truck through which the weight of the car or locomotive and the pressures due to braking, accelerating, etc., are transmitted to the axle. Usually of the friction type, called journal brass. This is a brass casting lined with babbitt or some similar low-friction metal. Other types are the ball and the roller. All journal bearings are placed in dustproof boxes called journal boxes; (see Boxes, journal.)

BEARINGS, MISCELLANEOUS.—This classification includes such types of bearings as are not otherwise listed herein. Among these miscellaneous types are the following: chain-oiling, collar-oiling, oilless and self-oiling; annular combination radial and thrust; die-cast, lead-lined, wood-lined; besides other types designated according to the machinery or part for which they are designed, such as shaft-hanger, pillow-block, turbine, automobile, etc.

Manufacturers:

Bearings Co. of America, The, Harrisburg & College Aves., Lancaster, Pa.
Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. "Bound Brook."
Bunting Brass & Bronze Co., The, Toledo, Ohio.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Muzzy-Lyon Co., Detroit, Mich. "Mogul."
Nolu Oilless Bearing Co., 6 E. Johnson St., Germantown, Philadelphia, Pa.
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
S. K. F. Industries, Inc., 165 Broadway, New York, N. Y.

BEARINGS, PLAIN.—Bearings in which there is no special feature for continuous oiling or reduction of friction by the use of balls or rollers. The shaft rests on the bearing metal or lining which may be babbitt, bronze or other suitable low-friction material. Among the types of plain bearings are babbitt, bronze and wick-oiling; see these three types herewith. Also see Bearings, ring-oiling.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

BEARINGS, RING-OILING.—A plain bearing with the addition of one or more rings on the shaft which are large enough to dip into a reservoir of lubricating oil beneath the bearing. As the shaft turns, the rings turn also and carry up oil which is thus distributed to all parts of the bearing. Ring-oiling bearings are very common in moderate sizes of dynamoelectric machines.

Manufacturers:

Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Hill Clutch Co., The, W. 65th St., & Breakwater Ave., Cleveland, Ohio.
Ideal Electric & Mfg. The, 153 E. 5th St., Mansfield, Ohio.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
Nordberg Mfg. Co., Milwaukee, Wis.

BEARINGS, ROLLER.—A bearing in which friction is reduced by rollers between the shaft and the stationary parts. The rollers give rolling friction with a very small amount of sliding friction, the total friction being much less than that of a plain bearing. The rollers are sometimes cylindrical, but are more commonly conical with the apexes of the cones directed toward the shaft. Hollow cylindrical rollers, wound helically from flat strip chrome-nickel steel, are largely used and as they are flexible they adjust themselves to slight inaccuracies in the journal. Roller bearings are used where heavy loads have to be carried, and are sometimes used under these conditions as thrust bearings with success.

Manufacturers:

Bailey Co., George D., 4505 Ravenswood Ave., Chicago, Ill.
Bantam Ball Bearing Co., The, Bantam, Conn.
Bock Bearing Co., The, Phillips Ave. & Michigan Central R. R., Toledo, Ohio.
Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa.
Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.
Graham Roller Bearing Co., Coudersport, Pa.
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
New York Bearings Co., Inc., 311 W. 59th St., New York, N. Y.
Norma Co. of America, The, Anable Ave., Long Island City, N. Y.
Pratt Mfg. Co., William E., 190 N. State St., Chicago, Ill. "Twinline", "Makutchan."
Pyott Co., George W., North Ave. & Noble St. Chicago, Ill.
Railway Roller Bearing Co., Syracuse, N. Y. ("Rollway" railway bearings.)
Standard Machinery Co., Auburn, R. I. (P. O. address, Elmwood Station, Providence, R. I.).
Standard Steel & Bearings, Inc., 5001 Lancaster Ave., Philadelphia, Pa. "S. R. B."

BEARINGS SELF-ALINING.—One in which the bearing metal is free to turn through small angles in any direction about a point on the axis of the shaft at the middle of the bearing, thus permitting the bearing to aline itself automatically with the shaft. There are also several types of self-alining ball bearings.

BEARINGS, STEP.—A bearing, usually vertical in which the shaft has two considerably different diameters jointed by a plane surface perpendicular to the axis of the shaft. This surface, in vertical-shaft machines, forms the surface of the bearing which supports the weight of the machine. Oil under very heavy pressure is forced between the bearing surfaces, so that the weight rests on a layer of oil. Step bearings are used with vertical-shaft steam turbine and waterwheel generating sets, also vertical motors and vertical synchronous converters. By having part of the shaft of smaller diameter accurate centering of the shaft is secured.

Manufacturers:

Bantam Ball Bearing Co., The, Bantam, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.

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New York Bearings Co., 311 W. 59th St., New York, N. Y.
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Pryibil Machine Co., P., 513-524 W. 41st St., New York, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

BEARINGS, THRUST.—A bearing designed to hold against a force acting in the direction of the shaft. This force occurs in such machines as ventilators and pumps or other machines driving a propeller of a ship, and in heavy vertical machines where the lower bearing supports the weight. There are two classes of thrust bearings; those in which the load is supported by plates or surfaces between which are placed balls or rollers on which the revolving plate is carried; those in which the load is supported by plates or surfaces between which a film of oil is maintained. The first class is best suited for comparatively light loads and low speeds. The second class, sometimes called "marine type," often consists of several collars turned on a shaft, between which horseshoe-shaped rings are placed for the collar to bear on. Later developments have made use of a single bearing surface, where the rotating and stationary surfaces are separated by a film of oil supplied under high pressure. Spring-supported bearings have been developed to employ a single collar effectively and thus give a fairly simple and compact construction.

Manufacturers:

American Ball Co., 115 Clifford St., Providence, R. I. "American." (Ball end thrust.)
Bantam Ball Bearing Co., The, Bantam, Conn.
Bearings Co., of America, The, Harrisburg & College Aves., Lancaster, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian S. K. F. Co., Ltd., 83 King St., W., Toronto, Ont., Can.
Fafnir Bearing Co., The, New Britain, Conn.
G. A. Ball Bearing Mfg. Co., 123-141 Albany Ave., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. Spring supported thrust bearings which have been demonstrated successful on different classes of ships for use on propeller shafts and also in large central power station installations. Bearings of any size required can be furnished. The use of single collar thrust bearings has proved that it is safer to carry the load on a single bearing with high unit pressure than to try to obtain low unit pressure by a more or less unsuccessful distribution over six or more bearings. The size, weight, first and operating costs of a spring thrust bearing are less than for a multi-collar bearing. (Bulletin 49710B.)—See adv. pages 1203-1223.—Adv.
Graham Roller Bearing Co., Coudersport, Pa.
Gurney Ball Bearing Co., Jamestown, N. Y.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Langhaar Ball Bearing Co., The, Aurora, Ind.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
New York Bearings Co., Inc., 311 W. 59th St., New York, N. Y.
Norma Co. of America., The, Anable Ave., Long Island City, N. Y.
Pratt Mfg. Co., William E., 190 N. State St., Chicago, Ill. "Pratt."
Railway Roller Bearing Co., Syracuse, N. Y. "Rollway."
Schafer Bearing Corp., 4500 Ravenswood Ave., Chicago, Ill.
S. K. F. Industries, Inc., 165 Broadway, New York, N. Y. "S. K. F."
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

BEARINGS, WICK-OILING.—A bearing in which lubrication is secured through a wick that conveys grease up from a reservoir to the bearing by capillary attraction. This is a common type on fractional-horsepower motors and very small generators.

BEATON & CADWELL MFG. CO.—New Britain, Conn. Manufacturer of conduit and pipe hangers, valves, steam specialties, etc. W. H. Cadwell, president.

BEATS AND BEAT RECEPTION.—In radio communication, if two sources furnish undamped oscillations of different frequencies which act together on the same circuit, the resultant oscillations in the circuit obtained by adding the two components will consist of beats or a periodic rise and fall in amplitude, which will occur at a rate equal to the difference in frequencies of the two oscillations. In the reception of undamped signals, this is one method used, called the heterodyne method. The incoming signals represent one component oscillation, the other being generated in the receiving apparatus. The resultant, when rectified, furnishes a musical note in the telephone, the pitch of which can readily be altered by varying the frequency of the local oscillations.

BEATTIE ZINC WORKS. — Reading, Mass. Manufacturers of wet batteries and battery zincs. Business established 1887. President, Avery W. Clark; treasurer and general manager, Alvah W. Clark.

BEATTY BROS., LTD.—Fergus, Ont. Can. Manufacturer of electric washing machines.

BEAUDETTE & GRAHAM CO.—Boston, Mass. Manufacturer of farm lighting plants.

BEAUMONT CO., INC., R. H.—Philadelphia, Pa. Manufacturer of coal and ash handling machinery. Business established 1906. President and general manager, R. H. Beaumont; secretary, E. A. Thumlert; treasurer, A. J. Wunderle; sales manager, H. E. Birch. Main office, 315-19 Arch St., Philadelphia, Pa. Branch offices, 50 Church St., New York, N. Y.; 618 Citizens Bldg., Cleveland, Ohio; Kresge Bldg., Detroit, Mich.; 230 5th Ave., Pittsburgh, Pa. Sales representatives, P. I. Perkins Co., 141 Milk St., Boston, Mass.; Abell-Howe Co., 232 S. Michigan Ave., Chicago, Ill.

BEAVER.—Trade name for lighting fixtures, switches and other electrical specialties manufactured by the Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J.

BEAVER.—Trade name for pipe and conduit cutters and die stocks manufactured by the Borden Co., Warren, Ohio.

BEAVER MACHINE & TOOL CO., INC.—625 N. 3rd St., Newark, N. J. Manufacturer of lighting fixtures and fittings, switches and other electrical specialties. Business established 1914. President, Ernest B. Slade; vice-president and secretary, H. E. Slade; vice-president and general manager, A. T. Doud; treasurer, E. B. Slade. Sales representative, R. A. Belmont, 50 Church St., New York, N. Y.

BEAVERETTE.—Trade name for die stocks made by the Borden Co., Warren, Ohio.

BECCO.—Trade name for automobile specialties manufactured by the Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich.

BECHTOLD, EDMUND E.—1926 S. Wabash Ave., Chicago, Ill. Manufacturer of candles for electric candelabra. Proprietor, Edmund E. Bechtold.

BECK BROS.—3648 N. 2nd St., Philadelphia, Pa. Manufacturers of laboratory galvanometers and Wheatstone bridges.

BECKER BROS.—25 N. Jefferson St., Chicago, Ill. Manufacturers of automobile testers and commutator and other brushes. President, O. E. Becker; vice-president, C. J. Becker; secretary and general manager, W. F. Becker.

BECK & CO., OSCAR.—280 Maujer St., Brooklyn, N. Y. Manufacturers of hydrometers and thermometers. Business established 1914.

BECKER ELECTRIC WORKS. — 3055 Lincoln Ave., Chicago, Ill. Manufacturers of bell-ringing transformers and other electrical apparatus. Business established 1918. Julius Becker, sole owner. Exclusive distributor for bell-ringing transformers, Peerless Light Co., 665 W. Washington Blvd., Chicago, Ill.

BECKER MILLING MACHINE CO.—Boston, Mass. Manufacturer of motor-driven milling machines. Main office, 53 Franklin St., Boston, Mass. Factories, Hyde Park and Worcester, Mass. Branch offices, New York, N. Y.; Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Indianapolis, Ind.; Worcester, Mass.

BECKER PROCESS. — An electrolytic process for the production of metallic sodium from a bath of fused caustic soda and sodium carbonate; the operation is quite similar to the Castner process, which see.

BECKLEY MACHINE & ELECTRIC CO.—Beckley, W. Va. Manufacturer of coils. Business established 1919. President, W. E. Griffith; secretary and general manager, J. T. Evans; treasurer and sales manager, A. J. Trumas.

BECKMAN & LINDEN ENGINEERING CORP.—604 Mission St., San Francisco, Cal. Manufacturer of electric furnaces for smelting ore. President, J. W. Beckman; vice-president, H. E. Linden; secretary and treasurer, W. A. Jackson.

BE-CO.—Trade name for motors manufactured by the Birtman Electric Co., Lake & Desplaines Sts., Chicago, Ill.

BECO.—Trade name for fixture stems, hangers and insulating specialties manufactured by the Butler Electric Co., 3531 Cottage Grove Ave., Chicago, Ill.

BECQUEREL, ALEXANDRE E. — A French physicist (born 1820, died 1891). He and his son, Antoine Henri (born 1852, died 1908), were distinguished for their investigations of electric light, phosphorescence, fluorescence, etc. The younger Bacquerel was the discoverer, in 1896, of the emission from luminous bodies of invisible penetrating radiations known now as Becquerel rays. This discovery helped lay the foundation for later discoveries in radioactivity.

BECQUEREL CELL.—An early attempt to convert the chemical energy of carbon direct into electrical energy by consuming the carbon in a special form of primary cell. See Carbon cells.

BEDFORD FOUNDRY & MACHINE CO.—Bedford, Ind. Manufacturer of electric cranes and hoists. President and treasurer, Ed. A. Sohn; secretary, F. E. Pitman; sales manager, Leo B. Sohn. Main office and factory, Bedford, Ind. Branch offices, 30 Church St., New York, N. Y.; Railway Exchange Bldg., Chicago, Ill.

BEE LINE.—Trade name for electrical underground construction tools and specialties manufactured by the Brooklen Underground Electrical Mfg. Co., Glenside, Pa.

BEEBE MFG. CO.—Minneapolis, Minn. Manufacturer of electric washing machines.

BEE-DEE.—Trade name for lighting fixtures manufactured by the Brandt-Dent Co., Watertown, Wis.

BEEHIVE.—Trade name for industrial lighting reflector manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

BEEKS.—Trade name for radio condensers, keys, etc., manufactured by J. H. Bunnell & Co., 32 Park Place, New York, N. Y.

BEERS, I. F.—1158-60 Portland Ave., Rochester, N. Y. Manufacturer of thermostats.

BEERS SALES CO.—1 Hudson St., New York, N. Y. Manufacturer of portable lamps. President, A. S. Lyhne; secretary, Herman K. Beach; treasurer, George G. Beers.

BEESWAX.—The plastic material secreted by bees and used by them in the construction of honeycomb cells. It is largely produced both in the United States and Europe, but much is also obtained from parts of Asia and Africa. It is a solid, tough substance of a pale yellowish-brown color. It melts at about 153° F. It is used as a finish for wood, in the manufacture of sealing wax, lithographic crayons, mastic varnish, etc. When used by itself as an insulator it has a dielectric strength of about 250 volts per mil. It is widely used as an ingredient of insulating waxes and compounds, which are used to impregnate magnet wire and cotton and silk-covered wires and cables. It has a resistivity of 10^{14} to 10^{17} ohm-cm.

Manufacturers:

Candy & Co., 401 N. Paulina St., Chicago, Ill.
Chamberlin & Johnson, Inc., 1238-40 Voskamp St., Pittsburgh, Pa.

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Strohmeyer & Arpe Co., 139-141 Franklin St., New York, N. Y. "Montan," "Ozokerite," "Carnauba."

BEE-VAC.—Trade name for electric vacuum cleaner manufactured by the Birtman Electric Co., Lake & Desplaines Sts., Chicago, Ill.

BEGGS & CO., JAMES.—36 Warren St., New York, N. Y. Manufacturers of boilers, blowers, feed water heaters and other power plant specialties.

BELAND.—Trade name for track drills manufactured by the Aldon Co., 3338 Ravenswood Ave., Chicago, Ill.

BELCHER.—Trade name for ground clamps manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

BELDEN BRICK CO., THE.—712 Tuscarawas St., W., Canton, Ohio. Manufacturer of acidproof brick for battery rooms, etc. Business established 1885. President, John T. Blake; vice-president, L. B. Hartung; secretary and general manager, P. B. Belden; treasurer, P. W. Hartung.

BELDEN MFG. CO.—Chicago, Ill. Manufacturer of wires, cables and cords. Business established 1902. President, J. C. Belden; vice-president, N. B. Parsons; secretary, H. E. Wilkins; treasurer, W. D. Rumsey; sales manager, C. P. Belden. Main office and factory, 2300 S. Western Ave., Chicago, Ill. Branch office, Metuchen, N. J.

BELDENAMEL.—Trade name for enamel magnet wire manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

BELDENITE.—Trade name for rubber-covered wire and cable manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

BELDENMOLD.—Trade name for molded insulations manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

BELDENTAPE.—Trade name for cotton tape and webbing manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

BELFRY & CRAIGHEAD. — Tribune Bldg., Chicago, Ill. Manufacturers of soldering irons and torches. Business established 1920. Factory, Maywood, Ill.

BELKNAP SYSTEM.—Trade name for electric addressing machine manufactured by the Rapid Addressing Machine Co., 46 W. 23rd St., New York, N. Y.

BELL, ALEXANDER GRAHAM.—An American scientist (born at Edinburgh, Scotland, 1847), distinguished for his invention of the telephone. He received his education in Edinburgh and at the London University. In 1870 he moved to Canada. He was greatly interested in his father's system of instruction of the deaf and dumb, and in 1872 he became professor of vocal physiology in Boston University. Soon thereafter he began experiments which led to the invention of the telephone, and for this on Feb. 14, 1876, he received the basic telephone patent. Further experiments led to the improvement of the apparatus and a company was organized for its development. Among his more important inventions are the harmonic multiple telegraph (1874); the fundamental method that underlies the electric transmission of speech (1875); the photophone for transmitting speech and other sounds to a distance by means of a beam of light (1880); tetrahedral kites and kite structures (1903); joint inventor in a number of improvements designed to promote aerial locomotion in connection with the Aerial Experiment Association (1903-1908). Many medals and honorary degrees have been conferred upon him. Dr. Bell is still keenly interested in science in general and especially in methods for minimizing the handicaps of the deaf.

BELL & HOWELL CO.—Chicago, Ill. Manufacturer of motion-picture machinery and accessories. Business established, 1907. President, R. J. Kittredge; vice-president, A. S. Howell; secretary, C. A. Ziebarth; treasurer and general manager, J. H. McNabb; sales manager, P. N. Flum. Main office and factory, 1801-15 Larchmont Ave., Chicago, Ill. Branch offices: 220 W. 42nd St., New York, N. Y., Los Angeles, Cal. Sales representative: Robertson-Cole Co., Singer Bldg., New York, N. Y.

BELL ELECTRIC MOTOR CO.—Garwood, N. J. Manufacturer of motors and generators. President, A. C. Bell; vice-president, T. R. Bell; secretary, A. L. Bell. Main office and factory, Garwood, N. J. Branch office, 30 Church St., New York, N. Y.

BELL-JAR CELL.—A general type of electrolytic cell, used mainly in the electrolysis of brine solutions, in which a bell-jar arrangement, combined with the action of gravity, serves to keep the anode and cathode solutions separate, thus making a diaphragm unnecessary. See Alkali, electrolytic.

BELL LUMBER CO.—Security Bldg., Minneapolis, Minn. Manufacturer of cedar poles, posts and ties. President, M. J. Bell; secretary, W. C. Meader; treasurer, Robert Kelly. Butt treating plants and shipping yards, Newport, Wash.; Ashland, Wis.; Schofield, Wis.; Minnesota Transfer, Minn.

BELL RINGERS OR TOLLERS.—See Ringers and tollers, bell, motor-operated.

BELL-RINGING TRANSFORMERS. — See Transformers, bell-ringing.

BELL WASHER & WRINGER CO.—1051 Power Ave., Cleveland, Ohio. Manufacturer of electric washing machines.

BELLE CITY MALLEABLE IRON CO.—1500 Kewanee St., Racine, Wis. Manufacturer of malleable iron and electric steel castings. Business established 1892. President, J. F. Stone; secretary and treasurer, C. S. Anderson.

BELLS, ALTERNATING-CURRENT. — Signal appliances in which the vibrating hammer is operated by the armature of an electromagnet specially designed for operation on a-c. circuits. They are distinguished from transformer bells in that they can operate directly from 110 or 220-volt lighting or power mains and do not require a transformer.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on page 1231-1234.)
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
EDWARDS & CO., INC., New York, N. Y. Loud ringing bells to operate with low voltage transformers. Sizes



Edwards Loud Ringing Bell

3 to 12 in. Particularly desirable for schools, industrial plants, etc. Saves buying or replacing batteries. See "Bells, Weatherproof," for Rectibells, for 110 or 220 volts, alternating current.—Adv.
Haas Electric & Mfg. Co., The R., 305 E. Monroe St., Springfield, Ill. "Ideal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C." "AD."
KLAXON CO., Newark, N. J.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo. (For railroads only.)
SAMSON ELECTRIC CO., Canton, Mass.
Schwarze Electric Co., E. Church St., Adrian, Mich.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Standard Transformer Co., The, Dana Ave., Warren, Ohio.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

BELLS, DIFFERENTIAL. — Differential bells have the magnet windings wound to oppose one another. When the armature is drawn over by one magnet winding, it makes contact which energizes the other winding and since the two oppose, the cores are demagnetized and the armature is drawn back by its spring. There is practically no sparking with a differential bell, hence it is used on circuits of relatively high voltage.

BELLS, ELECTRIC VEHICLE.—These are large vibrating bells used on electric vehicles in place of the horn used on gas automobiles. They are made to operate on direct current of 88 volts or less and are connected to the vehicle battery. Gongs from 5 to 10 ins. in diameter are made and they are placed out of sight on the car. A push button is installed either on the floor of the car to be operated by the foot or in the end of the controller handle or some other convenient place.

Manufacturers:

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Gong Bell Mfg. Co., The, East Hampton, Conn.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."

BELLS, ELECTROMECHANICAL.—The name indicates the method of operation. The bell is actuated by a spring which is wound mechanically and held by a locking lever. This lever is subject to release by an electromagnet armature. The tripping current in some types is as small as 50 milliamperes. This principle is used chiefly on fairly large bells whose operation as straight electric bells would take much heavier current than is desired to use on the circuit. Such bells must be frequently inspected to see that they are properly wound, else they become unreliable.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess," "Circle H."
Reiter, G. C., Canton, Ohio.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

BELLS, EXTENSION TELEPHONE.—An extension bell is simply a telephone bell located at a distance from the telephone set to attract attention in case the regular bell can not be heard. It is useful in sheds, warehouses, stores, residences, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
KLAXON CO., Newark, N. J.
Leich Electric Co., Genoa, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

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BELLS, FIRE-ALARM.—Bells employed for fire-alarm purposes are equipped with gongs of large sizes ranging from 8 to 12 ins. in diameter and are of either the single-stroke or the vibrating type. The single-stroke bells are used on closed-circuit code-ringing systems, giving the number of the box from which the signal originated. Open-circuit systems do not have this feature and employ vibrating alarm bells.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
KLAXON CO., Newark, N. J.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York N. Y. "Hess," "Circle H."
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Reiter, G. C., Canton, Ohio.
SAMSON ELECTRIC CO., Canton, Mass.
Schwarze Electric Co., E. Church St., Adrian, Mich.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "USEM."

BELLS, MARINE.—Electric bells having the magnet coils and other operating parts enclosed in water-tight and often also vapor-tight casings designed especially for use on shipboard and in other damp locations. Special protection is necessary not only to prevent grounding due to excessive moisture, but also to guard against corrosion from salt water in the case of seagoing vessels. Bells of this type are also needed in such damp or gas-laden places as chemical plants, mines, dye houses, laundries, packing houses, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. Ruggedness in structure, liberal sized current carrying parts, effective insulation and careful selection of metals are worthy features of Benjamin bells which are made in water tight and non-water tight styles, vibrating or single stroke and for alternating or direct current.—Adv.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
National Marine Lamp Co., The, Forestville, Conn.
Reiter, G. C., Canton, Ohio.
Schwarze Electric Co., E. Church St., Adrian, Mich.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."

BELLS, MOTOR-DRIVEN. — A small ironclad motor of the universal type under the gong operates the hammer and will operate on either a-c. or d-c. lighting circuits or battery current. The bells are of large size for use where noise of machinery, etc., makes a loud-sounding gong necessary. They are also used on fire engines, ambulances, and patrol wagons. The gongs are made in sizes from 10 to 36 ins. in diameter.

Manufacturers:

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Reiter, G. C., Canton, Ohio.

BELLS, SINGLE-STROKE.—The magnets and armature are spaced a considerable distance from each other, thus giving the hammer a long and powerful stroke which is aided by its attachment to a flat, strong spring. At each closing of the circuit the armature throws the hammer against the gong and the spring instantly pulls it back, thus giving clear, distinct signals. They are useful in connection with code-signaling systems, as in a factory where each of the men to be called has a definite number. Fire-alarm systems, in which the location of the box giving the call is determined by the number of strokes, use this type of bell extensively.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. "Benjamin" single stroke bells; also a full line of industrial signals.—Adv.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Consolidated Car Heating Co., Albany, N. Y.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
KLAXON CO., Newark, N. J.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Reiter, G. C., Canton, Ohio.
SAMSON ELECTRIC CO., Canton, Mass.
Schwarze Electric Co., E. Church St., Adrian, Mich.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

BELLS, SKELETON.—The term "skeleton" is applied to bells in which the magnets, coils, armature and contact points are without an enclosing cover. This is done to cheapen the construction, although some skeleton bells are very well made. They should not be used where they are exposed to dust, dampness or mechanical injury.

Manufacturers:

Brach Mfg. Co., L. S., 129 Sussex Ave., Newark, N. J.
EDWARDS & CO., INC., New York, N. Y. The Edwards Economy bell is a fully insulated, loud ringing, iron frame bell for all ordinary purposes.



Economy Bell

Sizes 3 to 12 in. The Economy bell is widely used because of its simplicity of design and lasting qualities.—Adv.
HOLTZER-CABOT ELECTRIC CO., 123 Armory St., Roxbury, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stanley & Patterson, West & Hubert Sts., New York, N. Y.

BELLS, STREET AND INTERURBAN CAR.—Used to transmit starting, stopping and other signals between the car conductor and motorman, or between the guards, conductor and motorman on electric trains. Usually located one on each platform, and mechanically operated by means of a bell cord. Each pull on the cord gives a single stroke on the bell. The bell, clapper, retrieving spring and other mechanism are mounted in a suitable frame, adapted for convenient attachment to the car. (For street car gongs, see Gongs, car.)

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn.
Brill Co., The, J. G., 62nd St. & Woodland Ave., Philadelphia, Pa. "Retriever."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Reiter, G. C., Canton, Ohio.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.

BELLS, TELEPHONE. — These are usually polarized magneto bells, having an electromagnet, an armature pivoted at the center, a clapper, and two gongs. They are called magneto bells because they were usually rung by a magneto hand generator. They are usually rung by alternating current. Some telephones (private or apartment house) have the ordinary battery bell rung by direct current. Another form of telephone bell is the biased bell, which is equipped with a spring or other device to hold the clapper to one side. It responds to pulsating current in one direction but not to reverse pulsations. It is used in party-line selective signaling. Also see Ringers, telephone.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Ansonia Electrical Co., The, Ansonia, Conn.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
Leich Electric Co., Genoa, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Monitor."
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday," "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BELLS, TRANSFORMER.—Transformer bells are operated from an a-c. lighting circuit in connection with a low-voltage bell-ringing transformer. They are made in sizes from 2½ to 12 ins. and are used extensively in large installations and in fire-alarm and signal work. Some transformer bells are very similar to ordinary vibrating bells, but have carbon contacts, while others have no contacts. They may be wired in multiple and a large number operated from a single transformer. The bells without contacts may also be connected in series, thus reducing the current value. Their chief advantage is that they obviate the expense and trouble of battery maintenance and renewal. (Also see Transformers, bell-ringing.)

BELLS, TROUBLE, FOR FIRE-ALARM SYSTEMS.—Signal bells connected in fire-alarm circuits in such a manner as to operate in the event that trouble of any nature, such as grounds, crosses, short-circuits, etc., or failure of operating current occurs. They are usually of the enclosed type and are mounted in control cabinets.

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Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., 160-162 Duane St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."

BELLS, UNMOUNTED. — Unmounted bells are the bells, gongs or sounding devices proper made to be mounted on an electric bell mechanism. They may be made to give various pitches of tones, also richer, louder or more distinctive tones than the average bell; this is often important to permit distinguishing two bells mounted close together. They are made for use by manufacturers of bell mechanisms, who have not suitable facilities for casting bells of suitable tone values.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bevin Bros. Mfg. Co., East Hampton, Conn.
East Hampton Bell Co., The, East Hampton, Conn.
Gong Bell Mfg. Co., The, East Hampton, Conn.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Reiter, G. C., Canton, Ohio.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

BELLS, VIBRATING.—The most widely used type of electric bells, employed extensively for door bells and many other signaling systems. They consist of a contact screw in a fixed post, the point of the screw breaking the circuit at a contact on the upper part of the armature when it is drawn over, thus de-energizing the magnet coils; a flat spring then acts causing the armature to return to its original position where the contact screw again completes the circuit and energizes the magnet coils and pulls over the armature. This causes a continuous vibration of the armature as long as the circuit is closed, and the gong is struck at each vibration. Because of the arcing at the contacts vibrating bells are confined to low-voltage circuits using batteries or bell-ringing transformers as a source of supply. The following list of manufacturers produce vibrating bells for miscellaneous service not specifically included in the various other listings under bells.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Acme," "Wizard," "Eureka."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. "Benjamin" vibrating bells and industrial signals made in water tight and weatherproof types. Write for circular.—Adv.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDWARDS & CO., INC., New York City. A complete line of iron box bells, with many exclusive features: Fahnestock clip in place of screw terminal saves time and makes loose wires impossible.



Edwards Iron Box Bell

Hammer protected by gong. Dust-proof and bugproof cover, securely attached. All parts finished in attractive manner. Also a complete line of bells for all uses.—Adv.
Electric Signal Mfg. Co., Inc., 31 Tremont Ave., Orange, N. J. "Emka."
ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Hub Dome."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Elite," "Premier," "Nonpareil," "Crescent," "Crescendo," "Peerless."
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Reiter, G. C., Canton, Ohio.
Rutherford Mfg. Co., R. T., Brooklyn, N. Y. (Exclusive distributor, Electrical Trading Co., 200 Broadway, New York.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Spies Electric Co., 564 W. Van Buren St., Chicago, Ill. "Selco."
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR," "Ekla," "Eclipse," "XXX," "Marlo," "Rex."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

BELLS, WEATHERPROOF.—Electric bells of this type are protected from moisture by heavy cast iron covers enclosing the base, the back of which is painted with moistureproof compound. They are used principally by railroads and industrial plants for outdoor audible signals.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Write for circular.—Adv.
EDWARDS & CO., INC., New York, N. Y. Recti vibrating bells are rugged, clear ringing and weatherproof. Used extensively for mines, motor vehicles and industrial plants. Sizes from 3 to 18 in. in various styles. Have japanned case, with oil soaked gasket to keep out moisture. Supplied as shown, also in underdome type or for surface conduit. Hammer rod is of plunger type working in a direct line, not on the arc of a circle. Contacts are of standard 10M carbon rod. Approved by National Board of Fire Underwriters. Made for battery; also for 110-volt or 220-volt A. C. or D. C. circuits.—Adv.



Recti Bell

Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

BELT DRESSING.—A belt dressing is any substance which, when applied to a belt, will tend, primarily, to preserve the natural qualities of the belt material and, secondarily, to increase the adhesion of the belt to the pulley surface. Pure castor oil is considered to be the best dressing for a leather belt, but neatsfoot oil is good, if used sparingly. Melted beef tallow or a mixture of tallow and beeswax are both good. A common but very poor practice is to combine resin with the dressing to increase adhesion, which is accomplished at the expense of the life of the belt. Belt dressings should be applied only when the belt becomes so dry that it begins to slip and only enough should be used to restore its pliability.

Manufacturers:

Alexander Bros., 3rd & Callowhill Sts., Philadelphia, Pa.
Allen Mfg. Co., W. D., 566 W. Lake St., Chicago, Ill. "Magic," "Pease," "Ajax."
Buffalo Belt Dressing Co., 962 Kensington Ave., Buffalo, N. Y. "Buffalo."
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill. "Beltex."
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Cling-Surface Co., 1032-48 Niagara St., Buffalo, N. Y. "Cling-Surface," "Erusa."
Dixon Crucible Co., Joseph, Jersey City, N. J.
Indian Refining Co., 244 Madison Ave., New York, N. Y. "Bull Dog."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y. "Howard."
Philadelphia Belting Co., 601-03 Spring Garden St., Philadelphia, Pa.
Rahmann & Co., George, 31 Spruce St., New York, N. Y. "Triumph," "Rahmann's."
Raniville Co., F., 241-247 Pearl St., Grand Rapids, Mich. "Penatrol."
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa.
Ruboil Belting Co., 41 N. 10th St., Philadelphia, Pa.
Schieren Co., Charles A., 30-38 Ferry St., New York, N. Y. "Schieren," "Fly Foot."
Whitlock Mfg. Co., The, 1506 W. 112th St., Cleveland, Ohio. "Seal Oil," "Miown," "Velvetone."

BELT, "ELECTRIC." — A belt with groups of metal electrodes bearing directly against the skin of the wearer, usually on the abdomen. These electrodes, with the perspiration of the skin as electrolyte, form small batteries whose currents are claimed to be curative of various diseases. Actually the currents are so feeble as to be barely detected, so their benefit is largely imaginary. One of the few instances in which the popularity of the word "electric" has been taken advantage of by crafty impostors.

BELT FASTENING AND LACING DEVICES.—Numerous devices are made for splicing or fastening belt ends together. Frequently they are laced together using a bronze or other metallic wire or a leather thong or selected rawhide. Metallic fasteners are more commonly used. One form is a special steel claw that is hammered into one end of the belt and interlocks with a corresponding piece put on the other end, the two being held together as a hinge by a steel rocker pin. There are also numerous special brads and belt hooks. These are hammered into the belt and clinched on the other side. A small plate with rivet holes is sometimes used to fasten the belt ends, the rivets passing through the plate and belt and being upset on the under side. There are also a number of other devices using steel wire in special forms.

Manufacturers:

Allen Mfg. Co., W. D., 566 W. Lake St., Chicago, Ill. "Alenco."
American Lace Leather Co., Inc., Richmond, Va. "Eagle."
Angell Belt Hook Co., Providence, R. I.
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.
Crescent Belt Fastener Co., 331 4th Ave., New York, N. Y. "Crescent."
FLEXIBLE STEEL LACING CO., 4607-4631 Lexington St., Chicago, Ill. "Alligator" (belt lacing); "Turtle," "High Duty" (belt fasteners).

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Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Schieren Co., Charles A., 30-38 Ferry St., New York, N. Y. "Duxbak," "Giant," "Casco," "Gowanus."

BELT TIGHTENERS.—See Tighteners, belt.

BELTEX.—Trade name for belt dressing manufactured by the Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

BELTING FOR MOTORS AND GENERATORS.—A belt is a flexible band carried on the periphery of pulleys and used to transmit motion from a prime mover, such as a steam engine, electric motor, gas engine or turbine, to some form of driven mechanism such as an electric generator; belts are also used to connect shafting to machinery and different parts of machines together. Belts are generally made of leather, canvas, rubber, band steel and of small steel links. While generally classed by itself, the rope drive is a form of belting. Leather belts are made of one or more plies in thickness, cemented together. Sometimes all plies are of the same kind of leather, but often different kinds of tannage are used in the same belt. Rubber belts are made of two or more layers of woven fabric cemented together with rubber which is vulcanized or "cured" in place. The steel belt is simply a band of tempered steel of excellent quality, with a brazed or riveted joint and running on narrow-faced pulleys. Steel link belts are composed of a larger number of small steel links formed with projections that engage sprocket teeth. These links lie side by side, the overlapping ends being carried on rivets or pins of various kinds.

Manufacturers:

Acme Belting Co., Niles, Mich. "Acme," "Black Diamond."
Acme Rubber Mfg. Co., Trenton, N. J.
Akron Belting Co., The, Akron, Ohio. "Akron."
Alexander Bros., 3rd & Callowhill Sts., Philadelphia, Pa.
Allen Mfg. Co., W. D., 566 W. Lake St., Chicago, Ill. "Ajax," "Arm & Hammer," "Otter-Waterproof," "Arrow," "Alenco," "Victory," "Dynamo."
Allied Belting Co., The, Greenville, Ohio. "Ally."
American Belting & Tanning Co., 135 Oliver St., Boston, Mass.
American Mfg. Co., Front & Walnut Sts., Wilmington, Del.
Beardmore Belting Co., Ltd., 39 Front St., E., Toronto, Ont., Can.
Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa.
Boston Belting Co., 80 Elmwood St., Boston, Mass.
Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass. "Bull Dog," "Bison," "Congress," "Perfection," "Senate," "Warrior."
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.
Chicago Belting Co., 125 N. Green St., Chicago, Ill. "Reliance," "Sea Lion Planer," "Sterling."
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Cook Belting Co., H. N., Howard & Fremont Sts., San Francisco, Cal. "Golden State," "Progress," "Oakwood," "Dolphin," "Progress."
Detroit Oak Belting Co., Detroit, Mich. "Naiad," "Flexite," "Detroit Velocity," "King," "Hummer," "Dobeco," "Wolverine."
Diamond Rubber Co., The, Akron, Ohio.
Dick Co., Inc., R. & J., Passaic, N. J. "Dickbelt."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Dow, Inc., L. B., Keene, N. H.
Empire Mfg. Co., Lockport, N. Y. (Cotton.) "Emco," "Empire," "Nubian," "Union."
Empire Rubber & Tire Corp., N. Clinton Ave. & Mulberry St., Trenton, N. J.
Franklin Cotton Mill Co., The, N. E. Cor. Plum & Charles Sts., Cincinnati, Ohio. "Victor."
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio. "Blue Streak," "Glide," "Klingtite."
Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass. "Heart," "GraKnight," "GraKnight Dynamo," "Pryzoak," "Spartan," "Spar Oak," "Neptune," "Neptune Dynamo."
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.
Hamilton Engine Packing Co., 54-56 Alanson St., Hamilton, Ont., Can.
Hope Webbing Co., Providence, R. I. "Hope."
Jewell Belting Co., Hartford, Conn. "Black Diamond," "Capitol," "Jewell Chrome," "Jewell Diver," "Jewell King Philip," "Zenith."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Ewart."
Moloney Belting Co., 131 N. Franklin St., Chicago, Ill.
National Leather Belting Co., 423 E. 56th St., New York, N. Y.
New Jersey Car Spring & Rubber Co., Inc., Jersey City, N. J. "Carspring" for car lighting equipments.
New York Belting & Packing Co., 91 Chambers St., New York, N. Y. "Test Special."
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Page Belting Co., E. Penacock St., Concord, N. H. "Crown," "Eureka," "Merrimack," "Concord," "Anchor," "Crown Planer," "Tarpon," "Neverslip," "Hercules."
Palmer & Co., N., Bridgeport, Conn. "Water-Witch," "Palmers Extra," "Charter Oak," "Climax," "Apex," "Everlasting."
Peerless Belting Co., Gardenville, N. Y. "Black and Tan."
Philadelphia Belting Co., 601-03 Spring Garden St., Philadelphia, Pa.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Quaker City Rubber Co., 629 Market St., Philadelphia, Pa. "Ironsides," "Atlantic," "Desert," "Standard," "Hercules," "Crown."
Rahmann & Co., George, 31 Spruce St., New York, N. Y. "Comber," "Granite-Oak," "Kontak," "Tenacity Oak."
Raniville Co., F., 241-247 Pearl St., Grand Rapids, Mich. "Star," "Flex-Ite," "Wateride," "Oko."
Republic Rubber Corp., Youngstown, Ohio. "Chariot," "Hector," "Tonka," "Challenge."
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa. "Tannate," "Stronghold," "Volta Dynamo."
Ruboil Belting Co., 41 N. 10th St., Philadelphia, Pa. "Ruboil."
Russell Mfg. Co., 520 Russell Ave., Middletown, Conn. "Rusco."
Schieren Co., Charles A., 30-38 Ferry St., New York, N. Y. "Duxbak," "Casco," "Rock Oak." "Dixie."
Schwartz Belting Co., 74-76 Murray St., New York, N. Y. "Axiom," Atlantic," "Dynamo," "Globe," "Pacific," "H-O."
Southern Belting Co., 602-608 S. Peters St., New Orleans, La. "Water King," "Crawfish."
Stanley Belting Corp., 32-40 S. Clinton St., Chicago, Ill. "Stanley."
Stephenson Mfg. Co., Albany, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Victor Balata & Textile Belting Co., 38 Murray St., New York, N. Y. "V-B."
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J. "Criterion," "Sensation," "Power."
Webb Bros. Belting Co., Kansas City, Mo. "Pilot."

BELTS, LINEMEN'S TOOL.—A strong leather belt worn by linemen to carry heavy tools which otherwise would tear pockets. An outer strap is usually riveted on with ridges forming receptacles for the tools. Two rings are also generally provided into which the lineman snaps the ends of a safety strap that is thrown around the pole or a crossarm. (Also see Straps, linemen's safety.)

Manufacturers:

BUHRKE CO., THE R. H., 1240 Fullerton Ave., Chicago, Ill. Buhrke Quality tool belts with rings for safety strap are made of first grade oak tanned steer hide harness leather; main belt 2½ ins. wide, looping back through rust-proof finish 2 in. steel roller dee rings tested to 1500 lbs. The tool layer is 1½ ins. wide and formed into four tool loops. Buckle is 1½ in. rust-proof steel with roller tested to 750 lbs. A metal plier



Buhrke Tool Belt

holder is riveted to left end of belt. All rivets are coppered steel with double heads; all sewing done on hot wax lock stitch machine. They are made in waist lengths from 36 to 44 ins.—Adv.

Industrial Products Co., 1001 Chestnut St., Philadelphia, Pa. "Ipco."

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. We manufacture the famous "Klein" select harness leather tool belts, made with six tool loops, strong "D" rings sewn in and riveted to the main belt, which also pass through the main belt; sizes 2¼ ins. and 3½ ins. wide. We also manufacture safety straps 1¾ ins. wide by 6 ft. long, with strong snaps, at each end, provided with a buckle to shorten or lengthen the strap. See page 1259 for illustrations and additional information concerning Klein products and write for our complete catalog of construction tools.—Adv.

SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 458 tool belt 2¼ ins.



"Red Devil" No. 458

wide is made of the best oak tanned leather. Double leather back. Five loops for tools.—Adv.

BELVIDERE SCREW & MACHINE CO.—Belvidere, Ill. Manufacturer of screw machine products and spark plugs. President and treasurer, Frank S. Whitman; vice-president, George M. Marshall; secretary and general manager, Willis S. Brown.

BEMIS & CALL HARDWARE & TOOL CO.—Springfield, Mass. Manufacturer of wrenches. President, Howard R. Bemis; secretary, Edwin L. Bemis; treasurer, John C. Beggs.

BEMIS CAR TRUCK CO.—376 Birnie Ave., Springfield, Mass. Manufacturer of bolts, springs, etc. Business established 1912. President and treasurer, Warren L. Boyer; secretary, Joseph A. Lammon. Sales representatives: David L. Beaulieu, 73 Hamilton St., Dorchester, Mass.; Frank F. Bodler, Monadnock Bldg., San Francisco, Cal.

BENBOW.—Trade name for mine insulators manufactured by J. H. Parker & Son, Parkersburg, W. Va.

BENCHES, ELECTRICIANS' PORTABLE.—In electrical construction a work bench is necessary where conduit has to be cut, threaded and bent. Although a bench is often improvised out of planks or boxes found on the premises, a bench so made may represent much time lost in looking for materials and assembling them, and is frequently a rickety makeshift. The need is met by the portable bench provided with pipe vise and usually made of pipe framework that is readily set up and disassembled, so it may be moved in knocked down condition.

Manufacturers:

Henderson Electric Co., Ampere, N. J.
New Britain Machine Co., New Britain, Conn. "New Britain."
Standard Iron Works, Inc., 508-510 E. 74th St., New York, N. Y. "Standard."

BENCO.—Trade name for heavy-duty sockets made by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

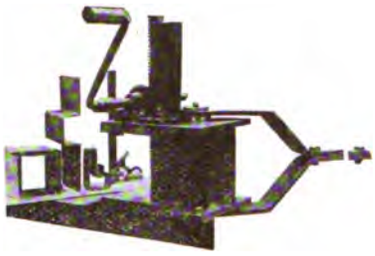
When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

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BENDERS, BUSBAR.—A type of vise-like bench tool by means of which powerful leverage can be applied in quickly bending copper strap busbars to any desired angle and securing smooth bends. Much used by switchboard manufacturers and erectors. A tool of this type is of special importance where the buses consist of laminated sets and where large bars are used.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
CHAS. J. PETERSON CO., INC., 725 Fulton St., Chicago, Ill. Standard and special busbar benders for bending bars up to 12 ins. x ¼ in., and 6 ins. x ½ in., or edgewise bending up to 1 in. x ¼ in. without annealing the copper. An indispensable tool in large power station installations where the copper busbars are made at the job, or for switchboard manufacturers. This tool has been used



Busbar Bender

successfully in this class of work for the last 11 years, in actual service and without a repair. Its design and construction embodies only the most practical methods of the mechanical art and insures accurate work without scars or scratches. Attention is called to the clamping device which is operated by a crank. There are no set screws to be tightened and loosened with every bend, all adjustments for the different dimensions of copper being automatic and positive. Cut shows samples of work (proportioned to a 12 in. combination square) turned out without any extra trueing up.—Adv.

BENDERS, CONDUIT AND PIPE.—Rigid metallic conduit must often be bent to fit turns and offsets, if elbows are not used. For this purpose electricians commonly use a so-called "hickey" made of pipe fittings. The shortcomings of this improvised tool are overcome by numerous manufactured conduit and pipe benders, which are of various types, such as the adjustable and self-adjusting hickeys, roll or grooved wheel benders, pressure benders, etc. Large pipe usually requires special bending machines. (See Bending machines for large conduit and pipe.)

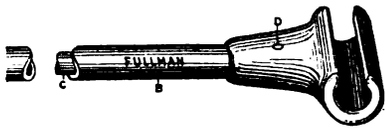
Manufacturers:

American Pipe Bending Machine Co., 39 Pearl St., Boston, Mass. "Wonder."
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill. "Rex."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Cox, J. Fillmore, Bayonne, N. J.
Henderson Electric Co., Ampere, N. J. "E. Z." "X. L."
HERBST, PAUL W., Chicago, Ill. Exclusive distributor for Anthony's "Sure-Grip" steel conduit hickey or bender. Designed after years of practical experience with all methods of pipe bending. The illustration shows its fine points. Scientifically designed; maximum strength, minimum weight. "V" notches give sure grip without kinking. Minimum projection permits close-work. Threaded for standard pipe. Made of extra quality steel. Can be readily used in confined spaces where clearance is limited. It never slips, never breaks. Made in three sizes, ½, ¾ and 1 in. See display adv. page 1258.—Adv.



Sure-Grip Hickey

Jones Tool Co., 1912 Van Buren Rd., Cleveland, Ohio. "Hercules."
Martin & Sons, H. P., Owensboro, Ky. "Martin."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Levier."
Penn Engineering Co., 2nd & Chestnut Sts., Reading, Pa. "Penn."
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display advertisement on page 1308.)
Rittenhouse Co., The A. E., Honeoye Falls, N. Y.
Skinner Co., M. B., 562 Washington Blvd., Chicago, Ill. "Boss," "Rex."
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.)



"Fullman" Conduit Bender

"Fullman" conduit benders for ½ and ¾ in. conduit.—Adv.

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. W. The "Lakin Hickey" shown at the left is useful in making short bends in awkward places. It will not kink the pipe. Threaded end fits a standard 1 in. pipe coupling. Screw piece of 1 in. pipe in the other end for coupling for handle. The "Standard" conduit elbow former



The "Lakin Hickey"



Standard Conduit Elbow Former

forms standard shape elbows perfectly and accurately at any point desired. It is more than merely a pipe bender. For ½ and ¾ in. pipe.—Adv.
Wrigley Co., Thomas, 504 Sherman St., Chicago, Ill.

BENDERS, RAIL.—A machine for bending rails to any desired curvature or for straightening curved rails. Such machines vary from crude field machines for bending light rails, to large and complicated machines bending the heaviest rails with the greatest accuracy. The small machines are usually operated by hand with the force applied by means of a lever or screw. The larger machines are operated by hydraulic or some form of mechanical power.

Manufacturers:

Aldon Co., The, 3338 Ravenswood Ave., Chicago, Ill. "Aldon."
Buda Co., The, Harvey, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Handlan-Buck Mfg. Co., 212 N. Third St., St. Louis, Mo.
Q. & C. Co., The, 90 West St., New York, N. Y. "Samson."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Superior."

BENDHICK.—Trade name for conduit fittings manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

BENDING MACHINES, LARGE CONDUIT AND PIPE.—To bend wrought iron and steel conduit or pipe over 3 ins. in diameter requires much more power than can be exerted by one man working with a hickey or similar improvised tool. For this purpose special machines, either motor-driven, hydraulic or otherwise power-operated or hand-operated by mechanisms multiplying the manual effort, are manufactured that facilitate bending of not only large pipe but also of smaller pipe when many similar pieces are to be bent.

Manufacturers:

American Pipe Bending Machine Co., 39 Pearl St., Boston, Mass. "Wonder."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Cox, J. Fillmore, Bayonne, N. J.
Rock River Machine Co., N. Main St., Janesville, Wis.

BENDING MOMENT.—A measure of the tendency to bend a beam or member of a structure, usually given as the product of load or bending force, times the distance through which it acts. Commonly expressed in pounds-feet or pounds-inches. Thus the bending moment on a pole due to a wind transverse to the line is the wind pressure on the pole and wires (one span) times the height above ground of the middle crossarm (approximately).

BENDS, ELBOWS AND OTHER FITTINGS, FIBER CONDUIT.—The fittings for fiber conduit are all of simple design. Standard bends are of radii from 18 to 36 ins., depending on the inside diameter of the conduit, and either 90° or 45°, or of S form, and are 5 ft. in extreme length. They are shaped from the wood pulp tubes that form the initial structure of standard fiber conduit, and after the desired degree and radius are obtained they are impregnated with the insulating and waterproofing compound. Special-degree and short-radius bends, and 90° and 45° elbows are produced by mitering and shaping the wood pulp tubes and then impregnating them. Bends are used for accommodating cables from underground conduit to poles for overhead distribution, also for central-station and sub-station distribution; the S bends are used where it is necessary to offset the alinement of cable runs. Elbows are used where it is desired to make sharp turns.

Couplings or sleeves for Harrington joints are generally furnished with the straight ducts designed for that joint, one coupling being supplied with each length of duct or fitting. Split couplings are also made with a bevel longitudinal slit permitting them to be slipped over two abutting duct ends; they permit short lengths of duct to be used, also ducts whose ends have been damaged and had to be cut off, thus preventing waste. Tees, crosses, caps, plugs and junction boxes of the one, two, three, or four-way type are also manufactured for use with fiber conduit. All fiber bends, elbows and other fittings are supplied with either the socket or Harrington type of joint. For straight fiber duct see Conduit, underground, fiber.

Manufacturers:

American Fibre Corp., 103 Park Ave., New York, N. Y. "American."
Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
FIBRE CONDUIT CO., THE, Orangeburg, N. Y. "Orangeburg."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
O. K. Metal Box Co., 198 Greenwich St., New York, N. Y.

BENEDICT.—Trade name for nickel anodes, rods, sheets, etc., manufactured by the American Brass Co., 414 Meadow St., Waterbury, Conn.

BENEDICT MFG. CO.—East Syracuse, N. Y. Manufacturer of tags. Business established 1888. President and general manager, H. L. Benedict; vice-president, Geo. N. Crouse; secretary and sales manager, L. E. Barnes; treasurer, R. B. Roantree.

BENJAMIN ELECTRIC MFG. CO.—Chicago, Ill. Manufacturer of electric lighting specialties, industrial lighting equipment, wiring devices, marine lighting and signaling apparatus, gas and vaporproof fixtures, industrial and automobile signals, panelboards and cabinets, punch press efficiency and safety devices, enameled steel reflectors and specialties, deep stamping and drawn work. Business established 1901. President, R. B. Benjamin; vice-presidents, J. H. Fall, Jr., and Walter D. Steele; treasurer, W. Clyde Jones; secretary, Keene H. Addington. Main office, 806 W. Washington Blvd., Chicago, Ill. Factories, Chicago and Desplaines, Ill. Branch offices and warehouses, 247 W. 17th St., New York, N. Y.; 580 Howard St., San Francisco, Cal.; Toronto, Ont.; Montreal, Que. District offices, Boston, Mass.; Pittsburgh, Pa.; Baltimore, Md.; Minneapolis, Minn.; St. Louis, Mo.; New Orleans, La.; Cleveland, Ohio, Seattle, Wash.

BENJAMIN-STARRETT.—Trade name for panelboards and cabinets manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

BENNETT.—Trade name for surge arresters manufactured by the Electro Service Co., Marietta, Ga.

BENNETT-O'CONNELL CO.—3600 S. Morgan St., Chicago, Ill. Manufacturer of polishers', platers' and buffers' equipment and supplies. Business established 1896. President, U. S. Ayer; vice-president,

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treasurer and general manager, O. M. Worthington; secretary, L. J. Qually. Branch office, Ayer-O'Connell Mfg. Co., Meriden, Conn. Factories, Chicago, Ill., and Meriden, Conn.

BENNINGHOFEN & SONS, C.—Hamilton, Ohio. Manufacturers of gasoline engines and mica slitting machines. Business established 1912.

BENOLITE CO., INC.—331 4th Ave., Pittsburgh, Pa. Manufacturer of insulating varnishes and compounds. Business established 1908. President, G. A. Benney. Factory, Manor, Pa.

BENSON CO., ALEXANDER R.—Hudson, N. Y. Manufacturer of soldering fluxes. President, Lloyd R. Benson; vice-president, H. B. Zetsche; secretary, E. B. Osgood; treasurer, L. R. Benson; sales manager, Robert B. Graves.

BENT GLASS NOVELTY CO., THE.—394 Canal St., New York, N. Y. Manufacturer of illuminating glassware. Business established 1894. Oliver C. Brown, sole owner.

BENT RUNG LADDER & MFG. CO.—725 South St., Indiana, Pa. Manufacturer of ladders for electricians, manufacturing plants and all general purposes. President, J. E. Powell; secretary, treasurer and general manager, W. F. Wettling.

BERENDSEN, INC., SOPHUS.—365 1st Ave., New York, N. Y. Manufacturer of adjustable electric lamps. J. Beckett, sales manager.

BERG ELECTRIC CAR CO.—501 5th Ave., New York, N. Y. Manufacturer of electric pleasure cars.

BERGEN CO., THE J. D.—Meriden, Conn. Manufacturer of table and reading lamps.

BERGER & SONS, C. L.—Boston, Mass. Manufacturers of levels and other mechanics' and surveyors' instruments.

BERGER BROS. CO.—229-237 Arch St., Philadelphia, Pa. Manufacturer of electricians', tinners' and roofers' supplies and tools. Business established 1874. President, William H. Berger; secretary, William Barth; treasurer, George B. Geiser; sales manager, M. L. Wolfe.

BERGHMAN CO.—5428 Fulton St., Chicago, Ill. Manufacturer of current indicators and adapters. Sales representatives, Paul Roche & Co., 43 Warren St., New York, N. Y.; James E. Gleason Co., 515 W. Jackson Blvd., Chicago, Ill.

BERGSOE PROCESS.—A process for the recovery of tin from tin scrap, in which the scrap is detinned by the action of a solution of tin chloride ($SnCl_4$); the resulting $SnCl_2$ solution is reconverted to $SnCl_4$ by the electrodeposition of part of its tin content.

BERKSHIRE.—Trade name for electric washing machines manufactured by the Pittsfield Machine & Tool Co., Pittsfield, Mass.

BERNFELD DIAPHRAGM. — A diaphragm designed to withstand the action of alkaline solutions in electrolysis; it is made by treating sheet asbestos with acid and baking.

BERNITZ FURNACE APPLIANCE CO.—15 State St., Boston, Mass. Manufacturer of fire brick and refractories for boiler furnaces.

BERNZ CO., OTTO.—Newark, N. J. Manufacturer of brazing outfits, torches, soldering coppers and fire pots. Business established 1876. General manager, Otto Bernz. Main office and factory, 17-37 Ashland St., Newark, N. J. Branch office and warehouses, 65 Vesey St., New York, N. Y. District office, 244 California St., San Francisco, Cal. Sales representatives, Henry J. Veith, Jr., New Orleans, La.; James J. Crawford & Co., Stahlman Bldg., Nashville, Tenn.; American Specialty Co., 26 N. 8th St., Richmond, Va.

BERRY.—Trade name for ventilating fans manufactured by the A. Hun Berry Fan Co., 28 Binford St., Boston, Mass.

BERRY BROS.—Detroit, Mich. Manufacturers of insulating varnishes. Business established 1858. Sales manager, C. L. Forgey. Main office, Detroit, Mich. Factories, Detroit, Mich., and Walker, Ont., Can. Branch offices, 103 Park Ave., New York, N. Y.; 199 Purchase St., Boston, Mass.; 331 N. 4th St., Philadelphia, Pa.; 117 W. Grand Ave., Chicago, Ill.; 418 E. 8th St., Cincinnati, Ohio; 250 1st St., San Francisco, Cal.

BERRY ENGINEERING CO., THE.—610-32 Crosby St., Chester, Pa. Manufacturer of feed water regulators, heaters and other steam specialties. Business established 1874. President and treasurer, William H. Berry; secretary and general manager, Paul B. Berry.

BERRY FAN CO., A. HUN.—28 Binford St., Boston, Mass. Manufacturer of ventilating fans. President, Helen A. H. Berry; secretary and treasurer, Mary H. Berry.

BERTH LAMPS.—For the convenience of passengers on sleeping cars each berth (especially the lower) is usually provided with a small incandescent lamp at each end, recessed in the outer wall of the car. There is either a push button switch below the lamp housing or the lamp itself is mounted on the inside of the hinged cover of the housing so that opening and closing the cover closes and opens the lamp switch. (For manufacturers see Fixtures, lighting, car.)

BERTHOLD ELECTRICAL MFG. CO.—127-129 S. Green St., Chicago, Ill. Manufacturer of electric washing machines. Business established 1918. General manager, Edw. E. Berthold.

BERTMAN.—Trade name for electric hair driers manufactured by Mathias Thome, 22 W. Monroe St., Chicago, Ill.

BERWICK.—Trade name for electric rivet heater manufactured by the American Car & Foundry Co., 165 Broadway, New York, N. Y.

BERYLITE.—Trade name for illuminating glassware manufactured by L. Plaut & Co., 434 E. 23rd St., New York, N. Y.

BESCO.—Trade name for battery repair shop equipment manufactured by the Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill.

BESCO —Trade name for electric iron manufactured by the Brock Snyder Mfg. Co., Grimsby, Ont., Can. Exclusive distributor, Wentworth Electric Co., Lister Bldg., Hamilton, Ont., Can.

BESCO. — Trade name for internally illuminated signs manufactured by the Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.

BESELER CO., CHARLES.—131-33 E. 23rd St., New York, N. Y. Manufacturer of lamps, spotlights and stereopticons. Business established 1869. President, F. Schwanhausser; secretary, W. G. Schwanhausser; treasurer and general manager, F. Schwanhausser, Jr. Sales representative, E. H. Kemp, 833 Market St., San Francisco, Cal.

BESO.—Trade name for low-voltage transformers manufactured by the Bertrand F. Miller Co., High & Canal Sts., Trenton, N. J. Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

BESSEMER GAS ENGINE CO.—Grove City, Pa. Manufacturer of gas and oil engines. President, John Carruthers; vice-president, A. J. Hull; secretary, John McCune, Jr.; treasurer, E. J. Fithian; sales manager, C. F. Fithian. Main office and factory, Grove City, Pa. Branch offices, 50 Church St., New York, N. Y.; 1101 Bessemer Bldg., Pittsburgh, Pa.; 815 Citizens Bldg., Cleveland, Ohio; 210 Waggoner Bldg., Fort Worth, Tex.; Newark Trust Bldg., Newark, Ohio; 615 Market St., Shreveport, La.; Bartlesville, Okla.; Ranger, Tex.; Parkersburg, W. Va.; Bremen, Ohio; Logan, Ohio; 403 Gwynne Bldg., Cincinnati, Ohio; Winchester, Ky.; 20 E. Jackson Blvd., Chicago, Ill.

BEST.—Trade name for attachment plugs manufactured by the Best Electric Corp., 476 Broadway, New York, N. Y.

BEST BEST IRON WIRE.—Common trade name for iron telegraph and telephone line wire of quality and purity superior to Best, but inferior to Extra Best Best wire. Usually abbreviated BB. (For manufacturers, see Wire, iron line.)

BEST ELECTRIC CORP.—New York, N. Y. Manufacturer of wiring devices and fixture fittings. President, Henry Hyman; treasurer and general manager, G. Frankel. Main office and factory, 476 Broadway, New York, N. Y. Branch offices, 549 W. Washington St., Chicago, Ill.; 235 Minna St., San Francisco, Cal.

BEST IRON WIRE.—A trade name introduced many years ago to designate what was then the highest quality iron wire for telegraph lines. It has since been exceeded by Best Best and Extra Best Best wire, and is now the lowest grade iron wire in use for overhead lines. (For manufacturers, see Wire, iron line.)

BESTIX.—Trade name for insulating cement for boiler settings manufactured by the Joseph W. Hays Corp., Michigan City, Ind.

BETA RAYS.—The second type of radiation emitted by radium and similar radioactive substances, the others being alpha and gamma rays. In penetrating power beta rays are intermediate between the others. They are markedly deflected by a magnetic field and in the opposite direction to alpha rays, this being due to the negative charges carried by the beta rays compared with the positive of the alpha rays. (See Radioactivity; also Radium.)

BETHANY.—Trade name for gaskets for flange joints manufactured by the Metallo Gasket Co., New Brunswick, N. J.

BETHLEHEM.—Trade name for spark plug manufactured by the Bethlehem Spark Plug Co., Inc., Bethlehem, Pa.

BETHLEHEM SPARK PLUG CO., INC.—Bethlehem, Pa. Manufacturer of spark plugs. Business established 1912. President, E. H. Schwab; vice-president and general manager, W. S. Moore; vice-president and sales manager, W. N. Davidson; vice-president, secretary and treasurer, E. B. Turn.

BETHLEHEM STEEL CO.—Bethlehem, Pa. Manufacturer of magnet and other steel. Main office, Bethlehem, Pa. Factories, Lebanon, Bethlehem, Steelton, Pa.; Baltimore, Md. Branch offices, Atlanta, Ga.; Detroit, Mich.; Baltimore, Md.; New York, N. Y.; St. Louis, Mo.; Boston, Mass.; Philadelphia, Pa.; San Francisco, Cal.; Chicago, Ill.; Washington, D. C.; Cleveland, Ohio; Pittsburgh, Pa.

BETSON PLASTIC FIRE BRICK CO., INC.—Rome, N. Y. Manufacturer of boiler settings, arches, baffle walls and furnace linings. Established 1900. President and secretary, F. J. Jewell; vice-president and treasurer, Nelson Adams. Main office, Rome, N. Y. Branch offices and warehouses, 50 Church St., New York, N. Y.; 308 S. Wabash Ave., Chicago, Ill.

BETTALYTE.—Trade name for tungsten and nitrogen lamps manufactured by the Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.

BETTALYTE INCANDESCENT LAMP CO., INC.—366 W. 15th St., New York, N. Y. Manufacturer of incandescent lamps. Business established 1920. President and general manager, G. M. Jost; vice-president, F. Alexander; secretary and treasurer, R. Press.

BETTER WASHER.—Trade name for electric washing machines manufactured by the Berthold Electrical Mfg. Co., 127-129 S. Green St., Chicago, Ill.

BETTS & BETTS CORP.—511 W. 42nd St., New York, N. Y. Manufacturer of electric signs, Christmas tree lighting outfits and other electrical specialties. Business established 1905. President and sales manager, James H. Betts; secretary, treasurer and general manager, Louis Hengerer. Factories, New York, N. Y., and Trenton, N. J. Sales representatives, Bittman & Battee, Inc., San Francisco, Cal.

BETTS PROCESS.—The process by which lead is refined electrolytically. The operation is very similar to that of the multiple system of copper refining. The tanks are of wood or cement lined with tar. The electrolyte is a solution of lead fluosilicate ($PbSiF_6$) and fluosilicic acid (H_2SiF_6), containing about 70 to 80 grams of lead and 100 to 110 g. of free acid per liter. A little glue or gelatine must be added to the electrolyte to make the deposit smooth and coherent at a suitable current density. The cathode starting sheets are made by pouring out a thin sheet of pure lead on an iron plate. The finished cathodes are 99.99+% lead. Bismuth as well as precious metals are recovered from the slimes. The anodes retain their shape in a spongy form as the lead is dissolved from them. "The process is too costly to compete with fire refining for ordinary lead, but for lead containing considerable bismuth the value of the latter, which is not saved in the other processes, makes it profitable. Electrolytic lead refineries are being operated at Omaha, Neb.; East Chicago, Ind.; and Trail, B. C., Canada.

BETZ CO., FRANK S.—Hammond, Ind. Manufacturer of electrical equipment for dentists, physicians and hospitals. Business established 1895. President, Frank S. Betz; vice-president, George Hannauer;

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secretary and treasurer, A. F. Rohrer; general manager, C. A. Taylor; sales manager, H. W. Margenau. Main office and factory, Hoffman St., Hammond, Ind. Branch offices, 30 E. Randolph St., Chicago, Ill.; 6-8 W. 48th St., New York, N. Y.

BEVEL GEARS—A pair of toothed wheels transmitting the rotation of one shaft to another at an angle, most commonly 90 degrees. If change of speed is also to be effected, the ratio of the number of teeth must be the inverse of the desired ratio of the shaft speeds. (See statement of general principles and practice under Gears.)

BEVIN BROS. MFG. CO.—East Hampton, Conn. Manufacturer of unmounted bells. Business established 1832. President, A. Torry Bevin; secretary, Mayo S. Purple; treasurer, C. G. Bevin. Sales representative, J. H. Graham & Co., 113 Chambers St., New York, N. Y.

BEYER & CO., L.—2337-39 E. 4th St., Cleveland, Ohio. Manufacturers of residence lighting fixtures.

B-G.—Trade name for self-feeding portable loader and portable conveyors manufactured by the Barber-Greene Co., Aurora, Ill.

BG.—Trade name for conduit boxes manufactured by the Michigan Stamping Co., Detroit, Mich.

B-H CURVE.—The name given to the saturation or magnetization curve of samples of iron or steel. It is a curve plotted between magnetic intensity (H) and flux density (B). See Magnetization curves.

Bi.—The form Bi is the chemical symbol for the metallic element bismuth.

BICHROMATE CELL.—A wet primary cell or battery with carbon and zinc as electrodes, and a strong solution of potassium bichromate and sulphuric acid as electrolyte. The zinc plate is usually amalgamated, placed between two carbon plates and arranged so it may be lifted out of the electrolyte when not in active use so as to prevent rapid disintegration. The cell gives the highest e. m. f. of any of the better known primary batteries (2 to 2.25 volts) but is troublesome in use because of the need of lifting the zinc; it is therefore but little used nowadays. This cell is also known as Poggendorf's cell.

BICKNELL-THOMAS CO. — Greenfield, Mass. Manufacturer of motor-driven tapping machines. President and treasurer, G. W. Carpenter; manager, F. A. Bicknell.

BIDDLE-GAUMER CO.—3846-56 Lancaster Ave., Philadelphia, Pa. Manufacturer of lighting fixtures and portable electric lamps. Business established 1882. President, Robert Biddle; vice-president, John L. Gaumer; secretary and treasurer, C. Lester Sherman, Jr.

BIDDLE, JAMES G.—1211-13 Arch St., Philadelphia, Pa. Manufacturer of electrical testing and indicating instruments. Business established 1895.

BIERCE.—Trade name for guy anchors, guy wire protectors and cable rollers manufactured by the Specialty Device Co., 106 W. 3rd St., Cincinnati, Ohio.

BIFILAR SUSPENSION.—Suspension of the moving element (coil or needle), of a galvanometer or similar instrument by means of two parallel fine wires, filaments or threads, whose twisting or torsion resists the deflection or swing of the moving element and brings it back to zero position.

BIFILAR WINDING.—A noninductive winding frequently used for resistance coils. The wire is first doubled back on itself and then wound on like duplex or twin wire. To avoid doubling back, the wire from two spools may be carefully spliced, the joint well insulated and then wound on the coil from both spools simultaneously. The inductance of one-half the winding neutralizes that of the other half which lies parallel with it throughout.

BIG BEN.—Trade name for gasoline engine manufactured by C. Benninghofen & Sons, Hamilton, Ohio.

BIG BEN.—Trade name for electric vacuum cleaners manufactured by the Clements Mfg. Co., 609 Fulton St., Chicago, Ill.

BIG BRUTE.—Trade name for test clips manufactured by the Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio.

BIG ELI.—Trade name for portable lighting and power plants manufactured by the Eli Bridge Co., Jacksonville, Ill.

BIG 4.—Trade name for graphite cylinder lubricators manufactured by the Carleton Co., 170 Summer St., Boston, Mass.

BIG SAVAGE FIRE BRICK CO.—Frostburg, Md. Manufacturer of fire brick. President, D. Armstrong; vice-president and treasurer, D. A. Benson. Branch offices, 438 Commercial Trust Bldg., Philadelphia, Pa.; 47 Kilpatrick Ave., Chicago, Ill.; 1241 Bessemer Bldg., Pittsburgh, Pa.

BIG 3.—Trade name for vacuum type electric washing machine manufactured by the Barlow & Seelig Mfg. Co., Ripon, Wis.

BIGELOW CO., THE.—New Haven, Conn. Manufacturer of fire-tube and water-tube boilers. President, George S. Barnum; secretary, Starr H. Barnum. Main office and factory, New Haven, Conn. Branch offices, Singer Bldg., New York, N. Y.; Oliver Bldg., Boston, Mass.; Commercial Trust Bldg., Philadelphia, Pa.

BIGELOW-HORNSBY.—Trade name for water-tube boilers manufactured by the Bigelow Co., New Haven, Conn.

BIGELOW-MANNING.—Trade name for fire-tube boilers manufactured by the Bigelow Co., New Haven, Conn.

BIGGS BOILER WORKS CO.—Akron, Ohio. Manufacturer of tanks for power houses, etc.

BIJUR MOTOR APPLIANCE CO.—Hoboken, N. J. Manufacturer of automobile starting and lighting systems. President, Joseph Bijur; vice-president and sales manager, Charles Marcus; secretary, E. E. Lewis; treasurer, Mr. Berggren; general manager, D. B. Gauchet. Main office and factory, 15th & Garden Sts., Hoboken, N. J. Branch office, 1208 Kresge Bldg., Detroit, Mich.

BILCHACO.—Trade name for insulating paints and varnishes manufactured by the Billings-Chapin Co., 1153 E. 40th St., Cleveland, Ohio.

BILLING MACHINES, ELECTRICALLY OPERATED.—Motor-driven office equipment, including typewriter and computing machine attachments for preparing bills, invoices, etc. These outfits are provided with flexible cord and attachment plug for connection to ordinary lighting circuits, as they require but little power for operation. They are characterized by accuracy, speed and neatness, being superior in each of these respects to even experienced bill clerks. Their use effects considerable saving in clerical expense in the case of electric central-station companies and other organizations that have large numbers of bills to prepare.

Manufacturers:

Elliott-Fisher Co., Harrisburg, Pa.

BILLINGS & SPENCER CO., THE.—Hartford, Conn. Manufacturer of pliers and forgings.

BILLINGS-CHAPIN CO., THE.—Cleveland, Ohio. Manufacturer of insulating and protective paints, varnishes and impregnating compounds. President, N. D. Chapin; vice-president, J. M. Bacon; secretary and treasurer, R. C. Acker; sales manager, N. T. Chapin. Main office and factory, 1163 E. 40th St., Cleveland, Ohio. Branch offices and warehouses, 146 High St., Boston, Mass.; 438 Pearl St., New York, N. Y.

BILLITER-LEYKAM CELL.—An electrolytic cell of the bell-jar type, designed for the production of alkali and chlorine from brine solution. See Alkali, electrolytic.

BILLITER-SIEMENS CELL.—An electrolytic cell of the horizontal diaphragm type, designed for the production of alkali and chlorine from brine solution. See Alkali, electrolytic.

BINAURAL.—Relating to or used with both ears. Much of man's ability to tell from which direction a sound is coming is due to his having two ears instead of one. If the sound comes from straight ahead, both ears hear the sound with equal loudness and at the same time. If it comes from a point to the right or left, the ear on the corresponding side hears it more loudly than the other. This same fact is made use of in the geophone, the submarine detector, etc.

BINDING POSTS.—These are terminals used on various apparatus to facilitate making either temporary or permanent connections to some outside source or circuit. They are generally made of brass in not very large sizes. The binding post may consist of a small screw with a shoulder on it mounted permanently on the apparatus. The bare wire or wire terminal may then be placed around or over the screw and a small round nut or wing nut screwed on to secure the connection. In other cases a brass post has a hole drilled at right angles to its axis and the wire is placed in the hole. A screw is placed along the axis so that it may be used to secure the wire in the hole. There are a number of other forms used for similar purposes; sometimes they are nickel-plated. Binding posts are made in large quantities by manufacturers of brass screw-machine products for use by electrical manufacturers.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco".

American Pin Co., The, Waterbury, Conn. "Ampinco".

American Radio & Research Corp., 21 Park Row, New York, N. Y.

Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)

Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.

EBY MFG. CO., H. H., 1302 Wallace St., Philadelphia, Pa. The accompanying cuts illustrate the "Leader", a new, patented binding post. The contact



Opened 75 Amps. 25 Amps.

surfaces extend the full width of the post and operate parallel to each other. This feature affords a greater and more positive contact and permits use of a smaller and less expansion post for a given current capacity. The caps are non-removable, preventing loss of any of the component parts. Made in 5 sizes, ranging from 5 to 300 amperes, plain or nickel plated.—Adv.

Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.

Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."

General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.

Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.

Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.

Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."

Morse, Frank W., 289 Congress St., Boston, Mass.

National Acme Co., The, E. 131st St., & Colt Rd., Cleveland, Ohio.

National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can

Parkin Mfg. Co., San Rafael, Cal.

Porcelain Binding Post Co., Jersey City, N. J.

Pyrolectric Instrument Co., 636-670 E. State St., Trenton, N. J.

Radio Electric Co., The 3807 5th Ave., Pittsburgh, Pa.

Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

Somerville Radio Laboratory, 102 Heath St., Somerville, Mass. "Sorala".

Standard Scientific Co., 9 Barrow St., New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y.

STATES CO., THE, 72 Francis Ave., Hartford, Conn.

Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.

Tresco, 1201 Kohl Bldg., Davenport, Iowa. "Perfection."

Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BINKS SPRAY EQUIPMENT CO.—3120 Carroll Ave., Chicago, Ill. Manufacturer of cooling ponds, power plant oil burners and paint spraying machines. Business established 1899 as Star Brass Works. President and treasurer, Joseph Binks; vice-president and general manager, H. D. Binks; secretary, E. W. Peterson.

BINNACLES, ELECTRICALLY LIGHTED SHIP'S COMPASS.—Electrically lighted binnacles are used to support and illuminate ships' compasses, and to contain all the necessary compensating devices, etc. Formerly oil lamps, one on each side of the binnacle, were used, but on the larger ships where electricity is used they are now illuminated by an electric lamp in the top of the hood. The connections are made through the base of the binnacle.

Manufacturers:

Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y. "Nautico."

BINSWANGER & CO., B.—829-835 N. 3rd St., Philadelphia, Pa. Manufacturers of insulating paints, varnishes, compounds, wood preservatives, etc. Business established 1879. President and general manager, I. Binswanger; vice-president, Carroll G. Binswanger; secretary, Morris Wolf; treasurer and sales manager, Jack Binswanger.

BIPOLAR.—Having two poles, one north and one south; commonly applied to two-pole generators and motors to distinguish them from machines having more than two poles, which are called multipolar machines.

BIPOLAR ELECTRODE.—A conducting plate or electrode placed in the electrolyte between an anode and a cathode. When the impressed voltage across the cell becomes sufficient to perform double electrolysis, as of two cells in series, current passes into the bipolar electrode on the side towards the anode, making that side a cathode, and leaves it on the side towards the cathode, making that side an anode. The intermediate plate thus becomes bipolar, acting as cathode on one side and anode on the other.

BIRCH PUMP VALVE CO.—1521-1523 Sedgwick St., Chicago, Ill. Manufacturer of pump valves for power plants.

BIRD-ARCHER CO., THE.—New York, N. Y. Manufacturer of boiler chemicals, foundry products, etc. Main office, 90 West St., New York, N. Y. Factories, Philadelphia, Pa; Chicago, Ill.; Watervliet, N. Y.; Cobourg, Ont., Can. Branch offices, Peoples Gas Bldg., Chicago, Ill.; 444 Frisco Bldg., St. Louis, Mo.; 1st National Bank Bldg., Pittsburgh, Pa.; 2nd & Bristol Sts., Philadelphia, Pa.; Elm St. & Cohoes Rd., Watervliet, N. Y.; Cobourg, Ont., Can.

BIRD, RICHARD H.—11 Gifford Ave., Waltham, Mass. Manufacturer of jewel bearings for instruments.

BIRKELAND-EYDE PROCESS.—One of the leading arc processes for the fixation of atmospheric nitrogen. A series of high-tension arcs are struck between two electrodes, and as the successive arcs form they are spread out in the shape of a disk of flame by the action of an electromagnet, thus giving a large surface to the flame of the arcs. Air is led in at the center of this disk and out radially, to bring it into the maximum contact with the arcs. A furnace of this type takes up to 3,500 kw. at 5,000 volts. The furnace gases carry 1 to 1.2 per cent of nitrous oxide, giving a yield of about 67 grams of nitric acid per kw-hr.

BIRMINGHAM WIRE GAGE.—This is the name of a gage used to express the size of most iron and steel wires. It has been employed largely in connection with wire of this character used for telegraph and telephone lines and armor wire. It is also known as Stub's iron wire gage, and is usually abbreviated B. W. G.

BIRNEY.—Trade name for electric railway cars manufactured by the J. G. Brill Co., 62nd St. & Woodland Ave., Philadelphia, Pa.

BIRTMAN ELECTRIC CO.—640 W. Lake St., Chicago, Ill. Manufacturer of electric vacuum cleaners. President, H. R. Butz; vice-president and secretary, F. A. English; treasurer, A. H. Apfel; general manager, E. F. Mulhern.

BISHOP & BABCOCK CO., THE.—Cleveland, Ohio. Manufacturers of electric pumps, regulators, carbonators, etc. Business established 1870. President, E. S. Griffiths; vice-presidents, H. H. Pinney and C. C. Harris; secretary, E. T. Sargent; treasurer, J. H. Champ; sales manager, C. H. Newman. Main office, 1200 E. 55th St., Cleveland, Ohio. Branch offices, St. Louis, Mo.; San Francisco, Cal.; Dallas, Tex.; Atlanta, Ga.; Denver, Colo.; Milwaukee, Wis.; St Paul, Minn.; Cincinnati, Ohio; 376 Lafayette St., New York, N. Y.; 39 W. Adams St., Chicago, Ill.

BISHOP & CO. PLATINUM WORKS, J.—Malvern, Pa. Refiners of platinum, gold and silver. Business established 1842. President, J. B. Matlack; secretary and treasurer, Charles J. Kerk; general manager, Stanley C. Kerk.

BISHOP GUTTA-PERCHA CO.—420-430 E. 25th St., New York, N Y. Manufacturer of rubber-covered wires and cables. President, Henry D. Reed; vice-president and treasurer, W. Boardman Reed; secretary, Louis F. Reed.

BISHOP MFG. CO., THE ROBERT.—South Boston, Mass. Manufacturer of cotton wiping waste. Main office, 157 W. 6th St., South Boston, Mass. Branch offices, New York, N. Y.; Pittsburgh, Pa.

BISHOP SPECIAL AND BISHOP STANDARD.—Trade names for rubber-covered wires and cables manufactured by the Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y.

BISHOP, W. S.—New Haven, Conn. Manufacturer of electroplating generators.

BISMUTH.—A grayish white metal. Its symbol is Bi; atomic weight 208; sp. gr. 9.8; m. p. 267°C. It expands on solidifying, its specific gravity just above the melting point being 10.55. It occurs chiefly as the sulphide Bi_2S_3, or the oxide, Bi_2O_3, and is frequently associated with lead ores. Bismuth is recovered in several ways, but chiefly by a reduction process using sodium carbonate as a flux, and as a by-product of electrolytic lead refining. In the latter it is recovered from the slimes, and is refined electrolytically in a hydrochloric acid solution. The process takes place in porcelain tanks, the anodes being impure bismuth carrying silver and gold. A considerable amount is recovered in this way in the United States, but from 50,000 to 100,000 lbs. is imported annually. The bulk of the world's production comes from Bolivia, where it is produced as crude bullion and shipped to London, where most of it is refined by Johnson, Mathey & Co. Its principal uses are in making stereotype alloys and special alloys of low-melting points.

BISON.—Trade name for rubber belting manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

BISSELL CO., THE F., TOLEDO-BISSELL MFG. DEPT.—226 Huron St., Toledo, Ohio. Manufacturer of fractional horsepower motors and vacuum cleaners. Business established 1892. President, Frederick Bissell; vice-presidents, Walter S. Bissell, James Hodge; secretary and treasurer, E. B. Terry.

BITS, AUGER, STANDARD, EXPANSIVE, EXTENSION, ETC.—The most common auger bits for boring through wood have a small screw for centering and self-feeding, and a cutting tip on the end of a helically twisted surface which extends from tip to shank and serves to remove the chips as the hole is being bored. An expansive or expansion bit is one that has a radially adjustable cutting edge, so that holes of various diameters may be drilled. Extension bits or bit holders consist of a long shank fitted at the outer end to hold several sizes of bits and used for boring deep holes that it is not possible to reach with a bit of the ordinary length. Gimlet bits have a conical or screw centering and cutting end with a short enlarging spiral merging into the shank. Bell hangers' gimlet bits are made up to 36 inches in length and to ⅝ inch in diameter. Pod bits have a rounded cutting end and straight fluted shank; they resemble a gauge. Also see Braces, electrician's bit.

Manufacturers:

Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio.
Deuse, J. S., Chester, Conn.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y.
Fastfeed Drill & Tool Corp., Toledo, Ohio. "Fastfeed."
Forest City Bit & Tool Co., Rockford, Ill.
Ives Mfg. Co., W. A. Wallingford, Conn. "Mephisto."
Kilborn & Bishop Co., The, Chapel & Lloyd Sts., New Haven, Conn. "Clark."
Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Morse Twist Drill Machine Co., New Bedford, Mass.
New Haven Copper Co., The, Seymour, Conn.
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto," "Samson."
SMITH & HEMENWAY CO., INC., Irvington, N. J.

BITU-DUCT.—Trade name for underground fiber conduit manufactured by the North American Electrical Products Co., Equitable Bldg., New York, N. Y.

BI-UNE.—Trade name for interior telephones manufactured by the Samson Electric Co., Canton, Mass.

B. I. W.—Trade name for insulated wires and cables manufactured by the Boston Insulated Wire & Cable Co., Boston, Mass.

B-L.—Trade name for wood crossarms manufactured by the Barnes-Lindsley Mfg. Co., 503 Couch Bldg., Portland, Ore.

BLACK & BOYD MFG. CO.—17 E. 47th St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1894. President, John E. Carpenter; vice-president, Herman Plaut; secretary, Avon C. Burnham, Jr.; treasurer, Leopold Plaut.

BLACK & DECKER MFG. CO., THE.—Towson Heights, Baltimore, Md. Manufacturer of electric portable tools and air compressors. President, S. Duncan Black; vice-president and general manager, Alonzo G. Decker; 2nd vice-president, Charles J. Fox; 3rd vice-president, Benjamin T. Ridgely; secretary, O. W. Dieffenbach; treasurer, George M. Kimberly. Main office and factory, Towson Heights, Baltimore, Md. Branch offices, Printing Crafts Bldg., New York, N. Y.; Boston, Mass.; 27 Watson St., Detroit, Mich.; Pittsburgh, Pa.; Philadelphia, Pa.; Cleveland, Ohio; Chicago, Ill.; San Francisco, Cal.; Atlanta, Ga.

BLACK AND TAN.—Trade name for belting manufactured by the Peerless Belting Co., Gardenville, N. Y.

BLACK CO., INC., JOHN B.—43 W. 2nd St., Chester, Pa. Manufacturer of linemen's axes and other tools. Business established 1806. President, A. R. Pendleton; vice-president, L. B. Swint; secretary, treasurer and general manager, E. L. Dannaker; sales manager, L. J. McDonald. Sales representatives, George Walter Davis, 258 Broadway, New York, N. Y.; W. W. Crandall Co., Nashville, Tenn.; John T. Roundtree, Inc., Salt Lake City, Utah; Denver, Colo.; Los Angeles, Cal.

BLACK CORE.—Trade name for rubber-covered wire manufactured by the Habirshaw Electric Cable Co., Point St., Yonkers, N. Y.

BLACK DIAMOND.—Trade name for power transmission belting manufactured by the Acme Belting Co., Niles, Mich.

BLACK DIAMOND.—Trade name for insulating tape manufactured by the M. W. Dunton Co., Providence, R. I.

BLACK DIAMOND.—Trade name for trolley hangers manufactured by the Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.

BLACK DIAMOND.—Trade name for belting manufactured by the Jewell Belting Co., Hartford, Conn.

BLACK HAWK.—Trade name for electric washing machine manufactured by the Sechler Implement & Carriage Co., Moline, Ill.

BLACKBURN-SMITH CORP., THE.—107 W. 40th St., New York, N. Y. Manufacturer of feed water filters.

BLACKBURN SPECIALTY CO.—East 35th St. & Perkins Ave., Cleveland, Ohio. Manufacturer of ground clamps. E. Blackburn, manager.

BLACKMER ROTARY PUMP CO.—Petoskey, Mich Manufacturer of electric pumps. Business established 1905. President, A. B. Klise; vice-president and general manager, E. L. Klise; secretary and treasurer, J. B. Huyck. Main office and factory, Petoskey, Mich. Branch offices, 85 Murray St., New York, N. Y.; 1119 Real Estate Trust Bldg., Philadelphia, Pa.; 1317 Book Bldg., Detroit, Mich.; 315 Old Colony Bldg., Chicago, Ill.; 727 Mason Bldg., Houston, Tex.; 315 Reserve Bank Bldg., Kansas City, Mo.; 1021 Hennepin Ave., Minneapolis, Minn.; Manx Hotel, Los Angeles, Cal.

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BLACKMERMAID.—Trade name for electric pumps manufactured by the Blackmer Rotary Pump Co., Petoskey, Mich.

BLACKSTONE.—Trade name for electric washing machines manufactured by the Blackstone Mfg. Co., Jamestown, N. Y.

BLACKSTONE MFG. CO., THE.—Jamestown, N. Y. Manufacturer of electric washing machines.

BLADES, ELECTRIC FAN.—Electric fan blades for small desk and bracket or wall fans and also for many exhaust fans are generally stamped from sheet brass and are highly polished and lacquered, nickel-plated or japanned. Brass-plated sheet steel has been used at times when copper was expensive. For large ventilating fans and blowers the blades or propellers are usually made of steel, japanned or painted; special shapes are often used to give quiet running or improved efficiency. Ceiling fans generally have large wooden blades which are mounted on a metal star frame attached to the armature shaft. These blades are sometimes made by specialty manufacturers and sold to the fan manufacturers, or are made to be sold separately for replacement purposes.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BLADES, HACKSAW. — Steel blades from 8 to 12 inches long secured in hacksaw frames and used for cutting armor, tubing, piping, etc. Usually sold in packages containing 12 blades. The blades are made up with various numbers of teeth per inch so as to give best results in cutting the different metals on which they are used, the variation being from 14 to 32 teeth per inch.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Clemson Bros., Inc., Middletown, N. Y. "Star."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Goddell-Pratt Co., Greenfield, Mass. "G."
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Napier Saw Works, Inc., Roland St., Springfield, Mass.
Simonds Mfg. Co., 470 Main St., Fitchburg, Mass.
SMITH & HEMENWAY CO., INC., Irvington, N. J.
Spartan Saw Works, 41 Taylor St., Springfield, Mass. "Spartan."

BLADES, SEMAPHORE OR SIGNAL.—Railway semaphore or signal blades are almost always made of wood. They are fastened to a casting carrying colored glass roundels and which is pivoted so as to be operated by the motor, solenoid or other mechanism. The combination of the blade and casting and roundels constitutes the semaphore or signal arm. These blades are made of well seasoned wood and are supplied for replacement service or to signal manufacturers who prefer to purchase their blades.

Manufacturers:

Hall Switch & Signal Co., Garwood, N. J.

BLAIR MOTOR TRUCK CO.—Newark, Ohio. Manufacturer of electric trucks.

BLAKE & JOHNSON CO., THE.—Box 1054, Waterbury, Conn. Manufacturer of brass and copper rivets. Business established 1849. President, John P. Elton; secretary, Charles E. Stevens; treasurer and general manager, L. P. Clark; sales manager, H. F. White.

BLAKE, EDWARD.—Newdale, N. C. Manufacturer of mica and mica products.

BLAKE ELECTRIC MFG. CO.—Boston, Mass. Manufacturer of automatic electric guiders for cloth cutting machines.

BLAKE SIGNAL & MFG. CO.—221 High St., Boston, Mass. Manufacturers of railway signaling systems and wiring specialties. Business established 1904. President, general manager and sales manager, E. J. Burke; vice-president, C. C. Blake; secretary and treasurer, S. Wentworth. Sales representatives, S. H. Couch Co., Inc., Boston, Mass.; S. R. Fralick & Co., 15 S. Clinton St., Chicago, Ill.; G. M. Stout, 1031 Healey Bldg., Atlanta, Ga.; Canadian Independent Telephone Co., 263 Adelaide St., W., Toronto, Can.; Keeler, White Co., 509 Mission St., San Francisco, Cal.; W. J. Clifford Co., 39 Cortlandt St., New York, N. Y.; Western Electric Co., 195 Broadway, New York, N. Y.,

BLAKELEY & SON, JOHN.—1089 Germantown, Ave., Philadelphia, Pa. Manufacturers of oiling and wiping cotton waste.

BLAKESLEE & CO., G. S.—Cicero, Ill. Manufacturers of electric labor-saving devices for the household and hotel. President, G. S. Blakeslee; vice-president and general manager, G. R. Blakeslee; sales manager, B. H. Blakeslee. Main office, 19th St. & 52nd Ave., Cicero, Ill. Factories, Chicago, Ill., and Sarnia, Ont., Can. Branch office, Sarnia, Ont., Can.

BLAKESLEE FORGING CO.—Plantsville, Conn. Manufacturer of linemen's pole climbers and electric railway forgings. Business established 1877. President, C. C. Chamberlin; vice-president, J. H. Pratt; secretary and treasurer, D. S. Blakeslee. Main office, Plantsville, Conn. Factories, Plantsville and New Haven, Conn. Branch office, Blakeslee Drop Forging Co., New Haven, Conn.

BLAKESLEE MFG. CO.—225 N. Chestnut St., Du Quoin, Ill. Manufacturer of single and duplex steam pumps. Business established 1862. President, S. B. Eaton; vice-president and general manager, J. W. Blakeslee; secretary, treasurer and sales manager, E. T. Blakeslee.

BLANCHERS, ELECTRIC, PEANUT.—Electric blanchers are motor-driven machines which remove the red skins from the peanuts after they are roasted. They also remove the bitter hearts or germs in the same operation.

Manufacturers:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich. "New Model."

BLANCO.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

BLANKETS, ELECTRICALLY HEATED.—Blankets made up with resistance wire enclosed in insulating material of a flexible character between the layers making up the fabric. Most types are equipped with an automatic thermostat which opens the circuit when the blanket reaches a certain predetermined temperature (about 180 deg. F.) and closes the circuit when the temperature falls to a certain point. A two or three-heat switch is usually part of the appliance. When used on beds on sleeping porches or in unheated rooms they are very useful in bringing the bed to a comfortable temperature before retiring, and in maintaining this temperature throughout the night. They have the added advantage of giving warmth without increased weight or pressure occasioned by the use of several blankets, quilts or comforters.

Manufacturers:

Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind. "Electro-Warm."
Hainert & Son, F. H., Minneapolis, Minn. "Comfy."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Vit-O-Net Mfg. Co., 1225 N. Clark St., Chicago, Ill. "Vit-O-Net."

BLASTER'S FRIEND.—Trade name for electric blasting cap and circuit testers manufactured by the New York Blasting Supply Co., 11 Broadway, New York, N. Y.

BLASTING APPARATUS, ELECTRIC, MISCELLANEOUS.—Equipment used for detonating powder charges in blasting operations and consisting of connecting or leading wires, detonating caps and "blasting machines." The latter consist either of a portable battery of dry or storage cells with a circuit-closing switch or key, or a portable magneto generator enclosed in a box with a projecting handle which is pushed or pulled, causing the rapid rotation of an armature which generates the required current for exploding the detonating caps and thereby the blasting charges. For parts of this equipment see Detonators, electric; Fuses, blasting; Wire, leading, for blasting.

Manufacturers:

Aetna Explosives Co., Inc., 120 Broadway, New York, N. Y. "Lion."
Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa. "Lilliput," "Push Down," "Davis."
Du Pont de Nemours & Co., E. I., Du Pont Bldg., Wilmington, Del. "Victor," "Pul Up," "U. S. Standard."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
New York Blasting Supply Co., 11 Broadway, New York, N. Y. "New York."

BLAU SERVICE, INC.—682 Montgomery St., Jersey City, N. J. Manufacturer of battery-charging sets and wet batteries. President and general manager, Leslie L. Blau; secretary and treasurer, Ellis J. Blau.

BLAW-KNOX CO. — Pittsburgh, Pa. Manufacturer of steel radio antenna and transmission towers, coal and ash handling machinery, welding outfits and other steel products. Business established 1905. President, A. C. Lehman; vice-presidents, I. F. Lehman, F. M. Bowman, Wayne Rawley; secretary and sales manager, C. H. Lehman; treasurer, B. L. Hirshfield; general manager, Wayne Rawley. Main office, Farmers' Bank Bldg., Pittsburgh, Pa. Factories, Hoboken, Pa., and Baltimore, Md. Branch offices and warehouses, 165 Broadway, New York, N. Y.; Peoples Gas Bldg., Chicago, Ill.; Monadnock Bldg., San Francisco, Cal.; Little Bldg., Boston, Mass.; Lincoln Bldg., Detroit, Mich.

BLEACH LIQUOR.—The common technical name for a moderately dilute solution of sodium oxychloride (NaClO), produced by the electrolysis of a solution of sodium chloride.

BLEADON-DUN CO., Chicago, Ill. Manufacturer of violet ray high-frequency apparatus. Business established 1912. President and treasurer, J. J. Bleadon; vice-president, Harry E. Kopald; secretary, M. R. Frank; general manager, William N. Meyerberg; sales manager, Theodore Mueller. Main office, 213 S. Peoria St., Chicago, Ill. Branch offices, 25 W. 42nd St., New York, N. Y.; 830 Washington St., Boston, Mass.

BLISS CO., A. H.—136 Hospital St., Providence, R. I. Manufacturer of ornamental and fixture chains. President, Frank H. Bliss.

BLISS CO., E. W.—Brooklyn, N. Y. Manufacturer of motor-driven power presses. Business established 1857. Main office, Adams & Plymouth Sts., Brooklyn, N. Y. Factories, Brooklyn, N. Y., and Hastings, Mich. Branch offices, Peoples Gas Bldg., Chicago, Ill.; Dime Bank Bldg., Detroit, Mich.; Union Bank Bldg., Cleveland, Ohio; Union Trust Bldg., Cincinnati, Ohio; Marine Bank Bldg., Buffalo, N. Y.; Boatmen's Bank Bldg., St. Louis, Mo.; Keenan Bldg., Pittsburgh, Pa. Sales representatives, Berger & Carter, San Francisco and Los Angeles, Cal.; Portland, Ore.; Seattle, Wash.

BLOCH & CO., L. D.—37-41 E. 18th St., New York, N. Y. Manufacturers of portable lamps, shades and lamp bases. President, Leon Bloch; vice-president, Henry Bloch; secretary and sales manager, Alfred Goldsmith; treasurer, Lucien D. Bloch; general manager, J. F. Milner.

BLOCK, FORMING.—See Forming block.

BLOCKS, CONNECTING AND INTERCONNECTING.—Bases of insulating material having mounted thereon a number of terminal connecting studs or binding posts, to which signal or other low-voltage circuits, such as for telephones, buzzers, or annunciators, may be connected, thus providing means for readily changing circuit connections or interconnections. Special blocks of similar kind are also used in some countries for ordinary house lighting circuits, but are not approved for this service in the United States or Canada.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduiet."
Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Laconite."

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Stanley & Patterson, 34 Hubert St., New York, N. Y.
STATES CO., THE, 72 Francis Ave., Hartford, Conn.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V.V."

BLOCKS, FIXTURE.—Fixture blocks are usually wooden blocks that are placed in a wall or ceiling while the wiring is being installed; they are securely braced, so that a heavy fixture may be supported therefrom.

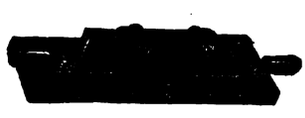
Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Manson Lumber Co., 101 Border St., East Boston, Mass.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

BLOCKS, FUSE.—Slate, marble or other insulating bases having terminal pieces or mounting clips designed to accommodate special forms of open or enclosed fuses. For standard types of plug, cartridge and open link fuses the bases are more commonly called cutout bases; see Bases, cutout. The term fuse block is more generally restricted to the bases for mounting large or special fuses, such as are not standardized by the National Electrical Code; for instance, fuses for voltages above 600. This is the meaning contemplated in this classification.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display advertisement on pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y. "Vitribestos," "Fire-Felt." "Thermo Fire-Felt," "Vitro."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., West, Detroit, Mich. The "Bull Dog" line of fuse blocks, sizes to cover every requirement; two, three



"Bull Dog" Fuse Block

and four poles, 250-, 500- and 600-volts, 3 to 1200 amps. These blocks are furnished with "cold flowed" terminal lugs and incorporate the superior features of "Bull Dog" switches, with an oil finished (not painted) electrical slate base. See entry under Switches, knife, standard; also see display adv. page 1285. —Adv.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display advertisement on pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Man-



T. V. Fuse Block

ufactures slate base fuse blocks in all sizes from 30 amp. 250 volt to 1200 amp. 600 volt.—Adv.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BLOCKS, LINEMEN'S.—A set of sheave wheels and rope used to multiply power for pulling up trolley wire, transmission wire, guy wires, etc.

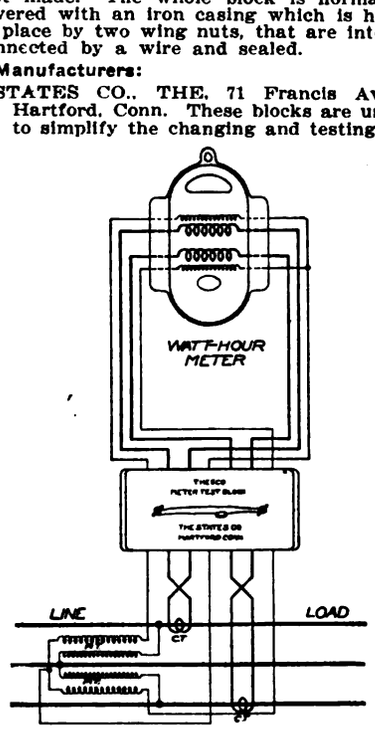
Manufacturers:

Columbus Handle & Tool Co., The, Columbus, Ind.
HERBST, PAUL W., Chicago, Ill.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. We manufacture the well-known "Klein" self-locking troublemen's blocks, having snap hook at each end. Furnished with 25 feet of ⅝ in. rope. A handy tool to attach grips to pull up the slack in wire. Can be furnished with an anchor hook for fastening to an insulator pin or other convenient anchorage. For illustrations and additional information concerning Klein products, see page 1259 and write for complete catalog of construction tools.—Adv.
SMITH & HEMENWAY CO., INC., Irvington, N. J.

BLOCKS, METER TESTING.—Meter testing blocks are porcelain terminal blocks of special construction, designed to simplify the testing, changing and installing of watt-hour meters used in conjunction with current or potential transformers or both. The regular circuit connections are made by means of ordinary binding posts, but a special test jack is provided for use in testing when it is desired to connect the rotating standard to the circuit in place of the customer's meter. No connections are changed or removed, but the test plugs are inserted in the proper jacks and the test made. The whole block is normally covered with an iron casing which is held in place by two wing nuts, that are interconnected by a wire and sealed.

Manufacturers:

STATES CO., THE, 71 Francis Ave., Hartford, Conn. These blocks are used to simplify the changing and testing of



Three-phase Installation with Test Block

watt-hour meters which are used in combination with current transformers or with current and potential transformers. The illustration shows a three-phase installation with test block. The block is arranged to short circuit current transformers when disconnecting or testing meter.—Adv.

BLOCKS, SWITCH.—Slate, marble, porcelain or other insulating base blocks on which most commonly isolated knife switches are mounted. This term is also used for the mounting blocks for other types of switches, such as wood blocks fastened between wall studs or screwed to the lathing on which are mounted surface snap switches connected to concealed wiring systems; also for wood, hard rubber or other base blocks on which are mounted low-voltage sliding multicontact switches. The term switch block does not apply to bases or sub-bases for snap switches; for these, see Bases, snap switch.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Lester Electric Co., Ltd., The, St. Thomas, Ont., Can. "Lester."
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

BLOCKS, TELEPHONE, PROTECTOR.—Telephone protector blocks are porcelain, fiber or composition blocks on which the protective apparatus is mounted. Standard protectors consist of fuses in series with the line and high-potential cutouts or lightning arresters bridged from line to ground. The arrester and fuses are commonly mounted on the one block, with an arrester in the middle and one tubular fuse on each side.

Manufacturers:

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BLOCKS, TERMINAL, GENERATOR AND MOTOR.—A block of insulating material fastened to some part of the frame of an electric machine upon which are mounted the terminals of the machine. The blocks are made of treated hard wood, fiber, slate, or composition insulating material. To the terminal studs in the larger machines are bolted the terminal lugs of the cables leading to the switchboard or control panel. Separate blocks are mounted on some machines for supporting a special field switch or equalizer switch.

Manufacturers:

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BLOCKS, TERMINAL, RAILWAY SIGNAL.—Railway signal terminal blocks differ from many other terminals and they are made to conform to the Railway Signal Association standards. Porcelain blocks are used and the terminal consists of a brass stud and shoulder with two washers and one hexagonal nut and one hexagonal locknut. They are very widely used on signal circuits and are sometimes provided with a brass tag to designate the circuit.

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Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

BLOCKS, TERMINAL, TRANSFORMER.—Distribution transformers are generally made with two primary and two secondary coils. The terminals of the primary coils are connected to terminals on a porcelain terminal block which is mounted within the transformer, below the oil level. The use of the terminal block permits changing coil connections and also facilitates the connection of the primary leads. The terminal blocks are generally made of porcelain, although composition blocks that are not affected by the oil, and other terminal arrangements are sometimes used. Four terminals suffice, but where voltage-adjusting taps are provided there may be additional terminals on the block to facilitate shifting the tap.

Manufacturers:

PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BLOCKS, WOOD MOLDING OR RACEWAY.—Mounting pieces of wood designed for use in connection with wood molding or raceways for securely mounting rosettes, receptacles, switches or other wiring fittings adapted for wood raceway systems.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

BLOMFELDT & RAPP CO.—108 N. Jefferson St., Chicago, Ill. Manufacturer of electric hair cutters. Business established 1886. President, Oscar Rapp; vice-president, Allen A. Blomfeldt; secretary and treasurer, Axel Blomfeldt.

BLOW TORCHES.—See Torches.

BLOWERS, FORCED-DRAFT, ELECTRIC.—Forced-draft blowers are used to give mechanical draft in steam power plants where the stack has insufficient area or height to carry off with natural draft the larger volume of flue gas formed with operation at increased rating. They are used with all underfeed stokers at full load or above, and generally also at light loads. The fans used are of special construction, for high-speed operation and high-pressure work. They are usually of the multiblade or multivane type, and must be capable of supplying heavy draft pressure to take care of the high combustion rates and attendant thick fires required on overload. Motor-driven blowers are widely used and are divided into two groups having constant and variable-speed motors. D-c. motors, connected to the blower by a flexible coupling, are generally used and the speed (and pressure) is regulated by hand or automatically by pressure-operated rheostats. A-c. motors of the induction type are also used, especially for constant-speed blowers, in which case the pressure is regulated by dampers.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco," "ABC."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Carling Turbine Blower Co., Inc., 104 Harding St., Worcester, Mass.
DeLaval Steam Turbine Co., Nottingham, Way, Trenton, N. J.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale," "Garden City."
Green Engineering Co., East Chicago, Ind.
Green Fuel Economizer Co., Beacon, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. and Diversey Blvd., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Johnson Fan & Blower Co., 115 St. Clinton St., Chicago, Ill.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWERS, FORCED-DRAFT, STEAM.—Steam-driven blowers are used to supply forced draft in a similar manner to electric blowers. They are used especially in plants where all the auxiliaries are steam-driven and in which the exhaust steam is put to service. They have the advantage of giving somewhat easier regulation of pressure than motor-driven blowers. Both turbines and steam engines are used, but the present tendency seems to be to turbines entirely. They are often connected to the blowers by special herring-bone gears in the larger sizes, but in some of the smaller sizes are direct-connected and run at the same speed as the turbine. Automatic pressure regulation is easily obtained by the variation in boiler pressure which controls a throttle valve supplying the turbine.

Manufacturers:

Beggs & Co., James, 36 Warren St., New York, N. Y.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Carling Turbine Blower Co., Inc., 104 Harding St., Worcester, Mass.
Green Fuel Economizer Co., Beacon, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Kerr Turbine Co., Wellsville, N. Y. "Economy."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWERS, FORGE, ELECTRIC.—Motor-driven blowers are widely used for supplying the air blast for forges in all but the smallest blacksmith shops. They provide a steady blast that is easily regulated, they relieve the blacksmith of the old task of operating a bellows or hand blower, and permit him to turn out more work. Electric forge blowers are made in several sizes ranging from a single small fire to five small or large fires, the blast piping being tapered in size to give each forge an equal supply of air; each forge has a damper so it may be cut off entirely. To permit uniform pressure regardless of the number of forges in service a speed regulator is usually provided for the blower motor; even on single direct-connected forge and blower sets speed control is often provided to regulate the amount of blast. Some of the large forge blowers are also used for cupola blast service in foundries.

Manufacturers:

American Blower Co., Detroit, Mich, "ABC."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion," "Midway," "400." "Lancaster."
Clements Mfg. Co., 609 Fulton St., Chicago, Ill. "Cadillac."
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale," "Garden City."
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
Kimble Electric Co., 534-46 N. Western Ave., Chicago, Ill. "Kimble." (a.c.)
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
North American Mfg. Co., The, 5902 Carnegie Ave., Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display advertisement on page 1308.)
Premier Emergency Corp., 767 3rd Ave., New York, N. Y. "Whirlwind."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

BLOWERS, INDUCED-DRAFT, ELECTRIC.—Induced-draft blowers are used in power plants having economizers, where the furnace gases are drawn through the economizer by the blower, which is located between the boiler and the stack. They are frequently used in conjunction with forced-draft blowers in large plants, especially those using both underfeed stokers and economizers. Because of the location of the blower, it handles all of the furnace gases and therefore is larger than a forced-draft blower for the same boiler. The same general construction is used, but provision is made for handling the hot gases and fumes. Motor drive is used more than steam-engine drive because the blower is rather inaccessible and the motors will operate satisfactorily with very little attention. Both a-c. and d-c. motors are used, and the motors are usually completely enclosed or set in a separate compartment to protect them from the gases. The feed water in the economizer tubes is usually at a lower temperature than the water in the boiler tubes; therefore, any unconsumed carbon in the gases is likely to deposit on the outside of the economizer tubes so that, in spite of mechanical scrapers to keep the tubes clean of soot, the economizer acts as a decided obstruction to the gases. The induced-draft fan by sucking the gases out of the economizer and forcing them up the stack neutralizes this obstructive action and prevents the creation of pressure in the boiler furnace and gas passages.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco," "ABC."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Garden City," "Cycloidale."
Green Fuel Economizer Co., Beacon, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Johnson Fan & Blower Co., 115 St. Clinton St., Chicago, Ill.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

BLOWERS, INDUCED-DRAFT, STEAM.—Steam-driven blowers for induced-draft systems are not used as widely as the electrically operated blowers, except in plants where all the auxiliaries are steam-driven. Because of the inaccessibility of the blower and the high speeds required reciprocating engines are rarely used, and small turbines, both direct-connected and those connected through reduction gearing, are usually found where steam drive is used. The blowers are specially constructed to handle the hot, corrosive gases, and are often made so that the rotor may be easily removed for periodic cleaning and painting.

Manufacturers:

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can.
Green Engineering Co., East Chicago, Ind.
Green Fuel Economizer Co., Beacon, N. Y.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWERS, MISCELLANEOUS, ELECTRIC.—Blowers are frequently made to meet special requirements and for purposes other than those listed herewith. Many of these miscellaneous applications, such as in chemical laboratories, battery rooms, dye houses, etc., where corrosive gases or high

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temperatures are encountered, require special construction and sometimes the use of different materials, such as hardened lead, monel metal and other resistive alloys.

Among interesting miscellaneous applications are the following: Blowers for driving a powerful blast of air through a molten mass of metal, the air oxidizing and removing certain impurities. High-pressure blowers for producing forced combustion in a gas or oil furnace. Blowers for blowing scale from dies in machine shops, the air being released on the dies at a pressure of from 12 to 14 oz. per sq. in. The velocity of the air from the nozzles of high-pressure blowers may reach 24,000 feet per minute.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco."
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. "Slip-on."
Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill. "Uniblade."
Beach-Russ Co., 220 Broadway, New York, N. Y. "Beach-Russ."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."
Clements Mfg. Co., 609 Fulton St., Chicago, Ill. "Cadillac."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale," "Garden City."
GENERAL ELECTRIC CO., Schenectady, N. Y. Centrifugal blowers or compressors designed for large volumes and low pressures, such as are required for the following classes of service: Oil and gas burning furnaces, foundry cupola blowing, pneumatic mail and cash conveying systems, agitation of liquids, sewage treating plants, blowing water gas generators, etc. These blowers are similar in design to the centrifugal pump and may be driven by d-c. motors with auxiliary apparatus for starting and controlling speeds, by 60-cycle induction motors for constant-speed service or by Curtis steam turbines. Blower and driver are direct-connected. The G-E centrifugal blower differs from the ordinary fan blower in that it is provided with discharge or diffusion vanes which convert the otherwise lost energy of velocity into pressure energy, resulting in high overall efficiency. Blower is completely housed. It will deliver practically constant pressure over a wide range of loads. The internal clearance is very large, thus there is no rubbing, and no internal lubrication is required. These blowers may be fitted with a constant volume governor which is simple in action, positive and accurate, and safeguards machinery in case of breakdown. Bulletins describing these units: For foundry service, No. 42800; for gas plants, No. 48600; for blast furnaces, No. 48601; industrial air and exhauster service, No. 48609. See adv. pages 1203-1223.—Adv.



Centrifugal Blower

Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Improved Appliance Co., 413 Kent Ave., Brooklyn, N. Y. "IACo," "Improved."
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
Maroa Mfg. Co., Maroa, Ill.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
North American Mfg. Co., The, 5902 Carnegie Ave., Cleveland, Ohio. (Gas-electric.) "Flameblast."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWERS, MISCELLANEOUS, STEAM.—Steam-driven blowers are used for many purposes in industrial plants and power plants where steam is supplied to all or most of the auxiliaries. One use is in connection with the air-washing system. The air used for cooling the generator is drawn by an exhaust blower through a spray chamber where the dust and dirt are removed. It is then forced through the ventilating ducts of the generator and then sometimes through the forced-draft blowers. All of these blowers may be steam-driven and are usually of the turbine type. Other uses are for ventilating and heating blowers; sawdust, shavings and dirt collectors; gas removers, etc.

Manufacturers:

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Carling Turbine Blower Co., Inc., 104 Harding St., Worcester, Mass.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. Centrifugal blowers or compressors for large volumes and low pressures direct-connected to Curtis steam turbines or electric motors. Described under Blowers, miscellaneous. See adv. pages 1203-1223.—Adv.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y. "Power," "Simplex," "S.A."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
TERRY STEAM TURBINE CO., THE, Hartford, Conn. Built in sizes up to



Terry Turbine Driven Blower

1,000 H.P. for all classes of service. There are more than 1800 Terry blower units installed.—Adv.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWERS, ORGAN, ELECTRIC.—Blowers for this purpose are constructed in many types. A common type is built so that an electric motor, by means of a lever having a fulcrum in the middle, operates a pair of bellows, one being filled while the other is discharging air into a pressure chamber and vice versa. Another type consists of motor-driven fans mounted on the same shaft in a wind-tight casing and successively adding wind pressure step by step until the final pressure is sufficient to operate the organ through a large upright pipe and bellows-regulating attachment.

Manufacturers:

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale," "Garden City."
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
KINETIC ENGINEERING CO.—60th St. and Baltimore Ave., Philadelphia, Pa. Kinetic Blowers attached to organs increase efficiency and volume materially. It being the first blower patented for this purpose, has valuable features not found elsewhere. It is most quiet in operation, and requires very little care, being almost foolproof and easily installed by an average mechanic.—Adv.
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
Spencer Turbine Co., The, Hartford, Conn. "Orgoblo."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Whitney Co., F. E., 65 Sudbury St., Boston, Mass. "Stanley."

BLOWERS, VENTILATING, ELECTRIC.—Motor-driven fans located in ducts or piping in such a way as either to draw out bad air or to drive in fresh air from the outside. The motors are usually arranged so that the speed and consequently the volume of air moved may be regulated. The smaller types of suction blowers are generally called exhaust fans, especially when they are not located in a duct. The most complete system of ventilation for auditoriums, large workrooms, schoolrooms, etc., is by use of both fresh air and exhaust blowers; the former supply the inlet air, which is often forced through heating and cleansing or other conditioning equipment, while the exhaust fans remove the foul or vitiated air.

Manufacturers:

Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill. "Uniblade."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C.G.E."
Carling Turbine Blower Co., Inc., 104 Harding St., Worcester, Mass.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale," "Garden City."
Green Fuel Economizer Co., Beacon, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

BLOWOUT, MAGNETIC.—Magnetic contactors and other controlling devices are often supplied with a magnetic blowout which assists in interrupting the flow of current when the circuit opens. The blowout usually consists of a series coil with a magnetic circuit so arranged that a magnetic field is set up which is perpendicular to the arc. The action of the field is to lengthen the arc and finally break it.

BLOW-RITE.—Trade name for fuse wire manufactured by the Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill.

BLUE BALL MACHINE WORKS.—Blue Ball (Lancaster Co.), Pa. Manufacturers of hand, power and electric house and deep well pumps. P. E. Shirk, proprietor.

BLUE BIRD.—Trade name for electric washing machine manufactured by the Blue Bird Division, Davis Sewing Machine Co., Dayton, Ohio.

BLUE BIRD.—Trade name for incandescent lamps manufactured by the Blue Bird Lamp Co., 45 E. 17th St., New York, N. Y.

BLUEBIRD.—Trade name for portable electric lamps manufactured by the Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio.

BLUE BIRD DIVISION, DAVIS SEWING MACHINE CO.—Dayton, Ohio. Manufacturer of electric washing machines. Factories, Dayton, Ohio, and St. Louis, Mo.

BLUE BIRD LAMP CO.—45 E. 17th St., New York, N. Y. Manufacturer of incandescent lamps.

BLUEPRINT DRIERS, ELECTRIC.—Drying machines, which in the common forms are arranged so that the printed paper, after passing under a line of sprinklers and through a special bath, goes through a set of rollers for removing as much water as possible and then passes through an enclosed casing heated by electric heating elements and leaves the enclosure through guide rollers, dry and ready for immediate use. In another form for drying separate prints an electrically heated oven is used.

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Manufacturers:

Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill. "Peerless."
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill.
Shaw Blue Print Machine Co., Inc., The, 9 Campbell St., Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa. "Franklin."

BLUEPRINTING FRAMES.—Blueprinting frames for sunlight printing are large wooden frames having a piece of clear, double-strength or plate glass backed up by a hinged or sectional back with several sets of springs or spring-operated bars. The frames are generally made of selected hard wood to prevent as much as possible any warping or swelling. With very large frames, it is sometimes difficult to get the tracing or negative to lie flat and maintain contact with the paper. To overcome this difficulty vacuum frames are made with a special rubber blanket. The air is exhausted from the space between the glass and rubber blanket by means of a small motor-driven exhaust pump and, as the blanket is securely held in place by the back and clamping members, the tracing or negative is smoothed out and held in perfect contact.

Manufacturers:

American Drafting Furniture Co., Inc., 103 Mill St., Rochester, N. Y.
Cole Co., The H., Columbus, Ohio.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill.

BLUEPRINTING MACHINES, ELECTRIC.—The general principle of these machines is to place the tracing upon the sensitized paper and then to pass a strong arc or other electric light over the tracing so that the light is thrown evenly over its surface, thus printing the lines on the blueprint paper. In some machines the tracing and blueprint paper are wrapped on a glass cylinder and an arc lamp moved at a uniform speed up or down on the inside of the cylinder. In other machines the light is stationary and the tracing and blueprint paper are moved together past the source of light. This latter type is more common where a large number of prints are regularly made. It usually is a continuous operation, the paper being fed from a roll and, together with the tracings, passing under a series of arc lamps. The tracings are separated from the paper, which then passes through a bath of water, a potassium or sodium bichromate bath, another bath of clear water, and then through the drier. In many of the large machines this is all accomplished by a single machine with motor-driven rolls and sometimes also an electric drier (see Blueprint driers, electric). Electric blueprinting machines permit blueprints to be made at any time regardless of the weather and are indispensable to large drafting rooms. The continuous type machine has special advantages where its extremely large capacity warrants its higher cost compared with the vertical cylinder type.

Manufacturers:

American Drafting Furniture Co., Inc., 103 Mill St., Rochester, N. Y.
Buckeye Engine Co., Salem, Ohio. "Buckeye."
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Levi, Benjamin, 355 W. Broadway, New York, N. Y.
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill. "Peerless."
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill. "Simplex."
Shaw Blue Print Machine Co., Inc., The, 9 Campbell St., Newark, N. J.
Wagenhorst & Co., J. H., 704 Dollar Bank Bldg., Youngstown, Ohio.
Wickes Bros., 512 N. Water St., Saginaw, Mich.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa. "Express," "Aurora."

BLUEPRINT-PAPER-COATING MACHINES, ELECTRIC.—These machines are motor-driven devices for unrolling paper and passing it through a coating solution, then through a drying oven or over drying coils and rolling it up on smaller rolls of 25, 50 or 100 yards in length, for later use in blueprinting machines or frames. The sensitized paper thus produced may be one of a number of forms, depending on the coating solution used. This is varied to give various printing speeds and also special kinds of prints and negatives.

The machines consist essentially of coating rollers and tank, together with a glass scraper, gas or electrically heated ovens and an automatic measuring and rerolling device.

Manufacturers:

Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill. "Duplex," "Simplex."

BLUE RIBBON.—Trade name for electric washing machine manufactured by the Haag Bros. Co., Peoria, Ill.

BLUE SEAL.—Trade name for dry batteries manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

BLUE STREAK.—Trade name for transmission belting manufactured by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

BLUE VITROL OR BLUESTONE.—Names extensively used in the trade for commercial copper sulphate. See Copper sulphate.

BLUFFTON MFG. CO.—Bluffton, Ohio. Manufacturers of electric washing machines.

B. M. CO. SPECIAL.—Trade name for babbitt metal manufactured by the Bronze Metal Co., 30 Church St., New York, N. Y.

BOARD OF TRADE UNIT.—The kilowatt-hour. The name "Board of Trade Unit" is used very extensively in England, where the Board of Trade is an official body having jurisdiction, among other things, over electricity supply service, including the units used in its measurement. In the United States the term is never used.

BOARDS, DRAFTING. — Drafting or drawing boards are made in several sizes from about 10x12 inches up to 48x84 inches. They are not provided with any supporting stands, as are drafting tables, but are means to be placed on a desk, table or bench while in use. The smaller boards are sometimes made of three-ply veneer white basswood and the larger boards are made of selected pine. Hardwood edges are provided and the individual boards, of which the finished drafting board is composed, are held together by special hardwood cleats or clamping members.

These boards are used widely for drawing, designing, curve plotting, etc., in connection with various branches of the electrical industry. Also see Tables, drafting.

Manufacturers:

American Drafting Furniture Co., Inc., 103 Mill St., Rochester, N. Y.
Economy Drawing Table & Mfg. Co., S. Center St., Adrian, Mich. "Economy."
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.

BO-ARROW.—Trade name for crossarms manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

BOBBINS FOR COILS.—Bobbins are small cylindrical or spool-shaped bodies on which coils for electromagnets or solenoids are wound. Bobbins and spools may be exactly similar, but the term bobbin generally applies to the base for finished and complete coils, while a spool is used for holding a quantity of wire ready for use. Bobbins are sometimes made of metal in tubular or cylindrical forms. They are also made of insulating materials, such as fiber, cardboard, molded composition, etc. The molded bobbins are sometimes made with the iron core molded in place for magnet construction or with a hole for the plunger of a solenoid.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Stephenson Mfg. Co., South Bend, Ind.
Woodturning Products Co., Inc., Quincy, Mass.

BOCH-METSCH PORCELAIN CO., THE.—East Liverpool, Ohio. Manufacturer of porcelain specialties. Business established 1920.

BOCK BEARING CO., THE.—Phillips Ave. & Michigan Central R. R., Toledo, Ohio. Manufacturer of taper roller bearings. General manager, R. E. Clingan.

BODINE ELECTRIC CO.—Chicago, Ill. Manufacturer of motors, motor-generators, grinders, rotary converters and labboratory lathes. Business established 1905. President, C. D. Bodine; vice-president, E. C. Bodine; secretary, treasurer and sales manager, P. J. Bodine. Main office and factory, 2254 W. Ohio St., Chicago, Ill. Branch offices, 127 Federal St., Boston, Mass.; 95 Liberty St., New York, N. Y.; 922 Sansom St., Philadelphia, Pa.; 4 W. Third St., Cincinnati, Ohio.

BOEC.—Trade name for oil engines manufactured by the Baltimore Oil Engine Co., Baltimore, Md.

BOEKEL & CO., WILLIAM.—516-518 Vine St., Philadelphia, Pa. Manufacturers of electric water baths, centrifuges and sterilizers for laboratories. Julius Boekel, sole owner.

BOESCH LAMP CO.—960-62 Mission St., San Francisco, Cal. Manufacturer of automobile signals and sheet metal stampings. Business established 1869.

BOETTCHER PATTERN CO.—Chicago, Ill. Manufacturer of electric floor sanding machines. William J. F. Boettcher, proprietor. Main office and factory, 440 N. Peoria St., Chicago, Ill. Branch office, 152 Chambers St., New York, N. Y.

BOGUE ELECTRIC CO., CHARLES J.—513 W. 29th St., New York, N. Y. Manufacturer of electroplating generators.

BOILER COMPOUNDS.—See Compounds, water treating.

BOILER HEAT INSULATION.—See Covering, boiler and pipe; also Heat insulation, brick, cement, etc.

BOILER-ROOM EQUIPMENT.—Boiler-room equipment comprises all of the equipment in a power plant for handling the fuel, delivering it to the furnaces, burning it, utilizing the heat in the boilers to generate steam, superheating the steam and delivering it to the engine or turbine room. To accomplish this result economically and efficiently a great deal of apparatus and many auxiliary devices are required. Much of this equipment and the most important boiler-room auxiliaries are described and listed elsewhere in this book. In the following brief outline reference is made to most of these descriptive articles.

Handling and care of the fuel is a most important function of much boiler-room equipment. This includes, in most plants, removal of the coal from cars, vessels or storage spaces to crushers, where it is reduced to the proper size, and then deposited into the bunkers, from which it is fed by gravity into the stokers. Coal scales are often provided to permit weighing the coal either continually or at least during tests. In some plants, where only poorer grades of coal are available, it is pulverized before being fired. In any coal-burning plant, removal of ashes must be arranged for. For all such equipment see Coal and ash handling machinery; Coal crushers; Coal storage bunkers, bins, etc.; Cars, power house; Pulverized coal equipment; Scales, coal. Also see general article on Coal handling in power plants.

When fuel oil is used facilities must be provided in the way of burners, pumps and tanks; see general article on Oil-burning equipment; also see Oil burners; Oil reservoirs and tanks; Pumps, oil. Occasionally natural gas or producer gas is used as fuel; see Meters, air and gas; Gas producers.

For the boilers themselves there are many important accessories that are practically parts of the boiler unit, such as the boiler furnace, grates, stokers, tubes, setting, covering, superheaters, etc. Then also there is the draft equipment and means for carrying off the smoke and gases, including forced and induced draft blowers, breeching, stacks and chimneys, draft regulators, etc. See general articles on Boilers; Draft, mechanical. Also specific articles on Boilers, fire tube; Boilers, water tube; Boiler settings, arches, etc.; Boiler tubes; Furnaces, boilers; Grates, boiler furnaces; Stokers; Covering, boiler and pipe; Superheaters; Blowers, forced-draft; Blowers, induced-draft; Breeching, boiler smoke; Chimneys, power plant; Stacks, smoke; Regulators, boiler-furnace draft; Soot blowers.

To supply the boilers with suitable feed water, preferably at high temperature, requires a number of essential auxiliaries, including Pumps, boiler feed; Injectors, power plant; Feed-water heaters; Economizers; Feed-water regulators; Meters, feed water.

The piping is a very important feature of boiler-room equipment. See a general discussion of Piping; also Pipes, high-pressure, power plant; Pipes, miscellaneous

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power plant; Brackets, steam and other pipe supporting; Hangers, conduit and pipe; Straps, conduit or pipe; Expansion joints for steam, water, etc., pipe lines; Covering, boiler and pipe.

Boiler-room instruments are essential in any modern plant. See separate article below.

BOILER-ROOM INSTRUMENTS.—Anything that is instrumental in accomplishing the work of power production efficiently is an instrument. If the wheel barrow is the only way of measuring the coal it is a good instrument and one worth using; likewise the barrel for measuring water. Instruments may show what is happening; these are called indicating instruments. They may show what has happened—recording instruments. They may totalize what has happened—integrating instruments. All three types are desirable. The indicating instruments help the boiler-room force by showing or indicating what is going on. The recording instruments show what has gone on at any time, thus shedding light on how the plant is functioning, and what is needed in the way of more care, different fuels and apparatus and new methods, etc. The integrating instruments serve to give the management information on the total output and consumption for any period.

The management is most interested in results. The coal meter and the steam or water meter give the input and output of the plant, the over-all efficiency and performance. These show the money that was spent and what was got in return. The men that run the boiler-room are more vitally concerned in how each part of the whole functions. Combustion efficiency and all that affects it concerns them vitally. The draft gage shows what is happening in the way of air supply; it shows too thick or too thin a fuel bed, holes in the fire, clogging due to clinkers, etc., open fire doors, or improper damper setting. The CO_2 meter shows the effects of the conditions indicated by the draft gage. The draft gage suggests the cause, the CO_2 instrument shows the effect. Both are extremely desirable for the fireman. The stack thermometer shows the temperature of the furnace gases after all chance of utilizing the heat has passed. It shows when boiler heating surfaces are covered with soot on the outside and scale on the inside; it suggests that baffles may have fallen or become leaky. But the stack thermometer is only of most use when interpreted in conjunction with the draft gage and the steam flow meter. The true significance of stack temperatures is understood only when one knows the rate of evaporation (from the flow meter) and the amount of excess air (from the draft gage or CO_2 meter).

It is not one instrument but all instruments taken in conjunction that count. Indicating instruments are necessary for the enlightenment of the firemen actually engaged in the work. Recording instruments are necessary for the men that have charge, so that wastes can be discovered and eradicated and improvements effected. Both are instruments of quality—quality of operation. The integrating meters are instruments of quantity: coal and steam or water meters give the sum-total of everybody's effort, the actual performance of the plant.

Smoke indicators may also be desirable where there are city smoke ordinances or where smoke is particularly objectionable. There are smoke recorders on the market. Many engineers install a form of periscope by which they are able to watch the stack while in a position to manipulate the stack damper, etc. Smoke represents waste of fuel by incomplete combustion. A smokeless stack may indicate waste of heat by excess air. A smokeless stack indicates efficiency only when one sees that the CO_2 instrument or its equivalent shows high carbon dioxide.

All instruments may save fuel when they are properly installed, properly maintained intelligently interpreted and diligently followed. When these things happen, boiler-room instruments are a gilt-edge investment

For descriptions and listing of individual boiler-room instruments, see Flue-gas analysis instruments; Gages, draft; Gages, boiler water level; Gages, steam, indicating; Gages, steam, recording; Meters, air and gas; Meters, feed, water; Meters, oil; Meters, steam flow; Meters, water; Recorders, combustion or CO_2; Regulators, boiler-furnace draft; Scales, coal; Thermometers, feed water; Thermometers, flue gas; instruments, boiler-room, miscellaneous.

BOILER SETTINGS, ARCHES, BAFFLE WALLS, FURNACE LININGS.—A boiler setting generally supports and incloses the boiler. Internally fired boilers require no settings. Settings for the other types have become more or less uniform. For water-tube boilers a steel structure is used for supporting the boiler proper, and the brick enclosing walls are merely self-supporting. A double-wall construction is frequently employed having a dead air space to minimize radiation and to allow for the differential expansion of inner and outer surfaces. Firebrick is employed for the inner surface.

Firebrick arches, baffle walls and the furnace linings are built in place under, in and around the boiler to confine the combustion zone and control the passage of the hot gases.

Manufacturers:

Betson Plastic Fire Brick Co., Inc., Rome, N. Y.
Brownell Co., The. N. Findlay St., Dayton, Ohio.
Burke Furnace Co., 320 E. North Water St., Chicago, Ill.
Cole Mfg. Co., R. D., Newnan, Ga.
Engineer Co., The, 17 Battery Pl., New York, N. Y.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Green Engineering Co., East Chicago, Ind.
Jointless Fire Brick Co., 1130 Clay St., Chicago, Ill. "Plibrico."
Houston, Stanwood & Gamble Co., The, Cincinnati, Ohio.
Keeler Co., E., Williamsport, Pa.
McLeod & Henry Co., Troy, N. Y.
Murray Iron Works Co., Burlington, Iowa.
United Conveyor Corp, Old Colony Bldg., Chicago, Ill.

BOILER, STEAM POWER PLANT.—A boiler is a vessel for evaporating water. For power-plant service boilers are classified as internally and externally fired, fire and water tube, through and return tubular, and vertical and horizontal. For power work upon land the fire or return-tubular and the water-tube types are used almost exclusively.

Boilers are rated according to their heating surface, 10 sq. ft. of surface being equivalent to 1 boiler horsepower. The rated evaporation per boiler hp. is 34.5 lbs. of water from and at 212°F. per hour. Actually, every square foot of boiler surface can evaporate from two to four times as much water as this, providing the water is not scale-forming nor contaminated with oil and other constituents that cause blistered tubes or foaming.

The highest steam pressures in vogue are around 350 lbs. per sq. in. Ordinary high pressures are from 200 to 250 lbs.; medium pressures are from 125 to 200 and low pressures up to 100 lbs.

The actual efficiency of boilers is much the same for all types. In practice, however, the ratio of grate surface to boiler surface, the boiler setting and furnace volume, the arrangement of boiler baffling and rate at which the furnace gases pass over the heating surfaces are determining factors. In other words, the choice of boiler is of less importance than is the arrangement and proportionment of fuel-burning equipment.

Boiler efficiency is determined by the amount of heat absorbed from a given amount of heat available. Radiation losses from boilers should, therefore, be kept down by using heat-insulating coverings for drums and boiler tops and in other ways conserving heat. Much excess air seeps in between the joints between metal and brickwork. These should always be closed up, as the air leaking through lowers gas temperatures and overtaxes the stacks.

Furnace, boiler, superheater, grate, breeching and ash pit should all be considered as integral parts of the whole. Each is a controlling factor in cost of operation, capacity derivable and efficiency. Each is dependent, to some extent, upon the fuel to be used. High-volatile coals require high boiler settings and large furnace volume; high-ash coals may require large ash hoppers, mechanical draft and special stokers to care for clinker. The rate of evaporation of the boiler depends upon the rate that fuel can be burned; this in turn depends upon the grate surface and volume of the furnace and the ability of the stack to carry off the products of combustion. The arrangement of the baffling depends, in turn, upon whether mechanical or natural draft is used, the ratio of heating to grate surface, volume of gases passing through the boiler passages and their velocity. Superheaters are used to increase the boiler capacity, reduce steam losses, and to improve the plant economy in general. Also see Superheaters.

BOILER TUBES.—Boiler tubes are made either seamless or lap-welded from open-hearth steel. For pressures up to about 210 lbs., No. 10 B. W. G. steel is used. Where the working pressure is above this and up to 260 lbs., No. 9 gage is used. Above this value No. 8 is generally used. Tubes are commonly made in sizes of 1½ to 4 ins. external diameter.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Cole Mfg. Co., R. D., Newnan, Ga.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Heine Safety Boiler Co., 5316 Marcus Ave., St. Louis, Mo.
International Engineering Works, Inc., Waverly St., Framingham, Mass.
Keeler Co., E., Williamsport, Pa.
Murray Iron Works Co., Burlington, Iowa.
O'Brien Boiler Works Co., 1601 N. 11th St., St. Louis, Mo.
Parkesburg Iron Co., Beale Bldg., Parkesburg, Pa.
Pittsburgh Steel Tube Co., Beaver, Pa.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

BOILERETTE.—Trade name for automatically controlled electric hot water boilers manufactured by the Electric Boiler Corp., 491 Main St., Cambridge, Mass.

BOILERS, ELECTRICALLY HEATED.—Water heating apparatus for homes, restaurants, laboratories, etc., which make use of electric heating coils. The coils are immersed in the water, in some cases, and in other styles a flexible unit is wrapped on the outside of the boiler. The boilers are usually provided with a heat-insulating covering to retain as much of the heat in the water as possible. Two and three-heat switches are provided which permit the water to be heated in a short time and then the current may be reduced to merely maintain the water at that temperature.

Manufacturers:

Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Electric Boiler Corp., 491 Main St., Cambridge, Mass. (Automatic) "Boilerette."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

BOILERS, FIRE-TUBE, FOR POWER PLANTS.—These are generally return-tubular boilers. The return-tubular boiler is rarely used for capacities above 500 hp. and usually 400 hp. is the maximum. The tendency is to make about 250 hp. the limit on the score of safety. The return-tubular boiler costs less than the water-tube type of equal rating, but occupies greater volume per unit of capacity. It cannot attain the high evaporation rates of the former, nor will it maintain as close steam pressure regulation.

In the return-tubular boiler, the furnace gases pass through tubes after passing beneath the shell in the opposite direction. The fire tubes are usually 3 to 4 ins. in diameter and from 12 to 18 ft. long. Frequent soot removal is necessary and soot becomes a more important factor in wasting coal than with the water-tube type of boiler.

As there is no way of segregating the boiler contents, failure of a return-tubular boiler liberates the entire stored energy in the boiler. Thus, return-tubular boiler explosions are usually extremely dangerous and work great havoc. With the water-tube boiler, on the other hand, failure of a tube liberates only a small amount of energy at the instant. The dissipation of energy is thus less rapid than with the return-tubular type and so less dangerous.

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The reasons for the return-tubular boiler not being made in capacities above 500 and usually 250 to 400 hp. are because of the danger in case of failure, its adaptability to medium steam pressures only, its poor steam regulation and comparatively low rates of evaporation.

Manufacturers:

Bigelow Co., The, New Haven, Conn. "Bigelow-Manning."
Brennan & Co., John, 24th St. & M. C. R. R., Detroit, Mich. "Detroit."
Bridgeport Boiler Works Co., The, 202 Housatonic Ave., Bridgeport, Conn.
Chicago Tile Arch Furnace Co., 321 W. Austin Ave., Chicago, Ill.
Clark Engine & Boiler Co., Kalamazoo, Mich.
Coatesville Boiler Works, Coatesville, Pa.
Cole Mfg. Co., R. D., Newnan, Ga.
Decarie Boiler & Incinerator Co., 3324-30 St. Hubert St., Montreal, Que., Can.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass.
Dover Boiler Works, Dover, N. J.
Erie City Iron Works, Erie, Pa. "Economic."
Fitzgibbons Boiler Co., Oswego, N. Y.
Gem City Boiler Co., The, Dayton, Ohio.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Herbert Boiler Co., 140 Root St., Chicago, Ill.
Houston, Stanwood & Gamble Co., The Cincinnati, Ohio.
International Engineering Works, Inc., Waverly St., Framingham, Mass.
Keeler Co., E., Williamsport, Pa.
Kroeschell Bros. Co., 440 W. Erie St., Chicago, Ill.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
Mohr & Sons, John, 96th St. & Calumet River, S. Chicago, Ill.
Murray Iron Works Co., Burlington, Iowa.
Nagle Engine & Boiler Works, Erie, Pa.
O'Brien Boiler Works Co., John, 1601 N. 11th St., St. Louis, Mo.
Oil City Boiler Works, Box 137, Oil City, Pa.
Orr & Sembower, Inc., Reading, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Wickes Boiler Co., The, 502 N. Water St., Saginaw, Mich.

BOILERS, WATER-TUBE, FOR POWER PLANTS.—All boilers for high pressure and high capacity are of the water-tube type. This type may be operated at two to four times nominal rating with safety, provided the water does not form scale or contain oil, either of which will cause bags and blistered tubes.

The water-tube boiler has good pressure regulation and presents maximum surface to the furnace gases. It possesses high steaming rates and, because of the manner in which the water is distributed throughout the tubes and drums, it minimizes the sudden energy dissipated on tube failure. For a given weight, higher pressures can be safely carried. Lower weight of metal may be used compared with the fire-tube or return-tubular boiler. Water-tube boilers are also much lighter and smaller per unit of capacity than fire-tube boilers, and easier to maintain.

Water-tube boilers are made in standard ratings from 150 to about 1250 hp. Larger special boilers have been built with nominal ratings to 2365 hp.; these operate frequently at 4800 to 5000 hp. Such large boilers are provided with a separate furnace and stoker at each end in order to get the requisite grate surface for burning the large amount of coal needed. A number of these huge units have been in successful use for several years in plants of the Detroit Edison Co., Detroit, Mich.

Manufacturers:

Babcock & Wilcox Co., The, 85 Liberty St., New York, N. Y. "B. & W." "Stirling."
Badenhausen, Phillips, 1425 Chestnut St., Philadelphia, Pa.
Beggs & Co., James, 36 Warren St., New York, N. Y. "Worthington."
Bigelow Co., The, New Haven, Conn. "Bigelow-Hornsby."
Brennan & Co., John, 24th St. & M. C. R. R., Detroit, Mich. "Detroit."
Bridgeport Boiler Works Co., The, 202 Housatonic Ave., Bridgeport, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Tile Arch Furnace Co., 321 W. Austin Ave., Chicago, Ill.
Connelly Boiler Co., The D., Cleveland, Ohio. "Connelly."
Decarie Boiler & Incinerator Co., 3324-30 St. Hubert St., Montreal, Que., Can.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass.
Edge Moor Iron Co., Edge Moor, Del. "Edge Moor."
Erie City Iron Works, Erie, Pa.
Freeman Mfg. Co., Racine, Wis.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Heine Safety Boiler Co., 5315 Marcus Ave., St. Louis, Mo. "Heine."
Herbert Boiler Co., 140 Root St., Chicago, Ill.
International Engineering Works, Inc., Waverly St., Framingham, Mass.
Keeler Co., E., Williamsport, Pa.
Kroeschell Bros. Co., 440 W. Erie St., Chicago, Ill.
Ladd Co., The George T., First National Bank Bldg., Pittsburgh, Pa.
Mohr & Sons, John, 96th St. & Calumet River, S. Chicago, Ill.
Morrin-Climax Boiler Co., Jersey City, N. J.
Murray Iron Works Co., Burlington, Iowa.
Nagle Engine & Boiler Works, Erie, Pa. "Franklin."
Nuway Boiler Co., 810 Monadnock Block, Chicago, Ill.
O'Brien Boiler Works Co., John, 1601 N. 11th St., St. Louis, Mo.
Oil City Boiler Works, Box 137, Oil City, Pa. "Geary."
Page Boiler Co., 815-819 Larrabee St., Chicago, Ill. "Midget."
Pardel Corp, Bailey Bldg., Philadelphia, Pa.
Smith Co., The H. B., 640 Main St., Cambridge, Mass.
Springfield Boiler Co., Springfield, Ill. "Springfield."
Union Iron Works, Erie, Pa. "Union."
Vogt Machine Co., Henry, Louisville, Ky.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Ward Engineering Works, The Charles, Charleston, W. Va.
Wickes Boiler Co., The, 502 N. Water St., Saginaw, Mich.

BOISSIER ELECTRIC CO.—Long Island City, N. Y. Manufacturer of electroplating generators.

BOLOMETER.—A bolometer is an instrument in which heat is measured by the change of resistance which it produces in a conductor. For precise measurements of radiant heat, a bolometer consisting of a blackened strip of metal is used with a Wheatstone bridge. In radio measurements, a bolometer is used to measure high-frequency current. This consists essentially of a fine wire, the resistance of which increases as it is heated by the current passing through it. This change is measured on a Wheatstone bridge.

BOLT CLEVIS.—See Clevis, bolt.

BOLTS.—A bolt is a bar or rod with a head on one end and a thread, adapted to receive a nut, on the other. A bolt is contrasted to a stud, which has a thread on each end. Bolts are made of all of the commoner metals and in an almost endless variety of forms and sizes. A bolt is intended to pass completely through two or more pieces which it is desired to fasten together, and to have a nut screwed on the threaded end. A bolt which is intended to screw into a tapped hole but not to be used with a nut is generally called a cap screw, and is usually finished all over. Bolts are generally sold with their surfaces in their original condition. The bolts used in the electrical industries are much the same as in other industries, except that vast numbers of bronze, brass and copper bolts are used to obtain the requisite conductivity where conducting parts are fastened in place.

BOLTS, BRASS.—Large quantities of brass bolts are used in the manufacture of electrical apparatus. They have the advantages over common iron bolts that they are nonmagnetic, are better electrical conductors and do not corrode readily. The first two properties are utilized in numerous instances, while the latter is always an advantage. Brass bolts do not have as high conductivity as copper bolts, but are stronger and can be more accurately threaded. They are generally made as machine bolts or U-bolts.

Manufacturers:

Eastern Brass Works, 221-23 13th Ave., Newark, N. J.
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Waterbury Mfg. Co., 286 Grand St., Waterbury, Conn.

BOLTS, CARRIAGE AND STOVE.—Carriage bolts are made with an oval head and a square shank section or square subhead immediately below it. The stem or rod has rolled threads for a little more than a third of its length and square nuts are usually furnished with the bolts. They are made in a number of sizes up to about ⅝ by 16 ins. Carriage bolts are used for attaching the braces to crossarms on many overhead transmission lines, the standard bolt for this purpose being ⅜ by 4½ ins., and for telephone work ⅜ by 4 ins.

Stove bots are much smaller, being made in sizes up to ⅝ by 3 ins. They have either round or flat slotted heads similar to a wood or machine screw. Square nuts are usually furnished with stove bolts. The thread extends about one-third of the length and is rolled on.

Manufacturers:

American Equipment Co., Norristown, Pa.
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Bayonne Bolt & Nut Co., Bayonne, N. J.
Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
Clark Bros. Bolt Co., Milldale, Conn.
Galvanized Products Co., First St., Phillipsburg, N. J.
HUBBARD & CO., Pittsburgh, Pa. Hubbard carriage bolts are made of open hearth steel with a tensile strength of 55,000 to 65,000 lbs. per sq. in., and have finished points and rolled threads. Like Hubbard machine bolts, these carriage bolts have a generous length of thread.—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lamson & Sessions Co., The 2188 Scranton Rd., Cleveland, Ohio. "Buckeye," "Lamson."
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Marine Lamp Co., The, Forestville, Conn.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Pawtucket Mfg. Co., 327 Pine St., Pawtucket, R. I.
Pawtucket Screw Co., Pawtucket, R. I.
Reed & Prince Mfg. Co., Worcester, Mass.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BOLTS, DOUBLE-ARMING OR SPACING.—These bolts do not have heads on them, but are threaded at both ends (like a long stud) and furnished with four square nuts, two on each end. Bolts up to 12 ins. in length have threads for 4 or 5 ins. at each end. This distance increases and for 17-in. bolts or longer is 8 ins. at each end. Spacing bolts are used to maintain a certain space or distance between two pieces as, for instance, a double crossarm. The two nuts with washers between them may be tightened on opposite sides of one crossarm and the other pair of nuts on the adjoining crossarm; the bolt will then hold the arms properly spaced from each other.

Manufacturers:

American Equipment Co., Norristown, Pa.
HUBBARD & CO., Pittsburgh, Pa. Hubbard's double arming bolts are made of open hearth steel having a tensile strength of 55,000 to 65,000 lbs. per sq. in. The 12-in. bolts have 5 ins. of thread on each end; 13 and 14-in. bolt, 6 ins. of thread; 15 and 16-in. bolts, 7 ins. of thread; 17-in. and longer, 8 ins. of thread. The points are finished and

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each bolt is furnished with four square nuts.—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Oliver Iron & Steel Co., 10th & Murial Sts., Pittsburgh, Pa.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

BOLTS, EXPANSION.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

BOLTS, EYE.—Eye bolts, as their name implies, are made with a drop-forged or welded eye at one end and are threaded for either 4 or 6 ins. at the other end. They are furnished with one square nut and a washer, as a rule, and generally have a hot-galvanized finish. Eye bolts are used largely for line construction work, with guy wires, messenger strands, etc. They are made in sizes up to ¾ by 20 ins.

Manufacturers:

American Equipment Co., Norristown, Pa.
Bemis Car Truck Co., 376 Birnie Ave., Springfield, Mass.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Chain Products Co., The, 3924 Cooper Ave., Cleveland, Ohio.
Eagle Bolt & Forging Co., The, 1435 E. 45th St., Cleveland, Ohio.
HUBBARD & CO., Pittsburgh, Pa. Hubbard drop forged eye bolts have 6 ins. of rolled thread, and are furnished with square nuts and round washers. (See Hubbard entry under Rods, anchor.)—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio. "Buckeye," "Lamson."
Lanz & Sons, Mathew, Pittsburgh, Pa.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BOLTS, FOUNDATION.—These are generally long round-head machine bolts furnished with hexagon nuts. They are inserted in the concrete, masonry or other foundation during construction and have the threaded portion projecting from the finished surface. They are used in this manner for fastening the bedplates for various electrical and other heavy machinery in place, for rigidly fastening ornamental or other iron posts used for street lighting, for securing transmission line and radio towers to their foundations, etc.

Manufacturers:

American Equipment Co., Norristown, Pa.
Bayonne Bolt & Nut Co., Bayonne, N. J.
Cherry Tree Machine Co., Cherry Tree, Pa.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lanz & Sons, Mathew, Pittsburgh, Pa.
National Acme Co., The, E. 131st & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
St. Louis Screw Co., Clarence St., & Bulwer Ave., St. Louis, Mo.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

BOLTS, INSULATED.—Insulated bolts are generally of the eye-bolt type. A special malleable iron fork with a spool insulator between the sides is mounted on the end of a machine bolt or "through bolt." The guy wire or cable is passed over the insulator and does not come in contact with the bolt. Other forms of insulated bolts have also been developed, and are used with some kinds of trolley suspension materials. These have an insulating sleeve around the bolt stem and insulating washers under the head and nut to insulate it from the hanger. In other cases a molded insulating compound is placed all around the upper portion of the bolt.

Manufacturers:

Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Electrose."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
OHIO BRASS CO., THE, Mansfield, Ohio. Insulated by Dirigo. Strong mechanically, reliable electrically, and weather resisting.—Adv.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BOLTS, MACHINE.—Machine bolts are usually made with square heads and have square nuts furnished with them. They are large bolts, as a rule, running in size up to 1¼ ins. in diameter and 24 ins. in length. The threads are either rolled or cut and the points are finished. Machine bolts are used for a great many purposes in the electrical industry in connection with electrical machinery, power plant and line construction, etc. For overhead line construction machine bolts are used for fastening crossarms to the poles; they are also known as "through bolts." Hexagonal heads and nuts may be furnished, if desired, but at an additional cost, as the square nuts are standard.

Manufacturers:

American Equipment Co., Norristown, Pa.
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Bayonne Bolt & Nut Co., Bayonne, N. J.
Bemis Car Truck Co., 376 Birnie Ave., Springfield, Mass.
Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
Clark Bros. Bolt Co., Milldale, Conn.
Galvanized Products Co., First St., Phillipsburg, N. J.
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., Pittsburgh, Pa. Hubbard machine or "through" bolts are made of open hearth steel, having a tensile strength of 55,000 to 65,000 lbs. per sq. in. They have longer threads than ordinary machine bolts. Rolled threads are furnished as standard, as they are 13% stronger than cut-thread bolts. Rolled threads are more uniform and smoother than cut threads. Rolled thread bolts have been adopted as standard by many large users.—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio. "Buckeye," "Lamson."
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Marine Lamp Co., The, Forestville, Conn.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Pawtucket Mfg. Co., 327 Pine St., Pawtucket, R. I.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Montreal, Que., Can.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BOLTS, SUSPENSION.—Several types of bolts are used for suspending insulators, lamps, motor platforms, etc., from ceiling joists, beams, roofs, etc. They usually have special names in the trade to indicate their construction or form. One is known as a hanger bolt; it has a lag-screw thread for screwing one end into the ceiling or other support, the lower end being provided with a machine-screw thread and nut for securing the part to be suspended. Eye bolts with either lag-screw or machine-screw threads (the latter provided with a nut) are much used for lamp suspension; in some cases the eye bolt has a shoulder directly above the eye. Fork bolts are frequently used for suspension purposes; they have the lower part split and transversely drilled to form a fork support. The insulated fork bolt (sometimes called insulated eye bolt) has a U-shaped strap or fork supported by the lower end of the bolt; between the ends of the fork is a horizontal pin carrying a porcelain insulator or knob; these bolts are much used for supporting heavy feeders from mine roofs, in which case a fetter-drive lag-screw thread is provided on the upper end of the bolt.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y.
National Acme Co., The, E., 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
St. Louis Screw Co., Clarence & Bulwer Ave., St. Louis, Mo.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

BOLTS, THROUGH.—These are long bolts used in overhead line construction. The bolt passes through the pole and the crossarm and is the main attachment of the arm to the pole.

BOLTS, TOGGLE.—Toggle bolts are used to push through a small hole in a hollow wall and fasten securely in place by getting a fairly large bearing surface on the inside of the wall. Several forms of bolts are used. In most of them a hinged or swinging head attached to a nut on the bolt folds back to allow the nut and head to pass through a comparatively small hole. As soon as the head is clear on the inside it drops down and is perpendicular to the axis of the hole, thus giving a good bearing surface. A round or flat slotted head is placed on the other end of the bolt for tightening the nut on the inside. Other types have a nut on the outside which serves to draw the inner head up tight and then the extra length of the bolt is cut off.

Manufacturers:

Barrett Sales Co., 568 W. Washington Blvd., Chicago, Ill. "Universal."
Chicago Expansion Bolt Co., 324 W. Washington St., Chicago, Ill.

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Chicago Nut Co., 2513 W. 20th St., Chicago, Ill. "Ajax."
Diamond Expansion Bolt Co., 90 West St., New York. N. Y. "Diamond."
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
McGill Mfg. Co., Valparaiso, Ind. "Crescent."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Paine Co., The, 1742 W. Van Buren St., Chicago, Ill.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
U. S. Expansion Bolt Co., 139 Franklin St., New York, N. Y. "U S E."
Waldman, J. J., 64-66 Murray St., New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wrigley Co., Thomas, 504 Sherman St., Chicago, Ill.

BOLTS, TRACK.—Standard track bolts are made with a button head and an oval neck. They are furnished with either square or hexagonal nuts. Track bolts are used for bolting rail joints together, both for ordinary joints or for insulated joints, and also for securing some specialties, such as braces, car stops, derails, etc., to the track ties.

Manufacturers:

Ames & Co., W., Jersey City, N. J.
Inland Steel Co., 1st National Bank Bldg., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
National Bolt & Nut Co., Pittsburgh, Pa.
St. Louis Frog & Switch Co., St. Louis, Mo.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

BOLTS, "U."—These are bolts shaped like the letter "U" with each end threaded to receive a nut. They are made for use with pipe frameworks and are widely used in connection with switchboard and panel construction, bus supports, and various other insulating and clamping members. They are also used in some cases for conduit and pipe construction work where it is desired to hang heavy conduit or pipe from an I-beam, channel or girder.

Manufacturers:

Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.

BOND CO., CHARLES.—617-19 Arch St., Philadelphia, Pa. Manufacturer of power transmitting machinery, belting, elevating and conveying machinery. Business established 1888. President, Charles Bond; vice-president, J. R. Grundy; secretary and treasurer, M. F. Shaw.

BOND FOUNDRY & MACHINE CO.—Manheim, Lancaster Co., Pa. Manufacturer of power transmitting machinery. President, Charles Bond; vice-president, Joseph Burr; secretary, M. F. Shaw; H. M. Beamsderfer; managing director, M. T. Williams; sales manager, G. C. Noros.

BONDED.—Trade name for linemen's and electricians' and linemen's tools and appliances manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

BONDING OF CABLES.—The lead sheaths of underground cables often carry stray current from trolley lines, etc. Where the current leaves the cable to pass into the earth, it acts as an electrolytic anode and eats away the lead, exposes the paper or other insulating core to moisture, and in time puts the cable out of business. To prevent this a bond is put from the cable at known points of departure to the power circuit so that the current will leave the lead sheath by way of a metal path and not into the ground. This stops such electrolytic corrosion.

BONDING TOOLS.—A general term used to designate the various tools used in electrically bonding the joints on railway track. Inasmuch as there are a great variety of bonds fastened to the rail in a number of ways, some of which require special tools, the name has a very broad application. It may be said to include tools varying from an ordinary light hand sledge to complicated electric arc-welding apparatus. Hand, electric or compressed-air drilling sets are commonly used.

Manufacturers:

American Mine Door Co., The, Canton, Ohio.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We can supply any tool required in connection with the installation of rail bonds.—Adv.
Buda Co., The, Harvey, Ill. (Drills) "Buda-Wilson."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Electric Railway Improvement Co., The 2070 E. 61st Place, Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. In addition to rail bonds to meet every service requirement, this company can furnish bonding tools and accessories, including track drills of various types, hand tools, rail bond compressors and clamps, electric grinders, blow torches and portable bond testers (Bulletin 44002A). See adv. pages 1203-1223.—Adv.
Indianapolis Switch & Frog Co., Springfield, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BONDS, CABLE, ELECTROLYSIS PREVENTIVE.—To minimize injurious electrolysis action from stray trolley currents upon underground cables, the cable sheaths of all cables in a run are bonded together in certain manholes. The bonding device usually consists of a metal band which can be conveniently clamped around the cable and is designed to make a good connection between the bonding ribbon or wire and the lead cable sheath. Close to the power house or substation of the electric railway system the sheaths of the underground cable network are connected to the negative bus by means of a similar bonding device.

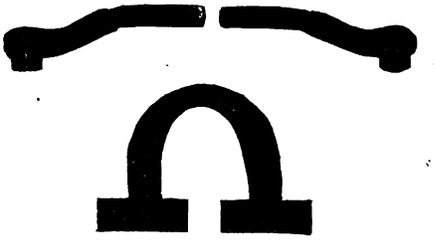
Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

BONDS, RAIL.—Rail bond is a name applied to the various devices in use for connecting the two rail ends at a joint and thus increasing its electrical conductivity, in order that the rails may be used as a part of the return power circuit in electric railways and part of the signal circuit in steam railways. There are a very large variety of bonds on the market, many of which are patented. Some connect the bases of the two rails, others the webs; some lie underneath the joint plates and others outside these plates; still others connect the heads of the two rails. Some types of bonds are soldered in place, others are welded and there are a great number that are held in place by means of some mechanical fastening, such as channel pins.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We maintain a fully equipped bonding department supervised by able and experienced engineers, and manned by competent workmen, which has for many years and with marked success attended to all matters pertaining to bond installation. This department is at the disposal of those in need of expert bond service.—Adv.
Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Brown, Harold P., 120 Liberty St., New York, N. Y. "Edison-Brown."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can. "C. G. E."
Copper Clad Steel Co., Rankin, Pa.
Electric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.



Protected Rail Bonds

"Protected" rail bonds are made in various designs with pin-driven or compression type terminals and in capacities to meet all conditions of rail bonding. They are made to withstand vibration in that the end terminals, by a special process of manufacture, provide a protecting sleeve over the strands where they emerge from the terminals, thus eliminating breakage of strands at this point. They have been standard on the market for over 20 years. This line of rail bonds also includes electric and flame weld bonds, rail bond compressors and rail drilling machines and other miscellaneous bonding material.—Adv.

GENERAL ELECTRIC CO., Schenectady, N. Y. A great variety of forms to meet the widely varying conditions encountered in electric railway service. Standard designs modified when necessary to obtain best results. Rail bond manufacture is done in a department devoted exclusively to forging of metal by drop hammers. The various operations of forging, welding, assembling, crimping, etc., are under the expert supervision of men especially trained in this class of work. Only the best grade of pure copper with requisite physical properties is used. This company will gladly submit recommendations on rail bonding for any conditions. Further information and description of G-E rail bonds and bonding tools in Bulletin 44002A.—See adv. pages 1203-1223.—Adv.
Indiana Steel & Wire Co., Muncie, Ind.
Indianapolis Switch & Frog Co., Springfield, Ohio. "Stay Put."
National Electric Co., 302 Kanawha National Bank Bldg., Charleston, W. Va. "National."
OHIO BRASS CO., THE, Mansfield, Ohio. Rail bonds manufactured for every service, for electric railways, mines, electrified steam roads, third rail and automatic signal track circuits. O-B bonds are made in electric or gas welded types or with stud terminals. O-B welded bonds have many exclusive features.—Adv.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BONITA.—Trade name for cable ring manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

BONNETT & CO., NICHOLAS.—619 W. Adams St., Chicago, Ill. Manufacturers of wood turnings for electrical purposes. Business established 1902. President and general manager, Nicholas Bonnett; secretary, E. P. Singer.

BONNEY VISE & TOOL WORKS, INC.—Allentown, Pa. Manufacturer of vises and wrenches. Business established 1876. President, J. E. Durham; vice-president and secretary, J. E. Durham, Jr.; vice-president and treasurer, F. S. Durham. Main office and factory, Allentown, Pa. Branch office, 405 Stephen Girard Bldg., Philadelphia, Pa.

BOOKKEEPING MACHINES, ELECTRICALLY DRIVEN.—These are motor-driven machines designed to simplify and reduce the work necessary to keep various accounts and to reduce the possibility of inaccuracy. They are essentially adding

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machines, to which is added a supplementary mechanism, the character of which depends upon the nature of the business or the accounts to be kept. The machines are very nearly automatic in their operation, printing on a loose-leaf journal entry sheet or card the date, folio number, character of entry, amount and the subtotal. All of the machine operations, such as tabulating, shifting and returning the carriage, printing operations, etc., are performed by the motor-driven mechanisms. Several models of bookkeeping machines are made and they may be applied to many varied accounting systems.

Manufacturers:

Burroughs Adding Machine Co., Detroit, Mich. "Burroughs."
Elliott-Fisher Co., Harrisburg, Pa.
Underwood Typewriter Co., Inc., Underwood Bldg., New York, N. Y. "Underwood."
Wales Adding Machine Co., Wilkes-Barre, Pa. "Wales."

BOOM, DIVERTING.—Booms are used in connection with water-power plants to prevent floating debris from reaching the head gates. They may be either floating or fixed, and are commonly made of logs or heavy timber, or of concrete. They are also used to divert ice or logs over chutes provided for that purpose.

BOONTON RUBBER MFG. CO.—Boonton, N. J. Manufacturer of Bakelite, Condensite and other insulating materials. Business established 1891. President, Richard W. Seabury; vice-presidents, Charles B. Seabury, George K. Scribner; secretary, Berton E. Holley; treasurer, G. H. Middlebrook; sales manager, Charles B. Seabury.

BOOSTER.—A generator whose armature is connected in series with those of the main generators so that the total voltage acting in any desired circuit may be adjusted independently of that of the main generators. This adjustment of voltage may be made through a range of values from zero to the maximum voltage of the booster, plus or minus. The booster may be at the generating station or at a substation; in the latter case it is connected in series with the line or feeder. D-c. boosters are the most common, a-c. boosters being practically limited to their use with synchronous converters. D-c. boosters may be shunt, series or compound wound, with manual or automatic control of the voltage. They may be direct-connected or belt-driven by electric motors or prime movers, direct motor drive being the most common. The principal uses of d-c. boosters are the regulation of the voltage on long railway feeders or Edison three-wire feeders, and the control of the charge and discharge of storage batteries.

The term booster is also used, though less commonly, for a boosting transformer used to raise the voltage of a long a-c. feeder. See Transformers, boosting.

BOOSTER, CONSTANT-CURRENT. — A nonreversible d-c. booster used with a storage battery in connection with a lighting and motor load for the purpose of maintaining the voltage on the lamps very nearly constant. The motors, in parallel with a storage battery, get their current through the armature and differential series winding of the booster. Its shunt winding is across the line. The booster maintains an approximately constant current and the battery charges at light loads and discharges at heavy loads.

BOOSTER, DIFFERENTIAL.—A reversible d-c. booster used in connection with a storage battery in parallel with the load, having its armature in series with the battery, its differential series winding in series with the load and battery and its shunt winding in parallel with the load. The booster charges the battery at light loads and discharges it at heavy loads.

BOOSTER, NEGATIVE.—A d-c. booster connected in series with the negative feeders in a street-railway system to assist in draining the track of its return current and thus reducing stray currents and electrolysis in adjacent underground piping, cables and other metal conductors.

BOOSTER, SERIES.—A series wound d-c. generator whose voltage is added to that of the main supply to compensate for line drop in certain feeders. Its armature and series winding are connected in series with the feeder and as long as the iron of its magnetic circuit is not saturated, its voltage is approximately proportional to the load current.

BOOSTER, SHUNT.—A d-c. booster generator used to charge a storage battery by adding to the voltage of the supply. It has shunt excitation and is used where changes in load are slow, so that the battery is charged during the period of light load.

BOOSTERS, BELTED OR ENGINE-DRIVEN.—Any of the types of boosters described above may be arranged to be belt-driven, using either a motor or an engine as the driver; direct-connected engine drive is also used occasionally. In either case the booster is usually furnished independently of the driving motor or engine; even where direct-connected engine drive is used, a common bedplate for the set is exceptional, although it can be specially ordered where demanded.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Jantz & Leist Electric Co., Western Ave. and York St., Cincinnati, Ohio.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BOOSTERS, DIRECT MOTOR-DRIVEN.—Direct motor-driven boosters or motor-generator boosters are more commonly used than any other type of booster set. Motor-driven boosters are almost invariably furnished as a complete unit, usually with a common bedplate for both motor and booster. The motor may be of any type to suit the source of electric power available. The generator may be a constant current, shunt, series or any other type of booster described above.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Motor generator booster sets for use in railway stations to raise the potential of feeders; for storage battery charging and regulation; for station excitation systems; and in connection with the Edison 3-wire lighting system. Boosters are sometimes more economical than additional feeder copper. The design is closely dependent upon the application. Constructed in either series or shunt wound types and may be arranged for either automatic or hand regulation. Described with motor-generator sets for other purposes in Bulletin 42552A. See adv. pages 1203-1223.—Adv.
Jantz & Leist Electric Co., Western Ave. and York St., Cincinnati, Ohio.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BOOTH ELECTRIC FURNACE CO.—326 W. Madison St., Chicago, Ill. Manufacturer of electric furnaces. Business established 1917. President, L. E. Myers; vice-president, C. H. Booth; treasurer, W. H. P. Weston. Sales representatives, Edward B. Stott & Co., Flatiron Bldg., New York, N. Y.; M. A. Beltaire, Jr., Hammond Bldg., Detroit, Mich.; Northern Engineering Co., 308 Chestnut St., Philadelphia, Pa.; Gassman & Cunningham, Brown-Marx Bldg., Birmingham, Ala.; Charles L. Fooster Co., The Arcade, Cleveland, Ohio; Buckeye Products Co., 919-929 W. 5th St., Cincinnati, Ohio; Curtis Engineering Co., Pacific Electric Bldg., Los Angeles, Cal.

BOOTH FELT CO., INC., THE.—Brooklyn, N. Y. Manufacturer of felt gaskets, cushions, wicks, washers and other felt products. President, treasurer and general manager, N. E. Booth; vice-president, E. W. Booth; secretary, J. H. Gaiser; sales manager, F. S. Warren. Main office, 463 19th St., Brooklyn, N. Y. Factories, Brooklyn, N. Y., and Chicago, Ill. Branch office, 732 Sherman St., Chicago, Ill.

BOOTHS, MOTION-PICTURE. — Small portable rooms or enclosures made of noncombustible materials and designed for enclosing the motion-picture projecting lamp and apparatus and the operator; usually provided with suitable openings for the projecting light beam, and for observation and ventilation. Such booths are often made in knockdown or sectional types to be readily portable. They are much used when motion pictures are displayed in an assembly hall not regularly equipped for this purpose. The inflammability of the picture film requires special fireproof construction for the booth, which is likely to be placed on the main floor among the audience.

Manufacturers:

Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.

BOOTHS, PNEUMATIC SPRAY PAINTING.—Booths for pneumatic spray painting are usually made of sheet metal. They are usually closed on three sides and the top. Motor-driven ventilating or exhaust fans are provided to withdraw the paint fumes and finely divided particles in the air that are not deposited on the article being painted. These booths are more or less special in construction to adapt them to particular forms of work. Where pianos, automobile bodies, etc., are being sprayed a large cabinet is required. At the same time the ventilating fans which are ordinarily installed in the rear are not effective when the article being sprayed is so large as to occupy considerable space. Special ventilation with the fans located overhead is usually provided in such cases. Where heavy articles are finished assembled, such as a piano, desk, motor, generator, transformer case or other large article a pneumatic lift and turntable are provided to facilitate handling. These booths and spraying outfits are being widely used for various manufacturing purposes in connection with the electrical and other industries.

Manufacturers:

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.

BOOTHS, TELEPHONE.—Telephone booths are made in a number of styles and finish to conform with the woodwork and general decoration of the room or building in which they are installed. Their purpose is to give privacy and eliminate the outside noises. They are generally made with a glass door and sometimes glass windows. Several styles are used, some having a single door, and others where space is limited having a folding door which folds into the booth. The booth is often provided with a lamp and in some cases a quiet running fan, which may operate by means of a door switch when a person enters the booth and closes the door. The telephones are usually mounted on the wall and a shelf is provided for holding telephone directories, writing pad, parcels, etc.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)

BOOTS, LINEMEN'S RUBBER.—Linemen's boots are similar to any other rubber boots, being made both as hip boots and knee-height boots. They are usually of very good grade of rubber or gum and have a woolen or felt lining.

Manufacturers:

Goodall Rubber Co., Inc., 11th and Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Hodgman Rubber Co., Tuckahoe, N. Y.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Perfection."

BORAX-ETTE.—Trade name for welding compound manufactured by the Cortland Welding Compound Co., Cortland, N. Y.

BORDEN CO., THE.—Warren, Ohio. Manufacturer of pipe and conduit cutting and threading tools. Business established 1900. President, W. A. Neracher; vice-president and sales manager, Alfred F. Howe; secretary and treasurer, M. W. Bechtel. Main office and factory, Warren, Ohio. Branch office, 86 Warren St., New York, N. Y. Sales representative, Borden-Canadian Co., Toronto, Ont., Can.

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BORDERS, STAGE LIGHTING.—Borders are long sheet-metal reflecting troughs, in which one or more rows of incandescent lamps are mounted, usually in flush receptacles. They are placed along the stage borders and serve to project the light on the stage or scenery where it is wanted and yet have no glare to disturb the audience. They are often protected with wire guards to prevent scenery or combustible material from coming in contact with the lamps. Movable borders are connected to the source of supply through border-light cable. The lamps are often arranged in groups of different color on different control circuits to enable almost any desired color combination to be obtained.

Manufacturers:

Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Display Stage Lighting Co., 314 W. 44th St., New York, N. Y. "D. S. L. Ray."
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" borders contain individual X-Ray reflectors for each lamp. Wiring box is separate, bolted on. Each reflector equipped with removable color



"X-Ray" Border

frame. Section illustrated for use with 100 or 150-watt Mazda lamps. Another type supplied for wide distribution of light; these types meet requirements of any production. Supplied in short lengths for road shows, dance floors, cabarets, etc. Also see Bunches, clusters, footlights, strips. See adv. page 1405.—Adv.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill. "Ready-2-Install."
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Strachan, Inc., R. & H., 395 Fulton St., Brooklyn, N. Y.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Universal," "Kliegl," "Manhattan."
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

BORING MACHINES, EARTH, POLE OR POST HOLE.—Earth-boring machines are used for boring pole holes in uniform earth where there is plenty of space and where rocks or stones are not encountered. They are generally mounted on the rear of an automobile truck and are driven by the truck engine or motor. For the construction of long pole lines they save a very large portion of the time and labor ordinarily spent in digging holes by hand.

Manufacturers:

Marion Truck Corp., Kenosha, Wis.
Thompson Machinery Co., Ltd., Grand Bay, N. B., Can.

BORING MACHINES OR DEVICES, CEILING, JOIST AND WALL.—The electrician's kit may carry any or several of three types. One consists of an ordinary brace and an extension bit holder which will hold any size of bit from ⅝ to 1 inch. This tool is used to drill through heavy timbers where necessary, and through the studding and joists in partitions where an ordinary bit and brace will not reach. Another device consists of a standard carrying a bit holder and ratchet wheel at the upper end operated by a wire cable or chain over a lower ratchet wheel. This appliance has a rod and set screw for adjusting to heights of ceiling varying from 7 to 16 ft. and is used to bore holes for wires which must pass horizontally through joists or studding at a considerable height above the floor. A third machine is made up of a crank, shaft, and beveled gears and bit, so mounted that the bit can be adjusted both vertically and horizontally and is used for boring between joists and in corners where boring cannot be easily done with bit and brace. Modifications of these types and special patented types are also available on the market. All types aim to save labor and time, especially those that permit boring through ceiling joists while standing on the floor below and without climbing up ladders or scaffolding.

Manufacturers:

Arnold Electric Tool Co., Inc., Fort Trumbull Bldg., New London, Conn.
Bowlus Mfg. Co., The, Springfield, Ohio.
Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago,
Cincinnati Electrical Tool Co., The, 1501-03-05 Freeman Ave., Cincinnati, Ohio. "Cincinnati."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Henderson Electric Co., Ampere, N. J.
Hykon Mfg. Co., The, Alliance, Ohio. "Kyle."
Jones Tool Co., 1912 Van Buren Rd., Cleveland, Ohio.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Minnesota Electric Co., 309 2nd Ave., S., Minneapolis, Minn. "Chapman."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 2417 machine bores at a distance from 7 to 12 ft. above the



Red Devil No. 2417

floor by extending lengthening rod. Machines are equipped with cross tree holding rod or rest, which may be adjusted to any height on frame.—Adv.

BORN CO., H. A.—326 River St., Chicago, Ill. Manufacturer of electric refrigerating machines.

BOROLON.—Trade name for electrically produced abrasive manufactured by the Abrasive Co., James and Fraley Sts., Philadelphia, Pa.

BOSCH.—Trade name for automobile ignition, starting and lighting equipment manufactured by the American Bosch Magneto Corp., Springfield, Mass.

BOSCH, HERMAN J.—Hotel Biltmore, New York, N. Y. Manufacturer of electric hair driers.

BOSS.—Trade name for service entrance bushings manufactured by the Electrical Specialty Mfg., 51 Beaufort St., Providence, R. I.

BOSS.—Trade name for electric washing machines manufactured by the Boss Washing Machine Co., Cincinnati, Ohio.

BOSS.—Trade name for electric car loaders and circuit testers manufactured by the Maroa Mfg. Co., Maroa, Ill.

BOSS.—Trade name for adjustable wrenches manufactured by the Neverslip Works, Hamilton and Neilson Sts., New Brunswick, N. J.

BOSS.—Trade name for conduit benders made by the M. B. Skinner Co., 562 Washington Blvd., Chicago, Ill.

BOSS NUT CO.—1732-54 N. Kolmar Ave., Chicago, Ill. Manufacturer of bolts, nuts, rivets and screws. President and treasurer, J. D. Purcell; vice-presidents, J. A. MacLean and F. K. Shults; secretary, L. M. Thomas; general manager, A. J. Boyle.

BOSS WASHING MACHINE CO.—Cincinnati, Ohio. Manufacturer of electric washing machines.

BOSSERT CORP., THE.—Utica, N. Y. Manufacturer of sheet-metal stampings. General manager, James R. Jones; secretary and treasurer, Gilbert Butler.

BOSSING STICKS, LEAD CABLE.—Bossing sticks are hardwood sticks of special form having a large handle and a small cylindrical end. They are used for reaming, stuffing out or bossing out the lead sheath on a cable or a lead sleeve used in splicing a joint.

Manufacturers:

Bernz Co., Otto, 17-37 Ashland St., Newark, N. J. "Always Reliable."

BOSTON.—Trade name for cable clips manufactured by the Chase-Shawmut Co., Newburyport, Mass.

BOSTON.—Trade name for radio keys manufactured by the Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

BOSTON.—Trade name for wire cutters manufactured by H. K. Porter, 6 Ashland St., Everett, Mass.

BOSTON.—Trade name for motor-driven ice cream freezers manufactured by the F. E. Whitney Co., 65 Sudbury St., Boston, Mass.

BOSTON ARMATURE WORKS.—77 Washington St., N., Boston, Mass. Manufacturers of armatures, armature and coil taping and winding machines, commutators, generators, etc. Business established 1914. President, J. W. Head; vice-president, A. M. McGenley; secretary and sales manager, J. A. Murphy; treasurer and general manager, P. J. Murphy.

BOSTON BELTING CO.—80 Elmwood St., Boston, Mass. Manufacturer of belting, piston packing, etc.

BOSTON-ECONOMY LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—43 Hospital St., Providence, R. I. Manufacturer of incandescent lamps. General manager, E. F. Strong.

BOSTON INSULATED WIRE & CABLE CO.—Boston, Mass. Manufacturer of insulated wires and cables. Main office, Boston, Mass. Factories, Boston, Mass.; Hamilton, Ont., Can. Branch office, 268 Jefferson Ave., Detroit, Mich.

BOSTON LAST CO.—44 Binford St., Boston, Mass. Manufacturer of electric heating and ironing outfits for shoe factories. President and general manager, Oscar Heath; vice-president, M. F. Roach; secretary and treasurer, L. M. Friedman.

BOSTON LIGHTNING ROD CO.—7551 Boylston St., Boston, Mass. Manufacturer of lightning conductors. Business established 1873. President, Harvey D. Knox; vice-president, M. C. Willard; secretary, treasurer and general manager, George C. Willard; sales manager, H. E. Litchfield. Factory, Dedham, Mass.

BOSTON WOVEN HOSE & RUBBER CO.—Box 5077, Boston, Mass. Manufacturer of belting, packing, matting, friction and rubber tape, molded insulation, etc. Main office, Boston, Mass. Factories, Cambridge and Plymouth, Mass. Branch offices, Boston, Mass.; St. Louis, Mo.; Seattle, Wash.; Portland, Ore.; Pittsburgh, Pa.; Los Angeles, Cal.; Philadelphia, Pa.; San Francisco, Cal.: El Paso, Tex.; 332 S. Michigan Ave., Chicago, Ill.; 30 Church St., New York, N. Y.

BOSTWICK.—Trade name for folding gates manufactured by the William R. Pitt Composite Iron Works, 548 W. 27th St., New York, N. Y.

BOSWORTH.—Trade name for feed water regulators manufactured by the Crosby Steam Gage & Valve Co., Boston, Mass.

BOSWORTH-ARD MACHINE & FOUNDRY CO.—Anniston, Ala. Manufacturer of electric hoists, metal castings, manhole covers and frames, pulleys, shaft hangers and other power transmission equipment. President, C. E. Ard; vice-president, E. G. Bosworth; secretary, L. C. Watson.

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BOTANICAL DECORATING CO.—208 W. Adams St., Chicago, Ill. Manufacturer of electrically lighted flowers and stage lighting effects. President, treasurer and general manager, L. W. Selig; vice-president, A. Selig; secretary, L. Elkan.

BOUND BROOK OIL-LESS BEARING CO.—Bound Brook, N. J. Manufacturer of bushings, bearings and washers. President, Spencer Weart; vice-president, treasurer and general manager, George O. Smalley; vice-president, William F. Jennings; secretary, Orrel L. Wrench. Branch office, Detroit, Mich.

BOURN RUBBER CO.—58 Warren St., Providence, R. I. Manufacturer of rubber insulated wires and cables. President and general manager, S. W. Bourn; vice-president, F. R. McKenna; secretary, H. H. Bedell; treasurer, A. O. Bourn. Sales representatives, W. A. Leiser & Co., 1607 Sansom St., Philadelphia, Pa.; S. Robert Schwartz & Bros., 729 Broadway, New York, N. Y.; Ohio Distributing Co., 220 Lomax Pl., Chicago, Ill.

BOUSTEAD ELECTRIC & MFG. CO.—16 E. Hennepin Ave., Minneapolis, Minn. Manufacturer of switchboards. Business established 1914. President and general manager, George P. Svendsen; vice-president, Carl Ungerman; secretary and treasurer, Frank L. Johnsen.

BOWDENITE.—Trade name for wire manufactured by the American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.

BOWEN PRODUCTS CORP.—Auburn, N. Y. Manufacturer of oil and grease cups. President and treasurer, George W. Bowen; vice-president, George W. Severson; secretary, J. Henry Kerr. Main office, Auburn, N. Y. Factories, Auburn, N. Y.; Cleveland, Ohio; Detroit, Mich.; Minneapolis, Minn.; Windsor, Ont., Can. Branch offices, 220 Broadway, New York, N. Y.; 1607 Otis Bldg., Chicago, Ill.; Monadnock Bldg., San Francisco, Cal.; 409 Lyric Bldg., Cincinnati, Ohio; 903 Dexter Bldg., Boston, Mass.

BOWIE SWITCH CO.—Nevada Bank Bldg., San Francisco, Cal. Manufacturer of high-tension circuit breakers, switches, lightning arresters and specialties. Business established 1906. Sales representatives, Clapp & Lamoree, San Fernando Bldg., Los Angeles, Cal.

BOWL REFLECTOR.—A commonly used type of reflector having a shape similar to an inverted bowl. Its common use is to cover the lamp filament from the eyes, to avoid glare, and to reflect light in downward directions over a considerable area under and near the lamp. (Also see Reflectors.)

BOWLS, LIGHTING, ALABASTER, ETC.—These bowls correspond in form and use to the more commonly used glass bowls described below. They are made of alabaster (a dense, translucent form of gypsum or calcite) or other translucent material. Certain dense types of glass are also called "alabaster" because they resemble it.

Manufacturers:

Consolidated Lamp & Glass Co., Coraopolis, Pa.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa. "Franklin," "Nemalite," "Nebulite," "Micra."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Northwood Co., H., 36th and Wetzel Sts., Wheeling, W. Va. "Luna."

BOWLS, LIGHTING, GLASS.—Hemispherical or bowl-shaped pieces of glass designed to go under lamps to diffuse the light and reduce glare, or for ornamentation, or both. Bowls may be either placed against the ceiling or, as in semi-indirect lighting, hung some distance below the ceiling. In the latter case, the bowl acts to reflect part of the light to the ceiling, from which the room is lighted by diffuse reflection. (See also Bowl reflector.)

Manufacturers:

Art Shade Co., 224 N. Desplaines St., Chicago, Ill.
Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
Eagle Mfg. Co., Wellsburg, W. Va.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Gilbert Electric Shade Co., 101 Warren St., New York, N. Y.
Gill Glass Co., Inc., Amber and Venango Sts., Philadelphia, Pa. "Una," "Nova."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Glorianna."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Regent." (See display adv. pages 1266-1269.)
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Moran & McNair, Inc., 72 W. Lake St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Berylite."
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.

BOWLUS MFG. CO., THE.—Springfield, Ohio. Manufacturer of boring machines. Business established 1915. President and general manager, H. C. Bowlus; vice-president, G. W. Tehan; secretary, W. W. Witmeyer; treasurer, James Caldwell; sales manager, Bernard Carroll.

BOWMAN & CO., A. W.—23 Church St., Cambridge, Mass. Manufacturers of radio and scientific instruments. Business established 1911. Treasurer, D. J. Smith; general manager, A. W. Bowman. Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.

BOWSER & CO., INC., S. F.—Creighton and Bowser Aves., Fort Wayne, Ind. Manufacturer of tanks, measuring pumps, meters, oil filters, storage, distributing and reclaiming systems for oils and gasoline. Organized 1885. President, S. F. Bowser; vice-president, A. A. Bowser; secretary, H. J. Grosvenor; treasurer, W. G. Zahrt; general manager, S. B. Bechtel; sales manager, E. M. Savercool. Affiliated companies, S. F. Bowser Co., Ltd., Toronto, Ont., Can.; S. F. Bowser & Co. of Texas, Dallas, Tex.

BOWSHER CO., THE N. P.—South Bend, Ind. Manufacturer of armature balancing machines and tachometers. Business established 1882. President, N. P. Bowsher; vice-president, J. C. Bowsher; treasurer, D. D. Bowsher.

BOX & CO., INC., ALFRED.—Philadelphia, Pa. Manufacturer of electric cranes and hoists. Business established 1878. President, Herman L. Winterer; secretary and treasurer, Frank J. Winterer; sales manager, G. A. Mitchell.

BOX CONNECTORS, COVERS, HANGERS.—See Connectors, box and cabinet; Covers, conduit outlet box; Hangers, box.

BOX IRON WORKS CO., WILLIAM A.—Blake and 33rd Sts., Denver, Colo. Manufacturer of electric traveling cranes, mining machinery and railway crossing alarms. Business established 1907. President, William A. Box; secretary and treasurer, Edmund Wolff; sales manager, E. H. Platt.

BOX RELAY.—In telegraphy, an enclosed sounder relay that has a heavier lever for giving a louder sound than that of the ordinary relay, the resonance of the box assisting.

BOXES, BATTERY.—Battery boxes are used to enclose and protect batteries from mechanical injury and wear and to keep out dust and dirt. They are used for both storage and dry batteries. For use with storage batteries the boxes are made of hard wood and are paraffin-treated or painted with acid-resisting paint. They are of such size as to fit tightly around the battery jar or group of jars. Dry-battery boxes are either made of wood, fiber, or sheet steel. The wood and fiber boxes are commonly made to hold various numbers of cells up to 12, while the metal boxes are commonly used in two or three-cell size for telephone work or for electric bells. They add to the appearance and protect the batteries against broken connections, short-circuits, moisture, dust, etc. They are also supplied for batteries used in ignition systems of automobiles, launches, gas engines, etc. (Also see Holders, battery.)

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Baltimore Battery Separator Co., 5145 Reistertown Rd., Arlington, Baltimore, Md.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y. "Columbia."
Cowie Electric Co., The E. S., 1811 McGee St., Kansas City, Mo.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Eureka Supply Co., Sewell, N. J.
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo. "Lion."
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
PARAGON ELECTRIC CO., Old Colony Bldg., Chicago, Ill. Paragon battery



Paragon Battery Boxes

boxes, handy and attractive containers for dry cell batteries.—Adv.
Sexton Can Co., 123 Broad St., Boston, Mass.
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Texas.
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Union Hardware Co., Torrington, Conn.
Universal Battery Co., 3410 S. LaSalle St., Chicago, Ill.

BOXES, BRANCH.—Branch boxes are used to enclose the connections for a branch circuit. They are generally cast iron boxes with a hinged cover which may be gasketed if desired. The outlets for the branch circuit, which is usually a three-wire circuit, and for the main circuit are provided with porcelain bushings. One common form has split bushings for the main circuit, so that the conductors do not have to be cut, but merely have the insulation removed for a short distance where they may be fastened under the connecting clamp. This greatly facilitates installation. The branch circuit is provided with cartridge fuses which are mounted in the box. Branch boxes may be used for interior work or may be mounted in an outdoor exposed position. (Also see Boxes, subway branch.)

Manufacturers:

Canadian General Electric Co., 212 King St., W., Toronto, Ont., Can.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y., "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Michigan Stamping Co., Detroit, Mich. "BG."
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)

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BOXES, CABLE JUNCTION, LOW-TENSION MANHOLE TYPE.—In low-tension underground networks junction points are connected through junction boxes, usually of the fused type. The distributing mains are fused so as to disconnect any section between boxes which may become defective. The box must be water-tight and is of rugged cast iron construction with gasketed cover tightly held in place by bolts. Copper link fuses are used in many of the larger systems. Where moisture is not a serious matter, enclosed fuses of the cartridge type are sometimes used. Four-way, six-way and sometimes larger boxes are required in large city systems.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
NEWGARD & CO., HENRY, 947-953 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.

BOXES, CABLE, POLE.—These are metal or metal-covered boxes mounted on a pole and contain the terminals of one or more telephone, telegraph, fire-alarm or other signaling cables. The boxes may be plain (having terminals only) or protected (with lightning arresters, fuses, etc.)

Manufacturers:

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cook Electric Co., 900 W. Van Buren St., Chicago, Ill. "Cook."
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
NEWGARD & Co., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
PETERSON CO., INC., CHARLES J., 723-729 Fulton St., Chicago, Ill.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

BOXES, CONDUIT, FOR CONCRETE CONSTRUCTION.—Metal outlet or switch boxes of varying depths for use with different thicknesses of concrete. They are fastened to the wood forms by nails through lugs and the covers are shaped to prevent concrete from entering the boxes. In concrete buildings with concealed conduits special means must be taken to prevent the conduits and boxes from becoming obstructed when the concrete is poured. In the ordinary boxes this cannot be dependably done. Hence the need for the special boxes described. (They are always made in two pieces, as a ring and cover. The cover is removed while the conduit is being installed and replaced before the conduit is poured. Extension rings similar to those used on outlet boxes are also used to bring the box flush with the finished surface.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-116 S. Desplaines St., Chicago, Ill.
Canadian General Electric So., Ltd., 212 King St., W., Toronto, Ont., Can.

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CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill. Union stamped steel outlet boxes with removable back, have specially designed ears through which nails may be driven into wood form to



"Union" Concrete Outlet Box Unassembled

hold box securely in place. The conduit knockouts are located near the bottom, giving ample clearance. When they are removed, back or bottom cover taken off, box nailed to the concrete form is then ready for conduit. When cover is replaced, it can be securely locked by tightening the two screws. These boxes are made of various depths, and 4 ins. diameter. Union extension rings of similar diameter are designed for use where deeper box is required. Also



No. 103X Ring

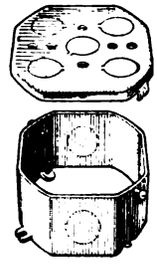


No. 105X Ring with Plate and Cover



No. 103X Ring Mounted On No. 103 Box

suitable for bracket work in partitions; provided with 4 knockouts furnished galvanized or enameled. Also made in octagonal shape to similar specifications.—Adv.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y. "Columbia."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Electric Motor & Engineering Co., The, 2nd St. S. W., and B. & O. R. R., Canton, Ohio.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display advertisement on pages 1266-1269.)
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Michigan Stamping Co., Detroit, Mich. "BG."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
Overbagh Co., Cameron, 221 W. Randolph St., Chicago, Ill.
Pratt-Chuck Co., The, Frankfort, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague boxes for this purpose are 4 in., octagon, in five depths, 1½ to 6 ins. They are flanged and lap-welded to prevent seepage of concrete or water. Back plate fits close, with securance screws easily accessible. Knockouts placed high to prevent weakening of concrete. Sprague products, see display adv. pages 1306-7.—Adv.
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.)



"Steel City" concrete boxes are furnished in 1½, 2, 3, 3½, 4, 5 and 6-in. depths for varying thicknesses of concrete. The knockouts are set high, so that concrete slab will not be weakened. The cap is lapped or flanged to prevent cement from working into box when concrete is poured. Time and labor savers, and very rugged.—Adv.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."

BOXES, CONDUIT, JUNCTION AND PULL.—Metal boxes placed at points in an interior conduit system where a junction is made or where it is necessary to get at the wires or cables to facilitate pulling them into the system. Pull boxes are used mostly with large wires or cables; they frequently accommodate several such wires and are consequently of large size and usually made of sheet steel with cover screwed in place. Smaller junction or pull boxes are often made of cast metal, with cast iron, sheet steel or porcelain covers.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1365.)
Adapti Co., The, 919-925 West St., Cleveland, Ohio. "Adapti-box."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
Arnesson Electric Co., 109 Broad St., New York, N. Y.
AURORA STEEL PRODUCTS CO., Aurora, Ill.
Austin Co., The M. B., 108-116 S. Desplaines St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Write for circular.—Adv.
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
C. & P. Electric Works, Inc., 92 Hawden St., Springfield, Mass.
CHICAGO FUSE MFG. CO., Laflin and 15th Sts., Chicago, Ill. "Union."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLUMBIA METAL BOX CO., 226 E. 144th St., New York, N. Y. "Columbia." See descriptive advertisement under Cabinets, sheet steel.—Adv.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Electric Motor & Engineering Co., The, 2nd St., S. W., and B. & O. R. R., Canton, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.

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Michigan Stamping Co., Detroit, Mich. "BG."
Monarch Electric Co., Ltd., St. Lawrence and Water Sts., St. Lambert, Que., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display advertisement on pages 1302-1304.)
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
O. K. Metal Box Co., 198 Greenwich St., New York, N. Y.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-729 Fulton St., Chicago, Ill.
Pratt-Chuck Co., The, Frankfort, N. Y. "Bau."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk and Niagara Sts., Buffalo, N. Y.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. "Spraguelets," as they are called, or conduit bodies, in the three forms shown embrace all requirements for exposed wiring, using ½ or ¾-in. conduit. They are adapted to any standard wiring device. Figure No. 1 shows the "shallow" Spraguelet, designed for the mounting and reception of all devices except "flush type." Assembled, makes a T conduit body. Figure No. 3 shows a "deep" Spraguelet, for "flush type" devices. The cover plates are secured direct to the device, in the same manner as a flush wall plate. Figure No. 2 shows the "branch" Spraguelet, designed for

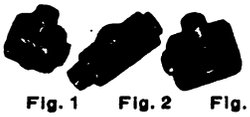


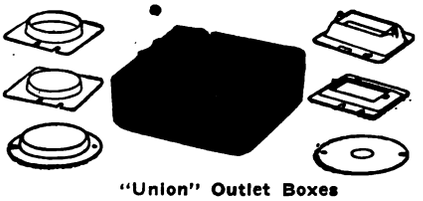
Fig. 1 Fig. 2 Fig. 3

branches, junctions, pull work or extensions. Spraguelet ½ in. coupling and ¾ in. coupling are designed for use with the above bodies in the various combinations. Sprague products, see display adv., pages 1306-7.—Adv.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Ovalduct." "Steel City."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

BOXES, CONDUIT OUTLET.—Conduit outlet boxes strictly are confined to pressed steel or cast iron boxes installed in an interior conduit run where either a receptacle outlet or fixture outlet is to be located. Switch boxes, junction and pull boxes, also outlet plates, should properly be separately distinguished as such, and not included under the term outlet boxes, although in the trade the term "outlet boxes" is quite often loosely used to include these types. The same box body may sometimes, by change of sectional attachments, be changed from an outlet box to a pull box, flush switch box or other fitting, so that in the trade it may be called by various names. Outlet boxes, especially of the nonsectional type, are usually provided with openings sealed by knockouts that may be knocked out by a blow of a hammer to permit ready connection of the conduit or conduits from several directions. Where the conduit or flexible tubing enters the box it must be secured by a locknut or other approved clamping device which in some cases forms part of the box. Another form of boxes used with outlet boxes are known as extension ring boxes. They are like the ordinary conduit boxes, but with the bottoms punched out, and with small openings to match the screw centers of the box, allowing the extension ring to be attached on top of the box, in place of the cover, thus furnishing a deeper box. They are used where it is necessary to run additional circuits, for which there is not room in the present conduit, especially necessary if the present boxes are concealed in the plaster. Both the extension ring and the new runs of conduit will be exposed outside the surface of the plaster.

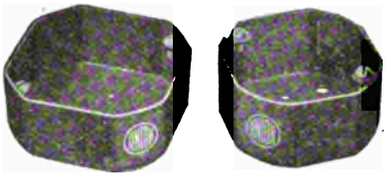
Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
Adapti Co., The, 919-925 West St., Cleveland, Ohio. "Adapti-box," "Adapti-Termi-Wire-Tap."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Arnessen Electric Co., 109 Broad St., New York, N. Y.
Austin Co., The M. B., 108-116 S. Desplaines St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (Watertight.) Write for circular.—Adv.
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.
CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill.—Union outlet boxes are drawn from No. 14 U. S. gauge steel, and have outlets for ½ and ¾ in. conduit, effectively closed with knock-



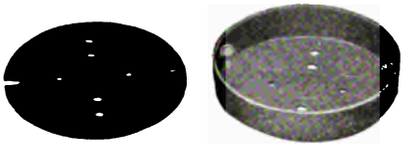
"Union" Outlet Boxes

outs, but easily removable by a single blow. Various sizes can be furnished as required in square, round, octagonal, or rectangular shapes. All boxes are either galvanized or finished with a



"Union" Outlet Boxes

heavy, smooth black insulating enamel, proof against rust or acid fumes. Galvanized screws are provided throughout. A wide selection of covers designed for every conceivable requirement in conjunction with Union outlet



"Union" Shallow Ceiling Conduit Box and Plate

boxes can always be supplied. Shallow ceiling, loom and conduit boxes, and deep ceiling boxes, fitted with ears, will take all standard outlet box plates and covers. See this company's entry under Boxes, conduit, snap switch.—Adv.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
Colgan Co., W. H., West Newton, Mass. "Rex."
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y. "Columbia."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet." Cleveland, Ohio.
Electric Box & Cover Co., Inc., 29 Ave. C, Newark, N. J.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Electrical Specialty Mfg. Co., 51 Beaufort St., Providence, R. I.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GILLETTE-VIBBER CO., New London, Conn. "Gee-Vee."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display advertisement on pages 1266-1269.)
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y. "Noark."
Kuhlman Engineering Co., The., 840 Champlain St., Toledo, Ohio.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mansfield Electric Hardware Co., Mansfield, Ohio.
Michigan Stamping Co., Detroit, Mich. "BG."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National" outlet boxes are stamped from a special highgrade quality of steel, providing the maximum strength and rigidity. Knockout plugs are completely cut away from the boxes, excepting only at the holding necks. "National" outlet boxes and covers are furnished in either sherardized or enameled finish, as specified. Sherardized boxes are absolutely rustproof. This process, the alloying of zinc with the steel surfaces, affords the best possible protection against corrosion, and is the only zinc protective treatment which can be uniformly applied to all portions of the surface. See display adv. pages 1302-4.—Adv.
O. K. Metal Box Co., 198 Greenwich St., New York, N. Y.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Overbagh Co., Cameron, 221 W. Randolph St., Chicago, Ill.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Renim Specialty Co., 110 K St., Boston, Mass. "Renim."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague outlet boxes are made in a line that is complete with fittings, for all purposes, including concrete work. Sprague products, see display adv., pages 1306-7. —Adv.



STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Steel City" outlet boxes and covers.



"Steel City" Outlet Boxes

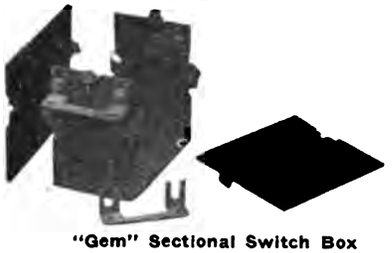
The knockout plugs are cleancut with clear space all around except at connecting neck. This separation insures easy removal.—Adv.
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

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BOXES, CONDUIT, SNAP SWITCH OR WALL.—Sheet steel or cast iron boxes installed in conduit wiring systems in walls to receive push button and rotary snap switches, receptacles, or other flush devices, the boxes usually having the standard mounting centers of 3⅜ ins. The boxes are about 3 ins. long by 2 ins. wide and of various depths from 2 ins. to 3½ ins. or more. They are attached by ears to supports, or fastened in position by nails driven through small holes in the box. A few types are 1⅞ ins. deep and are longer than 3 ins., but practically all are of standard width. Sectional boxes can be built up side by side, each section firmly attached to its neighbor, and with uniform and standard spacing to match the brass covers or flush plates made by the switch manufacturers. Most of these boxes are of such dimensions that the plate will completely cover them and hide the ragged edges of the surrounding plaster. Outlets are provided in the bottoms, sides and ends, or beveled corners, for the accommodation of rigid or flexible metallic conduit, or "loom," according to the design of the box, and with binding clamps if desired. A string of boxes built up side by side is known as a "gang" while a special box consisting of several sections arranged end to end is called a "tandem." Combined "gang" and "tandem" boxes of almost any combination can be secured.

Manufacturers:

Adapti Co., The, 919-925 West St., Cleveland, Ohio. "Adapti-box."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-116 S. Desplaines St., Chicago, Ill.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cavin, F. T., 400 W. Ave. 26, Los Angeles, Cal.
CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill.—Union boxes are designed to meet special, as well as ordinary requirements. An exceptionally popular line, known as the Gem sectional switch box, is most practical for all purposes. Both sides of box are removable, and gangs can be built from



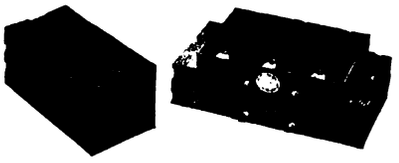
"Gem" Sectional Switch Box

single boxes without the aid of spacers. All sides are interchangeable, and can be assembled in a few seconds by means of a screw driver only. This extreme simplicity of construction, combined with rigidity and durability, make Gem boxes ideal for all installations. The Gem box is regularly equipped with type C ear, reversible,



"Gem" Sectional Switch Boxes

having an adjustment from ⅜ to ¾ inches, and affords ample room for setting screws firmly into lath or mounting board. Various sizes can be furnished, built with square or beveled corners to accommodate loom or conduit. Can be fitted with inside or outside clamps. The "Gem B D" can be used with standard B X conductors by employing box connectors. Gem boxes take all makes of standard, push button and rectangular base switches and receptacles. This sectional gang feature of Union switch boxes will undoubtedly appeal to all users. Union No. 160 will meet the demand for such requirements as plug receptacles, push button and rotary rectangular base switches. Union No. 170 is a sectional combination, loom and conduit, shallow switch box, for thin partitions and out-



Sectional Conduit Switch Boxes

side wall work. Any number of gangs can be built up with the aid of spacers. The hook-eye construction permits rapid assembling. Spacers have but one outlet; box has six holes in each end section. By equipping with flat steel covers, an ideal junction box for single and double main line blocks, meets the approval of the Underwriters.' "Union Solid Drawn" switch boxes, for flexible non-metallic conduit, for one, two or three gang installation. Single box at left has two knock-



"Union" Solid Drawn Switch Box



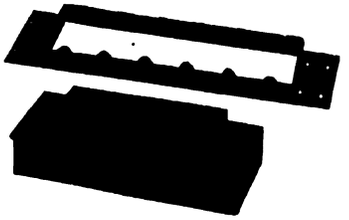
Universal Conduit Box

outs in each side, and two in each beveled end. Equipped with reversible and sliding ears; adapted for old and new work, has neatly rounded corners and is drawn from 14 gauge steel. The Universal box shown at right is ideal for exposed conduit and BX work, such as fans, soldering irons, or other portable devices having plug receptacles; also suitable for transposition from pipe work to exposed wiring. Union Tan-



"Union" Tandem Switch Box

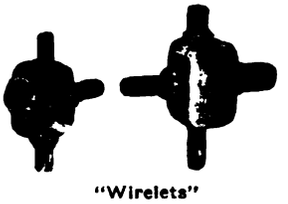
dem switch boxes, for flexible and rigid conduit, old and new work to fit all standard plates, takes all makes of P. B. switches, and can be supplied in any number of gangs, from 2 to 12. These boxes have solid sides, and have no partition between switches. Solid one-



"Union" One-Piece Switch Box and Cover

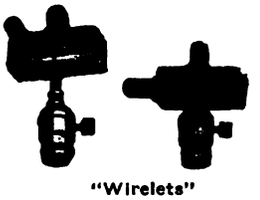
piece boxes made from pressed steel, complete with one-piece steel covers to match are available for from 2 to 10 gang capacities, are rigid and substantial, and have ½ or ¾ in. knockouts as desired.—Adv.

Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Kam-Lok Switch Box Co., 417 W. 35th St., New York, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Machen Electric Mfg. Co., 4639-4643 E. Thompson St., Bridesburg, Philadelphia, Pa.
Michigan Stamping Co., Detroit, Mich. "BG."
Motor City Stamping Co., 771 Maxwell Ave., Detroit, Mich.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National" switch boxes are made of stamped steel and are finished with a black acidproof enamel. The cover lugs are riveted to the box; special attention is called to the fact that these are riveted, and not formed from the sides of the boxes and turned over, which must necessarily weaken or crack the lugs at the point of bending. Knockout plugs are completely cut away from the box excepting only at the holding necks. "National" switch boxes are made in single, two, three and four gangs. See display adv. pages 1302-4.—Adv.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Potter-Acme Mfg. Co., The, 912-920 Champlain Ave., Cleveland, Ohio. "Potter."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Wirelets" conduit bodies, covers and connectors form a new standardized line that is readily adaptable to any stand-



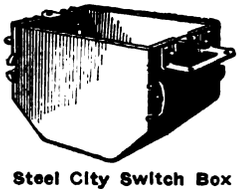
"Wirelets"

ard wiring device. The three stamped steel conduit bodies with numerous knockouts replace thousands of special



"Wirelets"

cast iron bodies with certain fixed conduit openings. There are two couplings, one designed for ½-in. conduit, the other for ¾-in. conduit; both couplings fit the one size knockout used throughout the three Wirelets. A few typical installations are illustrated. Steel City switch boxes are convenient and rigid



Steel City Switch Box

when assembled. The new form of interlocking lugs provides for quick removal of sides or assembling into gangs. The "Nimble Knockouts" are clean cut and may be easily removed.—Adv.

Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
TRUMBULL VANDERPOEL ELECTRIC MFG. CO., Bantam, Conn.

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V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WM., 21 S. 11th St., St. Louis, Mo. Wurdack Switch Boxes are made in one type only, but this one type is instantly adaptable and adjustable to any particular style of loom box required. The boxes may be used singly or ganged together in any number of gangs, and when ganged all of the sides inside the box are removed, thus giving one continuous box and maximum amount of room for aligning of switches. Every box is complete and there are no spacers, the sides being removed from boxes to make spacers. Boxes are standard in size and fit all standard switches and switch plates. The Uni-



"Wurdack" Switch Box

versal Ears give a wide range of adaptability by being adjustable to all styles of support, as:—

Short Ears for Old Work
Long Ears for New Work
Short Ears for New Work
Side Ears for Side Support

The Ear on back of box is shown as short Ear raised for Old Work. Ear on front of box is shown lowered as Short Ear for New Work. Sides are removed from boxes when ganging by holding box upside-down and striking bottom edge of side to be removed at point indicated on all boxes by the stamp "To open hit here." All sides



Three Boxes Ganged Together

on inside of box removed, making one continuous box, and all boxes ganged together by bridging ears between boxes. Ears on back of boxes are shown raised on Short Ears for Old Work. Ears on front of boxes are shown with the short side of ears used to gang boxes, allowing the long side of ears to project from boxes, thereby making Long Ears for New Work; one ear is also shown adjusted as Side Ear for Side Support. Only a minimum investment is required when stocking Wurdack Boxes, because this one type of box covers all types usually carried. Wurdack Boxes can be taken to a job without any previous knowledge of how they are to be installed and there best adapted to meet whatever conditions are found. If conditions are changed while the work is in progress, the boxes originally taken to the job can be immediately adjusted to meet the changed specifications, without any loss of time. There can be no "dead stock" of Wurdack Switch Boxes with Universal Ears, because every box in stock can be used by adjusting it to one type or another as required. Our latest catalog fully describes all our products. It will be sent on request.—Adv.

BOXES, CORRUGATED FIBER, PACKING AND SHIPPING.—Corrugated-fiber boxes are used for packing and shipping much breakable electrical equipment, such as porcelain and glass insulators, glass or enameled reflectors, glass bowls and shades and other fragile or easily damaged articles. They are used not only for shipping but for stocking the goods on the jobbers' and dealers' shelves, etc. The boxes are usually made three-ply with the corrugated ply in the middle and smooth sheets on the outside and inside. They are very light, but compact and strong and will withstand considerable jarring and rough handling while effectively protecting the contents.

Manufacturers:

Chicago Mill & Lumber Co., Conway Bldg., Chicago, Ill. "Chicago Mill."
Gair Co., Robert, Brooklyn, N. Y.
HINDE & DAUCH PAPER CO., THE 311 W. Water St., Sandusky, Ohio. (See display adv. page 1322.)
Sefton Mfg. Co., 1301 W. 35th St., Chicago, Ill.

BOXES, CUTOUT OR FUSE. — Metal boxes, usually cast iron or sheet steel, provided with a hinged and latched door or cover telescoping the sides of the box, designed to enclose the fuses of an electric circuit. They are for surface mounting and are used where the fuses would otherwise be exposed to mechanical injury, moisture, inflammable gases or dust, or easily ignitible material. Cutout or fuse boxes differ from panelboards, cabinets and distributing boards in that they serve merely as fuse enclosures and not also as centers of distribution for branch circuits.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
All-Steel-Equip. Co., Aurora, Ill. "All-Steel-Equip."
AMERICAN INSULATOR CORP., New Freedom, Pa. "Aico."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
AURORA STEEL PRODUCTS CO., Aurora, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Burns, James F., 713-15 Cherry St., Philadelphia, Pa.
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Chemelectric Co., The, 4327 Kenmore Ave., Chicago, Ill. (Exclusive distributor, G & W Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.)
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor."
COLUMBIA METAL BOX CO., 226 E. 144th St., New York, N. Y. "Columbia." (See descriptive advertisement under Cabinets, sheet steel.)
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.(See descriptive advertisement under Fuses, cartridge, non-renewable.)
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St. and S. W. & B. O. R. R., Canton, Ohio.
Electric Panelboard Co., Rochester, N. Y.
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
ISERT CO., JOHN H., Louisville, Ky.—Type A boxes for surface mounting in all sizes, approved by the Board of Underwriters. Write for list prices or ask us to quote on special requirements.—Adv.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Mendell Mfg. Co., Mattapoisett, Mass.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Can.
Michigan Stamping Co., Detroit, Mich. "BG."
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa., "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Potter-Acme Mfg. Co., The, 912-920 Champlain Ave., Cleveland, Ohio. "Potter."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Renim Specialty Co., 110 K St., Boston, Mass. "Renim."
Riggs, Distler & Stringer, Baltimore, Md. "Calvert."
Robertson Electric Construction Co., Mohawk and Niagara Sts., Buffalo, N. Y.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Star Metal Box Co., 508-509 W. 19th St., New York, N. Y. "Star."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

BOXES, DISTRIBUTION.—In an interior conduit system a steel or iron box, into which the main feeders pass, and from which branch feeders are taken off to the different floors or departments. Distribution boxes are used mostly in large buildings served from central-station lines. The box has single or double spring-hinged doors to protect the distribution board enclosed within, which serves in place of the main switchboard commonly found in generating plants. The distribution board usually has fuses for the various feeders, but no switches. In underground supply systems the service tap boxes from which service wires are run to nearby buildings are sometimes called distribution boxes; see Boxes, service tap, low tension.

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Manufacturers:

ADAM ELECTRIC CO., FRANK. 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
AURORA STEEL PRODUCTS CO., Aurora, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (Cast brass and iron.) (See display advertisement on pages 1231-1234.)
Canton Specialty Co., Gas & Electric Bldg., Canton, Ill. "C. S."
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor."
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Summach St., Toronto, Ont., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Electric Motor & Engineering Co., The, 2nd St. S. W. & B. & O. R. R., Canton, Ohio.
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Michigan Stamping Co., Detroit, Mich. "BG."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See advertisement on page 1287.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON & CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Western Electric Works, 213 6th St., Portland, Ore.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO. WILLIAM, 21 S. 11th St., St. Louis, Mo.

BOXES, FARE, ELECTRIC RAILWAY CAR OR STATION.—A receptacle for the receipt of coin put into it in payment of fare. Boxes of the simplest type are known as "locked" boxes, because they are accessible only to a cash taker or cashier. The principle of locking the box is employed also in coin counting and registering boxes. The latter boxes are frequently designed so that the money after being registered is available to conductors for change. Frequently they are arranged to handle both ticket and coin fares. The coin counting and registering mechanism is usually driven by a hand crank, though sometimes, as in stations and occasionally on cars, it is motor-driven.

Manufacturers:

Canadian Cleveland Fare Box Co., Ltd., Duke St., Preston, Ont., Can.
Cleveland Fare Box Co., Cleveland, Ohio.
Johnson Fare Box Co., 4619 Ravenswood Ave., Chicago, Ill.

BOXES, FIBER CONDUIT JUNCTION.—See Bends, elbows and other fittings, fiber conduit.

BOXES, FIRE-ALARM, INDOOR.—Metal boxes of either the pull-lever or break-glass type located at convenient points within a building, for sending in a fire alarm over an electric circuit. In the first type of box an alarm is sent in by opening the door and pulling down a lever which winds a spring. This spring actuates a code wheel which indicates on gongs the number of the box. In the break-glass box the breaking of the glass releases a spring and code wheel already set. The operation of these boxes may, in addition to actuating fire-alarm systems on the premises, also send an alarm to the nearest fire department headquarters direct or through the central fire-alarm station of the community.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "Jove," "Vulcan."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."
U. S. E. M. Co., 505 W. 42nd. St., New York, N. Y. "U S E M."
Waldman, J. J., 64-66 Murray St., New York, N. Y.

BOXES, FIRE ALARM, OUTDOOR—Heavy iron boxes mounted usually on metal posts in conspicuous places, as at street corners, and equipped with a door which may be readily opened in case of fire. Within the door is a lever, the pulling down of which winds a spring. This spring rotates a notched wheel which operates electrical contacts, thus sending a code signal (usually the box number) over wires to the central fire-alarm station or the nearest fire department headquarters. Some types of boxes have an inner locked compartment containing either a telephone or telegraph key by which the fire marshal or chief can signal headquarters for additional fire-fighting equipment. The entire box is made weatherproof in all cases.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "Jove," "Vulcan."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Rope Fire Escape Co., 1626 Market St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 36 Hubert St., New York, N. Y. "Faraday."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
Waldman, J. J., 64-66 Murray St., New York, N. Y.

BOXES, FLOOR, ORDINARY DUST-PROOF.—Metal outlet boxes, generally cast iron, for installation in floors for the purpose of making connection to electric circuits through a receptacle in the box and a flush plug inserted through the cover of the box. The boxes frequently have polished brass covers with adjusting features so that the cover may be made to set flush with the floor even if the box was not properly set.

Manufacturers:

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Caldwell Electric Corp., 1002 Market St., Champaign, Ill.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet"
Devoe Electric Switch Co., The, 414 Notre Dame St., W. Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Koven & Bro., L. O., 154 Ogden Ave., Jersey City, N. J.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Michigan Stamping Co., Detroit, Mich. "BG."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Pratt Chuck Co., The, Frankfort, N. Y.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Fullman."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BOXES, FLOOR, WATER-TIGHT.—Metal outlet boxes for installation in floors with special provision for excluding moisture, dust, dirt, etc. Many of these boxes are provided with rubber gaskets between the cover and box, thus rendering the box water-tight. Others have an adjustable feature for the cover so that it always alines itself with the floor and in these a rubber gasket is inserted in the adjusting ring and it is then filled with a sealing compound to make it water-tight. The boxes are generally tapped to receive the conduit and the holes not used are closed with steel screw plugs.

Manufacturers:

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet"
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."

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STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Fullman" water tight floor outlets are made in adjustable and non-adjustable models. Fullman adjustable outlets are automatically adjustable for leveling and height, as indicated in the first illustration. This shows the Fullman No. 400 outlet and No. 413 brass flange in-



"Fullman" Floor Outlet

stalled in a modern fireproof floor. The box is shown out of level (a usual condition). This method of adjustment and aligning insures an even distribution of stresses and a watertight joint. Fullman non-adjustable, watertight floor outlets (see sectional view of Type No. 477 in second illustration) are made for all kinds of electric service, and are designed for wood floors where



"Fullman" Floor Outlet, Sectional View

cover plate can be made to align with surface of floor without the aid of any adjusting feature in the box itself.—Adv.

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 59th St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BOXES, HEAVY-DUTY RECEPTACLE.—Enclosures for attachment plug receptacles having ratings in excess of 10 amperes, 250 volts. These are generally made of cast iron and are intended for use in such locations as machine shops, railroad shops, etc., where portable motor-driven drills, grinders and other tools are used, and in garages for storage-battery charging. Because of the many designs of plugs and receptacles intended to prevent short circuits or reversal of polarity, the housings or boxes are also made in a variety of forms. They are generally quite heavy and substantially made and often waterproof so that they may be used outdoors. Spring covers are used in many cases to keep out dust, moisture, etc., when not in use. Heavy-duty boxes for use on theater stages are usually of special design and are often called "stage pockets"; they are listed under Receptacles. stage.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
GLEASON & CO., J. L., 241 Franklin St., Boston, Mass.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BOXES, JOURNAL OR OIL.—Dust and weatherproof metal boxes of general rectangular cross section which contain the bearings in which the truck axles of cars revolve, and also the oil and waste for lubrication of the bearings. Journal boxes are essential elements of car or locomotive trucks, as the weight of the car or locomotive is transmitted through them, and their contained bearings, to the axles and thence through the wheels to the track. It is important in the design of journal boxes that the thickness of top and bottom walls be sufficient to withstand the loads to be carried and that the side walls have sufficient thickness to provide for a reasonable wear due to movement in the pedestals. It is becoming quite general practice to provide the wearing faces of journal boxes with renewable hardened wearing pieces, thus prolonging the life of the box. Boxes are made of cast iron, cast steel, malleable iron, or a special metal mixture called semisteel, and are held in position in the truck frame by means of castings or forgings, called pedestals. Journal boxes are provided at the outside ends with easily opened dust and weatherproof lids for insertion of oil and waste for lubrication and for renewal of bearings. The rear ends have circular shaped openings through which the truck axle enters the box, and these openings are provided with devices called dust guards, which prevent dust and other foreign material from getting into the box.

Manufacturers:

Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.
Graham & Co., James, 293 Wooster St., New Haven, Conn.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo. "Arctic."
North American Smelting Co., 9th & Thompson Sts., Philadelphia, Pa.
Railway Roller Bearing Co., Syracuse, N. Y. "Rollway."
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.
Stucki Co., A., 419 Oliver Bldg., Pittsburgh, Pa. (side bearings.)
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BOXES, JUNCTION, HIGH-TENSION MANHOLE TYPE.—In primary distributing systems which are entirely underground, the feeder and main system must be provided with means for disconnecting and testing in emergencies. These facilities also usually embody connections by which the parts of the circuit which are not in trouble may be supplied from an emergency connection pending repairs on the damaged section. Such junction boxes are designed to act as selector switches, only very small currents being interrupted in their operation. Hence they usually embody some form of blade switch connections, with suitable insulating barriers between opposite polarities and compound-filled terminals for the cable connections into the cast iron box. Water is excluded by the use of gaskets or an overlapping cover which does not permit water to enter the box, even though it may be submerged.

BOXES, JUNCTION, LOW-TENSION SURFACE TYPE.—Where manholes are badly crowded, as at important intersections or where drainage of the manhole is not feasible, the surface type junction box has advantages. This box has a cover which is accessible after removing a street surface cover. The inner cover is gasketed and the box is connected through iron pipe laterals from a nearby manhole. The fuses are thus accessible for testing and quick replacement from the surface in an emergency.

Manufacturers:

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Fuses, cartridge, nonrenewable.)

BOXES, LETTER AND BELL OR SIGNAL.—Cast or sheet metal boxes for receiving letters in house or apartment building vestibules and provided with nameplates and with push buttons for sounding a buzzer or bell in the respective apartments when mail is deposited in the box or visitors announce their arrival. They are usually combined with speaking tubes, but in large and most modern apartment buildings the speaking tubes are replaced by private or interior telephones. In this case one transmitter and receiver usually is made to serve for an entire bank of letter boxes and is often placed in a box in the center of the bank.

Manufacturers:

Build-Craft Electric Mfg. Co., 37-39 Maspeth Ave., Brooklyn, N. Y.
Corbin Cabinet Lock Co., New Britain, Conn.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass. "Nested."
Lovell & Co., F. H., Arlington, N. J.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y. "Standard," "Challenge."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Sexton Can Co., 123 Broad St., Boston, Mass.
Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

BOXES, LOAD.—See Loads, artificial or phantom; also Testing outfits, watt-hour meter.

BOXES, LOW-TENSION INTERCONNECTING.—Low-tension interconnecting boxes are used with low-voltage signaling systems, such as annunciators or alarm systems and also telephone circuits. The boxes are usually made of sheet steel and arranged for flush mounting. They have a hinged locking cover. Terminal blocks are mounted within the box on a special base or arranged in some other manner, so that cables may be run underneath the terminals, generally without forming, and connect to the proper binding post. When it is desired to install another telephone or signal set, or change numbers, etc., the connections are changed in the box.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

BOXES, MARINE, OUTLET AND JUNCTION.—Heavy metal boxes, generally cast iron or brass, which are tapped to receive the conduit. They are often standard sized round boxes and are provided for keyless or key receptacles. A flange on the inner surface of the box is used as a seat for a rubber gasket, which permits either a glass globe or metal cover to be screwed in tight and gives a thoroughly water, steam and gas-tight joint. Because of this feature they are used on shipboard for deck lights and in the engine and boiler rooms; also in other damp places, such as laundries, dye rooms, refineries, plating rooms, etc.

Manufacturers:

Adapti Co., The 919-925 West St., Cleveland, Ohio. "Adapti-box."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benjamin line of marine fittings and fixtures, the prominent features of which are sturdy construction, standardization and interchangeability of all parts. Write for catalog and see display advertising pages 1231-1234—Adv.



CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conneaut."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."

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Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Marine Electric Co., 195 Fremont St., San Francisco, Cal.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Unibco."

BOXES, METAL MOLDING OR RACEWAY, OUTLET AND JUNCTION.—Sheet metal outlet and junction boxes of special construction for use with metal molding or raceways. These boxes, which are usually of shallower dimensions than those used in regular conduit work, are equipped with knockouts for receiving the type of raceway for which they are designed. The boxes are made as corner boxes, junction boxes, drop-cord boxes, fixture boxes, switch boxes, etc., and have various covers, such as porcelain, blank metal, switch base, etc.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Burns, James F., 713-15 Cherry St., Philadelphia, Pa.
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Fancleve Specialty Co., Jamaica Plain, Boston, Mass. "Fancleve."
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display advertisement on pages 1302-1304.)
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See advertisement on page 1287.)
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Scranton Button Co., The, 409 Cherry St., Scranton, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BOXES, METER PROTECTIVE.—Steel boxes used to enclose and protect service meters and prevent tampering with their connections, etc. One use for special forms of these meter boxes is to install them in the basement wall with the back flush with the inside wall and the meter mounted so that its dials are visible from the outside. A special protecting cover with a small glass window is placed on the outside of the wall. These greatly facilitate meter reading as there is no waiting nor any necessity for return calls. When any repairing or testing is required the box may be opened from the inside. Also see Trim, meter protective.

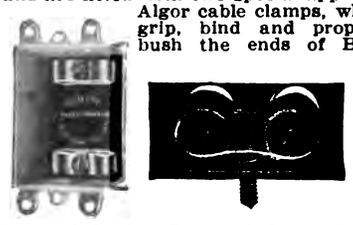
Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Donley Bros. Co., The, E. 74th St., & Aetna Rd., Cleveland, Ohio.
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
Safety Meter Box Co., The, 217 Erie Bldg., Cleveland, Ohio. "Safety."
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)

BOXES, OUTLET AND SWITCH, FOR ARMORED CABLE OR FLEXIBLE STEEL CONDUIT.—Outlet and switch boxes are made especially for use with armored cable or flexible steel conduit. While ordinary conduit outlet or switch boxes may be used for this type of work, special box connectors are required. The boxes designed especially for this construction have connectors as part of the box, consisting of a hole or cylindrical recess into which the cable or conduit is pulled. A small wedge is then put in place by tightening a screw and the conduit or cable armor is held securely. The wires pass right through the opening into the box. These are made as outlet boxes, for supporting receptacles, rosettes, fixtures, etc., and also as switch boxes.

Manufacturers:

Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass.
Clemence Bros., 164 Linden Ave., Irvington, N. J. "Sterling Bi-Plex."
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor" BX Type, Cat. No. 134, sectional switch and receptacle boxes are 2½ ins. deep and are fitted with two special approved Algor cable clamps, which grip, bind and properly bush the ends of BX-2



"Algor" Switch Box and Cable Clamp

Nos. 10, 12, or 14 B. & S., and BX-3, 12 and 14 triple conductors as well as ⅛ and ⅜ Greenfield flexible cables. Algor cable clamps eliminate all shorts and other troubles in switch and junction boxes. Algor cable clamps have the hearty approval of electric wiring inspectors everywhere. The illustrations show the perfect BX installation with Algor cable clamps.—Adv.
Fancleve Specialty Co., Jamaica Plain, Boston, Mass. "Fancleve."
Standard Electrical Mfg. Co., 220-222 High Ave., S. E., Cleveland, Ohio. "Standard."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T & B" "Dead Ground" Boxes embody a simple but thoroughly effective connecting and grounding device based on the wedge and inclined plane principle. It is easy to install, and the mechanical and electrical connections between the box and armor are perfect. The boxes are galvanized. Deep boxes for straight electric and combination gas and electric work are 3 ins. in diameter by 1⅛ ins. deep. Shallow boxes are 3 ins. by ¾ in. deep. The "T & B" Standard Box for armored conductors is designed principally for finished house work. Fits flush with the surface of the wall. —Adv.



Type No. 880-860

BOXES, OUTLET AND SWITCH, FOR FLEXIBLE TUBING.—Outlet and switch boxes for flexible tubing, or nonmetallic conduit, are generally made with ⅝-in. knockouts which are set in a beveled corner. This facilitates fishing in the tubing or "loom", as it is often called, especially when old buildings are wired or rewired. Switch boxes are often of the sectional form to permit the construction of the necessary gang boxes. A special split bushing is pushed through the hole and the flexible conduit is held in place without the use of any tools.

Manufacturers:

AURORA STEEL PRODUCTS CO., Aurora, Ill.
Clemence Bros., 164 Linden Ave., Irvington, N. J. "Meleady" loom box.
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "ALGOR" A-114 Loom type sectional switch and receptacle boxes are 2 ins. deep. For description of these, see the Collinson-Holland Co. entry under Boxes, outlet and switch, for armored cable or flexible steel conduit.—Adv.
Fancleve Specialty Co., Jamaica Plain, Boston, Mass.
Habermaas & Delporte, Inc., 1325-1327 S. 7th St., St. Louis, Mo. "All-in-O."

BOXES, OUTLET, SWITCH OR JUNCTION, FOR EXPOSED CONDUIT.—These are sheet steel or cast iron boxes used for exposed conduit work, having formed extensions which are tapped to receive standard sizes of rigid metal conduits. Other boxes are made which are adaptable to a certain extent and may be used in a number of places. By using only two or three box bodies almost any number of conditions may be taken care of with certain attachments. These are sometimes called "conduit bodies." Special covers and switch mounting plates are provided so that the box may be used as a switch, junction or outlet box. (Also see Conduit bodies.)

Manufacturers:

SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. "Spraguelets." (See display adv. pages 1306-1307.)

BOXES, PACKING, CORRUGATED FIBER.—(See Boxes, corrugated fiber, packing and shipping.)

BOXES, PARK CABLE.—Park cable boxes are for use with park cables or steel-tape armored cables which are buried directly in the earth without conduit protection. They are cast iron boxes and are made for a straight junction or a tap splice (tee box). The boxes are split horizontally and the flanges are provided with a groove for packing with jute to make them waterproof. The cables are clamped securely in place by means of a bolted clamp, which is packed with jute or burlap. The top half of the box is provided with a standard pipe plug, which is removable, so that after the splice is made and the box is closed it may be filled with a special filling compound and thus sealed on replacing the plug.

Manufacturers:

Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
G & W Electric Specialty Co., 7430-52 S. Chicago, Ave., Chicago, Ill. "G & W."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

BOXES, POLICE OR PATROL.—Boxes of heavy metal type equipped with door and lock and containing a telephone for communicating with headquarters and often also a lever or pull mechanism for sending to headquarters a code signal indicating that the box has been operated or "pulled." Some types of boxes also have a lamp or audible signal by means of which the patrolmen can be called to the box so as to receive urgent or other special instructions from police headquarters.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.

BOXES, RAILROAD YARD.—Enclosing boxes for receptacles for attachment plugs. They are enclosures of rugged construction, generally cast iron housings with spring covers. They are used in railroad yards, round houses, stations, etc., where it is required to have receptacle at convenient points for charging the storage batteries in cars, attaching vacuum cleaners, etc. It is modern practice to run all the wires in conduit, either underground or on the surface, and provide a row of outlets between every other track. The receptacle boxes may be set flush in concrete or mounted on a hollow concrete pedestal or small wooden post. The housings are always weatherproof and are made to accommodate either single or double receptacles, as it is usually necessary to have different voltages for the battery-charging circuit and the one for attaching the miscellaneous appliances, such as vacuum cleaners, portable tools, trouble lamps, etc.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.
CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."
Stanley & Patterson, 34 Hubert St., New York, N. Y.

BOXES, RESISTANCE.—In electrical measurements resistance boxes are extensively used. Among their uses are the

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control of current in a circuit, to provide a known resistance, or for balancing or comparing resistances. They are almost invariably used in tests of high accuracy and are consequently of accurate construction. To eliminate inductance in the coils they have a noninductive winding. The capacitance of the coils of the ordinary types is negligible at commercial frequencies. For high-frequency work a coil of special design is made. Wire used in the coils is of high resistance, usually an alloy of low temperature coefficient, and of small diameter. The wire is generally wound on spools. To obtain variation in the total box resistance, the box is made up of a number of units of different resistance.

The ends of each coil are soldered to heavy brass or copper rods, which extend through the hard-rubber top and are connected to heavy brass blocks. Connections between the coils are made by slightly tapered plugs or dial switches. The coils may be arranged in several different ways. The more common arrangement for small boxes is a series of 1, 2, 2 and 5-ohm coils with similar sets for the tenths, tens, hundreds and thousandths. With such an arrangement many plugs are necessary to make the desired connections. Two other combinations, decade and dial, are commonly used; these arrangements require fewer plugs.

The decade arrangement consists of a series of coils of equal resistances, nine 1-ohm, nine 10-ohm, nine 100-ohm, etc., in a row of several parallel rows. The individual coils may be arranged for either parallel or series connections; many different arrangements are available. The dial arrangement also consists of a series of nine 1-ohm, nine 10-ohm, etc., coils connected so that any number of coils in one set may be connected in series with any other set. The coils are, however, arranged in circles so that connections between them can be made by a rotatable switch. Resistance boxes are made in forms and ranges to meet almost every special need.

Manufacturers:

Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
General Radio Co., 11 Windsor St., Cambridge, Mass.
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Pyroelectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Standard Scientific Co., 147-153 Waverly Pl., New York, N. Y.

BOXES, SERVICE.—Metal or asbestos-lined wooden boxes installed as near as possible to the point where the electric wires enter a building and containing the service switch and fuses to which the service wires are connected. These boxes are provided with a door usually having a spring hinge and latch and are often designated as enclosed service switches. Those types of service switches in which the switch is operated from the outside of the enclosing box are now commonly called "safety service switches"; they include the switch, fuses and box. For this type see Switches, safety service. For underground street service boxes see Boxes, service tap, low-tension.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
AURORA STEEL PRODUCTS CO., Aurora, Ill.
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Canton Specialty Co., Gas & Electric Bldg., Canton, Ill. "C. S."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor."
COLUMBIA METAL BOX CO., 226 E. 144th St., New York, N. Y. "Columbia." (See descriptive advertisement under Cabinets, sheet steel.)
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Dominion Electric Switch Box Co., 60 Summach St., Toronto, Ont., Can.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Mansfield Electric Hardware Co., Mansfield, Ohio.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne, Toronto, Ont., Can.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See advertisement on page 1287.)
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
United Electric Supply Co., 1250 Atlantic Ave., Brooklyn, N. Y.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BOXES, SERVICE TAP, LOW-TENSION.—Where many building services are connected to a section of underground main, the location of trouble on any service is greatly facilitated if means of disconnection are provided in a service tap box. This does not contain a fuse, but each tap may be disconnected by removing a bolted lug.

BOXES, SHIPPING, CORRUGATED FIBER.—See Boxes, corrugated fiber, packing and shipping.

BOXES, SPARK COIL.—Spark coils are usually enclosed in hardwood or steel boxes. The boxes differ considerably depending on the purpose for which the coil is used. For automobile ignition systems they are sometimes mounted on the dash and furnished in highly polished wooden cases. Steel cases filled with impregnating compound are also used in many cases as they are not so readily affected by moisture or the elements. Some boxes have a hinged cover which conceals the vibrator adjusting screw, but in a large number of boxes the adjustment is all accomplished from the outside. Spark coil boxes for radio work are provided with two auxiliary sparking terminals on the top of the box. Most of these boxes are made of hardwood and are highly polished. When the boxes are used to enclose spark coils for gas lighting and other miscellaneous purposes they are not as well finished as a rule.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.

BOXES, STARTING.—An old name for motor-starting rheostats. See Rheostats, motor-starting.

BOXES, SUBWAY BRANCH.—Subway branch boxes are designed for manhole mountings and are usually cast iron, with special bushings. Their purpose is to enclose the connections for branch circuits. The main is usually broken to make the connection, being bolted or soldered to terminals at both ends of the box. The interior connections are made by small copper straps or buses. The branch circuits are provided with cartridge fuses.

The majority of these branch boxes are made for two branch circuits for a three-wire system. Four-wire distributing systems are sometimes used and then the branch boxes are provided with four-wire branch circuits also.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. See Fuses, cartridge, nonrenewable.—Adv.
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W".
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

BOXES, SWITCH AND CUTOUT.—Cast iron or steel boxes in which are installed switches and fuses. Such boxes are provided with a hinged door and latch, as in enclosed switches. Switch and cutout boxes in this group usually control only one or two circuits, differing in this respect from panelboards and cabinets. Cartridge or plug fuses are commonly employed as the cutouts. If the switch may be operated from outside of the box without exposure to danger, it is known as a "safety switch"; see Switches, safety.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
All-Steel-Equip Co., Aurora, Ill. "All-Steel-Equip".
American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
AURORA STEEL PRODUCTS CO., Aurora, Ill.
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Burns, James F., 713-715 Cherry St., Philadelphia, Pa.
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union".
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor."
COLUMBIA METAL BOX CO., 226 E. 144th St., New York, N. Y. "Columbia." (See descriptive advertisement under Cabinets, sheet steel.)
Columbian Hardware Co., The, Cleveland, Ohio.
Consolidated Electric Mfg. Co., Inc., 223-25 N. 13th St., Philadelphia, Pa. "Diamond C."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Greater New York Metal Box Co., Inc., 143 W. 19th St., New York, N. Y. "G.N.Y."
Hall Switch & Signal Co., Garwood, N. J.
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

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Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Magnus Electric Co., Inc., 109 Broad St., New York, N. Y.
Mansfield Electric Hardware Co., Mansfield, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Michigan Stamping Co., Detroit, Mich. "BG."
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display advertisement on pages 1302-1304.)
O. K. Metal Box Co., 198 Greenwich St., New York, N. Y.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Potter-Acme Mfg. Co., The. 912-920 Champlain Ave., Cleveland, Ohio. "Potter."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Renim Specialty Co., 110 K St., Boston, Mass. "Renim."
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Sexton Can Co., 123 Broad St., Boston, Mass.
Sieffert Electric Co., 210 Main St., Evansville, Ind. "Sieco."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Standard Electrical Mfg. Co., 220-22 High Ave., S. E., Cleveland, Ohio.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Western Electric Works, 213 6th St., Portland, Ore.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

BOXES, TELEPHONE RINGER OR BELL.—These boxes are of wood or metal, in which telephone bells are mounted. The bell may be an extension bell or the bell which forms part of a desk set. Bell boxes of the latter type are usually mounted near the telephone without being in the way. The box protects the bell or ringer from dust, dirt and mechanical injury.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Leich Electric Co., Genoa, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BOXES, TELEPHONE TOLL OR COIN.—see Coin collectors, telephone.

BOXES, TELEPHONE WALL SET.—A large number of telephone boxes for wall sets are being made. These vary considerably because of the varied equipment that is to be mounted in the box and the method of mounting. On the small intercommunicating telephones, where only the ringer, induction coil, condenser, transmitter, etc., are mounted on the box they are quite small, and may be made either of wood or pressed steel. These are generally made for surface mounting, but some are arranged for flush mounting. Where larger systems are used the boxes are often provided with various calling and designating devices, etc. Magneto or local-battery sets for connection to commercial systems are provided with a compact magneto generator and sometimes the dry cells are also mounted within the box. Various designs and constructions are carried out, one feature often being a small shelf.

Manufacturers:

C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Leich Electric Co., Genoa, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BOXES, TERMINAL.—Cast iron or other metal boxes containing a terminal block with posts or lugs to which the wires at the end of a circuit may be secured and from which circuits to motors or other electrical equipment may be taken off when desired. One end of the box is tapped to receive the conduit and the opposite end has a porcelain or other insulating cover with as many holes as there are wire terminals on the block.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

BOXES, TOOL, PORTABLE.—Tool boxes are used by electricians for carrying various tools and supplies to and from a job and for safeguarding them while not in use. They are generally made of wood, provided with a hinged cover and often have a tray for small tools; the corners are protected and reinforced by pieces of steel or brass. A leather carrying handle is placed on the top and a lock on the cover. Tool boxes are distinguished from tool cases in that the latter consist of a number of small drawers. Chests for tools, which see, are usually larger and contain more trays and special compartments.

Manufacturers:

Battery Equipment & Supply Co., The, 1400 S. Michigan Ave., Chicago, Ill. "Besco."
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Little Giant Tool Box Co., Boston, Mass.
Lyon Metallic Mfg. Co., Aurora, Ill.

BOXES, WATCHMEN'S SIGNAL.—Boxes located at various points in a building so that watchmen may on their rounds, by the use of a special key, operate the mechanism of the box and send an electric signal to a central station where it is recorded, with the time, on a tape register or other permanent record sheet. Also see Clocks, electric, watchmen's time recording.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Hall Switch & Signal Co., Garwood, N. J.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

BOXES, WOOD, FOR INSTRUMENTS, METERS, ETC.—Almost all portable electrical instruments are mounted in an outer covering of wood. Wood is used both on account of its lightness and the beauty of finish obtainable. While any wood that is straight-grained and free from sap may be used, in practice mahogany is used more than any other. Careful seasoning is necessary. Workmanship of the highest quality is demanded, most corners being dovetailed. Most boxes are furnished with brass fittings, including hinges, clasp or lock, and with leather handles, occasionally also leather carrying straps. In some cases, the instrument to be protected is permanently attached to the base or body of the box and the cover of the box is detached when the instrument is in use. Wood boxes are frequently made by manufacturers specializing in fine wood products for manufacturers of electrical instruments, meters, apparatus, etc.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Churchill Cabinet Co., 2119 Churchill St., Chicago, Ill.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Hall Switch & Signal Co., Garwood, N. J.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

BOXES, WOOD MOLDING OR RACEWAY, OUTLET AND JUNCTION.—Shallow porcelain, wood or metal boxes employed with wood molding or raceway where it is desired to have an outlet. The metal and wooden boxes usually have a porcelain insert in the side which has either two or three holes. The porcelain extends out from the box and the raceway base comes right up to it. The raceway capping is cut a little longer to cover the entrance to the porcelain block. Metal and porcelain covers are made to support receptacles, or have bushed openings and nipples. Junction boxes of similar construction are used where it is desired to make a turn in the raceway.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
GILLETTE-VIBBER CO., New London, Conn. "Gee-Vee."
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.

BOXILL-BRUEL CARBON BRUSH CO.—1022 E. Michigan St., Indianapolis, Ind. Manufacturer of carbon brushes. Business established 1913. President and general manager, H. A. Boxill; vice-president, S. W. Bruell; secretary and treasurer, C. N. Dallow; sales manager, R. N. Hudson. Sales representatives, C. B. Fall Co., St. Louis, Mo.; Herman H. Sticht & Co., 15 Park Row, New York, N. Y.; J. D. Nelson, Detroit, Mich.

BOYCE.—Trade name for automatic fire extinguishers manufactured by the Boyce-Veeder Corp., 68 Hunters Point Ave., Long Island City, N. Y.

BOYCE-VEEDER CORP.—68 Hunters Point Ave., Long Island City, N. Y. Manufacturer of automatic fire extinguishers. President, Harrison H. Boyce; treasurer, Paul L. Veeder; general manager, W. Covert Jones.

BOYER.—Trade name for motor-driven hammers manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

BOYER-KELLER.—Trade name for motor-driven hammers manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

BOYLE'S LAW.—The relation that the volume of a given quantity of a gas varies inversely as the pressure applied to it, temperature being kept constant. Another way of stating this is to say that at constant temperature the density of a gas is proportional to the applied pressure, or varies directly as the pressure it sustains. This is true of gases far removed from their condensing points; it is only approximately true of vapors nearly ready to condense to the liquid state.

BOYTS, PORTER & CO.—Connellsville, Pa. Manufacturers of electric and steam pumps. Business established 1868. President, C. M. R. Boyts; treasurer and general manager, R. B. Reid.

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BOYTZ.—Trade name for diamonds for industrial purposes manufactured by the Diamond Drill Carbon Co., 53 Park Row, New York, N. Y.

B. P.—Abbreviation for boiling point, especially in tables or other data giving boiling points in degrees temperature.

BR.—The form Br is the chemical symbol for the nonmetallic element bromine.

BRACES, CROSSARM AND SIDE ARM—To give stability to crossarms while linemen are working on them, they are supported by iron braces. The size varies with the size of the arm and the weight of the conductors, the usual size for ordinary distribution being 26 ins. long and of ¼x1¼-in. strap iron.

Where arms are supported at one end, as is common in alley construction, they are called side arms or alley arms and the braces must be longer and more rugged. A single brace of 1¾-in. angle iron from 5 to 7 ft. long is generally used for distributing lines. The brace is provided with a step near the middle for the use of the lineman.

Manufacturers:

Aetna Nut Co., Southington, Conn.
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv. page 1258.)
Bethlehem Steel Co., South Bethlehem, Pa.
Caldwell & Co. Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Galvanized Products Co., First St., Phillipsburg, N. J.
HUBBARD & CO., Pittsburgh, Pa. Hubbard crossarm braces are made only from new open hearth steel. No old rail stock, much used for cheap braces, enters the Hubbard plant. A Hubbard flat brace may be bent cold back upon itself without fracture. Old rail braces having an uncertain formula are sometimes brittle and may be broken by a blow of the hand ax while being installed. For heavy construction, particularly high voltage lines, Hubbard one-piece angle, or drop braces, are ideal. Hubbard vertical, alley arm and back braces are furnished to meet all conditions.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Slater Co., Ltd., N., 36 Sydney St., Hamilton, Ont., Can. "Peirce."
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACES, ELECTRICIANS' BIT, ANGLE AND RATCHET.—Tools for holding and turning auger bits and drills. Some of these are designed for use in places inaccessible with ordinary braces. Ratchet braces permit the bit to be turned in one direction only, when it is possible to turn the brace handle through only an arc of the circle. Angle braces usually consist of an attachment which fits in an ordinary brace and is arranged so that the mechanism may be locked at any desired angle and can be used for boring in otherwise inaccessible places. Another form of angle brace, called a corner brace has two handles, a stationary one with a right-angle bend, and the driving handle, which is set at an angle with the chuck and connected with the stationary handle at the other end.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Peck, Stow & Wilcox Co., The, Southington, Conn. "Samson," "Peck's," "Pexto."

BRACES, RAIL.—Rail braces are malleable iron devices of various shapes that are used for fastening to the ties by bolts or spikes and have an upright piece that rests against the web of the rail and braces it. They are used for tee and girder rails in electric railway construction and are made in a number of sizes and designs. Their object is to prevent sliding or toppling over of the rail under load and they are used principally on curves.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Atlas Railway Supply Co., 1526 Manhattan Bldg., Chicago, Ill. "Atlas."
Buda Co., The, Harvey, Ill.
Q & C Co., The, 90 West St., New York, N. Y. "Q & C."
Ramapo Iron Works, Hillburn, N. Y.
St. Louis Frog & Switch Co., St. Louis, Mo.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
Weir Frog Co., Station H., Cincinnati, Ohio.

BRACES, TRENCH.—Trench braces are used in the construction of underground conduit lines where a rather deep trench is used in soft soil, or where there is danger of the trench sides and street pavement caving in. Such a brace consists of an adjustable iron rod threaded at both ends to receive shoes; the rod is placed between boards or planks which are set against the opposite walls of the trench, and then lengthened by means of a wrench or bar inserted in an eye in the rod so that the trench sides are pushed apart and held in position.

Manufacturers:

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa.

BRACH MFG. CO., L. S.—127-129 Sussex Ave., Newark, N. J. Manufacturer of electric railway signals and other specialties. Business established 1908. President, treasurer and general manager, L. S. Brach; vice-president, A. G. Brach; secretary, R. Tuchman; sales manager, G. Gort.

BRACKETS, ARC LAMP. — Arc-lamp brackets are used to support an arc lamp from a pole or building. Because of the weight of the lamp, these brackets are heavier than brackets for incandescent lamps, and they are often guyed from the outer end by means of a chain or rod. They may be plain or ornamental. Cutout pulleys are often supported on the bracket to permit lowering of the lamp for trimming and cleaning.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv. page 1258.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
L. F. Mfg. Co., 426-428 Hoboken Ave., Jersey City, N. J. "L. F."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BRACKETS, AUTOMOBILE LAMP.—The lamp brackets for gasoline automobiles and electric vehicles are made in an almost endless variety of forms. The smaller lamps are arranged for the use of one bracket arm either round or rectangular. The larger lamps, such as headlights, generally provide for a two-arm bracket, in this case generally round in section. Usually the maker of the bracket does not concern himself as to the source of illumination, supplying the same bracket for electric, oil or gas lamps.

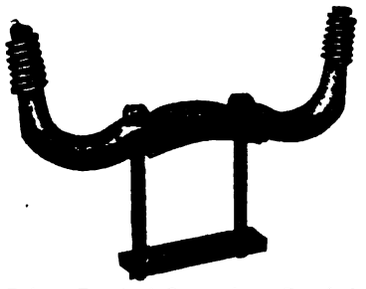
Manufacturers:

Bonney Vise & Tool Works, Inc., Allentown, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

BRACKETS, CROSSARM. — Crossarm brackets mount on a crossarm, usually being secured by two bolts, one on either side of the arm and a strap which goes over the top and is secured by means of nuts on the two bolts. The brackets are usually made for supporting insulators and terminate in one or more insulator pins. They are made of angle or bar iron as a rule and have a number of forms to permit carrying two wires vertically from one arm to another, to run extra wires on the end or underneath filled crossarms, or for taking off service connections for power, lighting or telephone circuits, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Frye & Co., J. Marshall, Hattiesburg, Miss. "Krekoe."
HUBBARD & CO., Pittsburgh, Pa. Peirce Presteel crossarm brackets are made of open hearth steel, hot galvanized for all conditions, spreader brackets, break arms, transposition brackets,



Peirce Presteel Cross Arm Bracket

terminal brackets, etc. They are much stronger than similar brackets made of malleable iron. See Hubbard catalog. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., The, Lachute Mills, Que., Can.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
United States Hardware & Mfg. Co., 16 Warren St., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACKETS, DESK TELEPHONE.—These are brackets mounted on a desk or table by means of screws or a clamp, having a swivel joint and a long arm on which the telephone set is mounted. Several styles are made, some of them keeping the 'phone entirely off the desk and in an upright, out-of-the-way position by means of a pantograph construction. Others have an arm of lazy-tong type so that the set may be pushed in close to the bracket when not in use. The swivel joint permits any of the various types to be swung around and used by more than one person or from various places on or near the desk.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Burns," "Burns Hi-Lo," "E-Z," "Economy," "Hilo."
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio. "Phon-Arm."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Equipoise."
Kallajian Mfg., L. S., 1930 Washington St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. "Sperry." (See display adv. page 1327.)
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."

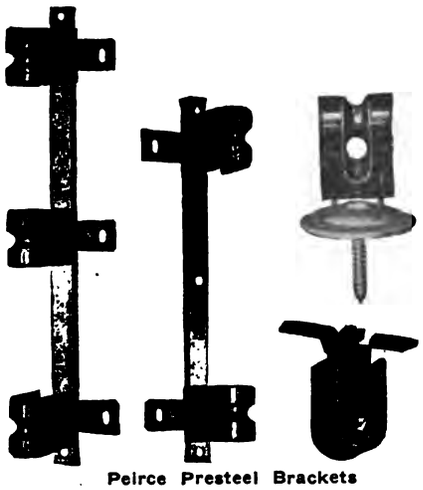
BRACKETS, HOUSE SERVICE.—Overhead service wires are supported at the building end by brackets of various special types. Services are supported on walls of

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brick or masonry by brackets secured by expansion bolts and the labor of installation is reduced if the bracket is made in one piece to carry three wires, since two bolts are sufficient to hold it. Service brackets are usually of stamped steel or malleable iron. Secondary racks are used as service brackets in some cases (see Racks, secondary).

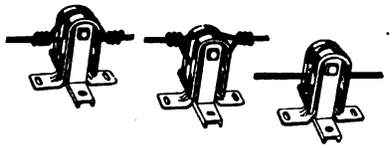
Manufacturers:

BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Buffalo Chandelier Corp., 233 Ellicott St., Buffalo, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Eastern Malleable Iron Co., The, Naugatuck, Conn. "Beardsley."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., Pittsburgh, Pa. Peirce Presteel house service brackets, wire-holders and racks made of open hearth steel, hot galvanized, for every condition. The Presteel house brackets



Peirce Presteel Brackets

are furnished with spring threads for standard petticoat insulators. The Peirce wireholders and racks come completely assembled with insulators. The wireholders largely eliminate tie



Peirce Wireholders

wires, thus save labor and material. See Hubbard & Co.'s catalog. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National" brackets are furnished in single, two and three-point types. These brackets are furnished complete with insulators; they do not require tie wires; they are practically universal in application. Their sherardized surface makes the metal parts rustproof and noncorrosive. "National" brackets may be used in practically any position. The two and three-point types may be used as break arms. They are especially adapted for use as secondary racks. See display adv. pages 1302-4.—Adv.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.

BRACKETS, INSTRUMENT AND METER.—Metal brackets intended for mounting on the pipe or angle iron framework usually at the end (but occasionally on top) of switchboards for the purpose of supporting one or more instruments or meters, such as voltmeters, ammeters or synchroscopes. The brackets are usually made with a swivel or hinge so that the instruments may be turned at various angles to the face of the panel or pushed back flush or parallel with it when desired. These brackets are used largely on boards on which readings are taken only occasionally and where the same instrument is connected in various circuits by means of instrument switches.

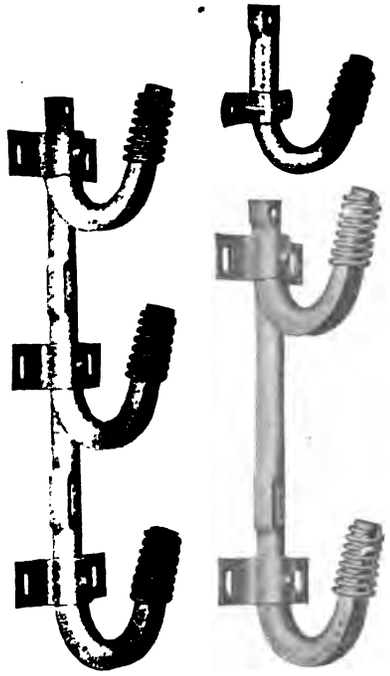
Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Brackets, swinging and pivoted, as furnished in connection with Indicators (Bulletin 46015.)—See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."

BRACKETS, INSULATOR.—In making cross connections on a pole insulators must often be mounted on brackets attached directly to the pole or to the side of a crossarm. Such brackets may be of malleable iron or pressed steel and are usually attached by lag screws. Wood brackets are frequently used, especially for telephone lines, where they are nailed to the side of the pole which usually carries few wires. These brackets are cheaper, but not as secure or durable as metal brackets. This type is also often used to support a wire at the side of wood house or barn.

Manufacturers:

AMERICAN LINE MATERIALS CO., 1461 McCormick Bldg., Chicago, Ill.
Best Electric Corp., 476 Broadway, New York, N. Y.
Cottage Planing Mill Co., Everett, Pa.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Ajax."
Eastern Malleable Iron Co., The, Naugatuck, Conn. "Beardsley."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., Pittsburgh, Pa. Peirce Presteel insulator brackets are made of open hearth steel, hot galvanized. There is a Peirce Presteel bracket



Peirce Presteel Insulator Brackets

for every condition. See Hubbard & Co.'s catalog. (Slater & Barnard, Ltd., of Hamilton, Ont., act as our Canadian agents.)—Adv.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
L. F. Mfg. Co., 426-428 Hoboken Ave., Jersey City, N. J. "L.F."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Locust Pin Co., Front Royal, Va.
McGlauflin Mfg. Co., Petaluma, Cal.
Mountain Lumber & Supply Co., Mount Union, Pa.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display advertisement on pages 1302-1304.)
National Pin & Bracket Co., North Vernon, Ind.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
PARKER & SON, INC., J. H., Parkersburg, W. Va. Malleable iron brackets, right angles, U's, and goose-neck. —Adv.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACKETS, OUTDOOR ORNAMENTAL LIGHTING.—This is the form of bracket commonly used for entrance lights, as for the entrances to apartment buildings, public buildings, public garages, at the gates to private grounds, golf or country clubs, parks or other public grounds, etc. The fixture is generally of iron with an enameled or oxidized finish. The glassware of the more simple styles is generally opal and totally enclosing. Stipled or cut glass is used in the more ornamental lantern types.

Manufacturers:

Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Day Co., Thomas, 725 Mission St., San Francisco, Cal.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Flour City Ornamental Iron Works, Minneapolis, Minn.
Fremont Foundry & Machine Co., Fremont, Nebr.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Granden Electric Co., 1511 Howard St., Omaha, Neb.
Herwig Art Shade & Lamp Co., 2140 N. Halsted St., Chicago, Ill.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
KING MFG. CO., THE, St. Joseph, Mo.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Mott Iron Works, The J. L., Trenton, N. J.
M. S. W. Mfg. Co., Inc., 1527-1529 Niagara St., Buffalo, N. Y.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio. (Porch.)
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

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Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Smyser-Royer Co., York, Pa.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., Cedar Rapids, Iowa. "Stelco."
Union Metal Mfg. Co., Canton, Ohio. "Union."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACKETS, PHANTOM.—A phantom bracket is a pole fixture attached to a crossarm for holding four line insulators so as to transpose all four wires of a telephone phantom circuit. Phantom brackets are used in making running transpositions.

Manufacturers:

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.

BRACKETS, POLE TOP.—Where a wire is carried on the top of the pole, as is common in smaller transmission systems, a special bracket, made with two base arms to fit the sawed roof of the pole, is used to carry the insulator and wire.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Carolina Cross Arm Co., Inc., P. O. Box 122, Elkin, N. C.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Lord & Co., Lee H., Box 693, Peoria, Ill.
Mountain Lumber & Supply Co., Mount Union, Pa.
National Pin & Bracket Co., North Vernon, Ind.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Philadelphia."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395,-1402.)

BRACKETS, POTHEAD.—Where potheads of the porcelain type for single-conductor cables are mounted on crossarms, a suitable bracket is required to hold them rigidly against strains caused by movement of the cable. Multiple-conductor potheads usually have lugs for bolts on the base and no separate bracket is needed.

Manufacturers:

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

BRACKETS, SPREADER.—In making crossovers on a pole a spreader bracket is often used in preference to two ordinary insulator brackets. The spreader bracket carries one wire at each end and is attached to the crossarm in a vertical position.

Manufacturers:

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hebendahl Co., J. P. 228-232 Broadway, Elizabethport, N. J.
HUBBARD & CO., Pittsburgh, Pa. Peirce Presteel spreader brackets. See Brackets, crossarm. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.

BRACKETS, STEAM AND OTHER PIPE SUPPORTING, FOR POWER HOUSES.—Brackets used to support power-house piping are made in various forms depending upon the weight and size of the pipe or pipes to be held. For simple installations, where only one or two small pipes are supported, bar iron brackets are used, being made from a single strip. Larger pipes require channel-iron construction and a special grooved plate is often used as the top member, so that the pipes will lie in their proper places.

Manufacturers:

Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."

BRACKETS, STREET LIGHTING.—A type of fixture for supporting a street lamp a short distance from a pole, the fixture being attached to the pole. Brackets may be plain or ornamental. They are either inside-wired, in which the wires run through a hollow pipe which forms the bracket, or outside-wired, where the wires are entirely exposed until they enter the lamp socket or hood over it. The former are usually employed with underground supply circuits, the latter with overhead circuits.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv. page 1258.)
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description under Fixtures, lighting, street.—Adv.
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J. "PL." "FL."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., Pittsburgh, Pa. See Hubbard's entry under Mastarms, street lighting. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Massey Concrete Products Corp., 122 S. Michigan Ave., Chicago, Ill. "Hollowspun."
Mott Iron Works, The J. L., Trenton, N. J.
Perfecilite Mfg. Co., 119 Main St., Seattle, Wash.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco'."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Smyser-Royer Co., York, Pa.
United States Hardware & Mfg. Co., 16 Warren St., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACKETS, TRANSPOSITION. — This type of pole-line bracket is a fixture attached to a crossarm to hold line insulators in a vertical line to enable them to be readily transposed. It is used in the running transposition of telephone lines.

Manufacturers:

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., Pittsburgh, Pa. Peirce and Hubbard transposition brackets are made of open hearth steel, hot galvanized, in many styles for all conditions. See Hubbard catalog. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

BRACKETS, TROLLEY SUSPENSION.—An arm consisting of pipe, tubing or structural steel mounted on the sides of a trolley pole for supporting overhead trolley wires. The most popular form is the "flexible" type in which a strand is drawn taut about 6 or 8 ins. below the bracket arm, the trolley being suspended from this strand and thus giving a flexible support. An over truss rod or a 45° brace is commonly used to support the arms.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv. page 1258.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRACKETS, WALL, INDOOR, FIXTURE OR LIGHTING.—This term is applied to any fixture having short bracket arms to which the sockets are directly attached, and which is mounted on a wall. These brackets are generally made of spun brass, though enameled iron or wood and cast brass are sometimes employed. Wood is often used for the plate attached to the wall, as it is a material more easily adapted to fixtures of period design. The most extensive use for wall brackets is in residence lighting, particularly in living, dining, bed and bath rooms. They are generally single or two-socket fixtures and are designed to be in harmony with the ceiling fixtures in the same room. There is a tendency in living rooms to use brackets for decorative lighting chiefly, the main illumination being obtained from ceiling fixtures or portable floor or table lamps that are less likely to cause glare than the ordinary bracket outfit.

Manufacturers:

Abco Mfg. Co., 1633 Walnut St., Chicago, Ill.
Andresen Co., Jacob, 258 Third Ave., S., Minneapolis, Minn.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Reedware Mfg. Co., 780-782 Milwaukee Ave., Chicago, Ill. "Chicago."
Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600," "1100."
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

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Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Findlay Mfg. Co., Inc., Robert, 224 5th Ave., New York, N. Y.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio. "Frankelite."
Franks Mfg. Co., Rock Island, Ill.
Garden City Chandelier Co., 552 W. Jackson Blvd., Chicago, Ill.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Granden Electric Co., 1511 Howard St., Omaha, Neb.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y.
Lighting Appliance Co., 4 White St., New York, N. Y. "Laco."
Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.
LUMINOUS UNIT CO., DIV., ST. LOUIS BRASS MFG. CO., St. Louis Mo. Manufactures a complete line of Brascolite wall bracket lighting fixtures. See display advertisement pages 1276-7. —Adv.
Mayer Co., Leon, 237 Center St., New York, N. Y.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Mitchell Vance Co., Inc., 503-511 W. 24th St., New York, N. Y. "T.R.B."
Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" wall brackets; standard designs for hospitals, auditoriums, residences, etc., embodying indirect lighting by X-Ray reflectors. Special designs without charge or obligation to prospective patrons. See adv. on page 1405.—Adv.
New England Incandescent Supply Co., 266 Bowery, New York, N. Y. "Neiscolite."
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y. "Nylco."
Newman Mfg. Co., 717-721 Sycamore St., Cincinnati, Ohio.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Polacheck & Bro. Co., Charles, 217 3rd St., Milwaukee, Wis.
Polly Mfg. Co., Milwaukee, Wis.
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
Rogers Silver Plate Co., Danbury, Conn. "Moon-Glow." (Exclusive distributor, Eclipse Light Co., 587 Broadway, New York, N. Y.)
Schwartz & Bro., S. Robert, 729-731 Broadway, New York, N. Y.
Scott-Ullman Co., The, 3311-3325 Perkins Ave., N. E., Cleveland, Ohio.
SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y.
Snyder-McFadden Co., 602 Pierce St., Sioux City, Iowa.
STANDARD ELECTRIC & MFG. CO., 208 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
United Metal Mfg. Co., Inc., 27 Shipping St., Norwich, Conn.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.
White Co., The O. C., 17 Hermon St., Worcester, Mass.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

BRACKETS, WALL, OUTDOOR, FOR INSULATORS.—Wall brackets are used for mounting insulators of various types for outdoor work. One common form of wall bracket is the house service bracket, which see. Very often brackets are used to support insulators when it is necessary to run a line or circuit along the side of the building, or when a long span is supported at the corner of an adjacent building, etc. They are generally made of malleable iron and are provided with insulator pins. Some wooden wall brackets are used in telephone construction work, and these are either nailed or bolted to the wall, depending on the material thereof.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Chance Co., The, Centralia, Mo.
Eastern Malleable Iron Co., The, Naugatuck, Conn. "Beardsley."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., Pittsburgh, Pa. See this company's entry under Brackets, house and insulator. (Slater & Barnard, Ltd., of Hamilton, Ont., act as our Canadian agents.)—Adv.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Mountain Lumber & Supply Co., Mount Union, Pa.
National Pin & Bracket Co., North Vernon, Ind.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Talman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
United States Hardware & Mfg. Co., 16 Warren St., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Spartan Junior." (See display adv. pages 1395-1402.)

BRADFORD & CO., I. L.—178 W. Jackson Blvd., Chicago, Ill. Manufacturer of color-matching lamps and equipment for electrical stores. I. L. Bradford, sole owner.

BRADLEY-LOVEJOY PROCESS.—The first process worked out in the United States for the production of nitric acid from the air. The apparatus consisted of a vertical iron cylinder through the walls of which numerous insulated platinum electrodes were inserted; a central shaft with radiating arms rotated and carried corresponding electrodes past the other set of electrodes. With the shaft rotating rapidly and a voltage of 8,000 to 10,000 volts applied arcs were drawn out between the electrodes for a distance of 4 to 6 ins., at the rate of 414,000 arcs per minute. This resulted in the production of a gas carrying 2 to 3% of nitrous oxide (NO), or a yield of 86 grams of nitric acid (HNO_3) per kilowatt-hour. The apparatus, however, proved too complicated for successful operation.

BRADLITE.—Trade name for color-matching lamps manufactured by I. L. Bradford & Co., 178 W. Jackson Blvd., Chicago, Ill.

BRADNEY MACHINE CO., INC.—Middletown, N. Y. Manufacturer of motor-driven lumber stackers and portable cranes. President and general manager, J. O. Bradney.

BRADSTO APPLIANCES, INC.—65 Main St., Buffalo, N. Y. Manufacturer of automobile locks and headlight deflectors. Business established 1918. President and treasurer, George R. Stowe, Jr.; secretary, J. H. Weir; sales manager, J. R. Fitzsimmons. Sales representatives, Gould Sales Co., Law Bldg., Baltimore, Md.; Staff Bros., 1755 Broadway, New York, N. Y.; Breslauer Co., 377 Jefferson St., Milwaukee, Wis. Exclusive distributor, International Accessories Corp.

BRADY ELECTRIC & MFG. CO.—42 Center St., New Britain, Conn. Manufacturer of street-lighting fixtures, pole-line hardware, etc. Business established 1879. President and treasurer, Mrs. Nellie J. Brady; vice-president, William P. Brady; secretary and general manager, Fred M. Brady.

BRADY FOUNDRY CO., JAMES A.—45th St. & Western Blvd., Chicago, Ill. Manufacturer of mechanical stokers and coal and ash conveyors. Incorporated 1900. President, Guy S. Burtis; vice-president and engineer, Joseph Harrington.

BRAKE HORSEPOWER.—The useful horsepower or power output of a prime mover as ascertained by the application of a brake or absorption dynamometer. It is a term used chiefly with steam engines to distinguish between the indicated horsepower developed in the engine cylinder and the actual useful horsepower available at the pulley or shaft. It has no distinctive meaning when applied to electric motors, because their output as commonly expressed in horsepower is identical with their brake horsepower.

BRAKE SHOES, ELECTRIC RAILWAY.—A block of material, nearly always of cast iron, pressed against the wheels of an electric railway vehicle usually by means of air pressure and suitable brake rigging to effect retardation or complete stoppage. Much study is given to the composition of the iron entering into brake shoes so that they will give long wear and at the same time cause minimum wear to the car wheel.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.
Wheel Truing Brake Shoe Co., The, 219 Tuxedo Ave., Detroit, Mich.

BRAKES, AIR, ELECTRIC CAR, LOCOMOTIVE OR TRAIN.—A brake system embodying the use of compressed air acting in a cylinder against a piston, and through suitable levers, rods, etc., to produce the force manifest at the brake shoes which is required in the retardation and stopping of cars, locomotives or trains. It comprises electric motor-driven air compressors, air storage tanks, piping, control and other valves, brake cylinder and body truck brake levers and rods. Two general types are used: (a) "straight air"; (b) "automatic." A modification of the first, known as straight air with emergency feature, is also installed in special cases. Single car operation only is almost universally carried out with brakes of straight air type. Where trains are operated, automatic air brakes are generally used. In the straight air brake system, the engineer's or motorman's valve controls directly the application of pressure to the brake cylinder and thus to the brake shoes. In the automatic system the engineer's valve indirectly controls the application of pressure to the brake cylinder and then to the brake shoes through a "triple valve." This latter valve provides the "automatic" feature, as it is designed so that a broken pipe, ruptured horse, or train "pull in two" will automatically apply the brakes.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Automatic Straight Air Brake Co., 210 11th Ave., New York, N. Y.
Brill Co., The J. G., 62nd St. and Woodland Ave., Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Air brake equipments for all classes of electric railway service. These include straight air brake equipment, Bulletin 44564; straight air with emergency feature, Bulletin 44555; combined straight and automatic equipment, Bulletin 44551.1 and variable release automatic, Bulletin 44565. See adv. pages 1203-1223.—Adv.
National Brake & Electric Co., Belleview Pl., Milwaukee, Wis. "National."
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.
Westinghouse Traction Brake Co., Pittsburgh, Pa.

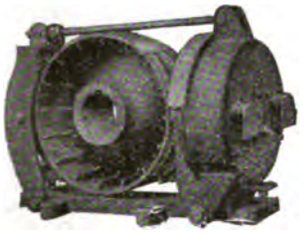
BRAKES, ELECTRIC CRANE.—Electric crane brakes may be divided into four classes: dynamic, magnetic, mechanical, and air. The dynamic brake may be used for two purposes, to effect quick stops and to retard descending loads. All systems of dynamic braking require that the motor field current be maintained while braking. As series motors are the type used on hoisting machinery, the dynamic brake includes a device which connects the field directly across the line when the armature circuit is broken. To effect a quick stop the brake device connects a resistance across the armature when it is disconnected from the line. The motor then acts as a generator and tends to stop the machine it drives; the braking force depends upon the power generated in the armature. Consequently, if a fixed resistance is used, since the voltage and current both decrease with decreasing armature speed, the braking force diminishes rapidly. A high braking

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force can be maintained by using a variable resistance, which is reduced in successive steps as the speed of the armature falls off, in this way holding the current to a high value; for reducing this resistance generally the same device is used as for accelerating the motor. Dynamic brakes for retarding a descending load, though in principle the same as the brakes for quick stopping, are more complex and more accurate in their control. They have a variable resistance in series with both the armature and field, a resistance permanently in series with the armature, and a resistance which may be shunted across the field, connected in series with the armature, or cut out of the circuit. By a controller which changes the connections and the resistances in the circuits, the lowering speed is regulated. Dynamic braking is only operative when the load is in motion. Other types of brakes are therefore provided to hold the load when the motor is stopped. One form, a mechanical brake of the strap type, applicable only to holding the load, has the strap ends fastened to a lever mounted in the plane of the brake wheel. Rotation in direction of lowering causes the lever to turn on its pivot so as to tighten the belt; rotation in the opposite direction causes the belt to loosen. Magnetic brakes are of two types, shoe or strap and disk. The brake shoe types are generally actuated by a spring which is released or compressed by a solenoid. The magnetic disk types are usually mounted directly on the motor shaft. There are two sets of disks, one stationary and one rotating with the armature shaft. The latter disks are clamped between the stationary disks by a spring controlled by an electromagnet. Air brakes are used where very heavy loads are handled and a quick stop is essential. Manually operated band or shoe brakes are occasionally used.

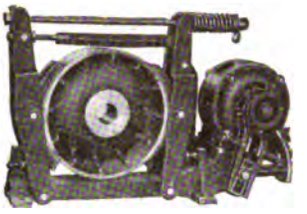
Manufacturers:

Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis., Type M Shoe Brakes (for d-c. service). Type RS Shoe Brakes (for a-c. service). Both types are used extensively, not only on electric cranes but on electric elevators, electric hoists and for practically every type of motor-driven machine where electric brakes are used. The design



Type M Shoe Brake

of Type M Brakes is unique. The direct action between the operating magnet and the brake shoes eliminates all toggles, bell cranks and levers, which are usually required to change the direction or amplitude of the actuating force. The use of a very short stroke magnet, made possible by the direct action between the magnet and the shoes, insures quick, smooth, quiet braking effect. The maximum travel between the armature and the field is not over ⅛ in or ¼ in. for each shoe As a result, the time required for application or release is practically instantaneous. The distance traveled is so short that there is no chance for bouncing on application, or hammer blow on release. There are no fragile parts and nothing that is apt to get out of adjustment and cause faulty brake action. The motion of any of the brake parts is very slight, so that the wear, except on the brake linings, is infinitesimal By removing only one pin at the top of magnet, the rod which connects the magnet to the opposite brake shoe may be lifted and the hinged arm swung back to permit the removing of the brake wheel and motor armature. This is accomplished without disturbing, in any way, the setting of the brake or the alinement between the brake and the motor. The brake shoes can be removed and replaced readily because here again only one pin holds each shoe in place. Type M Brakes are thoroughly weatherproof and are used on out-of-door cranes with the same success that is typical of inside installations. The compact design and the shallow overall height permit installation almost anywhere. The actual headroom required is little more than is necessary for the brake wheel itself. Type M Brakes are series or shunt-wound, according to the service on which the brakes are to be used. Series-wound brakes are furnished for either one-half-hour or one-hour duty. Continuous-duty series-wound brakes can also be supplied. Shunt-wound brakes are available for either intermittent or continuous duty. Intermittent duty, as here used, means current "on" for one minute, or "off" for one minute or its equivalent. The longest continuous application of voltage should not exceed one-half hour. Type M Brakes are built in six standard sizes suitable for use with motors from 1 to



Type RS Shoe Brake

300 hp. Type RS Shoe Brakes are operated by a rotating magnet and for this reason possess advantages which are unusual in brakes used for a-c. service. The adoption and development of the rotating magnet, in place of the ordinary solenoid or clapper magnet, has produced an a-c. brake whose reliability is unquestioned. The rotor operates through a pinion and toothed sector to which a lever is attached. This lever spreads the brake arms and releases the brake shoes as the rotor revolves. It requires only one and one-half turns of the magnet to release the brake, after which it stalls and holds the brake in the released position until the control switch is opened. On applying the brake, the heavy coil spring, shown in the illustration above the rotating magnet, forces the brake shoes against the wheel. In brakes depending on solenoid or clapper-magnet operation, there is a tendency on light settings for the magnet to seal and hold the brake shoes away from the wheel, because of residual magnetism. Rotating magnet operation entirely eliminates this danger. There is no possible chance that the brake will fail at some critical moment. It is not necessary to immerse the mechanism of Type RS brakes in oil to procure quiet operation. There is no mechanical contact between the reacting members and consequently very little noise in operation. No dashpot, with its liability to stick and get out of adjustment, is needed to obtain smooth, steady application of the brake shoes. The small rotor of the rotating magnet acts as an inertia governor to ease the shoes on to the brake wheel after which the rotor overruns freely and does not affect the shoe pressure. The rotating magnet draws a practically constant current from the line. The amount is small and does not disturb conditions on the line or introduce difficulties, such as are commonly experienced in connection with a-c. brakes operated by solenoids or clapper magnets. Type RS brakes are rated for intermittent and continuous duty, intermittent-duty brakes being designed for one-half-time duty. They are available in six standard sizes, suitable for handling motors up to 300 hp. See display adv. pages 1225-1230.—Adv.

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. Automatic solenoid brakes for controlling crane and hoist motors for both direct and alternating current. Made for motors of 1 hp. and above, with equal braking torque in both directions of rotation. See adv. pages 1203-1223.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

BRAKES, ELECTRIC ELEVATOR.—The types of brakes used on elevators driven by d-c. motors are essentially the same as those supplied for electric cranes, but sometimes with a different mounting. Where a-c. motors are used dynamic braking is not practical and the magnetic and mechanical types are the only ones used. (For details see Brakes, electric crane.)

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.—See discussion of C-H electrically-operated brakes under Brakes, electric crane. See display adv. pages 1225-1230.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

BRAKES, ELECTRIC HOIST.—Brakes used on electric hoists are practically of the same types as those provided for electric cranes, except for the method of mounting. (For further information regarding them, see Brakes, electric crane.)

Manufacturers:

Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.—See discussion of C-H electrically-operated brakes under Brakes, electric cranes. See display adv. pages 1225-1230.—Adv.
Denver Engineering Works Co., The, 30th and Blake Sts., Denver, Colo.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Nordberg Mfg. Co., Milwaukee, Wis.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

BRAKES, ELECTRIC MOTOR, MISCELLANEOUS.—Under this classification come the various special brakes designed for braking motors on miscellaneous motor-driven machinery not otherwise listed. As a rule, they are in principle the same as the various brakes listed herewith, but modified in form to suit the machine or motor to which they are applied.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG CO., THE, Milwaukee, Wis.—C-H Disk Brakes (Type WT) and C-H Brakes used with magnetic clutches. In addition to the electrically operated shoe brakes already described under "Brakes, electric crane," this company manu-

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factures electrically operated disk brakes for use where conditions demand a fully enclosed structure and occasionally for other reasons, such as special mounting arrangements, very limited space available, etc. The working parts of Type WT Disk Brakes — weather-proof operating magnet, heavy steel compression spring and stationary and rotating disks—are all assembled compactly in an enclosing case. Stationary disks are faced with a metallic asbestos brake lining and are keyed to the enclosing case. The rotating disks are keyed to the hub which is itself keyed to the main motor shaft. Normally the spring pushes the armature away from the field and forces the two sets of disks into frictional engagement. The pressure exerted by this spring can be varied to suit load conditions. The brake is released by energizing the magnet, which action compresses the spring and relieves the pressure between the disks. The rotating disks are then free to turn with the motor armature. Type WT Disk Brakes are supplied with either series or shunt windings. Type WT Disk brakes are available in seven sizes suitable for motors up to 120 hp. C-H Brakes used, with magnetic clutches are operated by C-H iron-clad solenoids. The combinations of clutch and brake are a unit and are used principally in rubber mills and other manufacturing plants where the safety feature is an important consideration. For emergency or safety stops, the releasing of the magnetic clutch and the setting of the brake are simultaneous and the result is a very quick stopping of rolls and other machinery. See display adv. pages 1225-1230.—Adv.



Type WT Disk Brake

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Standard Electric Machinery Co., Baltimore, Md., "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

BRAKES, ELECTROMAGNETIC, RAILWAY CAR OR TRAIN.—A brake system employing electromagnets as the primary source or force in retarding or stopping a train. Used only in special cases, as extreme grades or the like. A shoe bearing on the track rail and acting in connection with shoes on the car wheels is usually a feature of this type of brake.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

BRAKES, STREET CAR, HAND TYPE.—Hand brakes are used to some extent as the only brake on small street cars, and also on cars equipped with air brakes for emergency use in case that brake fails. They usually consist of a chain attached to the brake rigging, a rod upon which the chain winds, and a hand-operated wheel or crank on a staff which, acting sometimes through a series of gears, turns the rod. As most car vestibules are too small to allow a full turn of the handle, the staff is usually equipped with a dog and ratchet device. In the staffless type the chain sometimes comes up through the floor of the vestibule and winds upon a rod geared to a vertical handwheel.

Manufacturers:

National Brake Co., Inc., 888 Ellicott Sq., Buffalo, N. Y. "Peacock," "Peacock Staffless," "Ackley Adjustable."

BRAKING, DYNAMIC.—Dynamic or electric braking is used on installations where it is desirable to stop the motor quickly and where a mechanical brake is not necessary for holding the load. It is also used in connection with mechanical brakes to assist in stopping and to reduce the wear on the brakes. On direct current a resistor is usually connected across the motor armature when the line circuit is broken. The motor then acts as a generator and forces current through the resistor and the stored energy of the machinery is in this way dissipated. On polyphase motors electric braking can be obtained by energizing one phase winding with direct current.

BRAMHALL, DEANE CO.—261-265 W. 36th St., New York, N. Y. Manufacturer of electric sterilizers, cooking, heating and labor-saving devices. Business established 1859. President and general manager, Edward B. Brooks; vice-president and treasurer, William H. May; secretary, J. W. Wilson; sales manager, A. L. Altenbrand. Factory, Brooklyn, N. Y.

BRAMMER MFG. CO., H. F.—Davenport, Iowa. Manufacturer of electric washing machines. President, H. W. Hubers; vice-president, Henry Braunlich; secretary and treasurer, Howard W. Power.

BRANDELL CO., THE.—Union Central Tower, Cincinnati, Ohio. Manufacturer of motor-driven machinery for the manufacture of concrete products. Factory, Columbus, Ind.

BRANDEN. — Trade name for pump valves manufactured by the Crosby Steam Gage & Valve Co., Boston, Mass.

BRANDERS AND BRANDING DEVICES, ELECTRIC.—Portable branders or branding irons are constructed something like an electric soldering iron and made convenient for connecting to an electric circuit by a flexible cord. The conductors pass down through a wooden handle and terminate in a heating element inside the iron or die. They are used for imprinting leather, wood and meat products. Often these devices takes the form of a machine into which the work to be branded is fed as in a punch press, and a large imprint is made. This type of machine is used for labeling wooden boxes, etc.

Manufacturers:

Detroit Electrical Branding Iron Co., 205 Griswold St., Detroit, Mich. "Detroit."
Electric Heat Unit Co., 1504 S. Grand Ave., St. Louis, Mo.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Schneider Mfg. Co., G. J., Detroit, Mich.
Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y.

BRANDES, INC., C.—32 Union Sq., New York, N. Y. Manufacturer of radio receivers. Business established 1908. President and treasurer, Frederick Dietrich; vice-president, John L. Stamp; secretary, H. C. Fried.

BRANDT-DENT CO.—Watertown, Wis. Manufacturer of lighting fixtures. President, Gabriel B. Levy; vice-president, Alfred J. Price; secretary and treasurer, George A. Richards.

BRANDT, RANDOLPH.—70 Cortlandt St New York, N. Y. Manufacturer of packings for pistons, valves, etc., gaskets and valves. Business established 1876.

BRANDYWINE FIBRE PRODUCTS CO.—P. O. Box 122, Wilmington, Del. Manufacturer of electric candles, fiber sheets, rods, etc. Business established 1915. President and general manager, H. J. Davis; vice-president and treasurer, G. K. Davis; secretary, H. J. Davis, Jr.

BRANFORD ELECTRIC CO., INC.—9 Church St., New York, N. Y. Manufacturer of electric heating appliances and wire. Business established 1918. President and treasurer, W. E. Hitchcock; secretary and general manager, T. A. Lewis. Factory, Branford, Conn.

BRANSTON CO., CHARLES A.—Buffalo, N. Y. Manufacturer of X-ray and electro-therapeutic apparatus. Business established 1915. President and owner, Charles A. Branston; treasurer, Theresa Glover; general manager, James S. La Trobe; sales manager, W. S. Wallace. Main office, 41-45 Ellicott St., Buffalo, N. Y. Factories, Buffalo, N. Y., and Toronto, Ont. Branch offices, 505 5th Ave., New York, N. Y.; Garden Pier, Atlantic City, N. J.; 355 Yonge St., Toronto, Ont., Can.

BRANTFORD WASHING MACHINE CO., LTD.—72 Colborne St., Brantford, Ont., Can. Manufacturer of electric washing machines. A. C. Lyons, owner.

BRASCO.—Trade name for switch extension manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., St. Louis, Mo.

BRASCOLITE.—Trade name for semi-indirect lighting fixtures manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

BRASS.—One of the best known and most commonly used metals or alloys. In general, brass is an alloy of copper and zinc, although lead or tin is often present in small quantities. Generally speaking, when the zinc content is greatly decreased and tin is added, the alloy is known as bronze. When both tin and lead are omitted and nickel added the alloy is known commercially as nickel silver, formerly called German silver. Depending upon its intended use, brass contains from 60% to 80% of copper, and 40% to 20% of zinc. For special purposes, such as the making of spring brass, about 1½% of tin is added, while for other special uses 1½% to 2% of lead is used. Brass is both malleable and ductile to a marked degree. The best known makers vary the analysis somewhat, depending upon whether the desired finished product is to be sheet, rod, tube or casting. Depending upon its analysis, brass melts at from 1600° to 1800° F. and has a tensile strength ranging roughly from 30,000 lbs. per sq. in. in castings to 78,000 lbs. per sq. in. in wire. Brass is very largely used in electrical work on account of its high conductivity, nonrusting qualities and ease of working into small parts.

BRASS BARS, SHEETS, RODS AND TUBING.—The commercial forms of brass for manufacturing purposes are bars, sheets, rods and tubing. In these forms it is used for the manufacture of parts of many electrical products. It is malleable and ductile and the various compositions that may be used provide great flexibility in the characteristics of the finished product. Brass bars are used for various conducting strips in apparatus, and the bars may be milled or cut into special shapes. The brass sheets are adapted to a large number of uses. By means of punch press operations hundreds of small parts are made, such as terminals, contacts, springs, magnetic shields and many other parts where the corrosion-resisting properties are utilized. Brass sheets and large tubes are used extensively for spinning lighting fixture parts. Rods are also extensively used as they are adapted to screw-machine work. Various forms of terminal screws, binding posts, connectors, plugs, lugs, etc., and many special forms are made from rods. Brass tubing is also used very largely. By means of swaging, punch press, and numerous screw-machine and other lathe operations a great number of articles may be made from tubing. Many fixture stems, telephone parts and various lugs, etc., are included in this number.

Manufacturers:

Alloy Steel Products Corp., 123 Liberty St., New York, N. Y.
AMERICAN BRASS CO., THE, Waterbury, Conn. Sheet brass in various grades for drawing, stamping or spinning. Brass rods, extruded or rolled and drawn in round, square, hexagon, rectangular and special shapes. Free turning brass rods for screw machine work. Seamless tubes for condensers. I. P. S. brass tubes for plumbing installation. Brazed tubes for electrical fixtures, etc. (For location of mills and factories, see alphabetical listing under firm name.)—Adv.
American Copper Products Corp., 200 Broadway, New York, N. Y. (Sheets.)
American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa. (Sheets, rods.) "Spare's."
Bridgeport Rolling Mills, Inc., The, Bruce and Stratford Ave., Bridgeport, Conn. (Bars, sheets.)
Canadian Seamless Wire Co., Ltd., 198 Clinton St., Toronto, Ont., Can. (Tubing.)
Chase Metal Works, 236 Grand St., Waterbury, Conn.
Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn. (Sheets.)
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

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Mueller Mfg. Co., H., Decatur, Ill.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Newman Mfg. Co., 717-721 Sycamore St., Cincinnati, Ohio.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Randolph-Clowes Co., The, Box 1012, Waterbury, Conn.
ROME BRASS & COPPER CO., Rome, N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry—Adv.
Rome Hollow Wire & Tube Co., Railroad St., Rome, N. Y.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display advertisement on page 1327.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Taunton-New Bedford Copper Co., Taunton, Mass. (Bars, sheets and rods.)
Titan Metal Co., Bellefonte, Pa. (Rods.)
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. (Tubing for compressed air.) "U. S."
United Wire & Supply Co., 1497 Elmwood Ave., Auburn, R. I.
Wheeler Condenser & Engineering Co., Carteret, N. J. (Tubing.) "Crescent."
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich. (Tubing.)

BRASS FIXTURES CO., THE.—Plantsville, Conn. Manufacturer of fixture fittings and metal spinnings. Business established 1915.

BRASS MELTING BY ELECTRIC FURNACE.—Brass has long been melted by means of a coal, coke or oil fire, but it is only within the last six years that electric brass-melting furnaces have been used. Their use has increased rapidly in that time due to several outstanding advantages and economies. The loss of metal by oxidation is reduced, as the metal is melted quicker and in a tightly closed space, and is not maintained at a high temperature for as long a time. The heat may be more easily controlled and more fully utilized, the working conditions are very much improved and storage of fuel and ashes eliminated. The net operating costs are generally much lower than those of fuel-fired furnaces.

BRAUN CO., THE.—1615-35 N. 23rd St., Philadelphia, Pa. Manufacturer of electric meat and food choppers, bone, coffee and laboratory grinders and meat slicers. Business established 1887. President, William P. M. Braun; vice-president and treasurer, W. F. H. Braun; secretary, H. Stein; general manager, L. J. Costa.

BRAUN GEAR WORKS.—1321-25 Gates Ave., Brooklyn, N. Y. Manufacturers of gears and pinions. Business established 1908. President and treasurer, A. M. Braun; vice-president and general manager, Jacob J. Braun; secretary and sales manager, Joseph J. Braun, Jr.

BRAZING.—Brazing is a method of permanently joining two pieces of metal by means of a joint composed of a film of brass or other metal or alloy of higher fusing point than ordinary solder. The term is applied oftenest to the joining of two pieces of ferrous metal by a nonferrous one. While there is no well marked line separating the terms "brazing" and "soldering," brazing is generally understood to involve the use in the joint of a copper-zinc alloy with a comparatively high melting point, while soldering means the use of a tin-lead alloy with a low melting point. In brazing, the parts to be joined are generally heated in a forge or in an open flame supplied by gas under pressure, while in soldering the alloy is usually melted by the heat of a heated "copper" or soldering iron to which it adheres, and by means of which it is applied to the joint.

BRAZING ALLOYS.—Brazing alloys are usually copper-zinc alloys of varying proportions. The melting point of the alloy depends upon the percentage of zinc present and is lowered as the zinc increases. The fusing point of the alloy should be as close as possible to that of the articles to be brazed. One common composition is about 50% each of copper and zinc. When copper or iron are to be brazed a richer copper alloy, up to about 85%, may be used, as these metals have a higher fusing point. Brazing alloys are often called brazing or hard solder or spelter. Very frequently the alloy is cast in ingots, which are then broken up into granulated form by hammering. Silver and tin in the form of ribbon are also used as brazing solder.

BRAZING COMPOUNDS.—A brazing compound is a flux used to prevent oxidation of the parts to be united, when they are heated sufficiently for the jointing metal or brazing solder to adhere. Borax from which the water of crystallization has been removed is the basis of many brazing compounds.

Manufacturers:

A. & J. Mfg. Co., The, 559 W. Lake St., Chicago, Ill.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Anti-Borax Compound Co., Fort Wayne, Ind. "Anti-Borax."
Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Phillips-Laffitte Co., The, Pennsylvania Bldg., Philadelphia, Pa. "Laffitte."
Soluminum Mfg. & Engineering Co., Inc., 1790 Broadway, New York, N. Y. "So-Luminum."
Standard Brazing Co., 45 Bromfield St., Boston, Mass. "Tichon Process."
Titan Metal Co., Bellefonte, Pa.
TURNER BRASS WORKS, THE, Sycamore, Ill. (See display advertisement on page 1326.)

BRAZING OUTFITS.—A brazing outfit consists of a supply of flux or brazing compound, clamps, either hand or bench or wire for holding the work, a forge or a blow pipe to furnish the necessary heat and a supply of hard solder, spelter or other brazing alloy, which may be either a copper and zinc alloy in granular form, silver ribbon or tin. The choice of the solder depends on the parts to be brazed and the strength desired. A brazing forge is a convenience but not a necessity.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Bernz Co., Otto, 17-37 Ashland St., Newark, N. J. "Always Reliable."
Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York, N. Y. "Bull Dog."
Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
TURNER BRASS WORKS, THE., Sycamore, Ill. (See display adv. page 1326.)

BREADTH-FACTOR.—The ratio of the voltage induced in a distributed winding of an a-c. armature to the voltage which would be induced if the distributed coils were concentrated into one coil of the same pitch and other conditions were maintained the same. It is, therefore, the ratio of the vector sum of the voltages of the distributed coils to their arithmetical sum. This ratio is also called the distribution-factor.

BREAKARMS.—Where series street-lighting circuits are looped to a lamp from an overhead circuit, a breakarm is substituted for a line insulator pin, for the support of adjoining spans. The breakarm is about 1 ft. long, carries an insulator at each end and is placed in a horizontal position by a metal pin in the middle, which fits into the crossarm. It is usually of malleable iron.

BREAKDOWN TORQUE.—The maximum torque which an a-c. motor can exert before being brought to rest, when this maximum torque is greater than the torque at zero speed. A motor which gives its greatest torque at zero speed has no breakdown torque. The term is used in connection with induction and synchronous motors. It is also called "pull-out torque" and "stalling torque."

BREAKERS, CIRCUIT.—Special forms of switches, usually automatic, for breaking a circuit under abnormal conditions. (For details, types and makers, see Circuit breakers.)

BREAK-NOT.—Trade name for hydrometer syringes manufactured by E. Edelmann & Co., 2638-56 N. Crawford Ave., Chicago, Illinois.

BREAST WATER WHEEL.—A practically obsolete type of water wheel which revolved in a curved bed or breast of masonry or timber and had the water strike it somewhere between the level of the axle and 30° to 45° from the top.

BREATHING VENTS, TRANSFORMER.—A device by which the inhalation and exhalation of air can take place with changing temperature, due to variation of transformer load, while introducing as little moisture as possible. A small tube, opening into the top of the transformer, connects to a chamber, in which is a drying chemical, such as quick lime, calcium chloride, etc. If for outdoor use, baffle plates to prevent the entrance of rain or snow are provided. A special type of these vents is called an oil conservator, which see.

BREAZNELL, J. H.—26 Court St., Brooklyn, N. Y. Manufacturer of dry battery connectors and terminal connectors for automotive ignition and electrical purposes. Established 1914. J. H. Breaznell, proprietor.

BRECHT CO.—St. Louis, Mo. Manufacturer of electric meat choppers.

BREECHING, BOILER SMOKE.—This is a sheet steel duct, usually of rectangular cross section, installed horizontally at the rear of the boiler for conveying the smoke and gases from the boiler flues to the smoke stack or chimney. When the stack serves a battery (or group) of boilers the breeching is made progressively larger as it receives the gases from the successive boilers.

Manufacturers:

Codd Co., E. J., 700-708 S. Caroline St., Baltimore, Md.
Lancaster Iron Works, Lancaster, Pa.

BREEZE METAL HOSE MFG. CO.—22 Calumet St., Newark, N. J. Manufacturer of flexible metal hose, tubing and accessories. Business established 1906. President, Orrin G. Cock; secretary, A. F. Miles; treasurer and general manager, Colman S. O'Loughlin.

BREEZER.—Trade name for electric fans manufactured by the Lindstrom, Smith Co., 3212-38 W. Lake St., Chicago, Ill.

BRENKERT LIGHT PROJECTION CO.—49 Cortland Ave., Detroit, Mich. Manufacturer of stereopticons, floodlight projectors, spotlights, searchlights and accessories. Business established 1909. President, J. W. Brenkert, Sr.; secretary, Joseph Brenkert; treasurer, Karl Brenkert.

BRENNAN & CO., JOHN.—24th St. and M. C. R. R., Detroit, Mich. Manufacturers of boilers, tanks, etc. Business established 1847. President, F. S. Werneken; vice-president, H. S. Werneken; secretary and treasurer, F. E. Werneken.

BRENOPTICON.—Trade name for stereopticons manufactured by the Brenkert Light Projection Co., 49 Cortland Ave., Detroit, Mich.

BREWSTER CO., INC., THE WILLIAM.—30 Church St., New York, N. Y. Manufacturer of demagnetizers and electric engravers.

BRICK AND TILE, ACIDPROOF FOR BATTERY AND ELECTROCHEMICAL ROOMS.—Brick and tile for this purpose should be vitrified. If laid in cement, the joints between the bricks should be protected by an asphaltic compound to protect the cement from acid which may be spilled on the floor. The bricks or tiles used should be as large as possible to reduce the number of the joints. The floor should slope about 1 in. in 9 or 10 ft. and the slope should end in a gutter connected with a tile drain.

Manufacturers:

Belden Brick Co., The, 712 Tuscarawas St., W., Canton, Ohio.

BRICKS, FIRE, FOR BOILER, ELECTRIC AND OTHER FURNACES.—Fire bricks are bricks made of special fire clays or compositions that will endure the very high temperatures now developed in boiler practice or in other furnaces. The qualities of a fire brick are judged by the plasticity, the hardness and probability of cracking, tensile and compressive strength, etc. The plasticity, or tendency of the brick to become plastic, usually occurs at a temperature much below the melting point, but it may cause the brick to become deformed under the stresses to which it is subjected. Fire bricks are generally made of fire clay of various compositions. For special purposes, such as for some very high temperature furnaces, other refractory materials,

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such as carborundum, silica, kieselguhr, etc., are made into bricks. The thermal conductivity of some of these is less than fire brick and this is very important in the construction of electric furnaces, for instance, where as much heat as possible should be retained in the furnace.

Manufacturers:

Bernitz Furnace Appliance Co., 15 State St., Boston, Mass.
Betson Plastic Fire Brick Co., Inc., Rome, N. Y.
Big Savage Fire Brick Co., Frostburg, Md.
Denver Fire Clay Co., Denver, Colo. "DFC."
Detrick Co., M. H., 155 E. Superior St., Chicago, Ill. "Detrick."
Drake Non-Clinkering Furnace Block Co., Inc., 3 Beekman St., New York, N. Y. "Drake."
Gravert, Inc., William J., 246 Jackson Ave., Long Island City, N. Y.
Green Fire Brick Co., A. P., Mexico, Mo. "Empire," "Crown," "Standard."
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Jointless Fire Brick Co., 1130 Clay St., Chicago, Ill.
King Refractories Co., Inc., 1709 Niagara St., Buffalo, N. Y.
Laclede-Christy Clay Products Co., St. Louis, Mo. (Also fire clay.)
Los Angeles Pressed Brick Co., Frost Bldg., Los Angeles, Cal.
Olive Hill Refractories Co., The, Ashland, Ky.
Pacific Clay Products Co., American Bank Bldg., Los Angeles, Cal.
Texarkana Pipe Works, Texarkana, Tex.
Woodison Co., The E. J., Detroit, Mich.

BRIDGEPORT BOILER WORKS CO., THE.—202 Housatonic Ave., Bridgeport, Conn. Manufacturers of water-tube and fire-tube boilers. Business established 1865. President, treasurer and general manager, H. N. McCathron; secretary, John McCathron.

BRIDGEPORT BRASS CO.—Bridgeport, Conn. Manufacturer of electrical wires, commutator bars, rings, segments, and other copper and bronze products. President, Frederick J. Kingsbury; vice-president, W. R. Webster; secretary, R. I. Neithercut; treasurer and general manager, Guy P. Miller; sales manager, Warren D. Blatz. Main office and factory, Bridgeport, Conn. Branch offices, Woolworth Bldg., New York, N. Y.; 1106 State-Lake Bldg., Chicago, Ill.

BRIDGEPORT CHAIN CO.—Bridgeport, Conn. Manufacturer of arc lamp and other chains.

BRIDGEPORT HARDWARE MFG. CORP., THE.—Bridgeport, Conn. Manufacturer of screw drivers, nail pullers, etc. President, Willis F. Hobbs; secretary, Arthur I. Platt; treasurer, Harry B. Curtis.

BRIDGEPORT ROLLING MILLS, INC., THE.—Bruce and Stratford Ave., Bridgeport, Conn. Manufacturer of brass, nickel silver and bronze. Business established 1919. President, William R. Bull; vice-president and general manager, George D. Stearns; secretary, treasurer and sales manager, Anton C. Raffauf.

BRIDGES.—Trade name for friction clutches manufactured by the Bawden Machine Co., Ltd., 163-175 Sterling Road, Toronto, Ont., Can.

BRIDGES, RAILWAY CATENARY AND SIGNAL.—Structures spanning railway tracks; usually made of structural steel. In electrified trunk-line railways using "catenary" overhead, the bridges support the messenger wire of the catenary and may be spaced as much as 300 ft. apart or more. In signal work similar bridges may be used to support the semaphores.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display advertisement on page 1257.)
Archbold-Brady Co., Syracuse, N. Y.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.

BRIDGES, RECEPTACLE MOUNTING.—Metal brackets used for mounting receptacles in outlet boxes, etc., which are usually made adjustable to accommodate the different receptacles. The adjustable bridges are usually formed out of sheet metal. Other bridges are small castings which are threaded to receive a fixture stud or iron pipe.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.

BRIDGES, WHEATSONE, LABORATORY STANDARD.—These are Wheatsone bridge sets of special design to secure the highest possible accuracy in laboratory measurements of resistance and conductance. Their coils for obtaining adjustable resistances and their ratio coils are usually certified to be within a certain guaranteed accuracy, which ranges from 0.05% to 0.01%. The adjustable coils are arranged either on the 1-2-3-4 plan, the 9 or 10-coil decade plan, or some special decade plan. Sometimes separate standard resistance units are used as ratio coils. The battery and galvanometer are nearly always separate from the bridge proper. All contacts and connectors are of large area to minimize errors due to contact resistance.

Modified forms of Wheatsone bridge are also much used. For accurate comparison of resistances, the Carey Foster bridge or the Kelvin double bridge may be used; the Carey Foster bridge also is well adapted to the measurement of temperature coefficients of resistance. The essential features of the Carey Foster bridge are a slide wire for the two ratio arms of the bridge and a commutating device by means of which the coils whose resistances are being compared can easily be interchanged. The distinctive advantage over the ordinary bridge measurements is the elimination of all contact and other unknown resistances. It is usually designed for the comparison of standard resistances, connection being made through mercury cups. The Kelvin double bridge is also well adapted for the measurement of low resistances, since by its use the resistance of contacts and other unknown resistances are eliminated. It differs from the four-arm bridge in the addition of two auxiliary resistances which are placed in series and shunted around the resistance to be eliminated.

Manufacturers:

Beck Bros., 3648 N 2nd St., Philadelphia, Pa.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Foote, Pierson & Co., 160-162 Duane St., New York, N. Y.
General Radio Co., 11 Windsor St., Cambridge, Mass.
Hindle, Charles F., 45 Spring St., Ossining, N. Y. (Special types.) "American."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa. "Hoopes."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Standard Scientific Co., 147-153 Waverly Pl., New York, N. Y. "Stansico."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

BRIDGES, WHEATSTONE, PORTABLE.—These bridges consist of a compact assembly of resistors and contact keys (sometimes also a portable galvanometer) for the convenient measurement of resistances. The resistors are connected to form a Wheatstone's bridge and are arranged in either the assorted-unit, the decade or the dial forms. The whole assembly is mounted in a box which is provided with a handle for convenience in carrying. Many different makes and styles are on the market. Also see Testing sets, portable (battery, bridge and galvanometer type).

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
General Radio Co., 11 Windsor St., Cambridge, Mass. (Slide wire.)
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

BRIDGETON CHANDELIER CO.—Belmont & Oxford Sts., Bridgeton, N. J. Manufacturer of lighting fixtures. Business established 1912. President, J. L. Rice; vice-president and sales manager, J. P. Reeves; secretary, treasurer and general manager, L. M. Felmey.

BRIDGING.—A term used in telephony to indicate the connection of bells and coils bridged across the two sides of the line or in multiple. It also refers to a system of party-line telephones in which the instruments are connected in this manner instead of in series.

BRIGGS & STRATTON CO.—Milwaukee, Wis. Manufacturer of battery-charging sets, circuit breakers, automobile lamps, refrigerators, relays, switches and other electrical specialties. Business established 1909. President and general manager, S. F. Briggs; vice-president, secretary and treasurer, F. W. Manegold; sales manager (electrical specialties), E. M. Soreng; sales manager (refrigerators), H. G. Jubell. Main office and factory, 1047 Louis Ave., Milwaukee, Wis. Branch offices, 708 Ford Bldg., Detroit, Mich.; 521 Guardian Bldg., Cleveland, Ohio.

BRIGHT STAR.—Trade name for flashlights made by the Bright Star Battery Co., 310 Hudson St., New York, N. Y.

BRIGHT STAR BATTERY CO.—New York, N. Y. Manufacturer of flashlights, flashlight batteries and cases. President, Israel Koretzky; secretary and treasurer, Harry Koretzky; general manager, Frederick D. Conklin. Main office and factory, 310 Hudson St., New York, N. Y. Branch offices and warehouses, 9 S. Clinton St., Chicago, Ill.; 534 Merchants Exchange Bldg., San Francisco, Cal. Sales representatives, Slaughter-Riter Co., 1521 Commerce St., Dallas, Tex.; Walter E. White, P. O. Box 302, St. Johns, New Foundland, Can.

BRIGHTMAN FURNACE CO.—2570 Broadway, Cleveland, Ohio. Manufacturer of boiler furnaces.

BRIGHTNESS.—A term referring to the appearance of an illuminated object or surface. Its brightness depends both upon the intensity of illumination and the diffusing properties of the surface, since much of the light is absorbed and lost; for an imperfect diffuser the brightness may vary with the angle of view. The brightness of two objects having equal illumination intensities but differing in color is different because of their different absorption Brightness is expressed in candlepower per sq. cm. or per sq. in., and in lamberts, which is the brightness of a perfectly diffusing surface radiating or reflecting one lumen per sq. cm. For most purposes the millilambert (0.001 lambert) is the preferable practical unit.

BRIGHTWHITE.—Trade name for white bronze for fixtures, etc., manufactured by the Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

BRILL CO., THE J. G.—62nd St. & Woodland Ave., Philadelphia, Pa. Manufacturer of electric cars and car equipment. Business established 1868. President, Samuel M. Curwen; vice-presidents, W. H. Heulings, Jr.; J. W. Rawle; secretary, Henry C. Esling; treasurer, Edward P. Rawle; general manager, Robert B. Liddell; sales manager, W. H. Heulings, Jr. Sales representatives, American Car Co., St. Louis, Mo.; G. C. Kuhlman Car Co., Cleveland, Ohio; Wason Mfg. Co., Springfield, Mass.

BRILLIANT.—Trade name for electric signs made by the Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo.

BRILLIANT MFG. CO.—1037 Ridge Ave., Philadelphia, Pa. Manufacturer of electric signs.

BRILLIANT SIGN CO.—3531 Washington Ave., St. Louis, Mo. Manufacturer of electric signs and letters. Business established 1891. President, Frederic A. Kehl; vice-president, Frank L. Kehl; secretary, John A. Kehl.

BRINK, INC., C. I.—24 Gold St., Boston, Mass. Manufacturer of electric signs and theatrical lighting equipment. Business established 1866. President and treasurer, Charles I. Brink; general manager, John C. Brink. Factory, South Boston, Mass.

BRISTOL.—Trade name for automatic counters manufactured by the C. J. Root Co., Bristol, Conn.

BRISTOL CO., THE.—Waterbury, Conn. Manufacturer of recording electrical instruments. President, Wm. H. Bristol; secretary, S. R. Bristol; treasurer, Harris Whittemore; general manager, J. P. Green;

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sales manager, H. L. Griggs. Main office and factory, Waterbury, Conn. Branch offices, Boston, Mass.; New York, N. Y.; Pittsburgh, Pa.; Chicago, Ill.; San Francisco, Cal.

BRISTOW.—Trade name for electrotherapeutic induction coils manufactured by the McIntosh Battery & Optical Co., 217-223 N. Desplaines St., Chicago, Ill.

BRITASDAY.—Trade name for lighting fixtures manufactured by the Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.

BRITE LITE LAMP MFG. CO., INC.—214 Oxford St., Providence, R. I. Manufacturer of tungsten lamps. President, George Coby; secretary and treasurer, Ely Egnatoff; sales manager, A. Ullman.

BRITELITE.—Trade name for commercial lighting unit manufactured by the J. H. Edmunds Co., Ltd., 225 Richmond St., W., Toronto, Ont., Can.

BRITERLITE.—Trade name for commercial lighting unit manufactured by the Wagner-Woodruff Co., 830 S. Olive St., Los Angeles, Cal.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Bldg., Vancouver, B. C., Can.

BRITISH COLUMBIA ELECTRICAL CO-OPERATIVE ASSOCIATION. — Chairman, George Kidd, general manager, British Columbia Electric Railway Co., Vancouver, B. C., Can.

BRITISH THERMAL UNIT.—The British thermal unit is the unit of heat commonly used in the United States and other English-speaking countries. It is the 1/180th part of the heat required to raise the temperature of one pound of water from 32° to 212° Fahrenheit. It is substantially equal to the heat required to raise the temperature of one pound of water from 63° to 64° F. One B. t. u. equals 252 calories. The British thermal unit is sometimes descriptively called the pound-degree Fahrenheit.

BRITTON & DOYLE.—205 Caxton Bldg., Cleveland, Ohio. Manufacturers of electric sheet and press plate heaters.

BRL.—Trade name for electric cranes, hoists, industrial trucks and tractors made by the Baker R & L Co., Cleveland, Ohio.

BROADSIDE.—Trade name for photographic arc lamps manufactured by M. J. Wohl & Co., Inc., Payntar Ave. & Hancock St., Long Island City, N. Y.

BROADWAY RADIANT.—Trade name for commercial lighting units manufactured by the Manhattan Distributing Co., Transportation Bldg., Chicago, Ill.

BROCKLEN UNDERGROUND ELECTRICAL MFG. CO.—Glenside, Pa. Manufacturer of electrical underground construction tools and specialties. Business established 1914. President and general manager, E. L. Brockway; secretary and treasurer, C. M. Brockway,

BROHARD CO.—Philadelphia, Pa. Manufacturers of expansion bolts.

BROILERS, ELECTRIC.—Electric broilers are cooking utensils in which the article being broiled, such as a steak, is subjected to the direct heat of the heating element which usually is placed above the food to be broiled. There is usually a heat-reflecting plate above the element to direct the heat down on the food. Separate broilers are made chiefly for hotel and restaurant use. Electric ranges frequently have a broiling oven below the baking oven with a single heating element between them. Broilers may sometimes be made from a chafing dish or grill by placing a reflecting plate over the heating unit, which is inserted above the dish containing the food.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)
Weeks Mfg. Co., H. G., Hamilton, Ohio. "Auto-Grill."

BROMATES.—Salts of bromic acid ($HBrO_3$). They are readily produced by electrolyzing alkali bromide solutions, using a smooth platinum anode.

BROMINE.—Bromine is a heavy, dark-red liquid which gives off abundant vapor when exposed to the air, the vapor having a strong, disagreeable odor and attacking the eyes and membranes of the throat and nose. Its symbol is Br; sp. gr. (liquid) 3.2; m.p. —7° C.; b.p. 59° C. It is recovered from the Stassfurt salt deposits in Europe and certain brines in Michigan, Ohio, and West Virginia. This is usually done chemically with chlorine, but may be done by electrolysis similarly to the production of chlorine. In 1919 about 2,000,000 lbs., valued at 70c per lb., was produced in the United States. It is used as an oxidizing agent and its compounds are used in photography, medicine and the dye industry.

BROMION.—The constituent of a bromide salt which is liberated by electrolysis at the anode.

BROMOFORM.—$CHBr_3$; can be made electrolytically using an electrolyte containing potassium bromide (KBr) and acetone or alcohol.

BRONZE.—Strictly speaking, bronze is an alloy of copper and tin, as contrasted with brass, which is an alloy of copper and zinc. Where other metals are alloyed with either bronze or brass a point is reached at which it is difficult to say whether the alloy is bronze or brass. The more commonly specified bronzes, such as phosphor, silicon, manganese, Tobin, etc., are stronger and more difficult to work than brass. The tools and methods for working them are much the same, however, as are their responses to the same heat treatment. Bronze has frictional characteristics superior to brass; it is much used for bearings, usually containing a small percentage of lead. Up to a copper content of 85%, the electrical conductivity of bronze is practically constant at 10% of that of pure silver. Above 85% copper the conductivity rises sharply to approach that of copper. Also see Phosphor bronze; Wire, bronze.

BRONZE INGOTS, SHEETS, RODS AND TUBES.—Bronze is frequently sold in the form of ingots to manufacturers who do not have the facilities for properly preparing the desired alloy compositions. In this form it is used for castings. The sheets, rods and tubes are used for a number of electrical products, where the characteristics of good conductivity and strength are desired. Many contact springs are made of bronze for use on relays, interrupters, etc. Bronze is also used extensively as a bearing material and is applied to small motors and many other rotating parts of machinery for this service. It may be worked in about the same manner as brass bars, sheets, rods, etc., which see, and is often used for similar purposes.

Manufacturers:

American Copper Products Corp., 200 Broadway, New York, N. Y. (Sheets.)
American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa. "Spare's."
Bridgeport Rolling Mills, Inc., The, Bruce & Stratford Ave., Bridgeport, Conn. (Sheets.)
Capitol Brass Works, Detroit, Mich. "Capitol."
Chase Metal Works, 236 Grand St., Waterbury, Conn. "Chamet."
Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn. (Ingots, tubes.)
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Lumen Bearing Co., Buffalo, N. Y. "Machinebronze."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Randolph-Clowes Co., The, Box 1012, Waterbury, Conn.
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (Sheets, rods and tubes.) (See display advertisement on page 1327.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Amboy."
Titan Metal Co., Bellefonte, Pa. (Rods and forgings.)
Wheeler Condenser & Engineering Co., Carteret, N. J. (Tubes.) "Crescent."

BRONZE METAL CO.—30 Church St., New York, N. Y. Manufacturer of brass, bronze and composition castings, journal bearings and babbitt metal. President, Alexander Turner; vice-president, Arthur N. Dugan; secretary and treasurer, Frank H. Senn. Factory, Meadville, Pa.

BRONZE POWDER WORKS CO.—Elizabeth, N. J. Manufacturer of bronze powders.

BRONZE POWDERS.—Bronze powders are powdered metals dissolved in amyl acetate or other solvent and used as a paint or tint to produce various metal finishes. They are used on some electrical products for this purpose. The finish produced is not necessarily a bronze but may be gold, copper, aluminum, etc.

Manufacturers:

Aluminum Co. of America., Oliver Bldg., Pittsburgh, Pa.
Barrett & Co., M. L., 233 W. Lake St., Chicago, Ill.
Bronze Powder Works Co., Elizabeth, N. J.
Coe Mfg. Co., W. H., Providence, R. I.
Drakenfeld & Co., Inc., B. F., 50 Murray St., New York, N. Y.
Illinois Bronze Powder Co., 170 W. Randolph St., Chicago, Ill.
Lucas & Co., Inc., John 322 Race St., Philadelphia, Pa.
Malone Bronze Powder Works, Inc., Malone, N. Y.
Morrill Co., George Co., Norwood, Mass.
National Bronze & Chemical Works, 220 W. 42nd St., New York, N. Y.
Nikolas & Co., G. J., 1227-35 Van Buren St., Chicago, Ill.
Ohio Bronze Powder Co., 1120 E. 152nd St., Cleveland, Ohio.
Rosenbush & Solomon, 33rd St. & Shields Ave., Chicago, Ill.
Scientific Mfg. Co., 8010 Superior Ave., Cleveland, Ohio.
Scientific Products Co., The, Castle Shannon, Pa.
United States Bronze Powder Works, Inc., 220 W. 42nd St., New York, N. Y.

BROODERS AND HOVERS, ELECTRIC.—Electrically heated enclosures in which young fowl are raised. The heating elements are controlled by a thermostat which turns the current "on" or "off," thus keeping the temperature uniform and at a predetermined point within the brooder. Another form, which is used more as a protection or overhanging shelter and is not completely inclosed, is known as a hover. Electric brooders and hovers are practically a necessity in any poultry farm that tries to raise many chicks at all seasons of the year.

Manufacturers:

Cyphers Incubator Co., Buffalo, N. Y. "Electrohover."
Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind. "Lectro-Hatch."
Reliable Incubator & Brooder Co., Quincy, Ill. "Reliable."
Winford Mfg. Co., 306 Alaska Bldg., Seattle, Wash. "Winford."

BROOKDUCT.—Trade name for non-metallic flexible conduit manufactured by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y.

BROOKINS CO., THE.—1741 Euclid Ave., Cleveland, Ohio. Manufacturer of aisle lighting fixtures for theaters. President, C. S. Brookins; vice-president, M. K. Munhall; secretary, W. B. Chapman; treasurer, E. F. Fisher.

BROOKLYN MEDICAL BATTERY & INSTRUMENT CO., INC.—991 Madison St., Brooklyn, N. Y. Manufacturer of electrotherapeutic apparatus. President, P. W. Tunison; vice-president, Edward E. Felten; secretary and treasurer, G. P. Clauss.

BROOKS & SONS, M. S.—Chester, Conn. Manufacturers of bridle rings.

BROOKS, GEORGE B.—101 N. Main St., Providence, R. I. Manufacturer of wiping waste.

BROOKS, HALL L.—Tomahawk, Wis. Producer of cedar poles.

BROOKSTEEL.—Trade name for flexible steel conduit and armored cable manufactured by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y.

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BROWN.—Trade name for friction clutch pulleys, clutches, etc., manufactured by the Brown Clutch Co., Sandusky, Ohio.

BROWN.—Trade name for pyrometers, tachometers and other electrical indicating and recording instruments manufactured by the Brown Instrument Co., Philadelphia, Pa.

BROWN & PENGILLY.—607 E. 4th St., Los Angeles, Cal. Manufacturers of relays, switchboards, switches and transformers.

BROWN & SHARPE GAGE.—This is the older name of the gage now used to express the size of nearly all electrical conductors sold in the United States. The name Brown & Sharpe Gage, abbreviated B. & S. G., is still very widely used, but it should properly be called the American Wire Gage, which is its official name. This gage was developed by one of the oldest machinery and gage manufacturers in the United States (Brown & Sharpe, of Providence, R. I.). It covers wire sizes from No. 40, for the smallest wire, to No. 0000 (or No. 4/0) for the largest numbered wire, whose diameter is 460 mils (=0.460 in.). Larger wires are designated by their circular-mil areas.

BROWN & SHARPE MFG. CO.—Providence, R. I. Manufacturer of gages and milling machines. Main office, Providence, R. I. Branch office, 628 W. Washington Blvd., Chicago, Ill.

BROWN CLUTCH CO., THE.—Sandusky, Ohio. Manufacturer of electric hoists, friction clutches, pulleys, and other power transmission equipment. President and general manager, T. T. Morgan.

BROWN CO., THE A. & F.—79 Barclay St., New York, N. Y. Manufacturer of gears, shaft hangers, shaft couplings and other power transmission equipment.

BROWN CO., THE W. B.—Bluffton, Ind. Manufacturer of lamp bases. Business established 1907. President, George S. Morris; vice-president, Albert B. Cline; secretary, treasurer and general manager, W. A. Patton.

BROWN ENGINEERING CO.—123-127 N. 3rd St., Reading, Pa. Manufacturer of friction clutches. Ellis E. Brown, manager.

BROWN, HAROLD P.—120 Liberty St., New York, N. Y. Manufacturer of rail bonds.

BROWN HOISTING MACHINERY CO., THE.—Cleveland, Ohio. Manufacturer of electric hoists and other conveying appliances. President, Alex C. Brown; vice-president and general manager, Melvin Pattison; secretary, George C. Wing; treasurer, Charles T. Pratt. Main office, Cleveland, Ohio. Factories, Cleveland and Elyria, Ohio. Branch offices, 50 Church St., New York, N. Y.; Oliver Bldg., Pittsburgh, Pa.; 208 S. LaSalle St., Chicago, Ill.; Monadnock Bldg., San Francisco, Cal.

BROWN INSTRUMENT CO., THE.—Philadelphia, Pa. Manufacturer of pyrometers, tachometers and other electrical indicating and recording instruments. Business established 1860. President, R. P. Brown; secretary, J. E. Goheen; sales manager, G. W. Keller. Main office and factory, Philadelphia, Pa. Branch offices, Hudson Terminal, New York, N. Y.; Oliver Bldg., Pittsburgh, Pa.; Ford Bldg., Detroit, Mich.; Conway Bldg., Chicago, Ill.; Railway Exchange, St. Louis, Mo.; 137 McGill St., Montreal, Que., Can.; 1742 Champa St., Denver, Colo.; 576 Mission St., San Francisco, Cal.; 363 New High St., Los Angeles, Cal.

BROWN LAND & LUMBER CO.—Merchants State Bank Bldg., Rhinelander, Wis. Manufacturer of treated and untreated cedar poles. President, L. E. Brown; vice-president, W. A. Brown; secretary, S. T. Ingram. Yards, Rhinelander and Green Bay, Wis.

BROWN-PORTABLE.—Trade name for entire line of portable elevating, conveying, loading and unloading machinery manufactured by Brown Portable Conveying Machinery Co., 10 S. LaSalle St., Chicago, Ill.

BROWN PORTABLE CONVEYING MACHINERY CO.—Chicago, Ill. Manufacturer of portable and electric freight elevators, portable conveyors, electrically operated loaders and unloaders. Business established in 1911. President and treasurer, Harwood Frost; vice-president and general manager, George W. Clark; secretary, Frank Hall Childs; sales manager, W. M. Lyman. Main office, 10 S. LaSalle St., Chicago, Ill. Branch office, 30 Church St., New York City. Factory, North Chicago, Ill.

BROWN SAFETY LADDER MFG. CO.—Manufacturers of ladders. Sales department, Swanstrom Sales Co., 825 Manhattan Bldg., Chicago, Ill.

BROWNE-NEIL PROCESS.—A process for the recovery of tin from tin scrap by boiling the scrap in a solution of ferric chloride ($FeCl_3$), the tin going into solution as stannous chloride ($SnCl_2$), with the reduction of the iron salt to ferrous chloride ($FeCl_2$). The resulting liquors are then subjected to electrolysis in concrete tanks with graphite anodes and tin cathodes, separated by clay diaphragms. Circulation is maintained from the cathode to the anode compartments, so that the successive action in the two compartments first removes the tin and then regenerates the ferric chloride.

BROWNE PROCESS.—An electrolytic process for the separation of nickel and copper. Anodes with approximately the same amounts of the two metals are electrolyzed with copper cathodes and an electrolyte made by treating some of the granulated anode material with chlorine in a brine solution. In this electrolysis most of the copper was deposited, the solution further purified chemically, and the nickel then deposited on nickel cathodes with graphite anodes.

BROWNELL CO., THE.—Dayton, Ohio. Manufacturer of engines, boilers, feed water heaters and tanks. Business established 1856. President and general manager, J. R. Brownell, Jr.; vice-president, F. C. Trowbridge; secretary and sales manager, W. A. Drake; treasurer, A. E. Hartnett. Main office and factory, N. Findlay St., Dayton, Ohio. Branch offices, Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Columbus, Ohio; 53 W. Jackson Blvd., Chicago, Ill.

BROWNHOIST.—Trade name for electric hoists, cranes and other conveying machinery manufactured by the Brown Hoisting Machinery Co., Cleveland, Ohio.

BROWNIE.—Trade name for electric hoists and pumps manufactured by the Cherry Tree Machine Co., Cherry Tree, Pa.

BROWNIE.—Trade name for oiling device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

BROWNIE SAFELIGHT.—Trade name for photograph enlarging lamps manufactured by the Eastman Kodak Co., Rochester N. Y.

BROWNING & CO., VICTOR R.—17701 Lake Shore Blvd., Cleveland, Ohio. Manufacturers of electric cranes, hoists, motors, controlling devices, dredges, etc.

BRUCE-MACBETH ENGINE CO., THE.—Cleveland, Ohio. Manufacturer of gas engines and flexible shaft couplings. President, C. W. Kelly; vice-president and general manager, C. E. Curtis; secretary and treasurer, C. J. Snow. Main office and factory, 2111 Center St., N. W., Cleveland, Ohio. Branch office, Oliver Bldg., Pittsburgh, Pa. Sales representatives, Sterns Electric Equipment Co., Buffalo, N. Y.; Hartwicke-Etter Co., Sherman, Tex.; Harron, Rickard & McCone, San Francisco, Cal., Los Angeles, Cal.

BRUMFIELD ELECTRIC SIGN CO.—18 7th St., San Francisco, Cal. Manufacturer of electric signs and sign lighting equipment. Business established 1910.

BRUNNER MFG. CO.—Utica, N. Y. Manufacturer of motor-driven air compressors. Business established 1904. President, L. J. Brunner; vice-president, W. R. Roemer; secretary, H. R. Beebe; treasurer and general manager, G. L. Brunner; sales manager, J. H. Mehan. Main office and factory, Broad & Gilbert Sts., Utica, N. Y. Branch offices, Kansas City, Mo.; Cincinnati, Ohio.

BRUNT PORCELAIN CO., THE.—Columbus, Ohio. Manufacturer of electrical porcelain specialties. Business established 1895. President, G. F. Brunt; vice-president, H. D. Clark; secretary, J. T. Herbert; treasurer and general manager, W. F. Steele. Main office, P. O. Box 493, Columbus, Ohio. Branch office, 1827 Republic Bldg., 209 S. State St., Chicago, Ill. Sales representatives, Henry Landesberg, 1827 Republic Bldg., Chicago, Ill.; W. H. Beaven, Jefferson County Bank Bldg., Birmingham, Ala.; W. D. Stewart, 1123 Broadway, New York, N. Y.

BRUSH.—A conductor which forms an electrical connection between a fixed and a rotating part, generally of a dynamo-electric machine. The rotating part may be a commutator, as in a d-c. machine, or a set of slip rings, as in an a-c. machine. The brushes are held by what are called brush holders; see Holders, brush.

The usual materials of which brushes are made are carbon, graphite, mixtures of metal and carbon or graphite, woven wire or gauze, leaf copper or thin sheets of other metal of high conductivity, such as bronze and brass.

BRUSH, CHARLES FRANCIS.—An American inventor (born at Euclid, Ohio, 1849), to whose work in the field of arc lighting and generator design much of the later development of electrical apparatus can be attributed. He was graduated, in 1869, from the University of Michigan as a mining engineer. In 1876 he perfected the dynamoelectric machine known by his name, and in 1878 the series arc lamp. Mr. Brush discovered the use of iron laminations for generators. To him is attributed the use of copper-plated carbon brushes and the damper winding used on certain generators and motors. He did much to develop and perfect the lead storage battery and secured many patents by which improvements in the manufacture of lead plates were effected. In 1881 he was decorated by the French Government as Chevalier of the Legion of Honor, in recognition of his discoveries in electricity. In 1899 the American Academy of Arts and Sciences awarded him the Rumford medal for "the practical development of electric art lighting." In 1913 the American Institute of Electrical Engineers awarded him the Edison medal.

BRUSH-HOLDER STUD.—A rod forming an electrical connection to and a mechanical support for the one or more brush holders of a set. The brush-holder stud is mechanically attached to, but electrically insulated from, the brush rocker, ring or yoke. It is electrically connected to a conductor which joins all brush sets of the same polarity to one terminal of the machine.

BRUSH HOLDERS.—See Holders, brush.

BRUSH LEAD.—The angle from the no-load neutral axis through which the brushes of a d-c. generator are shifted in the direction of rotation in order to place the coils as they undergo commutation in a weak field of the entering pole tip so that commutation may take place with as little sparking as possible. In d-c. motors the brushes may be shifted opposite to the direction of rotation, in which case they are said to have a backward lead or a lag. Machines with interpoles have practically no lead of the brushes.

BRUSH NAIL EXPANSION BOLT CO.—Greenwich, Conn. Manufacturer of expansion bolts.

BRUSH, PILOT.—A brush, often one of a pair, used to determine the voltage drop between any two segments of a commutator of a d-c. machine while it is running; also one of a pair of brushes left in contact with the commutator of a synchronous converter while all the other brushes are lifted off during the starting period. These brushes permit a voltmeter to show the polarity of the converter and an exciting current to pass through the shunt field winding.

BRUSH VOLTAGE DROP.—The electric pressure required to force the current through the brush and its contact on the commutator. The drop in the contact depends upon the pressure per unit area, the material of the brush, the speed and the current density. The contact resistance decreases while the current density increases, so that the voltage drop is approximately constant for all loads and is often taken as one volt.

BRUSH YOKE.—The rocker arm, quadrant, ring or other adjustable support for mechanically connecting and maintaining the brush-holder studs in their proper relative position. If the brushes as a whole are to be given a lead or lag, this is done by means of the brush yoke.

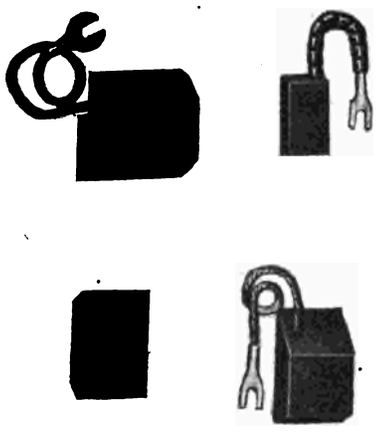
When writing to manufacturers please mention the
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BRUSHES, CARBON AND GRAPHITE.—Carbon and graphite brushes are used extensively for generator and motor work where the current density is not high, i. e., from 30 to 60 amperes per sq. in. Carbon brushes are usually treated to make them self-lubricating and are frequently combined with graphite, as this decreases the resistance, increases the current-carrying capacity and gives a softer brush. The contact resistance of carbon brushes varies from 0.04 to 0.01 ohm per sq. in., and decreases with an increase in current density. Carbon brushes are best suited for low peripheral speeds. Graphite brushes may be used with very high peripheral speeds, and their softness and excellent lubricating qualities minimize the wear on commutators or slip rings. Because of their relative softness a low contact pressure is required, usually from 1¼ to 2 lbs. per sq. in. Where machines are subjected to heavy duty an abrasive is sometimes included in the brush compound, giving a slight cleaning action. These brushes are made in both round and rectangular form and in a variety of sizes and special designs for shunt connections. Round brushes are used only on fractional-horsepower motors and other small machines. Carbon and graphite brushes may be set radially against the commutator or slip rings which is of special importance in motors that reverse direction of running.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Baylis Co., The, Nelson St., Bloomfield, N. J.
Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Boxill-Bruel Carbon Brush Co., 1022 S. Michigan St., Indianapolis, Ind. "B-B."
Calebaugh Self-Lubricating Carbon Co., Inc., 1503 Columbia Ave., Philadelphia, Pa. "No-Spark."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chapin Co., Charles E., 201 Fulton St., New York, N. Y.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Corliss Carbon Co., P. O. Box 377, Bradford, Pa.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Dominion Carbon Brush Co., 38 Duke St., Toronto, Ont., Can. "Dominion."
Eastern Parts Mfg. Co., Inc., 135 Spring St., New York, N. Y. "Pemko."
Fleck Carbon Co., 71 W. Broadway, New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hanson & Van Winkle, Newark, N. J.
Hart & Co., 124 N. Main St., Fostoria, Ohio. "Langleben."
Huff Electrostatic Separator Co., Box 66, Arlington, Mass. (Graphite.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Jeandron, W. J., 229 Fulton St., New York, N. Y. "Lecarbone."
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Le Valley-Vitae Carbon Brush Co., 521 W. 23rd St., New York, N. Y. "Vitae."
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
MORGANITE BRUSH CO., INC., 519-523 W. 38th St., New York, N. Y. Brushes for all types of electrical machinery in five classes, each class composed of several grades, which enables "Morganite" to meet the demands of any type of apparatus. "Standard Morganite," patented, is a natural graphite quality having exceptional commutating characteristics for all types of machines; particularly suited for high-speed rotary converters, generators, etc. Operates best on undercut mica. "Hard Morganite," also a graphite, range somewhat stronger mechanically than the above and designed for machines where running conditions are severe. "Morganite Carbon," a complete line of carbon brushes in ten different qualities of varying hardness and conductivity for all types of industrial motors. Morganite," also a graphite, range tised carbon brushes, very tough and have refractory characteristics, which enable them to withstand severe sparking without damage. "Copper Morganite" brushes are admixtures of copper



Morganite Brushes

and graphite in varying proportions for service where high conductivity brushes are needed. Battersea connection (next illustration) is a patented method of fixing flexibles to brushes by means of a special metallic powder. Superior mechanically and electrically to any soldered, screwed or bolted form. Send



Flexibles Fixed to Brushes

for bulletin and data sheets. The services of the company's technical department are at your disposal.—Adv.

Munning & Co., A. P., Church St., Matawan, N. J.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Pyramid."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Otter Mfg. Co., Inc., 243-45 W. 17th St., New York, N. Y. "Individual Container."
Perfection Supply Co., 98 Park Pl., New York, N. Y. "Perfection."
Pittsburgh Carbon Brush Co., Pittsburgh, N. S., Pa.
Pure Carbon Co., Wellsville, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Speer Carbon Co., St. Marys, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Superior Carbon Products, Inc., Poughkeepsie, N. Y. "Superior."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.
Van Nort Carbon Brush Co., 1214 Olive St., St. Louis, Mo.

BRUSHES, COPPER LEAF AND GAUZE.—Copper brushes in the leaf, gauze and combination forms are used chiefly on machines having a high current capacity, such as plating or electrolytic generators. They can carry 150 amperes per sq. in. with a contact drop of less than 0.5 volt. The leaf brushes are composed of several thin sheets or leaves of copper, securely clamped at one end. Gauze brushes are made of a finely woven copper cloth of high conductivity, closely wound. The gauze brushes are used largely on low-voltage heavy-duty machines, such as automobile starting motor service, etc. They are also made in both rectangular and round forms.

Manufacturers:

Barkelew Electric Mfg. Co., Middletown, Ohio.
Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Boxill-Bruel Carbon Brush Co., 1022 S. Michigan St., Indianapolis, Ind. "B-B."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton Ont., Can. "Westinghouse."
Chapin Co., Charles E., 201 Fulton St., New York, N. Y.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Corliss Carbon Co., P. O. Box 377, Bradford, Pa.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Dominion Carbon Brush Co., 38 Duke St., Toronto, Ont., Can. "Dominion."
Fleck Carbon Co., 71 W. Broadway, New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Co., 124 N. Main St., Fostoria, Ohio.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Munning & Co., A. P., Church St., Matawan, N. J.
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Ohio Electric Specialty Mfg. Co., The, Troy, N. Y.
Perfection Supply Co., 98 Park Pl., New York, N. Y. "Perfection."
Pure Carbon Co., Wellsville, N. Y.
Salem Electrical Supply Co., 9 Front St., Salem, Mass.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Superior Carbon Products, Inc., Poughkeepsie, N. Y. "Superior."
Walsh Co., John F., 28 Renne Ave., Pittsfield, Mass. (Leaf.) "K & W."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BRUSHES, COMMUTATOR, MISCELLANEOUS.—Commutator and slip-ring brushes are also made in a number of special types and forms for different purposes. Bronze and brass are sometimes used, especially in conjunction with slip rings. For commutators that have hard mica insulating segments, special brushes containing an abrasive are used to cause the mica to wear down at the same rate as the copper bars. Graphite or carbon is often combined with copper leaf or gauze brushes; such composite brushes give better lubrication and less scratching than all-metal brushes. Brushes are also furnished in pairs, connected together, and in various other forms, such as curved, round with turned ends, and small brushes having the shunt or pigtail enclosed in a spiral spring.

Manufacturers:

Barkelew Electric Mfg. Co., Middletown, Ohio.
Becker Bros., 25 N. Jefferson St., Chicago, Ill.
Boxill-Bruel Carbon Brush Co., 1022 S. Michigan St., Indianapolis, Ind. "B-B." (Automobile.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. "Champion."
Corliss Carbon Co., P. O. Box 377, Bradford, Pa.
Dixon Crucible Co., Joseph, Jersey City, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. Metite brushes for general use. Metite is a copper-graphite brush material of low resistance and containing lubricant. See adv. pages 1203-1223.—Adv.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
J & B Mfg. Co., 65 Eagle St., Pittsfield, Mass. "J & B."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

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MORGANITE BRUSH CO., INC., 519-523 W. 38th St., New York, N. Y. "Copper Morganite" brushes in five grades, containing copper and finest graphite procurable in varying proportions. Suitable grades for all conditions of running where low contact drop or high current density in the brush is required. Widely used for low voltage plating generators, rotary converter slip rings, alternator and induction motor slip rings. Also see this company's entry under Brushes, carbon and graphite.—Adv.



"Copper Morganite" Brushes

National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia Pyramid."
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Ohio Electric Specialty Mfg. Co., The, Troy, N. Y.
Perfection Supply Co., 98 Park Pl., New York, N. Y. "Perfection."
Pure Carbon Co., Wellsville, N. Y.
Speer Carbon Co., St. Marys, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BRUSHES FOR GLOBE CLEANING.—Brushes of special form that were formerly much used by arc-lamp trimmers for cleaning the globes of arc lamps. They are still used for cleaning these and other globes. The brush is usually round or oval in shape and made so that the bristles project on all sides. A twisted wire handle and bristle holder is often used.

Manufacturers:

Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. page 1323.)

BRUSHES FOR INSULATING COMPOUNDS, PAINTS AND VARNISH.—Brushes for this purpose are high-grade brushes of various shapes and sizes depending upon the character of the work and the material to be applied. Special attention should be given to the setting of the bristles, to see that they will not come out easily. The compounds are usually very sticky and thick and require a rather stiff brush. Paints and varnishes do not require as stiff a brush and where they are used also for decorative purposes, a very fine brush, usually with rather short bristles, is used.

Manufacturers:

Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Eclipse Air Brush Co., 79 Orange St., Newark, N. J. "Eclipse."

BRUSHES, PNEUMATIC PAINT SPRAYING.—These brushes are made in several sizes and forms depending upon the class of work, i. e., whether decorative or art work is to be done or whether it is to be used for house, building, machine, furniture or other painting. For the first class of work a very fine nozzle is used and the paint or color receptacle is a very small jar which is attached to the handle; the air connection is made through the handle. Such outfits are commonly called air brushes. For larger work, machine painting, etc., the paint, varnish, enamel, etc., are drawn from a drum through one tube and the air is forced through another tube, both leading to the brush, where they are mixed as they leave the nozzle. A trigger or other convenient control is provided, by means of which the air pressure is regulated to give either a fine line or a wide spread.

Manufacturers:

Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Binks Spray Equipment Co., 3120 Carroll Ave., Chicago, Ill.
Eclipse Air Brush Co., 79 Orange St., Newark, N. J. "Eclipse."
Impulse Tank Co., 2820 N. Spring Ave., St. Louis, Mo. "Vaporspray."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Spraguns."
Nikolas & Co., G. J., 1227-35 Van Buren St., Chicago, Ill.
Paasche Air Brush Co., 1219 W. Washington Blvd., Chicago, Ill.
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.

BRUSHES, VACUUM CLEANER.—These are small cylindrical brushes forming a part of most portable vacuum cleaners. The brush assists in loosening threads and other material that tends to adhere to the rug, carpet or surface being cleaned. The brush usually consists of a small metal cylinder rotated by two friction wheels as in a carpet sweeper, or in a few cases by means of a special belt arrangement which runs from the cleaner motor. The bristles are placed on the cylinder in spiral form. The brush is usually removable for cleaning its bristles and can be replaced when worn out. For the separate vacuum cleaner accessories, see Vacuum cleaner attachments.

Manufacturers:

Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Torrington Co., National Sweeper Division, Torrington, Conn. "Domestic."

BRYAN-MARSH.—Trade name for incandescent lamps manufactured by the Bryan-Marsh Division, National Lamp Works of General Electric Co., Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., New York, N. Y.

BRYAN-MARSH DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.,—Manufacturer of incandescent lamps. Four separately organized divisions as follows: Central Falls, R. I.; A. W. Marcou, general manager.—Chicago, Ill., 623 S. Wabash Ave.; A. H. Meyer, general manager. Branch offices, Minneapolis, Minn.; Kansas City, Mo.—Detroit, Mich.; W. G. A. Reid, general manager.—New York, N. Y., 33 Union Sq.; W. J. K. Johnston, general manager.

BRYANT ELECTRIC CO., THE.—Bridgeport, Conn. Manufacturer of sockets, switches and other wiring devices. Business established 1888. President and general manager, W. C. Bryant; treasurer, A. E. Frost; sales manager, R. M. Eames. Main office and factory, Bridgeport, Conn. Branch offices, 844 W. Adams St., Chicago, Ill.; 149 New Montgomery St., San Francisco, Cal.; Canadian Pacific Bldg., New York, N. Y. Sales representatives, J. R. Bartholomew, 25 Broad St., New York, N. Y.; F. B. Chapman, 870 Westfield Ave., Elizabeth, N. J.; American Huhn Metallic Packing Co., Woolworth Bldg., New York, N. Y.; Western Electric Co., 463 West St., New York, N. Y.

BRYANT MFG. CO.—323 W. Jackson Blvd., Chicago, Ill. Manufacturer of railway crossing bells and battery zincs. President and general manager, George Bryant.

BRYANT ZINC CO.—600 Orleans St., Chicago, Ill. Manufacturer of railway signals and alarms and battery zincs.

BRYLOCK.—Trade name for locking sockets manufactured by the Bryant Electric Co., 1421 State St., Bridgeport, Conn.

BRYTERLYTE.—Trade name for lighting unit manufactured by the Giese Art Metal Works, 4414 Germantown Ave., Philadelphia, Pa.

BSCO.—Trade name for wet batteries manufactured by Thomas A. Edison, Inc., Belmont Ave., Bloomfield, N. J.

BUCHER-SMITH CO., THE.—East Liverpool, Ohio. Manufacturer of electric keyseaters. President, O. O. Allison; vice-president, W. W. Ward; secretary, J. W. Manor; treasurer and general manager, James R. Meek. Main office and factory, Chester, W. Va. (Post office, East Liverpool, Ohio.)

BUCK.—Trade name for nonlocking lamp guard manufactured by the Racine Iron & Wire Works, Racine, Wis.

BUCK BROS.—Millbury, Mass. Manufacturers of electricians' and linemen's tools.

BUCKETS, TURBINE AND WATER WHEEL.—A series of rigid curved vanes, blades, cups or passageways, distributed regularly around the circumference of the runner of a hydraulic turbine for the purpose of receiving the water, utilizing its energy, and discharging it as nearly devoid of energy as possible.

BUCKEYE.—Trade name for incandescent lamps manufactured by the Buckeye Electric Division, National Lamp Works of General Electric Co., Cleveland, Ohio.

BUCKEYE.—Trade name for jacks manufactured by the Buckeye Jack Mfg. Co., Alliance, Ohio.

BUCKEYE.—Trade name for semi-Diesel engines manufactured by the Buckeye Machine Co., Lima, Ohio.

BUCKEYE.—Trade name for bolts manufactured by the Lamson & Sessions Co., 2188 Scranton Rd., Cleveland, Ohio.

BUCKEYE.—Trade name for electric pumps manufactured by Mast, Foos & Co., Springfield, Ohio.

BUCKEYE.—Trade name for porcelain knobs manufactured by the Trenton Porcelain Co., 803 E. State St., Trenton, N. J.

BUCKEYE.—Trade name for rigid metallic conduit manufactured by the Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio.

BUCKEYE ELECTRIC DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Cleveland, Ohio. Manufacturer of incandescent lamps. General manager, N. H. Boynton; sales manager, F. C. Foster. Main office, 1811 E. 45th St., Cleveland, Ohio. Branch offices, Pittsburgh, Pa.; Philadelphia, Pa.; Chicago, Ill.; Charlotte, N. C.; Dallas, Tex.; Cleveland, Ohio.

BUCKEYE ENGINE CO.—Salem, Ohio. Manufacturer of electric blueprinting machines and steam engines. Business established 1847. President, E. S. Griffiths; secretary and treasurer, H. A. Greiner; general manager, D. D. Lewis.

BUCKEYE GRAY.—Trade name for barriers for bus and switching chambers manufactured by the Ohio Quarries Co., Citizens Bldg., Cleveland, Ohio.

BUCKEYE IRON & BRASS WORKS.—3rd & Wyandot Sts., Dayton, Ohio. Manufacturers of brass valves. Business established 1860. President and general manager, W. B. Anderson; vice-presidents, R. C. Anderson and Torrence Huffman; secretary and treasurer, William P. Huffman.

BUCKEYE JACK MFG. CO., THE.—Alliance, Ohio. Manufacturer of jacks of all kinds.

BUCKEYE MACHINE CO., THE.—Lima, Ohio. Manufacturer of oil engines.

BUCKEYE PRIMA CO., THE.—Sidney, Ohio. Manufacturer of electric washing machines.

BUCKEYE TEMPERED COPPER & BRASS CO.—Mansfield, Ohio. Manufacturer of commutator bars and brass and copper castings. President, C. H. Voegele; vice-president, T. R. Barnes; secretary and treasurer, E. J. Gilbert; general manager, Theodore F. Frank.

BUCKINGHAM, W. H.—8-10 Bronson St., Binghamton, N. Y. Manufacturer of linemen's pole climbers. Business established 1885. W. H. Buckingham, owner.

BUCKSKIN.—Trade name for automobile tires manufactured by the Tuscan Tire & Rubber Co., Carrollton, Ohio.

BUCYRUS.—Trade name for electrically operated excavating machinery and dredges manufactured by the Bucyrus Co., South Milwaukee, Wis.

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BUCYRUS CO.—South Milwaukee, Wis. Manufacturer of electrically operated excavators and dredges. President, W. W. Coleman; vice-presidents, E. K. Swigart and W. F. Russell; secretary, G. A. Morison; treasurer, D. P. Eells. Main office, South Milwaukee, Wis. Factories, South Milwaukee, Wis., and Evansville, Ind. Branch offices, Birmingham, Ala.; Portland, Ore.; San Francisco, Cal.; Minneapolis, Minn.; Cleveland, Ohio; 322 S. Michigan Ave., Chicago, Ill.; 30 Church St., New York, N. Y.

BUDA CO., THE.—Harvey, Ill. Manufacturer of electric tractors and trucks, generating sets, electric headlights and track equipment. Business established 1881. President, L. M. Viles; vice-president and general manager, F. E. Place; secretary, William P. Hunt, Jr.; treasurer, H. M. Sloan; general sales manager, R. B. Fisher. Main office and factory, Harvey, Ill. Branch offices, Railway Exchange Bldg., Chicago, Ill.; 30 Church St., New York, N. Y.; Railway Exchange Bldg., St. Louis, Mo.

BUDA-ROSS.—Trade name for locomotive headlight generating set and locomotive headlights manufactured by the Buda Co., Harvey, Ill.

BUDA-WILSON.—Trade name for bonding drills manufactured by the Buda Co., Harvey, Ill.

BUD-E.—Trade name for gasoline engines manufactured by the Carlyle Johnson Machine Co., 52 Main St., Manchester, Conn.

BUELL.—Trade name for hollow handle tool sets manufactured by the M. W. Robinson Co., 296 Broadway, New York, N. Y.

BUETTNER CO., THE CHARLES H.—1924-1926 W. 8th St., Cincinnati, Ohio. Manufacturer of spark plugs, buffing wheels and other automobile and textile products. President, I. B. Davidson; secretary, E. B. Bame; treasurer, C. R. Fagin.

BUFFALO.—Trade name for belt dressing made by the Buffalo Belt Dressing Co., 962 Kensington Ave., Buffalo, N. Y.

BUFFALO.—Trade name for heating, ventilating and humidifying apparatus manufactured by the Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

BUFFALO.—Trade name for steam and electric pumps manufaotured by the Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y.

BUFFALO.—Trade name for wire enclosures for switchboards and machinery manufactured by the Buffalo Wire Works Co., 316-332 Terrace, Buffalo, N. Y.

BUFFALO.—Trade name for power plant injectors, oil and grease cups and oiling devices manufactured by the Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y.

BUFFALO.—Trade name for wire grips manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

BUFFALO AUTOMATIC.—Trade name for power plant injectors manufactured by the Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y.

BUFFALO BELT DRESSING CO.—962 Kensington Ave., Buffalo, N. Y. Manufacturer of belt dressing. Business established 1910. General manager, Paul J. Kihl.

BUFFALO BRAND.—Trade name for wood crossarms manufactured by B. F. Vreeland, 411 Commonwealth Bldg., Denver, Colo.

BUFFALO CHANDELIER CORP. — 233 Ellicott St., Buffalo, N. Y. Manufacturer of lighting fixtures. President, J. Markel.

BUFFALO FORGE CO.—Buffalo, N. Y. Manufacturer of conduit and pipe bending machines, drills and ventilating fans and blowers. President, H. W. Wendt; vice-president and secretary, H. W. Wendt, Jr.; vice-president and treasurer, E. F. Wendt; vice-president and sales manager, C. A. Booth. Main office and factory, 490 Broadway, Buffalo, N. Y. Branch offices, Detroit, Mich.; Pittsburgh, Pa.; Minneapolis, Minn.; 2113 E. 2nd St., Cleveland, Ohio; New Orleans, La.; Cincinnati, Ohio; 636 H. W. Hellman Bldg., Los Angeles, Cal.; St. Louis, Mo.; Portland, Ore.; Boston, Mass.; Denver, Colo.; Philadelphia, Pa.; Atlanta, Ga.; 562 W. Washington St., Chicago, Ill.; 39 Cortlandt St., New York, N. Y.

BUFFALO FOUNDRY & MACHINE CO.—Buffalo, N. Y. Manufacturer of impregnating apparatus, electric vacuum pumps and other vacuum equipment. Business established 1901. President, treasurer and general manager, H. D. Miles; vice-president, H. T. Dunbar; secretary, F. C. Slee; sales manager, E. G. Rippel. Main office and factory, 1541 Fillmore Ave., Buffalo, N. Y. Branch office, 17 Battery Pl., New York, N. Y.

BUFFALO SPECIALTY CO. — Buffalo, N. Y. Manufacturer of street-lighting mastarms. Business established 1885. President, Oliver Cabana, Jr.; vice-president, Elmer A. Cabana; secretary and sales manager, Martin J. Cabana; treasurer, Oliver Cabana. Main office and factory, 375 Ellicott St., Buffalo, N. Y. Branch office, 1 Hudson St., New York, N. Y.

BUFFALO STEAM PUMP CO. — 490 Broadway, Buffalo, N. Y. Manufacturer of electric and steam pumps. President, H. W. Wendt; secretary, H. W. Wendt, Jr.; treasurer, E. F. Wendt; sales manager, C. A. Booth.

BUFFALO WIRE WORKS CO.—Buffalo, N. Y. Manufacturer of wire machinery guards, switchboard enclosures, wire cloth and other wire products. Business established 1869. President, Martin Scheeler; vice-president and general manager, Ferdinand Grimm; secretary and sales manager, John C. Scheeler; treasurer, Charles A. Scheeler. Main office and factory, 316-332 Terrace, Buffalo, N. Y. Branch offices, 9-11 S. 7th St., Philadelphia, Pa.; 30 Church St., New York, N. Y.

BUFFERS, ELECTRIC, BENCH, PEDESTAL AND PORTABLE. — These are motor-driven machines used for buffing or polishing metal and other surfaces. They are made with the motor as an integral part of the machine and the buffing wheel is fastened to the motor shaft, one being placed on each end of the shaft in some cases. They are made chiefly for mounting on a bench for buffing small pieces or on a pedestal for larger work. Other buffers are made for portable use; these are made with smaller motors and use a smaller buffing wheel. They are used on large work that cannot be held up to an ordinary buffer. Stationary buffers of the pedestal type generally require a larger motor than the bench type in order that it will not slow down when the work is pressed against the wheel. Various kinds of buffing wheels are used, some having a slight abrasive or cutting action and others merely a smoothing or polishing action. The latter are usually made of many layers of cloth sewed and glued together and compressed between end plates which screw onto the motor shaft. Such wheels are often called buffs; also see Wheels, buffing.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.

Blakeslee & Co., G. S., Cicero, Ill. "Blakeslee."

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.

Cavicchi Polishing Machinery Co., 3-5 Woodworth St., Neponset (Boston), Mass.

Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."

Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."

Connecticut Dynamo & Motor Co., The, Lyons Ave. & Coit St., Irvington, N. J.

CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. The illustration shows a type in which stamina in the



Crawford Electric Buffer

motor together with exceptional materials and machining are combined.—Adv.

Dilg Mfg. & Trading Co., The, 27 E. 125th St., New York, N. Y. "Acme."

Dillon Electric Co., Mahoning Rd. & 11th St., N. E., Canton, Ohio. "Dillon."

Eager Electric Co., The, Watertown, N. Y.

Ely, C. Upham, 50 Vesey St., New York, N. Y.

Forbes & Myers, 172 Union St., Worcester, Mass.

Freeman Co., The Louis G., 909-911 Sycamore St., Cincinnati, Ohio. (Shoe repairing.)

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.

Green Electric Co., The W., 81 Nassau St., New York, N. Y.

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

Hanson & Van Winkle, Newark, N. J.

Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."

JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.

LeBron Electrical Works, 318-320 S. 12th St., Omaha, Neb.

L'Hommedieu & Sons Co., Charles F., 4521 Ogden Ave., Chicago, Ill. "Reliance."

Maxim Mfg. Co., 700 W. 22nd St., Chicago, Ill. "Sinteelo."

Miller, Charles E., Anderson, Ind. "Miller-Anderson."

Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."

Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."

Oliver Mfg. Co., The W. W., 1483 Niagara St., Buffalo, N. Y.

Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill. "Lectric-Lustre."

Rochester Electric Products Corp., Driving Park Ave. & Argo Park, Rochester, N. Y.

Roth Bros. & Co., 1400 W. Adams St., Chicago, Ill.

Standard Electric Tool Co., The, Cincinnati, Ohio. "Standard."

Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.

Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."

U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal. "Johnson."

Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)

Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

BUFFERS, MISCELLANEOUS.—These are nonelectrical buffers, usually belt-driven from a line shaft. They are widely used in manufacturing plants for the final or buffing process in polishing metal or other objects. Grinding and polishing are required before electroplating and buffing afterwards, to give the desired luster. Where only occasional buffing of small objects is required, pedal-operated buffers are sometimes used.

BUFFING MACHINES.—See Buffers.

BUFFS.—See Wheels, buffing.

BUFLOVAK.—Trade name for electric vacuum pumps, impregnating apparatus and other vacuum equipment manufactured by the Buffalo Foundry & Machine Co., 1541 Fillmore Ave., Buffalo, N. Y.

BUG.—Trade name for electric burglar alarms manufactured by the Cannon Ball Alarm Co., 524 5th Ave., South, Minneapolis, Minn.

BUHRKE CO., R. H. — 1238 Fullerton Ave., Chicago, Ill. Manufacturer of tool chests, linemen's tools, belts, bags, etc. Business established 1877. President, treasurer and general manager, J. E. Schank; vice-president and secretary, A. E. Buhrke; sales manager, A. F. Soutar.

BUILD-CRAFT ELECTRIC MFG. CO.—37-39 Maspeth Ave., Brooklyn, N. Y. Manufacturer of push button plates and letter boxes.

BUILDER'S IRON FOUNDRY.—Providence, R. I. Manufacturer of meters, pipe fittings, etc.

BUILDING-UP.—The process of accumulation of e. m. f. which a self-excited d-c. generator undergoes from the instant of starting until it reaches its maximum value. It is a result of the mutual reaction and reinforcing of the currents generated in the armature and flowing through the field coils.

BULBS FOR LUMINOUS RADIATORS.—These are carbon-filament incandescent lamps of cylindrical shape. They are designed primarily to give off heat and have merely a pleasant glow, and, therefore, are very inefficient from a lighting standpoint.

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They are made in rather large capacity, having a rating of either 250 or 500 watts as a rule.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y. "Glo-Ray."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BULBS, INCANDESCENT LAMP.—The bulb is the glass enclosing portion of an incandescent lamp which surrounds the filament. A word sometimes loosely used to designate the whole incandescent lamp as distinct from the complete lighting appliance or lamp into which it fits. Lamp bulbs are usually of thin clear glass. They are sometimes colored and sometimes wholly or partly frosted or enameled. Bowl-frosted lamps are those in which only the hemispherical part of the bulb near the tip is frosted. White opal is used to a limited extent. Three common shapes of bulbs are in use in the United States, viz.: pear-shaped (designated P. S.); straight sided with hemispherical tip (S); and spherical (G).

BULBS, GLASS, FOR X-RAY TUBES.—These glass bulbs require very skillful glass blowing as they are generally large and have a rather complex shape. Some bulbs are made of ordinary glass, while others are made of a lead glass which confines the rays to the tube window. Lead shields are provided on the other glass bulbs. The window through which the rays pass to the object to be exposed forms part of the bulb and is generally made of sodium glass which transmits the rays with little or no absorption.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill.
Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

BULL DOG.—Trade name for rubber belting and friction tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

BULL DOG.—Trade name for tool demagnetizers manufactured by the Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York., N. Y.

BULL DOG.—Trade name for split porcelain knobs manufactured by the Illinois Electric Porcelain Co., Macomb, Ill.

BULL DOG.—Trade name for belt dressing manufactured by the Indian Refining Co., 244 Madison Ave., New York, N. Y.

BULL DOG.—Trade name for switches, switchboards, panelboards, etc., manufactured by the Mutual Electric & Machine Co., 858 W. Fort St., Detroit, Mich.

BULL-DOG.—Trade name for spark plugs manufactured by the Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.

BULL-DOG.—Trade name for die stocks manufactured by the Oster Mfg. Co., Cleveland, Ohio.

BULLARD, E. A.—Tremont Bldg., Boston, Mass. Manufacturer of slate for electrical purposes.

BULLDOG.—Trade name for boiler-tube cleaners manufactured by the Liberty Mfg. Co., Frick Bldg., Pittsburgh, Pa.

BULLDOG.—Trade name for portable lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

BULLDOG.—Trade name for mine trolley clamps manufactured by the Ohio Brass Co., Mansfield, Ohio.

BULLETIN AND PROGRAM BOARDS, INTERNALLY ILLUMINATED.—Small boards can be effectively illuminated from behind by using a translucent glass surface for the board or putting the announcement or design on a translucent side, sheet or curtain placed directly back of a clear glass front; this permits ready change of the announcement and is much used in theaters and depots. This type of construction is also used for many display boards where the display is changed automatically by using several slides. These boards are almost always completely enclosed and are illuminated by means of one or more incandescent lamps.

Manufacturers:

Bulletin Machine Co., 10-16 Lock St., Buffalo, N. Y.
Clinton Sign Co., 134 5th Ave., Clinton, Iowa.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Standard Signs, Inc., 426 6th Ave., S., Minneapolis, Minn.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Star Monogram."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

BULLETIN BOARDS, EXTERNALLY ILLUMINATED.—Large bulletin boards and wall signs are usually illuminated by means of lamps and reflectors mounted in front of the upper edge of the board, the reflectors being either of special angle, box or trough type shaped to throw the light uniformly over the surface. Floodlight projectors are sometimes used for large boards when they can be placed at a fair distance.

BULLETIN MACHINE CO.—10-16 Lock St., Buffalo, N. Y. Manufacturer of electrical advertising specialties, bulletin and program boards and electric signs.

BULLIER FURNACE.—One of the early types of electric tapping furnace for the production of calcium carbide, in which the hearth of the furnace formed one electrode.

BULLITE.—Trade name for cutting and extrusion compounds manufactured by the Conversion Products Corp., 149 Broadway, New York, N. Y.

BUNCHES, STAGE LIGHTING.—Clusters of electric incandescent lamps with reflectors mounted on portable standards or designed for suspension in producing temporary stage lighting effects. Bunches are used where additional illumination is needed for part of a setting, but not of so intense or concentrated a character as that provided by spotlights. They are connected to floor or wall pockets (receptacles) by special stage cords or cables.

Manufacturers:

Display Stage Lighting Co., 314 W. 44th St., New York, N. Y.
Hallberg, J. H., 25 W 45th St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. No. 51 "X-Ray" projector, mounted on portable stand, equipped with color frames, is recommended for bunch light. See Projectors, floodlight, also theater lighting classifications. See adv. page 1405.—Adv.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

BUNDY.—Trade name for oil separators manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

BUNNELL & CO., J. H.—32 Park Place, New York, N. Y. Manufacturers of radio apparatus, fire alarm systems, lightning arresters, electrotherapeutic apparatus, electrical and scientific instruments, etc. Business established 1879. President, secretary and general manager, John J. Ghegan; vice-president and treasurer, Charles E. Graham; sales manager, John J. Johnston.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

BUNSEN CELL.—A primary cell consisting of an anode of amalgamated zinc in a sulphuric acid (about 8%) solution, separated by a porous cup from the cathode of retort carbon, which is surrounded by 66% nitric acid. It is used only in laboratory work. In the original form of this cell, as developed by Grove, the cathode was of platinum.

BUNTING BRASS & BRONZE CO., THE.—Toledo, Ohio. Manufacturer of brass and bronze bearings. President, J. W. Bunting; vice-president, W. H. Bunting; secretary and treasurer, C. E. Bunting. Main office and factory, Toledo, Ohio. Branch offices, Cleveland, Ohio; 722 S. Michigan Ave., Chicago, Ill.; Grand Central Palace, New York, N. Y.

BURDETT MFG. CO.—309 St. Johns Ct., Chicago, Ill. Manufacturer of oxygen and hydrogen gas generating apparatus. President, J. B. Burdett; secretary, A. H. Scholle; general manager, H. B. Pearson.

BURDICK CABINET CO.—Milton, Wis. Manufacturer of electrotherapeutic apparatus. Business established 1913. President, G. W. Coon; vice-president, F. A. Anderson; secretary, G. R. Boss; treasurer and general manager, F. F. Burdick; sales manager, H. N. Severseen. Main office and factory, Milton, Wis. Branch office, 518 Stewart Bldg., Chicago, Ill. Sales representatives, John Birk Co., Louisville, Ky.; Clapp-Anderson Co., Boston, Mass.; Physicians' Supply Co., Kansas City, Mo.; W. G. Cleveland Co., Omaha, Neb.; A. S. Aloe Co., St. Louis, Mo.; T. B. Snow Co., New York, N. Y.; Shaw Supply Co., Tacoma, Wash.; Charles Lentz & Sons Co., Philadelphia, Pa.

BUREAU OF STANDARDS.—The United States Bureau of Standards was established by the Fereral Government in 1901 and upon the creation of the Department of Commerce became an integral part of that Department. The Act of Congress which created the Bureau authorized it to deal with standards of measurement, standards of quality, standards of performance, standards of practice and standard values of physical constants. The early work of the Bureau was concerned principally with standards of measurement. The Bureau has charge of the custody and maintenance of the standards of measurement of this country which have been established by Congress and makes comparisons of these standards with working standards for the manufacturers and users of the various types of measuring standards and instruments. Research work is carried on to improve constancy of the physical standards, to improve the methods of measurement and comparison, to develop better types of measuring instruments and to increase our knowledge of those quantities and properties of materials which depend upon the most precise measurements.

The work of the Bureau has increased steadily in amount and scope until it now occupies seven main laboratories and a number of smaller buildings at Washington, D. C., and has branches at Pittsburgh, Pa., Northampton, Mass., Denver, Colo., and San Francisco, Cal. The employees of the Bureau number about 850. A great deal of testing of materials is done for other branches of the Government and this also involves a certain amount of investigation and testing with respect to standards of performance. Researches are carried on to determine accurately various physical constants which are of value in different branches of industry or of scientific work.

Scientific and technical work of the Bureau is organized in nine divisions which are concerned, respectively, with electricity, weights and measures, heat and thermometry, optics, chemistry, engineering instruments, engineering and industrial materials, metallurgy, and ceramics. The Bureau is equipped with a large instrument shop and accessories, a liquid air plant, a photographic laboratory, a library of 20,000 volumes, clerical force, etc.

The electrical division of the Bureau comprises various sections which are concerned with standards of electrical measurements, measuring instruments, electrochemistry (batteries), radio telegraphy and telephony, electrolysis, photometry, magnetism, safety standards, utility service standards, radioactivity and X-ray measurements. Researches have been made involving fundamental electrical units and their determination by means of the silver voltameter and the current balance; specifications for the standard cell; methods of measuring resistance, inductance and capacitance; comparison of the electrostatic

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and electromagnetic units; methods of magnetic measurements; formulas for the computation of self and mutual inductance; methods of electrolysis mitigation; developments in radio apparatus, including the radio direction finder; photometric standards and methods of measurement; and properties of electrical instruments. New methods of measurement have been devised, utility service and electrical accidents have been investigated and standards established for service and safety. Many of these subjects have been covered by Bureau publications, including Standards for Electric Service and National Electrical Safety Code. Standard specifications for transformers, dry cells, electric incandescent lamps, and for various materials have been prepared.

The publications of the Bureau number about 600 and are classified mainly as scientific papers, technologic papers, circulars, and handbooks. A complete list of publications is issued as Circular No. 24 and may be had upon application to the Bureau. Most of the publications are available in public and technical libraries and can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Bureau is a member of the Electrical Safety Conference, and has representatives on the International Electrotechnical Commission, the International Commission on Illumination, American Committee on Electrolysis, the American Engineering Standards Committee, the National Safety Code Committee, the Electrical and Signaling Committees of the N. F. P. A., and many similar bodies. The Bureau hears appeals from the findings of Underwriters' Laboratories. The director of the Bureau is Dr. Samuel W. Stratton, who has been its chief executive since the Bureau was created.

BURGESS BATTERY CO.—Madison, Wis. Manufacturer of batteries, battery chemicals and flashlights. Business established 1917. President and general manager, C. F. Burgess; vice-president and sales manager, Duncan Keith; secretary, W. B. Schulte; treasurer, B. S. Reynolds. Main office, Madison, Wis. Factories, Madison, Wis., Winnipeg, Man., Can. Branch offices and warehouses, Harris Trust Bldg., Chicago, Ill.; 701 Wellington Ave., Winnipeg, Man., Can.

BURGESS-NORTON MFG. CO.—Geneva, Ill. Manufacturer of screw machine products, steel stampings and hardware specialties. President, F. A. Burgess; secretary, H. W. Norton; sales manager, C. M. Burgess. Branch office, 65 Walker St., New York, N. Y.

BURGESS SOLDERING FURNACE CO.—Columbus, Ohio. Manufacturer of soldering furnaces.

BURHORN CO., EDWIN.—25 W. Broadway, New York, N. Y. Manufacturer of cooling towers.

BURK & CO.—Spokane, Wash. Manufacturers of cedar poles and posts.

BURKE.—Trade name for commutator slotting machine manufactured by the Electrical Devices Co., Mt. Vernon, N. Y.

BURKE.—Trade name for furnaces and chain grate stokers manufactured by the S & S Automatic Grate Co., 320 E. North Water St., Chicago, Ill.

BURKE.—Trade name for transmission line equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BURKE & JAMES.—240 E. Ontario St., Chicago, Ill. Manufacturers of electric photograph printing machines, photographic lamps, projectors and other photographic equipment. President, David James; secretary and treasurer, Henry Burke; general manager, T. W. Mudford.

BURKE ELECTRIC CO.—Erie, Pa. Manufacturer of motors, generators, motor-generators, electric drills, industrial ovens, welders and transformers. President and general manager, James Burke; vice-president, George H. Winkler, Jr.; secretary, Charles H. Schum; treasurer, G. Irving Blake; sales manager, Hugh A. Brown. Main office, 12th & Cranberry Sts., Erie, Pa. Factories, Erie, Pa., and Conneautville, Pa. Branch offices, 510 Morgan Bldg., Buffalo, N. Y.; 819 Illuminating Bldg., Cleveland, Ohio; 1904 Dime Savings Bank Bldg., Detroit, Mich.; 513 Hudson Terminal Bldg., New York, N. Y.; 1505 Arch St., Philadelphia, Pa.; 739 Oliver Bldg., Pittsburgh, Pa. Sales representatives, Underwood Electric Co., 309 Syracuse St., Cincinnati, Ohio; W. T. Osborn, 1002 Commerce Bldg., Kansas City, Mo.

BURKE FURNACE CO.—320 E. North Water St., Chicago, Ill. Manufacturer of boiler furnaces, chain grate stokers, electric coal and ash hoists and structural steel for transmission lines, etc. Business established 1892. President and general manager, E. W. Ritter; secretary and treasurer, W. T. Ritter.

BURLEIGH, MORRISON & GOWING.—80 Boylston St., Boston, Mass. Manufacturers of electric pumps for washing machines.

BURN BOSTON BATTERY & MFG. WORKS.—80 Boylston St., Boston, Mass. Manufacturer of dry batteries, flashlights and grounding devices. Business established 1910. Factory, South Boston, Mass. Thomas W. Byrne, proprietor.

BURNETT-LARSH MFG. CO.—Dayton, Ohio. Manufacturer of electric well pumps and pumping systems. President and general manager, C. E. Burnett; vice-president, J. A. Wortman; 2nd vice-president and sales manager, C. A. Kuebler; secretary, R. S. Shuey. Main office and factory, 537-545 E. Monument Ave., Dayton, Ohio. Branch offices, Grand Central Palace, New York, N. Y.; 231 Insurance Exchange Bldg., Chicago, Ill.

BURNLEY BATTERY & MFG. CO.—North East, Pa. Manufacturer of soldering paste. President, John G. Kline; secretary and general manager, F. B. Heath; treasurer, C. M. Grauel. Sales representatives, Charles E. Chapin Co., 201 Fulton St., New York, N. Y.; L. L. Fleig & Co., 212 W. Austin Ave., Chicago, Ill.; C. H. Wallis & Co., 1432 Syndicate Trust Bldg., St. Louis, Mo.; Baker-Taslin Co., 183 1st St., San Francisco, Cal.; Charles F. Belz, 937 N. St. Clair St., Pittsburgh, Pa.; Cravin-Hopkins, 905 Walnut St., Philadelphia, Pa.

BURNS.—Trade name for telephone bracket and mouthpieces manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

BURNS EXPRESS.—Trade name for telephone switchboards manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

BURNS HI-LO.—Trade name for telephone bracket manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

BURNS, JAMES F.—713 Cherry St., Philadelphia, Pa. Manufacturer of iron boxes and steel cabinets for electrical purposes.

BURNS SUPPLY CO., E. REED.—Brooklyn, N. Y. Manufacturer of electroplating materials, etc. Business established 1886. President, R. Reed Burns; secretary, H. R. Burns; treasurer, R. H. Burns. Main office, 21-27 Jackson St., Brooklyn, N. Y. Factories, Chicago, Ill., and Brooklyn, N. Y. Branch office, 1811 Carroll Ave., Chicago, Ill.

BURRELL & CO., INC., D. H.—Little Falls, N. Y. Manufacturer of motor-driven dairy machinery. Business established 1869. President, E. J. Burrell; vice-president, Loomis Burrell; treasurer, D. H. Burrell, Jr. Main office, Little Falls, N. Y. Branch office, Brockville, Ont., Can.

BURROUGHS ADDING MACHINE CO.—Detroit, Mich. Manufacturer of electric computing and bookkeeping machines. President, Standish Backus; vice-presidents, C. W. Gooch, F. H. Dodge; secretary and treasurer, A. J. Lauver. Main office, Detroit, Mich. Factories, Detroit, Mich., and Windsor, Ont., Can.

BURROUGHS CO., CHARLES.—141-149 Commerce St., Newark, N. J. Manufacturer of molded insulation and insulation molding machines, presses, etc. President and general manager, Charles F. Burroughs; vice-president, William H. Burroughs; secretary and treasurer, Frank L. Morton.

BURROWS.—Trade name for permeameter manufactured by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

BURROWS MFG. CO.—York, Pa. Manufacturer of feed water regulators and other steam specialties. George C. Ruby, general manager.

BURRS, FOR RIVETS.—Burrs are used with rivets for fastening canvas or leather belting or other leather or soft materials together. The burr is shaped like a washer and fits tightly around the rivet shank. When the rivet and burr are in place and the rivet is upset the burr causes the expansion to occur outside so as to form a head on the rivet. Without using the burr the entire shank would increase in diameter without forming a pronounced head. The burrs are made of the same material as the rivets, which in most cases is copper or occasionally bronze.

Manufacturers:

Clark Bros. Bolt Co., Milldale, Conn.
Cleveland Wrought Products Co., The, West 58th St., Cleveland, Ohio.
Reed & Prince Mfg. Co., Worcester, Mass.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.

BURT.—Trade name for oil filters and oiling systems manufactured by the Burt Mfg. Co., Akron, Ohio.

BURT CO., W. T.—New Cumberland, W. Va. Manufacturer of portable electric lamps.

BURT MFG. CO., THE.—Akron, Ohio. Manufacturer of oil filters and oiling systems. Business established 1890. President, W. F. Warden; vice-presidents, W. J. Frank, M. E. Knowles; secretary, J. Dwight Palmer; treasurer, F. E. Whittemore; general manager, J. Asa Palmer.

BURTSCHAELL, J. W.—357 Ellis St., San Francisco, Cal. Manufacturer of lighting fixtures. Business established 1893.

BUS.—A contraction of busbar, which see. Also a contraction of omnibus, a vehicle carrying a considerable number of passengers.

BUSBAR.—In electric power plants it is customary to have one or more sets of main circuits into which all of the generators feed and from which all the feeders receive their power. These are known as "busbars," a contraction of "omnibus bars"; a single busbar is often called a "bus" and a number of them are called "buses." For d-c. service the busbars going to the feeder circuits comprise a positive and a negative bus, and there is usually an equalizer between the generators, if compound wound. For three-wire d-c. service there is also a neutral bus and then usually a positive equalizer and a negative equalizer bus. The equalizer busbars are not always located on the switchboard and for railway work there is usually only one bus (the positive) on the board, the negative circuit being grounded. In a-c. systems, two busbars are used for single-phase circuits, three for three-phase, four for two-phase or three-phase four-wire.

If there is only a single set of busbars in a d-c. or in an a-c. installation, the system is often spoken of as "single throw." If there are two sets of busbars and the circuits can connect to either, the system of busbars is a "double throw"; but if the circuits can connect to both as well as to either, it is called a "selector" system. If there is a single bus divided by switches into two or more sections, it is a "sectional bus." With two sets of sectioned buses connected at the ends a "ring bus" is obtained.

Busbars are made of wire, rod, tubing, cable or strap, depending on the current to be carried and the voltage. Strap or bar copper is by far the most used material, hence the syllable bar is included in the term busbar.

BUSBAR BENDERS, CLAMPS, SUPPORTS.—See Benders, busbar; Clamps, busbar; Supports, busbar.

BUSBARS, COPPER, SOLID.—Solid copper busbars are used very extensively for low and medium-voltage work and where heavy currents are carried. The most common form is strap copper, from ⅛ to ⅜ in. thick and in varying widths up to about 10 ins. Strap possesses many advantages in the ease with which its capacity can be increased by additional straps in parallel forming a "laminated bus." When ¼-in. bars are used they are generally spaced ¼ in. apart and ⅜-in. bars are spaced ⅜ in. The number of bars used depends on the current capacity, a current density of from 800 to 1000 amperes per sq. in. being generally used. In large-capacity plants operating at the generator voltage the bus is usually placed in masonry compartments with each phase isolated by fireproof barriers. These busbars are usually supported on pillar type porcelain insulators, that are designed with sufficient mechanical strength to withstand the severe stresses set up at the time of short-circuit.

For connections to busbars wire, cable, rod, tubing or strap is used, depending on the current to be carried, the number of bends and similar features. For heavy currents laminated copper straps are usually

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best, and the connections are often made by means of busbar clamps, which see. Also see Supports, busbar.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Copper Products Corp., 200 Broadway, New York, N. Y.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chase Metal Works, 236 Grand St., Waterbury, Conn.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROME BRASS & COPPER CO., Rome N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry.—Adv.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Taunton-New Bedford Copper Co., Taunton, Mass.
Universal Chain Co., The, Stroudsburg, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSBARS, COPPER, TUBULAR.—For high-voltage service, either indoor or outdoor, open wiring is usually employed and for this service, as the amount of current is relatively small, tubing of copper or brass can be used with fairly long spans between the supporting insulators. The use of tubing permits a great saving in the amount of copper to be used and yet gives a very strong construction that will withstand the severe stresses occasioned at short-circuit. High-tension buses for indoor work are often placed in separate masonry compartments. This type of construction, using tubular busbars is gaining favor and is now being used extensively. The proper arrangement of the busbar and connections in an a-c. installation of large size will depend on the number and types of oil circuit breakers, disconnecting switches, etc., that are used and whether enclosed or open construction is desired. For high-frequency circuits, such as in radio work, the use of tubular conductors reduces skin effect to a minimum. Also see Clamps, busbar; and Supports, busbar.

Manufacturers:

Bridgeport Brass Co., Bridgeport, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROME BRASS & COPPER CO., Rome, N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry.—Adv.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSCH-SULZER BROS.-DIESEL ENGINE CO.—St. Louis, Mo. Manufacturer of Diesel engines. Business established 1898. President, August A. Busch; vice-presidents, James R. Harris, Adolphus Busch III, A. C. F. Meyer, C. Drummond Jones, Max Rotter; secretary and treasurer, C. Drummond Jones; general manager, J. R. Harris; sales manager, E. B. Pollister. Main office and factory, 2nd & Utah Sts., St. Louis, Mo. Branch offices, 60 Broadway, New York, N. Y.; 904 Rialto Bldg., San Francisco, Cal.; 604 Fletcher Trust Bldg., Indianapolis, Ind.

BUSES.—Common electrical spelling of the plural of bus, or contraction of busbars.

BUSH ELECTRIC CO., THE.—6654 Broadway, Cleveland, Ohio. Manufacturer of linemen's safety tools and accessories for use on high-voltage lines. Business established 1919. General manager, M. D. Douglas.

BUSHETTES.—Trade name for combination conduit bushing and pipe cap made by Walker Bros. & Haviland, Otis Bldg., Philadelphia, Pa.

BUSHING HOUSINGS, TRANSFORMER.—A type of bushing for outdoor transformers of moderate voltage, which makes it possible to dispense with transformer houses in localities where the houses are not specified by insurance and safety-first requirements.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. The lower portion of the bushing is similar to the standard G-E high voltage bushing. Housing is water-proof and ample clearance is provided within. Transformers so equipped receive standard high potential test without taping or other insulation on the bushings. Application limited by the voltage limits of the underground cable. Approved by the Associated Factory and Mutual Fire Insurance Companies. See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSHING TOOLS, FLEXIBLE STEEL CONDUIT.—Special tools for smoothing the entrance to or "bushing out" flexible steel conduit. Sometimes a tapered hardwood or steel pin with a handle on it is used, while in other cases a tapered steel reamer is employed. Both types of these tools are designed to be used on two or three sizes of conduit.

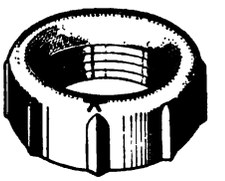
Manufacturers:

J. & B. Mfg. Co., 65 Eagle St., Pittsfield, Mass. "J & B."

BUSHINGS, CONDUIT, BOX AND CABINET.—Conduit bushings are threaded collars for placing on the exposed ends of conduit, the inside of the collar having a smooth rounded edge; these bushings are used where wires pass from a conduit to an open run and the bushing must have a separate hole for each conductor. Box and cabinet bushings are short threaded porcelain tubes provided with a metal threaded clamp or locknut for securing the tube in the hole; they serve to protect the wires from abrasion.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Duck, J. J., 436 St. Clair St., Toledo, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GARFIELD MFG. CO., Garfield, N. J.
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
Harvard Electric Co., 525 W. Van-Buren St., Chicago, Ill.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo. "Electrolet."
Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. Bushings manufactured by the National Metal Molding Co. are made from stamped steel and are cut and threaded by machines. The ¼-in., ½-in. and ¾-in. sizes are designed so as to make them self-thread-cleaning. They are lighter and yet stronger than those made of castings and will lock more securely. They are treated with a sherardizing process which protects them from rust and other destructive forces. The ridges on the outside prevent the wrench from slipping its grip. See display adv. pages 1302-4.—Adv.
New Process Specialty Co., 230 Hanover St., Milwaukee, Wis. (Exclusive distributor, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.)
Pratt-Chuck Co., The, Frankfort, N. Y.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display advertisement on page 1308.)
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.)
Fullman "Star" bushings are made of malleable iron. The threads are sharp, clean, full size. The original "rib" design makes easy turning in crowded spaces with blunt tool or screw driver. The entire surface is sherardized to provide a continuous rustproof coating. Made in all sizes from ⅜ to 8-inch.—Adv.

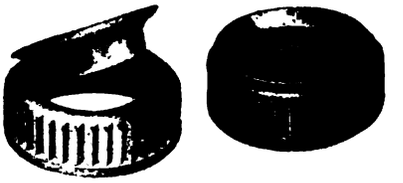


"Star" Bushing

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T & B" Watertight conduit bushing also prevents abrasion from vibration. It is furnished in four sizes—½, ¾, 1 and 1¼ in., designed for conduits of the same diameters.—Adv.



V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WALKER BROTHERS & HAVILAND, Otis Bldg., Philadelphia, Pa. "Bushettes" is the registered trade-name given to die-cast zinc bushings with knurled sides, flanged edges and a knockout cap, which remains in place while "roughing-in," and prevents foreign matter from stopping-up the conduit. When ready to pull wire the cap is pried out with a screw driver, leaving the bushing on the conduit to per-



"Bushettes"

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form its regular function without further handling. Not only are they easier and quicker to install, and furnish an insurance policy against loss due to clogged conduit, but they are better bushings because they are made by the die-cast process, which means they are molded, threads and all, in a steel master die, so that each one is as near perfect as possible. Furthermore, they are made of solid zinc, are rust proof, and still have the requisite strength. "Bushettes" are on the Underwriters' list of approved fittings.—Adv.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BUSHINGS, CONDUIT, END OUTLET.—End outlet bushings for conduit are used largely around machinery. The wiring is usually run in conduit right up close to the motor terminals, where it ends without the use of a box or similar fitting. The outlet bushings used at this point are made in several forms. They usually consist of a casting, drilled and tapped to screw over the conduit and belled out at the other end to permit either a porcelain or metal cover plate to be mounted. The plates have two, three or four holes in them which are well rounded and do not chafe the wire. At the same time they practically close the end of the conduit so as to prevent moisture from getting in.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Butte Electric & Mfg. Co., 534 Folsom St., San Francisco, Cal. "Sealet."
CROUSE-HINDS CO., Syracuse, N. Y.
Electrical Specialty Mfg. Co., Providence, R. I. "Boss."
Frankel Light Co., Cleveland, Ohio. "Ohio."
Freeman Electric Co., E. H., Trenton, N. J. "Termilet."
GILLETTE-VIBBER CO., 32 Maple Ave., New London, Conn. "Gee-Vee."
KILLARK ELECTRIC MFG. CO., 3940 Easton Ave., St. Louis, Mo. "Electrolets."
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
Paiste Co., H. T., Philadelphia, Pa. (Exclusive distributor, Hart & Hegeman Mfg. Co., Hartford, Conn.)
Phelps, James C., Springfield, Mass. "J. C. Caplets."
Robin, Charles G., 47 Warren St., New York, N. Y. "C. G. R."
Standard Specialty Mfg. Co., Cleveland, Ohio. "Diamond E."
V. V. Fittings Co., 1906 N. 6th St., Philadelphia, Pa.

BUSHINGS, FIBER.—Small and short threaded fiber tubes with a smooth inner surface widely used in the manufacture of electrical products. One common use is for screwing into sockets to protect the cord from abrasion by the socket threads. (See Bushings, socket.) They are also used on small motors where the lead wires pass through the frame. Simpler forms of bushings that are not threaded are used in many places where wires pass through metal bases, as in bells, telephone equipment, table and floor lamps, fixtures, etc., and in many places where hard rubber bushings were formerly used.

Manufacturers:

American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display advertisement on page 1320.)
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
Wilmington Fibre Specialty Co., Wilmington, Del.

BUSHINGS, HIGH-TENSION, ENTRANCE.—To pass a high-voltage conductor through a roof or wall requires a bushing of high insulating properties. These bushings usually consist of a copper tube surrounded by a special porcelain bushing made with corrugated surface to give a long arcover path. The bushing is held rigidly to the wall by one or two flanges. Terminal lugs are fastened to the ends of the copper tube for the line connections.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."
GENERAL ELECTRIC CO., Schenectady, N. Y. This company's standard entrance bushings are similar in design to the bushings for transformers, oil circuit breakers, lightning arresters, etc., except that both ends are enclosed in a petticoated porcelain shell and proportioned for operation in air, in contrast with apparatus bushings which are proportioned for operation with one end under oil. Below 73,000 volts the entrance bushings are of the solid type; above 73,000 volts the bushings are of the filled type in which oil or insulating compound forms the insulating medium. Some parts of these bushings are interchangeable with corresponding parts of this Company's standard apparatus bushings. See adv. pages 1203-1223.—Adv.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pittsburgh High Voltage Insulator Co., Derry, Pa.
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSHINGS, HIGH-TENSION TERMINAL, FOR TRANSFORMERS, ETC.—Insulating tubes, through which the high-tension leads are taken into the cases of oil-filled transformers, feeder-voltage regulators, etc. These are generally of porcelain. For very high voltage work they may have double walls, the intermediate space being oil-filled. The lower ends project down into the tank under the surface of the transformer oil. For outdoor transformers, extra surface is necessary to provide insulation when wet. This is generally obtained by circular corrugations or "sheds." Another kind of high-tension bushing is known as the condenser type. It is made of alternate layers of paper and mica insulation and tinfoil, rolled into a cylinder around the conductor. By using narrower layers as the thickness increases, the stress upon the insulation is kept constant and a much lighter and smaller terminal can be used for a given voltage.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. This Company's standard bushings are divided into two groups: The solid type, consisting of a treated paper core with the upper end above the cover enclosed in porcelain, has been standardized for operating voltages between 7501 and 73,000 volts. The filled type bushing has been standardized for voltages between 73,000 and 220,000 volts. The keynote in the design of these bushings, both electrical and mechanical, has been reliability; in their application it has been interchangeability. These bushings are interchangeable among all the standard classes of high-voltage apparatus. They are supplied in designs adapted to high and low altitudes and are uniformly suitable for outdoor service. (Bulletin 49401.) See adv. pages 1203-1223.—Adv.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Mica Insulator Co., Victoriaville, Que., Can.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pittsburgh High Voltage Insulator Co., Derry, Pa.
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Tennessee Burner Mfg. Co., Chattanooga, Tenn. "XL."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSHINGS, INSULATING, MISCELLANEOUS.—Bushings for insulating purposes are made of a large number of insulating materials and in numerous shapes and sizes. Many electrical products have small insulating bushings installed in them. These are sometimes made of porcelain, fiber, glass or rubber, but often of molded compounds, mica, cement, etc. The bushings are frequently made to screw into tapped holes or to be driven or placed in other holes to protect screws, insulate binding posts, and for numerous other purposes, and they are made in various forms to suit the conditions.

Manufacturers:

American Lava Corp., 1429 William St., Chattanooga, Tenn. (lava.)
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Bartlett, Inc., H. N., 19 Park Row, New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display advertisement on page 1320.)
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
GARFIELD MFG. CO., Garfield, N. J.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn, N. Y. "Lavarock."
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Mica Insulator Co., 68 Church St., New York, N. Y.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Powerlet."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pittsburgh High Voltage Insulator Co., Derry, Pa.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Simon, Emil J., 217 Broadway, New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

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WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BUSHINGS, MISCELLANEOUS.—Many bushings are used in electrical apparatus that are not insulating bushings. Where small shafts are supported by parts of the main frame or wall of a machine, instead of making a regular bearing surface, the wall is drilled and a special bushing of bearing material inserted. This method is used quite extensively in places where only a small shaft is used and when only a light bearing would be required. Pulleys of various kinds, such as idlers, belt tighteners, etc., are also fitted with brass or bronze bushings which serve as a bearing. Many special oilless bearings for small loads are also made in this manner as bushings.

Manufacturers:

Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. "Nigrum."
Bunting Brass & Bronze Co., The, Toledo, Ohio.
Capitol Brass Works, Detroit, Mich. "Capitol."
Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill. (Bronze.)
Legler-Ellerman Co., The, Dayton, Ohio.
Nolu Oilless Bearing Co., 6 E. Johnson St., Germantown, Philadelphia, Pa.
Randall Graphite Products Corp., 711-721 Fulton St., Chicago, Ill.

BUSHINGS, PORCELAIN, — Tubes of glazed or unglazed porcelain varying in internal diameter from ⅛ in. to 2½ in. and in length from ½ in. to 24 ins. and used very extensively throughout the electrical industry. They are useful in nearly all places where wiring is passed through wood or metal work, as in floors, joists, walls, switch cabinets, junction and cutout boxes, electric signs, plugs and sockets, transformers, motors and generators, meters and instruments, switchboards, metal ceilings and cornices, iron and steel beams, plates, etc. They are made in a number of forms for these various purposes, among which are clamp bushings, elbow bushings, split bushings and straight tube bushings. Commonly used special forms of porcelain bushings are listed separately under Bushings, conduit box and cabinet; high-tension entrance; high-tension terminal; service entrance.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Boch-Metsch Porcelain Co., The, East Liverpool, Ohio.
Brunt Porcelain Co., The, P. O. Box 493, Columbus, Ohio. "Brunt."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display advertisement on page 1260.)
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. Federal clamp bushings are made of one piece of the best grade of vitrified porcelain. Clamping rings are made of metal, threaded to fit threads on the porcelain. See display adv. page 1291.—Adv.



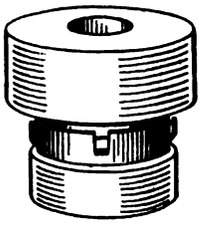
Federal Clamp Bushing

Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Findlay Electric Porcelain Co., The, Findlay, Ohio.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display adv. page 1301.)
Killoch Co., David, 57 Murray St., New York, N. Y. "K K K."
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi" clamp bushings for outlet boxes and steel



"Multi" Clamp Bushing

cabinets. The bushings consist of a threaded porcelain body made in sizes to fit the standard steel box knockouts and are clamped securely in place by the threading on of helix spring coil of wire, which is made to engage the threads to the porcelain.—Adv.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B bushings are used so extensively that a great many standard designs are available. In addition, O-B facilities for producing special shapes are practically unlimited.—Adv.
PARKER & SON, INC., J. H., Parkersburg, W. Va., Porcelain box and cab-



Porcelain Box and Cabinet Bushing

inet bushings, with metal fasteners which can be installed from the outside, and are self-locking.—Adv.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Pittsburgh High Voltage Insulator Co., Derry, Pa.
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Thomas & Betts Co., The, 63 Vesey St., New York, N. Y.
THOMAS & SONS CO., THE, R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BUSHINGS, RUBBER.—Small threaded tubes of rubber having a smooth inner surface with rounded entrances. In the form of hard rubber they are used very commonly in sockets attached to flexible or drop cord to protect the insulation from abrasion by the threads of the socket. (See Bushings, socket.) Soft rubber bushings are also used in generators and motors for giving additional protection to the lead wires where they pass through the frame, especially in machines exposed to moisture. Another use is in attachment plugs where the soft bushing grips the cord very tightly and gives a weatherproof plug. Both hard and soft rubber bushings are also used largely on instruments of various kinds.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Diamond Rubber Co., The, Akron, Ohio.
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
Salisbury & Co., Inc., W. H., 308-10 W. Madison St., Chicago, Ill.
Spaulding & Sons Co., Inc., J., 300 Wheeler St., Tonawanda, N. Y.

BUSHINGS, SERVICE ENTRANCE.—Porcelain tubes through the wall of a building, and sloped down towards the outside, through which ordinary service wires are led into the building. In place of such bushings it is permissible to use a special service entrance fitting or head with separately bushed holes for each wire, this fitting connecting to a service conduit passing through the wall; see Service entrance fittings. Bushings for high-tension services are special and not included in the above class; see Bushings, high-tension entrance.

Manufacturers:

Austin Co., The M. B., 108 S. Desplaines, St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electrical Specialty Mfg. Co., 51 Beufort St., Providence, R. I. "Boss."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Pittsburgh High Voltage Insulator Co., Derry, Pa.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

BUSHINGS, SOCKET.—Bushings, usually of composition material or hard rubber, smooth inside and externally threaded to turn into the opening through the cap of the socket, and designed to protect the insulation on pendent or drop cord from abrasion by the threads of the socket when the latter is not attached to a fixture but is used for either a pendant or hand lamp.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn. "Knostrain."
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

BUSHINGS, TROLLEY WHEEL.—A bearing inserted in the hub of the trolley wheel which carries the wheel on its axle. Designed to give long life with infrequent lubrication.

Manufacturers:

American Bronze Corp., Berwyn, Pa.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Bound Brook Oil-Less Bearing Co., Bound Brook, N. J. "Bound Brook."
East Hampton Bell Co., The, East Hampton, Conn.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
Hodgkins Co., J. F., Box 447, Gardiner, Me.
Holland Trolley Supply Co., The, 1623 E. 43rd St., Cleveland, Ohio.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Warner Electric Co., Muncie, Ind.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

BUSHKILL.—Trade name for ignition coils manufactured by the Doyle-Dacosta Mfg. Co., Easton, Pa.

BUSHNELL MFG. CO.—2926 Telegraph Ave., Berkeley, Cal. Manufacturer of motors, generators, electrotherapeutic apparatus, die sinking tools, etc. Business established 1920. President and general manager, John B. Bushnell; vice-president, James Butler; secretary and sales manager, W. T. Merriman; treasurer, Robert J. Pratt.

BUSS.—Trade name for fuses made by the Bussmann Mfg. Co., 3819 N. 23rd St., St. Louis, Mo.

BUSSMANN MFG. CO.—3819 N. 23rd St., St. Louis, Mo. Manufacturer of fuses. Business established 1914. President and

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treasurer, A. B. Bussmann; vice-president and sales manager, H. T. Bussmann; secretary, J. A. Bussmann. Factories, St. Louis, Mo., and East St. Louis, Ill.

BUSY.—A term applied to a telephone line, trunk or other apparatus when it is in use. A "busy test" is the act by means of which the operator or automatic switch tests a telephone line or trunk to see if it is free or in use. On a manual switchboard it is accomplished by the operator touching the tip of the plug to the sleeve of the jack of the line. If there is silence, the line is free. If a click is heard, the line is busy. The click is caused by a battery voltage placed on the sleeve of the plug. In an automatic switchboard, there is a relay in the switch which is energized by a similar voltage (if the line is busy) and this relay prevents connection and gives a busy tone to the calling subscriber. It is possible to put such an electrical condition on the test wire of a telephone line that it will appear busy to any operator or automatic switch which tests it. It is usually done by grounding the sleeve wire (manual) or the release trunk (automatic). This act is described by the term "To make busy."

BUSY BACK.—Apparatus in a central telephone office which returns to the calling subscriber an interrupted buzzing tone if the called line is busy. This is generally an automatic signal.

BUSY HOUR.—A term used in telephony to denote the hour of peak load, when the calls are coming in at a rate faster than during the hour before and the hour after. Business telephones have a busy hour in the forenoon and one in the afternoon, the former handling many more calls. Residence telephones frequently have a well defined busy hour also after the evening meal.

BUTLER-EDWARDS ELECTRIC CO.—Easton, Pa. Manufacturer of telephone ringing machines. Business established 1914. President, W. H. McCammon; vice-president and general manager, W. E. Butler; secretary and sales manager, Allen Harvey. Exclusive distributor, Western Electric Co., 195 Broadway, New York, N. Y.

BUTLER ELECTRIC CO.—3531 Cottage Grove Ave., Chicago, Ill. Manufacturer of fixture fittings, etc. Business established 1902. F. L. Butler, proprietor.

BUTTE ELECTRIC & MFG. CO.—534 Folsom St., San Francisco, Cal. Manufacturer of terminal fittings.

BUTTERFIELD & CO. DIVISION, UNION TWIST DRILL CO.—Derby Line, Vt. Manufacturer of reamers, threading taps and die stocks. Business established 1880. President, John A. MacGregor; vice-president, Simon McKay; secretary, W. B. McSkimmon; treasurer, J. H. Drury; general manager, F. S. Laythe; sales manager, L. H. Laythe. Main office, Derby Line, Vt. Factories, Derby Line, Vt., and Rock Island, Que., Can. Branch offices, 11 S. Clinton St., Chicago, Ill.; 220 King St., West, Toronto, Ont.; 131 St. Paul St, W., Montreal, Que., Rock Island, Que., Can.

BUTTERFLY.—Trade name for electric washing machines and cream separators manufactured by the Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.

BUTTER-KIST.—Trade name for electric corn poppers manufactured by the Holcomb & Hoke Mfg. Co., Indianapolis, Ind.

BUTTONS, PUSH.—See Push buttons.

BUZZERS, ELECTRIC, MARINE.—Signaling buzzers having their operating parts enclosed in water-tight and sometimes vaporproof casings designed especially for use on board ship or in very damp locations, such as docks, laundries, packing houses, etc.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin watertight marine buzzers are built for reliable signal service under severe conditions. Casings of brass or B. E. Metal tapped for ⅛ inch cir. pipe connection, arranged for bulkhead mounting. For d-c. Circuits only.—Adv.



Watertight Marine Buzzer

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

Marine Electric Co., 195 Fremont St., San Francisco, Cal.

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

BUZZERS, ELECTRIC, MISCELLANEOUS.—This classification includes buzzers for all the miscellaneous services not otherwise listed herewith. Among these are the buzzers so commonly used as a call or signal in offices, residences, stores, etc., either individually or in connection with an annunciator or with a bell system; in the latter case they give a much desired differentiated signal.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

Autocall Co., The, Shelby, Ohio.

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Heavy duty buzzers with clear distinctive tone pitch for use on call and warning systems in factories, mines, offices, etc. Made in weatherproof and open wiring types for outdoor and indoor installations. For d-c. or a-c. circuit 6 to 250 volts inclusive.—Adv.



Heavy Duty Buzzer

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

Clemens Electrical Corp., 725 Main St., Buffalo, N. Y. (Alternating current.)

EDWARDS & CO., INC., New York, N. Y. Lungen buzzers in varying sizes, having different tone volume. These buzzers are nickel plated, dustproof and bugproof. Compact and attractive.



Lungen Buzzers

Contacts are adjustable. Armatures are pivoted. Popular in offices on account of pleasing tone and dependability.—Adv.

Electric Signal Mfg. Co., Inc., 31 Tremont Ave., Orange, N. J. "Emka."

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.

GENERAL ELECTRIC CO., Schenectady, N. Y. "Remindo". A combined single-pole switch and buzzer mounted on one base and permanently wired in series. Adjustable vibrating spring is normally set to operate one to ten 25-watt lamps. For use on alternating-current circuits only, as a reminder that lamps are on, where light is invisible from point of control. See adv. pages 1203-1223.—Adv.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "Hub Dome."

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

Ostrander & Co., W. R., 371 Broadway, New York, N. Y.

PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.

Rutherford Mfg. Co., R. T., Brooklyn, N. Y. (Exclusive distributor, Electrical Trading Co., 200 Broadway, New York, N. Y.)

Schwarze Electric Co., E. Church St., Adrain, Mich.

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau," "Rex," "PR," "Eclipse," "XXX," "Mario," "Faraday."

BUZZERS, ELECTRIC RAILWAY CAR AND BUS.—Electromagnetic devices to produce an audible signal and operated by means of push buttons, sometimes from dry batteries, and more frequently from the trolley circuit with a series resistance. Used to signal the motorman that passengers desire to alight from the car or bus.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

Brill Co., The J. G., 62nd St., & Woodland Ave., Philadelphia, Pa.

Consolidated Car Heating Co., Albany, N. Y.

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. Faraday high-voltage car signal systems operate directly from the trolley



Faraday High Voltage System

circuit and provide a very reliable signal system for electric railway cars. This line consists of a large assortment of buzzers, bells, push buttons and resistance panels to meet every requirement. Complete low voltage systems also are cataloged. This company has had broad experience in this line and can render exceptional service.—Adv.

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

Schwarze Electric Co., E. Church St., Adrain, Mich.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

BUZZERS, ELECTRIC, WATCHCASE.—Buzzers enclosed in a small, usually nickel-plated, watchcase type cover and designed to give a clear sound in an ordinary sized room or office. They are also convenient for carrying in a pocket for testing work.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Acme," "Eureka," "Wizard."

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.

Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

Stanley & Patterson, 34 Hubert St., New York, N. Y.

BUZZERS, RADIO.—Buzzers giving a high pitched note are often used in radio circuits for setting up weak oscillatory currents for calibration purposes. The construction of buzzers for this purpose is not different from that of other types. Larger buzzers of special construction are also used for small loop transmitting sets.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."

Ansonia Electrical Co., The, Ansonia, Conn. "Acme," "Eureka," "Wizard."

Auth Electrical Specialty So., 422 E. 53rd St., New York, N. Y.

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "Buzzoplex."

CHICAGO INSULATED WIRE & MFG. CO., Sycamore Ill. (See display advertisement on page 1249.)

Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

Federal Telephone & Telegraph Co., Buffalo, N. Y. "Century."

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General Radio Co., 11 Windsor St., Cambridge, Mass.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Radio Corp. of America, 233 Broadway, New York, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

BUZZOPLEX.—Trade name for radio buzzers manufactured by J. H. Bunnell & Co., 32 Park Place, New York, N. Y.

B-W.—Trade name for coil tester manufactured by the Ballman-Whitten Mfg. Co., 4060 Forest Park Blvd., St. Louis, Mo.

B. W. G.—Abbreviation for Birmingham Wire Gage.

BX.—Trade name for flexible steel armored cable manufactured by the Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York, N. Y.

BYERS MACHINE CO., THE JOHN F.—Ravenna, Ohio. Manufacturer of electric hoists, cranes, etc. President, H. R. Loomis; vice-president, F. C. Byers; secretary, treasurer and general manager, H. C. Beckwith; sales manager, L. A. Babcock.

BYRNE-TURNER CO.—212 1st National Bank Bldg., Bellingham, Wash. Manufacturer of crossarms. Manager, Ralph S. Turner.

BYRON JACKSON.—Trade name for centrifugal and turbine pumps manufactured by the Byron Jackson Iron Works, Inc., 410 Sharon Bldg., San Francisco, Cal.

C

C.—Symbol for capacitance or electrostatic capacity.—Formerly also used as the symbol for current, as in the old formula for Ohms law C=E/R; now I is quite universally used for current.—C. is the common abbreviation for centigrade when giving a temperature on the centigrade scale.—C is also the chemical symbol for the element carbon.

C. & D.—Trade name for storage batteries and parts manufactured by the Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.

CA.—The form Ca is the chemical symbol for the metallic element calcium.

CABINET ELECTRIC.—Trade name for insulated screw driver manufactured by the Cronk & Carrier Mfg. Co., 109 W. Water St., Elmira, N. Y.

CABINETS.—As used extensively in electrical construction practice, cabinets are enclosures provided on the front with frames, mats or trims, in which hinged doors are hung; they may be designed for surface mounting on or flush mounting in a wall or partition. They differ from cutout boxes or other enclosing boxes in that the latter are usually mounted on the surface and have flanged doors or covers which are directly secured to and fit around or telescope with the walls of the box itself; the cabinets are also usually larger than boxes. Cabinets are made of sheet steel (of a thickness of at least No. 16 U. S. Gage), of composition material, or of wood which is lined with noncombustible material, such as asbestos board, slate, marble, steel, etc.

Cabinets are used for enclosing panelboards, distributing boards or feeder panels; groups of switches, circuit breakers or fuses; primary dry or wet batteries; also occasionally other electrical apparatus. They serve to protect these devices from the action of moisture, dust, dirt, deleterious gases or materials; also from short-circuits or grounding due to contact with tools or other conducting objects. Further, they protect persons from injury through contact with the live parts of the devices enclosed in the cabinets; special provision is often made to prevent any possibility of shock or other accident from this cause.

CABINETS, BATTERY, MISCELLANEOUS.—Battery cabinets are wooden or steel cabinets arranged for the mounting of several dry cells as a rule, although occasionally used for wet primary cells. The cabinets are either mounted on the wall surface or flush with it, in which case a special decorative trim is sometimes supplied. These cabinets are made to contain as many as 72 cells, several shelves being used for the larger cabinets, and the cells may be arranged in many combinations of series, series-parallel, and parallel. They are used for many purposes, some of the most important being for fire and burglar-alarm systems, annunciator and other signaling systems, etc.

Doors, either single or double, are usually provided with locks. Battery holders are often used within the cabinets, as they facilitate replacing and testing without disturbing the circuit connections, thus making it possible for inexperienced persons to make renewals. Also see Holders, battery.

Manufacturers:

Brink, Inc., C. I., 24 Gold St., Boston, Mass.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
U. S. E. M. Co., 505 W. 52nd St., New York, N. Y. "U S E M."

CABINETS, BATTERY, TELEPHONE.—Telephone battery cabinets are wall cabinets designed to enclose the dry cells used for a local-battery telephone system or an intercommunicating or house telephone system in a large apartment building, factory, store, etc. The cabinets are made for both flush mounting and surface mounting and in steel and wood. They are made for from 3 to 12 cells, which are mounted in an upright position, often on superposed shelves. The battery may be so arranged that some cells are used for the talking circuit and another set for ringing. These cabinets are generally provided with a locked door.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y. "Columbia."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

CABINETS, MISCELLANEOUS.—Although in present practice sheet steel is used for cabinets more than any other material (see the next classification), wood is still used in many cases, also composition materials such as asbestos lumber, etc. Wood cabinets are required to be lined with sheet steel, asbestos board, slate, marble, etc., to make them proof against possible fire originating from a short-circuit within the cabinet. As regards mounting of doors, trim, special wiring compartments, barriers, etc., these cabinets correspond closely to the sheet-steel cabinets. They are also used for similar purposes, such as for panelboards, branch feeders, switch and fuse groups, etc. In addition there are numerous other uses for such miscellaneous cabinets. Among these is the enclosure of relays and other delicate parts of control or regulating equipment that must be protected from dust and dirt, as for electric furnace and generator field regulators; enclosure of automatic telephone selector, connector or other switch groups (often in cabinets having glass sides or panels); enclosure of motors in flour mills, grain elevators, textile mills, or other dusty places or where there is special fire hazard, such cabinets being specially ventilated and fireproofed.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
AURORA STEEL PRODUCTS CO., Aurora, Ill.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
BURDICK CABINET CO., Milton, Wis.
Cavin, F. T., 400 W. Ave. 26, Los Angeles, Cal. "Cavin."
Churchill Cabinet Co., 2119 Churchill St., Chicago, Ill. (wood)
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y. "Columbia."
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
Electrical Development Co., 534 Bienville St., New Orleans, La. ("Clement" wall cabinet.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Flint Electric & Mfg. Co., The, 1412 Delgany St., Denver, Colo.
Globe Optical Co., 403 Washington St., Boston, Mass. (Electrical testing.)
Hobart Bros. Co., 113 Water St., Troy, Ohio. (Stock and accessory.) "HB."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill. (for blueprint filing)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Renim Specialty Co., 110 K St., Boston, Mass. "Renim."
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y.

CABINETS, SHEET STEEL, PANELBOARD, SWITCH, ETC.—Enclosures built up of sheet steel designed for the fireproof enclosing of panelboards, distribution panels or boards, groups of switches, cutout bases, etc. These cabinets are made for both flush or surface mounting. For surface mounting they are made with one door in the smaller sizes and two doors for large cabinets. The doors are either flat steel or paneled and in the larger sizes provided with an inner flange or edge to fit more closely over the edges of the opening and make the cabinet more nearly dustproof. Flush type cabinets are often furnished with separate mats or trim around the door, the trim being finished to har-

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monize with the finish of the room. In many cases there is a small door within a large door, the latter being locked and giving access to the circuit fuses, while the inner door is unlocked and is used to get at the circuit switches; this type is used with safety panelboards. If the cabinet contains more than four branch circuits, it must have back wiring spaces, side wiring spaces or side gutters, or other wiring compartments separated from the base or panel by barriers and well covered. When used in theaters or other places of special hazard, the cabinet should be entirely fireproof and its door should have a spring hinge and latch to keep it closed, or it should be hinged at the top so that it cannot be opened more than about 160°.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
All-Steel-Equip. Co., Aurora, Ill. "All-Steel-Equip."
AURORA STEEL PRODUCTS CO., Aurora, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Burns, James F., 713-715 Cherry St., Philadelphia, Pa. "Readytouse."
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Chicago Switchboard Mfg. Co., 426 S. Clinton St., Chicago, Ill.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cole Metal Products Co., 401 E. 23rd St., New York, N. Y.
COLUMBIA METAL BOX CO., 226 E. 144 St., New York, N. Y. Columbia sheet steel cabinets are manufactured in conformity with the Underwriters Code as to thickness of metal, doors, guttering, etc. Type A, at the left, is for surface work, and Type P, at the right, is for flush work. Regularly furnished also with knock-outs for



Type A



Type P

1-2 in. conduit. Special fittings, locks, knock-outs, etc., can be furnished on specification, also galvanized finish. Type P cabinets are provided with removable steel trim and door. Equipped with knob and turn catch, any style of hinges, catch or lock on request. Finish, black japan. This style especially adapted to panel boards. A complete line of guttered type cabinets for cut outs, panel boards and switchboards.—Adv.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Darby Sons Co., Edward, 416 N. 18th St., Philadelphia, Pa. "Pen-Dar."
Dill Mfg. Co., The, 694 E. 82nd St., Cleveland, Ohio.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Apparatus Co., 1275 Green St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
Goettmann, O. J., 526 E. Ohio St., N. S., Pittsburgh, Pa.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Hauer, Inc., J. B., 96-100 Bayard St., Brooklyn, N. Y.
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Kirtland Electric Construction Co., Inc., 47 Hudson Ave., Albany, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Mfg. Co., Inc., 3201-41 Carrollton Ave., New Orleans, La.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Mansfield Electric Hardware Co., Mansfield, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See advertisement on page 1287.)
O. K. Metal Box Co., 198 Greenwich St., New York, N. Y.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Potter-Acme Mfg. Co., The, 912-920 Champlain Ave., Cleveland, Ohio. "Potter."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y. "Perfection Quality."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Schmidt Electric Co., A. R., E. Water & Buffalo Sts., Milwaukee, Wis.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. A complete line of sheet steel cabinets for panel boards, switchboards and switches. Standard black enamel or special finishes. Sheet steel boxes for panelboards can also be furnished with wood doors and trims. Sprague products, see display adv. pages 1306-7.—Adv.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See adv. pages 1279-1281.)
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Star Metal Box Co., 507-509 W. 19th St., New York, N. Y. "Star."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-3.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., The, Bantam, Conn., Manufacturer of a complete line of panelboard cabinets.—Adv.
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y. "Umbco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse." (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo. (See complete description under "Panelboards, standard.")

CABLE.—In electrical practice a cable is a stranded conductor, or a combination of conductors insulated from one another. The first kind is a single-conductor cable and the second a multiple-conductor cable. The component conductors of a multiple-conductor cable may be either solid or stranded and the cable may or may not have a common insulating covering. The term cable is a general one and, in practice, is usually applied only to the larger sizes. The smaller sizes are called stranded wire, or if very flexible and well insulated, cord. Some specific forms of cable are defined below.

Concentric-Lay Cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid wires.

Duplex Cable. Two insulated single-conductor cables, twisted together, and either with or without a common insulating covering.

N-Conductor Cable. A general term referring to a combination of N conductors insulated from one another. These are usually referred to by a specific number, as 4-conductor or 12-conductor cables, etc.

N-Conductor Concentric Cable. A cable composed of an insulated central conducting core with (N-1) tubular stranded conductors laid over it concentrically and separated by layers of insulation. These usually have only two or three conductors and are used in a-c. circuits.

Rope-Lay Cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid groups of wire. This differs from concentric-lay cable only in that the main strands are themselves stranded.

Triplex Cable. Three insulated single-conductor cables twisted together, either with or without a common insulating covering.

Twin Cable. Two insulated single-conductor cables laid parallel and having a common insulating covering.

CABLE, ALUMINUM.—Aluminum is often used in the construction of cables for transmission lines. It is much lighter than copper but has a lower conductivity and must therefore be used in larger sizes to give equal conductivities. When these are equal the aluminum cable weighs approximately 48.3% of the copper cable. Aluminum cables are made up of several strands of wire and are suitable for most cases where very long spans are not required. This is because the elastic limit and ultimate strength of aluminum is less than that of copper, and for equal conductivity cables, the breaking load of the all-aluminum cable is 64% that of copper.

A very great improvement in the cable is obtained by using a steel reinforcing strand in small cables or a stranded steel core in larger cables, around which the necessary amount of stranded aluminum is placed. The steel is double galvanized and does not readily corrode, but it does increase the mechanical strength so that a steel-reinforced aluminum cable, having sufficient aluminum to give an equal conductivity to copper cable, will have an ultimate strength 34% greater than the copper and will weigh only 72% as much. Cable of this type has been used extensively for power transmission and in some cases has been used on spans a little over 5000 ft. in length.

Manufacturers:

Aluminum Co. of America, 2400 Oliver Bldg., Pittsbugh, Pa.

CABLE, ARC WELDING.—Cable used for connecting welding electrodes to a portable or movable arc welding outfit. It usually consists of a single conductor stranded in such a manner as to be very flexible, and must be able to withstand high temperatures. For this reason rubber insulation is not used as much as varnished cambric, which is applied in a uniform layer and protected with two layers of cotton braid. Other forms have merely the two layers of cotton braid, as the voltage of arc welding circuits is usually quite low. The wax or impregnating compound used on the braids must have a high melting point.

Manufacturers:

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

CABLE, ARMORED.—Flexible cable with two or more separately insulated conductors, usually stranded, enclosed in and protected by an outer wrapping or armor of steel tape or wire. The armored cable used so extensively for wiring finished houses and similar service consists of two or three rubber-covered solid or stranded conductors twisted together, bound with a paraffin-impregnated braid and enclosed in a flexible steel armor. Where such cable is to be used on shipboard or other damp locations, a lead sheath is applied over the braid; on top of this sheath is a serving of jute yarn, which is impregnated and the steel armor then put on. Sometimes one or two jute layers are put on over the armor to protect it from rusting or other corrosion, especially in cables to be buried

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directly in the ground (see Cable, park or suburban) and in submarine cables (see Cable, light and power, submarine; and Cable, telephone and telegraph, submarine). The conductor insulation in armored cables may be rubber, varnished cambric or paper. Where exposed to moisture, cambric and paper-insulated armored cables usually include a lead sheath. Where a lead sheath is not used on rubber-insulated cables, the rubber may be covered with a rubber-filled cotton tape. Aside from the uses mentioned, armored cable is employed extensively in mines, in garages, in shops for portable electric tools, etc. Smaller sizes of armored cable, especially two-conductor, are commonly called armored cord (see Cord, flexible, armored).

Manufacturers:

American Metal Moulding Co., 141-145 New Jersey Railroad Ave., Newark, N. J. "American."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products.—Adv.
Arrow Flexible Conduit Co., 210-12 Canal St., New York, N. Y.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Circle Flexible Conduit Co., Inc., 188 21st St., Brooklyn, N. Y. "Circle."
Columbia Metal Hose Works, 540-550 W. 58th St., New York, N. Y. "Columbia."
DEWES CO., THE A., 199 Lafayette St., New York, N. Y. Circle "D" armored cable is made to conform to the speci-



Circle "D" Armored Cable



Circle "D" Armored Cable

fications of the Underwriters' Laboratories. Upper illustration shows double strip; lower illustration, single strip.—Adv.
EASTERN TUBE & TOOL CO., INC., 594 Johnson Ave., Brooklyn, N. Y. "Brooksteel," "Ettco."
Federal Armored Cable Co., 609 W. 48th St., New York, N. Y. "Federal."
Garland Mfg. Co., West Pittsburgh, Pa. "Sterling."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flex-Steel" armored conductors and flexible metallic conduit can be used for wiring either old or new buildings. The smooth flat surface, inside and outside, makes Flexsteel easy to cut, strip and fish, and prevents catching or binding when pulling around joists or beams. Flexsteel has utmost flexibility; the interlocking of its armor strips prevents the walls from opening or spreading, no matter how short the radius to which it is bent or how severe the strain; and the thorough galvanization of its armor coat gives permanent protection against corrosion. There is a complete line of Flexsteel fittings. See display adv. pages 1302-4.—Adv.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROME WIRE CO., Rome N. Y. (See display adv. page 1247.)
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. "BX" armored conductor contains one, two and three wires, No. 14 to 2. Regular extra heavy or leaded insulation. This is made only by the Sprague company Sprague company. see display adv. pages 1306-7.—Adv.



Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triangle."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
Wolf & Davis, 71-73 Spring St., New York, N. Y.
Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio. "Realflex."

CABLE, ASBESTOS-COVERED.—Cables used in ducts or in exposed light and power circuits where high temperatures are encountered are frequently covered with asbestos. The cable is generally stranded and a thick coating of asbestos is applied and saturated with a cementing compound. An outer covering of cotton braid or braided asbestos yarn is then applied and treated to prevent injurious action of weather, acids or gases.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.

CABLE, BATTERY-CHARGING.—Cable used for connecting storage batteries of automobiles and electric vehicles to stationary battery-charging sets. Generally consists of two stranded conductors laid parallel and bound together with two or three layers of impregnated cotton braid. The individual conductors are rubber-covered and have one serving of cotton braid. In the larger sizes, usually No. 0 A. W. G. and larger, jute fillers are used to make the cable round instead of flat.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-5.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite."
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)

CABLE, BORDER LIGHT.—Cable used in theaters, on platforms or stages, to supply the border lights, and for other stage lighting or temporary power purposes or wherever a flexible multiple-conductor cable is required for lighting purposes. It usually consists of three or more individual rubber-insulated conductors of lamp cord strands, twisted together with heavy jute fillers to make it cylindrical. The cable as a whole is enclosed in two cotton braids saturated with a weatherproofing, or in some cases fireproofing, compound.

Manufacturers:

Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" border light cables are made in two sizes, 12 and 14 B. & S.; with 3, 4, 5, 6, 8 and 10 conductors. For other "Paranite" products, see pages 1235-1239.—Adv.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

CABLE BUTTING.—A term used to denote the preparation of a telephone switchboard cable for fanning out to a connecting or terminal strip. The covering is cut away for a distance and the end laced down or turned under and smoothed down.

CABLE, CAR JUMPER.—Cable used to connect the lighting circuit of the cars of an electrically lighted train or the control circuits of adjacent cars having a multiple-unit control system. They are made very flexible and are sufficiently protected to withstand the wear and weather conditions encountered in the constant swinging between cars. The number of conductors may be anywhere from 3 to 30. Each one is stranded and covered with a soft cotton separator, a heavy coating of rubber, and a colored cotton braid. The conductors are then cabled together with jute fillers, bound with a rubber-filled tape, covered with a layer of rubber compound, and finally protected by two layers of saturated cotton braid.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-5.)

CABLE CELL.—A voltaic cell formed in a defective cable between the broken strand of the conducting core as one electrode and the metallic sheath as the other electrode.

CABLE, "CIRCULAR MILS" OR LARGE STRANDED CONDUCTOR.—Cables having conductors larger than No. 0000 A. W. G. in which the sizes are expressed in circular mils to the nearest fifty thousand. These large cables are used as feeders in street-railway service, for heavy lighting mains and for moderate-voltage power transmission lines. The insulation is generally designed to meet special requirements and may be either paper, varnished cambric or rubber, with protective coverings of impregnated braids or lead sheaths, depending on the conditions to be met. The term "circular mils" cable does not specify the nature of the construction or use, hence it is not used by some cable manufacturers who prefer to use a more descriptive designation.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Copper Products Corp., 200 Broadway, New York, N. Y.
AMERICAN ELECTRICAL WORKS, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of cables of all types—aerial, underground and submarine.—Adv.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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ANACONDA COPPER MINING CO., Rolling Mills Department, Sales Office, 547 Conway Bldg., Chicago, Ill. The company's plant at Great Falls, Montana, is the only one of its kind located west of the Mississippi river. The advantages of this location for shipments



Anaconda Stranded Copper Conductors

to middle-western and western points is quite apparent. Every step from the mining of the ore to the stranding of the finished cable is conducted under Anaconda direction and supervision. Stranded copper conductors of any desired capacity and temper are made from Anaconda electrolytic copper the average conductivity of which is 100.75% Mathiessen's Standard. See display advertisement on page 1246.—Adv.

Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New, York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)

Bay State Insulated Wire & Cable Co., Hyde Park, Mass.

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chicago Insulated Wire & Mfg. Co., Sycamore, Ill.

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See adv. on pages 1244-5.)

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display advertisement on page 1251.)

INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" doublebraid cables are made in cir. mil sizes ranging from 250,000 to 2,000,000. "Paranite" flexible cables are made in sizes from 250,000 to 1,000,000 cir. mils, stranding is in various combinations from 399-22 to 615-18. For other "Paranite" products see pages 1235-1239. —Adv.

Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.

Knickerbocker Annunciator Co., 116 West St., New York, N. Y.

Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display advertisement on pages 1302-4.)

New England Electrical Works, Lisbon, N. H.

New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Raven."

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.

PHILLIPS WIRE CO., Pawtucket, R. I. "Phillips."

Roebling's Sons Co., John A., Trenton, N. J.

ROME WIRE CO., Rome, N. Y. Concentric-lay copper cable can be furnished in hard, medium hard or soft, bare or tinned. In this type of strand all wires are of the same size and each successive layer of wires after the second is twisted in a reverse direction from the preceding one, giving the smallest possible outside diameter for any carrying capacity. The illustration shows a type of cabling machine. All brazes made in individual wires are in accordance with best commercial practice and possess 95 per cent of the strength of the solid wire. The pitch of each wire is from 12 to 16 diameters of the finished cable, and the lay of the completed cable may be either right or left handed. All wire used is manufactured under the general Rome Wire specifications (see Wire, copper, classification) and the tensile strength of concentric-lay copper cable of standard pitch is at least 90 per cent of the total strength required of the wires forming the cable. For the purpose of calculating weights, cross sections, etc., the specific gravity of copper is taken as 8.89 at 20 deg. C. The resistance and mass of a stranded conductor are greater than in a solid conductor of the same cross sectional area, depending on the lay. Two per cent is taken as the standard increment of resistance and of mass. The standard style of stranding begins with seven wires of 15.1 mils each to form the 18 Brown & Sharpe gauge cable and runs up to 127 wires



Rome Cabling Machine

of 125.5 mils each to form the 2,000,000 circular mils cable. Various other methods of stranding copper cable can be furnished as desired using 7, 12, 19, 27, 37, 61, 91 or 127 wires to form any size required. For other Rome Wire products see display advertisement on page 1247.—Adv.

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CABLE CO., THE.—301 S. Wabash Ave., Chicago, Ill. Manufacturer of electrically operated pianos. President, George J. Dowling; vice-president, W. E. Guylee; vice-president and treasurer, H. L. Draper; secretary, Geoge W. Eddy.

CABLE CORE.—The core of any cable is the inner conducting strand or group of strands, which are covered by the insulation and sheath.

CABLE CURRENTS.—A submarine or other buried cable frequently has stray currents flowing in it. These may be earth currents or they may arise from a break or fractured end, which would cause a flow from the break into and along the lead sheath. Stray currents, due chiefly to leakage from the return circuits of electric railways, are very common in underground conduit lines and to prevent their harmful electrolytic effects bonding is resorted to. See Bonding of cables.

CABLE, DECK.—See Cord, flexible, deck or marine.

CABLE, ELEVATOR CONTROL, LIGHTING AND SIGNALING.—Flexible cables in which two or more individual rubber-insulated conductors are each provided with a plain cotton braid, and cabled together with or without a rubber, jute or compound filler or jacket and provided with one or more outer weatherproofed cotton braids or covers or two plain and one weatherproofed outer braids or covers. Flexible steel supporting strands are usually included in the cable. The lighting and control cables contain No. 14 or 16 A. W. G. wire. They are used for the elevator lighting circuit and for connecting the car controller to the stationary equipment. Elevator cables hang in the shaft from the floor of the elevator and are connected to a terminal board near the middle of the shaft. For the signaling circuits, connecting the push buttons on each floor to the annunciator or signal lamp in the elevator, the cable commonly used is similarly suspended and composed of a jute or rope coil with stranded separately insulated conductors (No. 18 A. W. G.) cabled around it and all enclosed in one or two cotton braids.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of cables for use in elevator lighting and signaling.—Adv.

Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."

Bay State Insulated Wire & Cable Co., Hyde Park, Mass.

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."

Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."

Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

Elevator Signal Co., 116 West St., New York, N. Y.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. See display advertisement on pages 1235-1239.—Adv.

Knickerbocker Annunciator Co., 116 West St., New York, N. Y.

Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."

Morse, Frank W., 289 Congress St., Boston, Mass.

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

Roebling's Sons Co., John A., Trenton, N. J.

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CABLE END BELLS.—A type of protection for the joint between a lead-sheathed underground cable and a station or indoor cable. It usually consists of an inverted bell or cup-shaped metal dish that fits snugly over the end of the cable sheath, to which it is joined by a wiped joint. The bell is filled with sealing compound and thus should protect the underground cable against entrance of moisture. The top of the end bell being usually open, the compound is not protected, however, and often cracks develop in it and permit entrance of moisture. Cable end bells are not much used nowadays, except in stations and other indoor installations, since cable potheads have been found to give superior protection; also see Potheads.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.

G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

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CABLE FAULT.—Any defect in a cable that interferes with its proper action or transmission is called a "fault." This may take several forms, such as a "cross," "short," "ground," "break" or "open," etc. The location of the fault and its nature may be quite accurately determined by taking resistance measurements with a testing set; this is called "fault finding."

CABLE, FIRE-ALARM.—Fire-alarm cables are usually made special to meet customers' requirements. They are used to connect the fire department headquarters with each of the alarm stations on the streets or in buildings. In the types most commonly used conductors are insulated with a coating of rubber and tape. The conductors are then cabled together and protected with a lead sheath for placing underground in conduit.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)

CABLE FLOAT.—A float or buoy used in laying a submarine cable. The cable is rested on the float to relieve the strain in the process of paying out. This is sometimes called a cable resister.

CABLE GRIPS.—See Grips, cable.

CABLE, HEATING OF, AND SAFE LIMITING TEMPERATURES FOR.—The load capacity of electrical cables, as of electrical machinery, insofar as temperature is concerned, is limited by the maximum temperature at which the insulating materials may be operated for long periods. The result of operating cables at temperatures in excess of the safe limit is to shorten the life of the insulating material.

The maximum safe limiting temperature in degrees centigrade at the surface of the conductor in a cable, as given in the A. I. E. E. Standardization Rules, shall be: For impregnated paper insulation (85-E), varnished cambric (75-E), rubber insulation (60-0.25E), where E represents the r.m.s. operating e.m.f in kilovolts between conductors. Thus at a working pressure of 3.3 kv., the safe limiting temperature for cables of the three classes would be 81.7°, 71.7° and 59.2° C., respectively.

CABLE, INSULATION RESISTANCE OF.—See Resistance, insulation.

CABLE JOINTING.—At each manhole the ends of adjoining lengths of cable are jointed and protected by a lead sleeve from moisture. On high-tension cables jointing operation requires special care to exclude all traces of moisture and to leave the joint without voids as nearly as possible.

The copper conductors are heated and soldered together in a suitable lug. Each is separately taped with the amount of insulation needed for the voltage to be carried and further insulated from the lead sheath by an over-all belt of insulation equivalent to that of the cable. A lead collar is then slipped over, wiped to the cable sheath, and filled with hot compound, after which the openings are soldered over, leaving it water-tight.

In telephone cables each conductor after being spliced is covered by a paper sleeve instead of being individually taped.

CABLE, LEAD-COVERED, MISCELLANEOUS.—Experience has demonstrated that whenever cable is to be used in underground conduits or exposed to acid, gases, extreme temperature changes or other destructive agencies, it should be encased in a lead sheath. For this reason much of the cable used in telephone, railway signaling and other signal systems, both aerial, submarine and underground, and light and power wiring underground and in damp places, etc., is enclosed in a lead sheath. The conductors may be either rubber, cambric or paper-insulated, twisted together with jute fillers and taped. Two conductors, laid parallel (twin cable), are also made up without the jute fillers, giving a flat cable. Lead-covered power cables and telephone cables are described separately below.

The lead sheath is applied by passing the cable through a die surrounded by molten lead, which is kept at a temperature just sufficient to maintain it in a molten state, a slight decrease in temperature causing it to solidify. The lead is applied under hydraulic pressure and is formed into a smooth uniform coating by the die, solidifying just as it leaves the die. The cable is fed through slowly, sometimes directly from a drying oven, as with paper-insulated and dry-core cables, and as it emerges from the die is coiled on a large reel about 15 to 20 ft. away, the time taken to travel that distance being sufficient to permit the sheath to harden.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of heavy rubber cables, lead sheathed, armored or lead encased and armored, for all services and voltages.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bajohr Lightning Conductor Co., Carl, 4055 Keokuk St., St. Louis, Mo.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Circle Flexible Conduit Co., Inc., 188-21st St., Brooklyn, N. Y. "Circle."
EASTERN TUBE & TOOL CO., INC., 594 Johnson Ave., Brooklyn, N. Y.
Federal Armored Cable Co., 609 W. 48th St., New York., N. Y., "Federal."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" lead encased cables are made as duplex in sizes from No. 12 to No. 0000, B. & S.; three-conductor, stranded, in sizes from No. 12 to No. 0000 B. & S. and single conductor, stranded, from No. 14 to No. 0000 B. & S. "Paranite" lead encased telephone cables are made in sizes carrying from 1 to 100 pairs. For other "Paranite" products see display advertisement on pages 1235-1239.—Adv.
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y.
New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Raven."
Okonite Co., The, Canal St., Passaic N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display advertisement on page 1247.)
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SAMSON ELECTRIC CO., Canton, Mass.
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CABLE, LEAD-COVERED, POWER TYPES.—Cables for use on underground systems serving power and lighting are of the lead-covered or sheathed type, insulated with oiled paper, varnished cambric, or rubber. The conductors are called single, duplex, triplex or multiplex, according as there are one, two, three or more separately insulated conducting cores. The lead sheath is protected by an outer armor of steel wire or tape in case the cable is to be buried in the ground without a conduit system or in the bed of a river; see Cable, park or suburban; also Cable, lighting and power, submarine.

In the larger sizes the outside diameter is limited by the size of the duct, and the strands are then arranged in the form of a sector of a circle (if duplex or triplex). Such cable is known as "sector type" and it is possible to use larger sizes of conductor than with cylindrical conductors.

Single-conductor cables are used for the larger sizes required in low-tension systems, and for distributing mains where there are many taps to be made. Duplex, triplex and quadruplex cables are used for feeders on two-wire, three-wire and four-wire systems quite generally. In the larger sizes two-conductor cables are often arranged with the conductors concentric, the duplex arrangement being too stiff for cable training. Multiple cables are used for pressure wires and other circuits using small conductors.

Oiled paper insulation is best for high-tension cables and is used in some systems for low-tension work as well. It is the least expensive in first cost. Varnished cambric is used up to 10,000 volts to a considerable extent. It is less subject to moisture absorption, in case of damage to the sheath, than is paper, but has a much higher dielectric loss than the better grades of oiled paper. This is of importance only at voltages above 10,000. Rubber is used for the voltages below 3000 to some extent. It is the most expensive type of insulation and has few advantages over varnished cambric as a moisture repellant.

CABLE, LIGHT AND POWER, SUBMARINE.—Stranded electric conductors each provided with an insulating covering and cabled together with a jute filler and having an enclosed lead sheath, another jute layer or two, and a protecting covering of spirally wound galvanized steel wire armor, which is finally guarded from corrosion by outer jute layers. Two, three or four conductors are generally used. Cable of this type is used where light or power circuits cross under rivers, lakes, bays, etc., and is usually securely anchored at each end.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture all classes of submarine cables for street railways, telephone and telegraph companies, and electric light and power plants.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement on page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1239.)
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite".
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CABLE, LIGHTNING CONDUCTING.—Stranded cables are now more generally used for protecting houses, barns, chimneys, church spires, etc., by conducting lightning discharges to ground, than the old-fashioned steel lightning rods. The cables are generally made of copper wire, as it gives good conductivity and does not corrode, and are composed of several strands of No. 17 or 18 A. W. G. wire twisted or woven together. Sometimes a twisted steel ribbon is used as a core to give greater strength. No insulation is applied to cables used for this purpose. They are superior to solid lightning rods because the latter are liable to crystallize and break or, if of steel, to corrode and break, in either case being worse than no lightning rod at all.

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Manufacturers:

Bajohr Lightning Conductor Co., 4055 Keokuk St., St. Louis, Mo.
Boston Lightning Rod Co., 7551 Boylston St., Boston, Mass.
Diamond Cable Co., Bourbon, Ind. "Diamond."
Electra Lightning Rod Co., 30 N. LaSalle St., Chicago, Ill. "Silver-Strand."
Goshen Lightning Rod Co., Goshen, Ind.
Kress Co., George R., 1900-1902 Brighton Rd., Pittsburgh, Pa.
Moore Bros. Lightning Rod Co., Maryville, Mo.
Nebraska Lightning Rod Co., Inc., 205 N. 17th St., Omaha, Neb. "Nebco."
Owen, J. D. & E. G., Janesville, Wis.
St. Louis Lightning Rod Co., 2135 DeKalb St., St. Louis, Mo. "Kretzer Brand."
Security Lightning Rod Co., The, 606-612 S. Pine St., Burlington, Wis.
Shinn Mfg. Co., W. C., 14 E. Jackson Blvd., Chicago, Ill. "Shinn-Flat."
Thompson Lightning Rod Co., Inc., The George E., Owatonna, Minn. "Silver Cord," "Loose Twist."

CABLE, MINING LOCOMOTIVE.—Mining locomotives of the gathering type which run into rooms or tunnels not equipped with trolleys, are connected to the source through a flexible insulated cable which is wound upon a reel and automatically paid out and rewound as the locomotive moves. The cable is sometimes single-conductor, but more generally two or three conductors, separately insulated with a rubber coating and braid, are cabled together either in the flat or round forms and covered with two or three layers of impregnated cotton braid.

Manufacturers:

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement on page 1252.)
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hazard Mfg. Co., 81 E. Ross Ct., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" gathering locomotive cable is made in sizes from 1 to 8 B. & S. Stranding ranges from 49 strands No. 25 to 133 strands No. 22 wire. For other "Paranite" products see pages 1235-1239.—Adv.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
ROME WIRE CO., Rome, N. Y. Rome Wire gathering locomotive cables are constructed with a flexible rope laid copper conductor, insulated with seamless rubber insulation of not less than ⅛ in. in thickness covered with either a tape and one braid, or with two



Rome Mine Locomotive Cable

braids. The illustration shows the various coverings described and general makeup of the cable, which can be furnished in No. 1 to 8 gauge conductors. A seine braid final covering or a triple braid covering can also be furnished if desired. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Co., and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.

CABLE, MINING MACHINE, CONCENTRIC AND FLAT.—Flexible conductors separately insulated with rubber and weatherproof braid, and laid parallel and bound together with two outer weatherproofed braids in the flat type. When three conductors are required they are insulated separately and cabled together with jute fillers and two outer weatherproofed braids applied, giving a round cable. The concentric type is constructed with a central stranded rubber-insulated conductor covered with a tape and a braid over which a number of wire strands equal in area to the central conductor are laid with an outer rubber insulation and covering of a tape and double braid. They are used extensively for cutting machines, drills, hoists and other electrical machinery in mines. Their principal advantages are that they are weatherproof, flexible and will withstand hard wear.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We are manufacturers of "Americore" and "Globe" mining machine cables in twin parallel flexible conductors, and duplex concentric stranded cables for low potential, 0 to 600 volts.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement on page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GLEASON & CO., J. L., 241 Franklin St., Boston, Mass.
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" mining machine cables are made in the flat type and covered with either two or three braids of hard cotton, in sizes from No. 8 to No. 2. Concentric cable, construction "A," has a belt of rubber code thickness applied over the outer wires and the cable is finished with tape and double braid saturated with a weatherproof compound. In construction "B" the outer rubber belt is omitted. See display advertisement on pages 1235-1239.—Adv.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire mining machine cables, duplex, are made up of two flexible rope laid conductors insulated with a rubber wall of code thickness. Each conductor is finished with a weatherproof braid, the two conductors are then laid side by side and covered with two or three braids of hard cotton, which is then saturated with a weatherproof compound. The illustration shows the various coverings and general makeup of Rome Wire mining machine cable. If desired the double braid cable may be made up with the outer braid of seine twine. A triple braid



Rome Mining Machine Cable

covering is also furnished. Manufactured in sizes No. 0 to 8 Brown & Sharpe gage in both the double and triple braid types. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Tirex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triangle."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I. "Duracord."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CABLE, MOVING-PICTURE.—See Wire, motion-picture.

CABLE, PARK OR SUBURBAN.—Cable designed for street lighting circuits in parks, suburbs, etc., where instead of installing conduit, the cable is placed directly in the ground in shallow trenches. It consists of one, two or three rubber-insulated conductors covered with a layer of rubber-filled tape or jute yarn and a lead sheath, over which another layer of jute and two layers of galvanized flat steel tape are placed with an outer covering of impregnated jute braid.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a standard line of flat, steel-taped park or suburban cables, rubber, cambric or paper insulated.—Adv.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CABLE RACK.—Trade name for portable lamp guards manufactured by the McGill Mfg. Co., Valparaiso, Ind.

CABLE ROAD OR RAILWAY.—A railway line, such as a street railway, in which the cars are driven by an endless moving cable running on pulleys usually below and midway between the rails. The cable is wound on a drum driven by an engine or other prime mover in the power house. A gripping lever suspended from the bottom of the first car, called the grip car, was controlled so that the moving cable pulled this car and trailers attached to it along with it. This system was the forerunner of the modern electric street-railway systems. It is obsolete except for incline railways on hillsides, mountains, etc.

CABLE SHIP.—A vessel designed and equipped with the proper cable holding tanks, paying out and reeling up equipment, which is usually motor-driven, and other cable splicing and repair equipment necessary for laying or taking up and repairing submarine cables.

CABLE, SPECIAL AND MISCELLANEOUS, NOT OTHERWISE LISTED.—Cables are required for such a variety of purposes that large quantities are made up to meet special requirements and conditions. As a rule, standard types of construction cannot be used for many special purposes, as the needs of these uses differ so greatly. Nearly twenty types of cables that are widely used are separately listed herewith; aside from these the number of special cables less widely used is almost countless. Some instances of special and miscellaneous types are cables for electric car wiring, "hard service" cables, railway signal cables, third-rail jumper cables, mastarm cables for arc and other street lamps, etc.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. See display advertisement on pages 1235-1239.—Adv.

CABLE, STAGE OR THEATER.—See Cord, flexible, stage or theater. Also see Cable, border light.

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CABLE STRANDING.—The number of wires in a stranded cable increases with its size. From 7 wires it proceeds to 19, 37, 61, 91, 127 and so on, by 1 plus multiples of 6, as the flexibility of the cable requires. Where great flexibility is required 7 strands of 7 or more wires each are used, making what is known as a "rope lay" cable. The length within which a strand makes a complete spiral is known as the "pitch" of the cable. The flexibility is affected by the pitch, a shorter pitch giving somewhat greater flexibility.

CABLE, SWITCHBOARD, FLEXIBLE.—Cable generally made up of tinned annealed copper wires stranded into a flexible cable and insulated with a coating of vulcanized rubber, finally protected with one or two smooth closely woven cotton braids impregnated with a weatherproofing or fireproofing compound. Cable of this kind is used for wiring on the back of a switchboard, or for brush-holder connections and other similar connections requiring a flexible cable. Telephone switchboard cable is listed separately.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture "Americore" rubber covered switchboard cables, National Electrical Code Standard, for low potential, 0 to 600 volts.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement an page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. See display advertisement on pages 1235-1239.—Adv.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROME WIRE CO., Rome, N. Y. (See display advertisement on page 1247.)
Runzel-Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago, Ill.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CABLE TANK OR WELL.—A strong water-tight compartment for holding coils or reels of cable for testing or preparatory to laying. They are most commonly used on cable ships for submarine cable laying.

CABLE TELEGRAPHY.—A system for transmitting telegraph messages through a cable. This may be a land line telegraph or submarine telegraph. Land line cables are not used widely outside of cities or congested districts. Submarine cable telegraph systems are much more important. The use of the cable gives rise to the terms "cable message" and "cablegram" or merely "cable" for a message transmitted in this manner. See "Submarine cable telegraphy" for more complete details, as well as development and present status of this art.

CABLE, TELEGRAPH AND TELEGRAPH, AERIAL AND UNDERGROUND.—Aerial and underground cables for telephone and telegraph lines are generally paper-insulated, having the individual copper conductors wrapped with one paper coating. The wires are twisted into pairs and then a lead sheath is applied to keep out moisture. The construction of the core of some of the cables with a very large number of conductors is somewhat like a concentric cable, having a central core with several concentric outer layers of conductors surrounding it. The whole core is usually bound together and wrapped with paper before the sheath is applied. An alloy of lead and antimony is often used for the sheath, this alloy withstanding abrasive action better than pure lead and having less tendency to crystallize due to vibration. These cables are made in a number of sizes having as many as 1200 pairs of conductors with a few spare conductors in a single cable. These large sizes are designed to be used primarily for underground construction and they are very seldom used for aerial lines in sizes over 400 pairs because of the weight of the cable. Aerial cables are of similar construction but smaller in size and are suspended from a messenger wire by means of cable hangers. Wool-insulated cable is often used as a terminal cable for connecting the underground or aerial cable with the main distributing frame. This has each wire separately wrapped with wool. Moisture does not readily enter it.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of cables for use on telephone and telegraph lines—aerial and underground. —Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement on page 1252.)
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite."
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CABLE, TELEPHONE AND TELEGRAPH, INTERIOR.—Interior telephone and telegraph cables are made in a number of forms and types, depending upon the circuits they are to be used in and their place in the exchange. They are made up of several pairs of individual conductors. There are two general types of interior cables, dry core and saturated core. Paper cable is almost always dry. Interior cable insulated with cotton or silk is usually dry, but sometimes it is saturated with a moisture-repelling substance, such as beeswax, paraffin, and other waxes combined. In general interior cables have the individual conductors insulated with cotton and silk floss laid on in layers, or with twisted paper insulation. The conductors are twisted together into pairs and covered with a binding cord and a layer of paper insulation. Some cables then have a leadfoil wrapping which is covered with a cotton braid saturated with fireproof paint. Paper cables are often covered with a lead sheath. Enamel is used instead of one layer of silk floss on other cables. In nearly all of these cables the color code is followed out in cabling the individual conductors. When two telephone circuits carrying a phantom circuit pass through a cable, special care must be exercised to keep the three circuits balanced among themselves and to other circuits. Cable which has each set of two pairs twisted together to form a "quad" is used for this purpose.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of telephone and telegraph cables for interior use.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Cable Co., The, Yonkers, N. Y. "Ecco."
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" rubber covered telephone cables are made in sizes carrying from 5 to 100 pairs. See display advertising on pages 1235-1239.—Adv.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
ROME WIRE CO., Rome, N. Y. (See display advertisement on page 1247.)
Runzel-Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago, Ill.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CABLE, TELEPHONE AND TELEGRAPH, SUBMARINE.—Cable especially designed to withstand immersion in water and in addition not to be damaged by considerable abrasion. It is usually insulated with rubber, gutta-percha or paper, with an armor of steel or iron wires or flat steel tape around the outside. Shore cable has much heavier armor than deep sea cable, because deep water is quiet. While the first successful submarine cables for telephone and telegraph lines employed gutta-percha as an insulating medium, this type of cable has not always been used. Paper-insulated cables have been successfully used, in which the individual conductors are wrapped in manilla paper and then twisted into pairs, these pairs being cabled together to form the cable core. This core was wrapped with a good paper tape and covered with a lead sheath. A single jute wrapping was placed over the lead and then a layer of armor wires and two more layers of jute which are run through a hot impregnating compound. The rubber-insulated cables are generally made in a similar manner, some being made with a lead sheath and others without it. Jute coverings are almost always applied

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over the armor. Several conductors are used in all of these cables, the numbers running into hundreds of pairs. The pairs are always twisted separately and then cabled to avoid trouble from induction.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture submarine cables of every type, for telephone and telegraph.—Adv.

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display advertisement on page 1252.)

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)

Hazard Mfg. Co., 81 Ross St., Wilkes-Barre, Pa.

INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1239.

Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Roebling's Sons Co., John A., Trenton, N. J.

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety." Mass. "Hasco."

SAMSON ELECTRIC CO., Canton, Mass.

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CABLE, TREE.—Tree cable or wire is especially designed to resist the wear caused by rubbing against the branches of trees, thus eliminating the necessity of trimming trees or providing battens or insulators, where lighting circuits or other overhead lines pass through sections where trees cannot be avoided. It is a special form of armored cable, although usually a nonmetallic protection is used. The conductor, which may be stranded or solid, is covered with a rubber coating, a layer of tape and impregnated jute, and then with the protective armor, which is sometimes treated fiber spirally wound. A weatherproof braid is applied over the armor.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See adv. on page 1327.)

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Fibrex."

CABLE, UNDERGROUND, INSTALLATION METHODS FOR.—Underground light and power cables are drawn into a conduit system, or laid directly in the soil. Cables are laid without a conduit system only in such places as parks and parkways where not more than one or two cables will ever be required and where, if repairs are needed, the cables can be reached without breaking through the paving. In places where there is paving and where cables may be added or removed from time to time, it is usual to provide a conduit line with manholes or handholes from which the cable is accessible for jointing and repairs. Underground telephone cables are now always installed in conduit. (See Conduit systems, underground).

Cable is installed in a conduit by setting up a reel at one end of a duct section, and pulling it through to the other end by a winch and steel cable. The pulling cable is first put through the section by pushing jointed conduit rods through from one end, disjointing them as they come out at the other end. Preliminary cleaning of the duct is often necessary. A special cable grip is used to grip the cable being drawn in. Power is applied from a motor truck or by man power through a capstan. The longest pull which can be made without danger of injury to the cable sheath is about 450 ft. and the length of the sections should not exceed this amount.

CABLE, VARNISHED-CAMBRIC-INSULATED.—Cables insulated with varnished cloth or cambric may be used in a number of ways and can be made to meet any voltage and many service conditions. They are made by winding thin varnished cotton or muslin tape around a stranded conductor, usually larger than No. 6. The voltage requirements determine the number of layers of tape applied. Generally a grease or insulating compound is applied between layers and the direction of winding is reversed every three layers. The separately insulated conductors are cabled together, using jute filler to round out the form, and it is then customary to place a few layers of varnished tape around the cable before the protective covering is applied. The covering differs according to the use; for connecting machinery and apparatus in central stations and other buildings a saturated cotton braid or a rubber-filled cotton tape and flameproof braid is used; underground cables have a lead sheath applied over the cambric coating; for outdoor service a rubber-filled cotton tape with one or two layers of galvanized steel armor, and a layer of saturated jute is used, and for building mains two layers of weatherproof braid are applied.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display advertisement on pages 1244-5.)

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

CABLING MACHINES.—Machines carrying a number of rotating reels of insulated wire, cord or twisted pair, on a spider which revolves around a central core drawn along the axis of rotation. Where a large number of separate conductors are required, as in telephone cables, the central core passes through several such spiders in succession, each one adding a layer of conductors. Machinery of this type is also used in laying the strands in various special forms of cable, such as "rope lay," "concentric strand," etc., as well as for multiple-conductor cable. Machines for twisting the individual strands into a stranded conductor are called wire stranding machines, which see.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

New England Wire Machinery Co., Water Front St., New Haven, Conn.

CADET.—Trade name for annunciators manufactured by the Edwards & Co., Inc., 140th & Exterior Sts., New York, N. Y.

CADILLAC.—Trade name for electric washing machine manufactured by the Cadillac Washing Machine Co., 325 W. Ohio St., Chicago, Ill.

CADILLAC.—Trade name for electric vacuum cleaners and portable blowers manufactured by the Clements Mfg. Co., 609 Fulton St., Chicago, Ill.

CADILLAC WASHING MACHINE CO.—325 W. Ohio St., Chicago, Ill. Manufacturer of electric washing machines. Business established 1920. President and general manager, H. D. Payne; vice-president, S. T. Sjoberg; secretary and treasurer, A. W. DeClerque.

CADMIUM.—A silver-white metal. Symbol Cd.; at. wt. 112.4; sp. gr. 8.60; m. p. 321° C., b. p. 778° C. It occurs chiefly associated with zinc and lead ores, in the treatment of which it may be recovered as a by-product. A large amount is produced in Germany by fractional distillation of zinc ores, the production having reached 40 tons annually just before the war. It is produced in the United States by the same method and also by extraction from lead smelter bag-house fume and electrolytic zinc plant residues. In the Stevens process the material is roasted and then leached with sulphuric acid. Copper, bismuth, etc., are first removed by electrolysis and the solution is then electrolyzed for cadmium. The deposit is usually noncoherent and false bottoms in the tanks are provided for its removal. This deposit is melted under a cover of fused caustic soda to remove arsenic and tellurium and then refined electrolytically in a solution of cadmium sulphate, sulphuric acid, and a salt of a sulphocyanic acid, which prevents deposition of copper, yielding a pure coherent deposit. Cadmium is marketed in the form of sticks of metal and the powder "cadmium yellow," CdS. The latter is used chiefly as a pigment and the former in making easily fusible alloys, particularly for automatic fire extinguishers. Another use for the metal is as an auxiliary electrode in storage-battery tests. The United States produced 50 tons of metal and 16 tons of sulphide in 1919, but has a reduction capacity of nearly 200 tons.

Manufacturers:

Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

Grasselli Chemical Co., The, Cleveland, Ohio.

Mallinckrodt Chemical Works, St. Louis, Mo.

CADY CO., INC., C. N.—Canastota, N. Y. Manufacturer of gasoline and oil engines. Business established 1909. President, treasurer and general manager, C. N. Cady; vice-president, C. P. Cady; secretary and sales manager, H. G. Burton.

CADY OF CANASTOTA.—Trade name for gasoline and oil engines manufactured by the C. N. Cady Co., Inc., Canastota, N. Y.

CALANDER MFG. CO., JOHN.—629-33 Jackson St., St. Paul, Minn. Manufacturer of traveling step ladders. Business established 1889. Sole owner, John Calander.

CALCITE.—Trade name for glass shades manufactured by the Steuben Glass Works, Corning, N. Y.

CALCIUM.—A whitish metal resembling aluminum and very soft when pure. Symbol Ca; at. wt. 40.1; sp. gr. 1.85; m. p. 780° C. A little is used in making calcium hydride, but other than this there is little in commercial use. The metal is obtained by electrolysis of a calcium salt, probably the best method being the use of a bath of pure calcium chloride kept at a temperature of about 760° C. Graphite anodes are used, and chlorine is evolved at the anode. A very high current density is used, of the order of 100 amp. per sq. cm. The metal is deposited molten, but solidifies around the iron cathode, and by gradually raising the latter the calcium is drawn out in an irregular rod. The current efficiency is low and difficult to keep at a satisfactory figure on account of the formation of metal fog around the cathods.

CALCIUM CARBIDE.—(CaC_2). It is made by the interaction of lime (CaO) and carbon when fused together in an electric furnace. Anthracite is generally used, sometimes charcoal or high-grade coke. The furnaces are of two types, those in which the carbide is obtained as a solid block and those in which it is tapped molten. Both are arc furnaces, and there is supplementary heating due to the resistance of the charge. The block furnaces may be of the discontinuous or the continuous type. The Horry furnace of the latter type is employed by the Union Carbide Co. at Niagara Falls. The tapping furnaces, such as the Alby are a later type. Calcium carbide is used mostly for the production of acetylene gas, which it liberates on the addition of water.

CALCIUM CYANAMIDE.—($CaCN_2$). Used as a fertilizer and in the fixation of atmospheric nitrogen. The action of steam on it produces ammonia, and other compounds can be made from it by suitable treatment. It is produced in large quantities in Norway and Sweden, and in America by the American Cyanamide Co. at Niagara Falls. The method depends on the absorption of nitrogen by calcium carbide. Finely ground carbide is put in an iron drum-shaped retort with pure dry nitrogen, all air being removed. The retorts have central resistors in the form of carbon rods. These are connected in horizontal channel furnaces and current turned on at about 75 volts. After 3 or 4 days, during which time the temperature rises to 1000° C., the process is completed, and the cyanamide is removed in a coke-like mass.

CALCIUM NITRATE.—See Nitrates.

CALCULAGRAPH CO.—Hudson Terminal Bldg., New York, N. Y. Manufacturer of telephone call measuring meters.

CALDWELL & CO., INC., EDWARD F.—36-40 W. 15th St., New York, N. Y. Manufacturer of lighting fixtures, portable lamps and lighting specialties. President, V. F. von Lossberg; vice-president, W. Klehr; secretary, L. Livingston; treasurer, E. T. Caldwell.

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CALDWELL & CO., E. R.—Bradford, Pa. Manufacturers of car wheel and forcing presses. President, E. C. Emery; secretary, T. S. Fannin; treasurer, V. H. Oxley.

CALDWELL & SON CO., H. W.—17th & Western Ave., Chicago, Ill. Manufacturer of elevating, conveying and power transmission machinery. President, S. C. Caldwell; vice-president and treasurer, Oliver N. Caldwell; vice-president, Frank C. Caldwell; secretary, H. W. Caldwell.

CALDWELL CO., W. E.—Brook & D Sts., Louisville, Ky. Manufacturer of friction clutch couplings, flexible shaft couplings, pulleys, shafting, belt tighteners, etc. President, W. E. Caldwell; vice-president, H. B. Wintersmith; secretary, W. S. Brentlinger; treasurer, J. V. Hall.

CALDWELL ELECTRIC CORP.—1002 N. Market St., Champaign, Ill. Manufacturer of electric lighting fixtures, lamps, reflectors, etc. Business established 1902. President and general manager, C. M. Caldwell; vice-president, B. J. Caldwell; secretary and treasurer, E. C. Caldwell; sales manager, E. A. Mayer.

CALEBAUGH SELF-LUBRICATING CARBON CO., INC.—1503 Columbia Ave., Philadelphia, Pa. Manufacturer of carbon and graphite brushes. President, C. B. Fithian; secretary and treasurer, Albert Gentel; general manager, J. C. Calebaugh; sales manager, Walter Geiser.

CALGARY IRON WORKS, LTD., THE.—410-416 9th Ave., East, Calgary, Alta., Can. Manufacturer of iron street lamp posts and portable lamp bases.

CALIBESTOS.—Trade name for asbestos metallic sheet packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

CALIBRATE.—To ascertain the caliber of, as to graduate the scale in the case of a thermometer, or to determine the action of and the proper rating for an electrical machine or instrument. A very common use of the word refers to the comparison of measuring instruments, such as wattmeters, ammeters or voltmeters, with the respective standards, to determine the variation in the readings of the tested instruments from the correct values; or it may mean the determination of the correct value of an instrument's indication throughout its range, as in the calibration of galvanometers. Also see Checking of ammeters, Checking of watt-hour meters, etc.; Testing of instruments.

CALIDO.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

CALIFORNIA PAINT CO.—Oakland, Cal. Manufacturer of insulating and protective paints and varnishes. President, O. S. Orrick; vice-president and manager, M. S. Orrick. Main office and factory, 11th, 12th & Pine Sts., Oakland, Cal. Branch offices, San Francisco, Cal.; Portland, Ore.; Seattle, Wash.; Salt Lake City, Utah.

CALIFORNIA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Secretary, J. W. Redpath, San Francisco, Cal.

CALKING TOOLS, ELECTRICALLY OPERATED.—Electric hammers of the motor or solenoid-operated type having working faces or heads specially designed for calking seams in wood, steel or concrete construction. They are used on ships where tarred oakum is pushed in between the boards to prevent leaking and on large slabs of stone, concrete and steel structures where joints left to permit expansion must be made waterproof by calking. In some cases they are used on steel plates where two pieces are joined together in a lap joint that must be made waterproof. Considerable hammer action is required in this case to drive the edge of the top plate down close to or into the under plate.

Manufacturers:

Electric Tool Mfg. Co., The, Petersburg, Va. "Paulero."
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

CALL SYSTEMS, AUDIBLE.—Audible call systems are used in factories, power plants, etc., to give signals and calls that may be heard by everyone in the plant. Usually some form of a horn or whistle is used for this purpose, as the noise of machinery is often so loud as to interfere with a bell or gong signal. These systems differ from ordinary code signaling systems in that they may be used to sound a general alarm or to give the starting and stopping signals for a generating unit or other machine, or signal for a change of shift or give some other general call. They are sometimes arranged so that they may also be used for a code call to summon a particular individual, as the superintendent or chief engineer.

Manufacturers:

Autocall Co., The Shelby, Ohio.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CALL SYSTEMS, SILENT—Signaling systems for use in department stores, penal institutions, etc., for transmitting silent signals to several points, usually from a central calling station. They operate by lighting indicating lamps that are not extinguished until the calls have been responded to. The lamps may operate directly from the lighting system without requiring relays, transformers or other auxiliary apparatus.

The lamp stations comprise a number of lamps of different color, size or shape and are located where they may be readily observed by the individuals called. A definite code is used. Silent calls are especially valuable in summoning an official, detective or guard without creating as much attention as is done by any audible signals. Another important application is in hospitals or asylums; for these see Signaling systems, hospital.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

CALL, TELEPHONE.—A call from one person to another may be made in a number of ways. If he calls by the voice through the air or through a speaking tube, it may be termed direct, but if he uses a telephone in reaching the other person, it is called a telephone call. When the two persons have finished talking over the telephone, it is called a completed call.

The person who originates a telephone call, or the calling subscriber, is known as the "calling party." The subscriber who is called by another person is known as the "called party." The number of the desired telephone is the "call number." There are a number of forms of telephone calls, the most important of which are described below.

Call by Appointment. This is a call set by agreement for a definite time.

Incoming Call. One which passes into an exchange or an office from some other place.

Local Call. A call between two subscribers in the same office or exchange.

Long-Distance Call. A call over a long-distance toll line.

Outgoing Call. A telephone call which passes from a subscriber in one office or an exchange to some other place.

Person-to-Person Call, or Particular-Party Call. This is a call which is paid for only if a specified person is secured.

Reverting Call. A call between two subscribers on the same party line.

Through Call. A call which passes from one toll office through a switching toll office to another toll office.

Toll Call. A call over a toll line.

Two-Number Call. A call which is paid for if any person at the called telephone answers. It is most used between a city and its suburbs.

CALL WIRE AND KEY.—The wire and key used in a telephone system between exchanges or between switchboards by means of which one operator signals the distant operator for the assignment of a trunk over which the call may be transmitted. The call wire is not available for conversation between subscribers. In a multiple switchboard each operator's position on the "A" board has a group of call-wire keys with which the operator may communicate with any other exchange or with any "B" board in the same exchange.

In other systems call wires are sometimes used for signaling only by subscribers or by different stations of an intercommunicating system.

CALLAHAN CO., THE W. P.—Dayton, Ohio. Manufacturer of gas and gasoline engines. President, R. J. Connelly; vice-president, J. DeF. Richards; secretary, L. W. James; treasurer, M. Costello.

CALLING DEVICE.—A calling device is a mechanism used on an automatic telephone by means of which the automatic switches are controlled. The dial calling device consists of impulse springs in the line circuit of the telephone, a driving spring, a governor, and a dial. The latter is exposed. It has numbers on or under it so that the subscriber may spell out the call number by rotating the dial once for each digit. There is also a push-button calling device which does the same thing, but it is used only by operators who need to call into an automatic switchboard.

CALLS, CARRIAGE, ELECTRIC.—Signaling devices placed outside of theaters, hotels, restaurants, etc., by means of which it is possible to call the cab driver or chauffeur waiting for any particular party. One common form consists of three banks of lamps, so arranged that it is possible to form on each bank any number up to 9. The three banks permit any combination up to 999. The circuits for these lamps are controlled by special switches operated by a doorman. The switches consist of a number of small contacts that close the circuits. In one form the driver and occupant are each given a card upon arriving. This card is numbered and perforated according to a code so that when the card is inserted in the control device, the contacts are automatically made to display the proper number on the call board.

While calls of this nature have been used successfully they cannot be applied to localities subject to dense fogs or other conditions that would interfere with the driver seeing the number. Loud-speaking telephones may, therefore, be used under these conditions. Several types of annunciators are also used; for these see Annunciators, carriage call.

CALLS, MESSENGER, DISTRICT AND TELEGRAPH.—Messenger calls are designed to permit numerous offices in any district to place a call for a messenger by merely turning a handle, pressing a button or some other similar operation. The calls operate in some cases similarly to a fire-alarm system, having a signal box in each office on the system and all connected on a closed circuit through which a small current flows. When the call is sent in a clockwork mechanism in the box is released and this interrupts the current according to a certain code. The interruptions register at the telegraph or messenger office and indicate the origin of the call, as each office has a separate code number. There are other systems used that are variations of this principle or that operate as an open-circuit system.

Manufacturers:

Bunnell & Co., 32 Park Plate, New York, N. Y. "Bunnell."

CALMAN & CO., EMIL.—100 William St., New York, N. Y. Manufacturers of insulating oil, varnishes and other insulating materials. Business established 1850. H. L. Calman, owner. Factory, Long Island City, N. Y.

CALOMEL ELECTRODE.—A small cell containing mercury, on top of which is placed calomel (mercurous chloride) and the whole covered by a saturated solution of calomel in water. Since the solubility of the calomel is low, the conductivity of the solution is increased by the addition of potassium chloride. Electrical connection is made with the mercury, and the whole is contained in a tube or bottle with a siphon-shaped capillary connecting tube which connects with the electrolyte to be investigated. The electromotive potential existing between the mercury in the calomel electrode and the anode or cathode of the electrolyzing cell is then measured by a high-resistance voltmeter or a potentiometer. These measurements are called single potentials referred to a standard calomel electrode.

CALOREL.—Trade name for electrically heated glue pots and automobile heaters manufactured by the National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C.

CALOREL STRIP.—Trade name for electrical heating devices manufactured by the National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C.

CALOREX CORP., THE.—10 W. 23rd St., New York, N. Y. Manufacturer of electric heating appliances. Business established 1919. President and general manager, W. P. Robertson; vice-president, W. C. Van Clief; secretary, M. J. Nicholas; treasurer, A. H. Schneer.

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CALORIE.—The unit of heat used in scientific work. A calorie is the heat required to change the temperature of one gram of water from 15° to 16° centigrade. Since the specific heat of water changes slightly with temperature, a definite temperature is specified as well as the amount of change. One calorie equals 0.003968 B. t. u. The calorie is sometimes called the gram-degree centigrade.

CALORIMETERS, COAL, ETC.—Much of the coal purchased in large quantities for use in power plants is bought on a basis of heating value as determined by test. It is of great importance to know the amount of heat that a certain grade of coal can develop and calorimeters have been designed to provide a simple method of making this determination.

In general, they consist of a combustion chamber which is completely surrounded by a vessel of water. The water vessel in turn is surrounded by an outer vessel which is sealed to provide an air jacket and thus prevent radiation or absorption of heat. A definite weighed quantity of dry powdered coal is placed in a crucible in the combustion chamber which is then sealed, and a measured amount of water is placed in the water vessel. The temperature of the water is recorded and then the charge ignited, usually by an electric spark. The water is stirred from the outside by mechanical means so that a uniform temperature is obtained. From the rise in temperature and the amounts of coal and water used the heating value of the coal is obtained. When using standard amounts of coal and water, this is determined directly from the temperature change by means of a table. Such calorimeters are also used for determining the heating value of other solid or liquid fuels, such as coke, charcoal, lignite, fuel oil, etc.

Manufacturers:

Precision Instrument Co., 21 Halsey St., Newark, N. J.

CALORIMETRIC PHOTOMETER. — A photometer which measures the value or intensity of light by absorbing it in a thermoelectric couple and then calculating the energy thus generated.

CALPACO.—Trade name for protective paint manufactured by the California Paint Co., 11th, 12th and Pine Sts., Oakland, Cal.

CALUMET.—Trade name for low-voltage rubber-covered wire and cable manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

CALUMET.—Trade name for ultra-violet ray apparatus manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

CALUMET MOTOR CO.—Calumet, Mich., Manufacturer of fractional horsepower motors. Business established 1920. President and sales manager, Ocha Potter; vice-presidents, O. D. McClure, C. H. Benedict; secretary and treasurer, John G. Bennetts; general manager, R. N. Early. Factory, Lake Linden, Mich.

CALUMET STORAGE BATTERY CO.—10113 Indianapolis Ave., Chicago, Ill. Manufacturer of storage batteries. President, W. L. Coulter; secretary and treasue, C. L. Wood.

CALVERT. — Trade name for cutout boxes manufactured by Riggs, Distler & Stringer, Baltimore, Md.

CAMBRIC, VARNISHED.—A thin white cotton or linen fabric coated with a mixture of boiled linseed oil, resin and benzine. Several coats may be added to give any thickness desired. This results in a slightly elastic material with a smooth hard surface. Its dielectric strength, in thicknesses from 5 to 16 mils, is about 19,700 to 51,000 volts per mm. Varnished cambric is used in tape form for cable insulation, usually being applied over a protective layer of paper or cloth and then protected by a weatherproofing compound and braiding or a lead sheath. In sheet form varnished cambric is used for armature and transformer element insulation.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., Valparaiso, Ind. (See display adv. page 1320.)
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. This product is woven from specially selected, long fiber cotton, finished in the company's own bleachery and especially for electrical purposes. The process insures a smooth, uniform finish with greatest dielectric and mechanical strength. Uniform coatings of any desired thickness are obtained by treatment in specially designed towers. This cambric is particularly adapted to cable insulation and repair work. It is furnished in yellow or black. The latter is of superior quality from the standpoints of dielectric strength, flexibility and heat-resisting properties. It was originated by the Irvington Varnish and Insulator Company and is treated with a compound having an asphaltic base, which gives it the dark color and heat-resisting quality. See display adv. page 1319 for all Irvington electrical products.—Adv.
Meirowsky Bros., 11 McPherson Pl., Jersey City, N. J.
Mica Insulator Co., 68 Church St., New York, N. Y. "Kablak."
Mica Insulator Co., Victoriaville, Que., Can.
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Standard Insulation Co., Rutherford, N. J. "Sico."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CAMBRIDGE.—Trade name for vibrating rectifiers and spark gaps manufactured by the Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

CAMBRIDGE BRASS CO.—815 Somerville Ave., Somerville, Mass. Manufacturer of outlet boxes, fixture fittings, castings, etc.

CAMBRIDGE GLASS CO.—Cambridge, Ohio. Manufacturer of illuminating glassware.

CAMERAGRAPH.—Trade name for motion picture machines manufactured by the Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.

CAMERAGRAPH CO.—Kansas City, Mo. Manufacturer of electric photograph printing machines. President and treasurer, Frank E. Jones; vice-president, E. B. Fish; secretary, R. W. Street. Main office and factory, Kansas City, Mo. Branch office, 261 Broadway, New York, N. Y.

CAMERAS, METER-READING. — Cameras are sometimes used to read meters and make a permanent record of the reading without any possibility of mistake. A special camera has been developed for this purpose and a picture of the register dials is taken, using a flashlight to give the necessary light. The film is then turned for a new exposure which is taken at the next house. While this practice gives a correct and indisputable reading it has not been used very much as yet.

Another adaptation of this principle is in a telephone exchange where some subscribers have metered service. A large number of meters for several subscribers are placed in one large cabinet with a glass front and by taking one exposure several meters are read simultaneously. As these meters or registers are quite small, a large number can be placed in one cabinet.

CAMERON. — Trade name for cable hanger manufactured by the Cameron Appliance Co., 46 Waters Ave., Everett, Mass.

CAMERON.—Trade name for electric and turbine-driven pumps manufactured by the Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

CAMERON APPLIANCE CO.—48 Waters Ave., Everett, Mass. Manufacturer of cable hangers, pole changers, ground clamps, etc. Incorporated 1902. President and general manager, T. A. Dissel; secretary and treasurer, J. T. Eddy.

CAMERON ELECTRICAL MFG. CO.—205 Main St., Ansonia, Conn. Manufacturer of commutators and commutator segments. Business established 1902. President and treasurer, John T. Kent; vice-president and general manager, John B. Davidson, secretary, John Elliot.

CAMERON STEAM PUMP WORKS, A. S.—11 Broadway, New York, N. Y. Manufacturer of steam reciprocating pumps. Factory, Phillipsburg, N. J.

CAMERON'S.—Trade name for electrodiagnostic and surgical instruments made by the American Surgical Specialty Co., 6 E. Lake St., Chicago, Ill.

CAMIA.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

CAMOGRAPH.—Trade name for oxy-acetylene cutting and welding outfits manufactured by the Davis-Bournonville Co., Jersey City, N. J.

CAMP.—Trade name for clay underground conduit manufactured by the National Fire Proofing Co., Pittsburgh, Pa.

CAMP BROS. & CO.—Washington, Ill. Manufacturers of electric washing machines.

CAMP CO.—LaCrosse, Wis. Manufacturer of electric hair driers.

CAMPBELL.—Trade name for wiring devices manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

CAMPBELL CO., A. S.—East Boston, Mass. Manufacturer of electrical specialties for automobiles and motor boats. President, A. S. Campbell; vice-president, A. Decort; treasurer, W. C. Martin; general manager, W. C. Cary; sales manager, J. G. Campazzie. Main office and factory, 161 Prescott St., East Boston, Mass. Branch office, 253 Broadway, New York, N. Y. Sales representatives, Norman Cowan Co., 451 Rialto Bldg., San Francisco, Cal.; F. E. Bruelheide, 517 Lumber Exchange Bldg., Minneapolis, Minn.; R. E. Foster, State and Lake Bldg., Chicago, Ill.

CAMPBELL ELECTRIC CO.—1529 Wyandotte St., Kansas City, Mo. Manufacturer of storage batteries, battery plates and battery parts. Business established 1919. President, Jesse Oppenheimer; vice-president, Harold Oppenheimer; secretary, treasurer and general manager, Herman Stern.

CAMPBELL ELECTRIC CO.—17 Stewart St., Lynn, Mass. Manufacturer of X-ray equipment. Business established 1901. President, Charles E. Campbell; vice-presidents, John B. Hadaway, Eugene B. Fraser; secretary, A. M. Rich; treasurer, Fred R. Campbell; general manager, Horace E. Norman; sales manager, Frederick H. Jackson.

CAMPBELL FIBRE CO.—Stanton, Del. Manufacturer of vulcanized fiber, sheets, rods, tubes, washers and disks. Business established 1917. President and general manager, T. W. Campbell; vice-president and treasurer, R. L. Campbell; secretary, George L. Townsend.

CAMPBELL MACHINE CO., INC.—Wollaston, Mass. Manufacturer of motor-driven floor-surfacing machines. President, W. C. York; treasurer, J. A. Campbell.

CAMPBELL PAPER BOX CO.—South Bend, Ind. Manufacturer of cartons for flashlights, etc.

CAN TOP.—A form of telephone cable terminal for pole mounting, whose covering is like a large can, inverted over the terminals to protect them from the weather. It is usually of heavily galvanized iron. See Terminals, telephone cable.

CANADA.—Trade name for electrical wires and cables manufactured by the Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can.

CANADA DRY CELLS, LTD.—Winnipeg, Man., Can. Manufacturer of dry batteries.

CANADA WIRE & CABLE CO., LTD.—Toronto, Ont., Can. Manufacturer of bare and insulated wire and cables. Business established 1910. President and general manager, F. John Bell; vice-president, H. Horsfall; secretary and treasurer, H. J. Boggis; sales manager, Thomas A. Gass. Main office, 2410 Dundas St., West, Toronto, Ont., Can. Factory, Leaside, Ont. Branch offices and warehouses, 143 Beaver Hall Hill, Montreal, Que.; 674 Barrington St., Halifax, N. S.; 592 Notre Dame Ave., West, Winnipeg, Man.; 738 11th Ave., West, Calgary Alta.; 1032 Hamilton St., Vancouver, B. C.

CANADIAN.—Trade name for hydraulic turbines manufactured by Charles Barber & Sons, Meaford, Ont., Can.

CANADIAN.—Trade name for spark coils manufactured by the Canadian Coil Co., Ltd., Walkerville, Ont., Can.

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CANADIAN.—Trade name for electric ironing machines manufactured by Meyer Bros., 99-101 Queen St., E., Toronto, Ont., Can.

CANADIAN ALOXITE CO., THE—Niagara Falls, Ont., Can. Manufacturer of abrasive materials. President, F. J. Tone; vice-president and secretary, George R. Rayner; treasurer, F. H. Manley; general manager, C. H. Greenwood; sales manager, W. W. Sanderson.

CANADIAN BEAUTY.—Trade name for electric household appliances manufactured by Renfrew Electric Products, Ltd., Renfrew, Ont., Can.

CANADIAN BLOWER & FORGE CO., LTD., THE—Kitchener, Ont., Can. Manufacturer of engine and turbine-driven blowers, fans, pumps and air washers. A. S. Capwell, secretary and treasurer.

CANADIAN BRAKESHOE CO., LTD.—101 Belvidere St., Sherbrooke, Que., Can. Manufacturer of electric brakeshoes, fenders, jacks, etc. Business established 1912. President and sales manager, P. McCullough; vice-president, H. V. Haight; secretary and treasurer, E. W. Jones; general manager, A. McAlpine.

CANADIAN CEDAR & LUMBER CO., LTD.—301 Electric Ry. Chambers, Winnipeg, Man., Can. Producer of electric railway ties and cedar poles. Business established 1917. President and general manager, Joseph Meloney; vice-president, J. H. Meloney; secretary, treasurer and sales manager, W. W. Scoville. Sales representative, Meloney Bros., Williams, Minn.

CANADIAN CLEVELAND FARE BOX CO., LTD.—Duke St., Preston, Ont., Can. Manufacturer of street car fare boxes. Business established 1921. President, general manager and sales manager, M. C. McElligott; vice-president, secretary and treasurer, L. L. McElligott.

CANADIAN COIL CO., LTD.—Walkerville, Ont., Can. Manufacturer of spark coils and battery switches. President and treasurer, C. C. Cleverdon; vice-president and secretary, J. R. Cleverdon.

CANADIAN CROCKER-WHEELER CO., LTD.—St. Catharines, Ont., Can. Manufacturer of motors, motor-generators, generators, oil switches, transformers, etc. Business established 1910. President, F. E. Lovell; vice-president and general manager, R. A. Stimson; secretary and sales manager, H. A. Burson. Main office and factory, St. Catharines, Ont. Branch offices, Montreal, Que.; Toronto, Ont.; Ottawa, Ont. Sales representatives, Northern Electric Co., Ltd., Montreal, Que.

CANADIAN DRILL & ELECTRIC BOX CO.—1402 Queen St., E., Toronto, Ont., Can. Manufacturer of safety switches and electrical boxes. President, E. R. Beatty; vice-president and manager, A. Heald; treasurer, W. Fawell.

CANADIAN DUPLEXALITE CO., LTD.—745 St. Catharine St., W., Montreal, Que., Can. Manufacturer of duplex lighting fixtures and fixture switches. Business established 1918. President, Thomas Hilliard; vice-president, Rex J. Cole; treasurer, H. J. Lyons.

CANADIAN EDISON APPLIANCE CO., LTD.—Downie St., Stratford, Ont., Can. Manufacturer of electric cooking and heating appliances. Managing director, J. R. Richardson; secretary and treasurer, R. S. Morgan.

CANADIAN ELECTRICAL ASSOCIATION.—Organized in 1890. An association devoted to the interests of the privately owned electrical companies in Canada. Its membership is divided into seven classes, which include corporations, firms and individuals interested in any branch of the electrical business, especially central stations, electric railways, manufacturers, jobbers, contractor-dealers, and their employees, and one privileged class of members who have especially been invited to join by the Executive Committee. An annual convention is usually held in June in some Canadian city. Officers for 1920-1921 are: President, A. Monro Grier, Toronto, Ont.; vice-presidents, P. T. Davies, Montreal, Que.; A. P. Doddridge, Quebec City, Que.; L. W. Pratt, Hamilton, Ont.; secretary-treasurer, Eugene Vinet, the Shawinigan Water & Power Co., Power Bldg., Montreal, Que. These officers and 13 other members constitute the Executive Committee. The Association has been affiliated with the National Electric Light Association for the past ten years and is now one of its geographic divisions.

CANADIAN FAIRBANKS-MORSE CO., THE.—Montreal, Que., Can. Manufacturer of generators, motors, oil engines, lighting plants, air compressors, pumps, etc. President, Henry J. Fuller; vice-presidents, C. J. Brittain, P. C. Brooks; vice-president and secretary, T. McMillan; treasurer, R. B. Potts. Main office, 84-98 St. Antoine St., Montreal, Que., Can. Factories, Sherbrooke, Que., Can., and West Toronto, Ont., Can. Branch offices, Halifax, N. S.; St. John, N. B.; Quebec, Que.; Ottawa, Ont.; Toronto, Ont.; Hamilton, Ont.; Windsor, Ont.; St. Catharines, Ont.; Fort William, Ont.; Winnipeg, Man.; Regina, Sask.; Saskatoon, Sask.; Calgary, Alta.; Edmonton, Alta.; Vancouver, B. C.; Victoria, B. C., Can.

CANADIAN GENERAL ELECTRIC CO., LTD.—Toronto, Ont., Can. Manufacturer of electrical measuring instruments, lightning arresters, controllers, wiring devices, fans, lighting fixtures, motors, generators, hoists, lamps, locomotives, pumps, transformers, electric heating devices, cables, wires, etc. Business established 1892. President and general manager, Frederic Nicholls; vice-president, Albert E. Dyment; secretary, W. H. Nesbitt; treasurer, A. E. Guest; sales manager, (electric apparatus) W. A. Bucke; sales manager, (electrical supplies) A. S. Edgar. Main office, 212 King St., W., Toronto, Ont., Can. Factories, Montreal, Que.; Toronto, Ont.; Peterboro and Stratford, Can. Branch offices and warehouses, Halifax, N. S.; Quebec, Que.; Windsor, Ont.; Calgary, Alta.; Montreal, Que.; Cobalt, Ont.; Edmonton, Alta.; St. John, N. B.; Ottawa, Ont.; South Porcupine, Ont.; Vancouver, B. C.; Sherbrooke, Que.; Winnipeg, Man.; Nelson, B. C. District offices, Sydney, N. S.; Hamilton, Ont.; London, Ont.; Victoria, B. C., Can.

CANADIAN GRATON & KNIGHT, LTD.—84 St. Antoine St., Montreal, Que., Can. Manufacturer of leather belting, straps, etc. Business established 1912. President, W. M. Spaulding; secretary, J. F. Haggeman; treasurer, C. A. Bartlett; general manager, G. W. Spomart.

CANADIAN HANSON & VAN WINKLE CO., LTD.—Toronto, Ont., Can. Manufacturer of electroplating equipment. President, E. N. Todd; treasurer, R. D. Foster; vice-president and general manager, R. G. Bruce.

CANADIAN HART ACCUMULATOR CO., LTD.—Drummond Bldg., Montreal, Que., Can. Manufacturer of storage batteries. Factory, St. Johns, Que., Can.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, M. A. Gee, Selkirk, Ont.; secretary, Alpheus Hoover, Green River, Ont.

CANADIAN INSULATORS.—Trade name for electrical porcelain and pole-line hardware manufactured by the Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.

CANADIAN LAMP & STAMPING CO., LTD.—Ford, Ont., Can. Manufacturer of automobile lamps and headlights. Business established 1913. Vice-president, C. Lang; secretary and treasurer, L. H. Bedford.

CANADIAN LINDERMAN CO., LTD.—Woodstock, Ont., Can. Manufacturer of farm lighting and power plants. Business established 1910. President, B. A. Linderman; vice-president and general manager, J. R. Shaw; secretary and treasurer, Miss M. B. McKay; sales manager, S. A. Ross.

CANADIAN MEAD-MORRISON CO., LTD.—285 Beaver Hall Hill, Montreal, Que., Can. Manufacturer of coal handling and hoisting machinery. Business established 1860. President, Frank B. Carpenter; vice-president and general manager, W. S. Martin; secretary, J. A. Johnson; treasurer, G. O. Norton; sales manager, D. W. Coe. Sales representatives, Harvey Turnbull & Co., Toronto, Ont., Can.; Kelly-Powell, Ltd. Winnipeg, Man., Can.; Robert Hamilton & Co., Vancouver, B. C., Can.; Williams & Wilson, Ltd., Montreal, Que., Can.

CANADIAN NATIONAL CARBON CO., LTD.—Toronto, Ont., Can. Manufacturer of incandescent lamps, rheostats, switchboards, battery testers, batteries, carbon brushes and carbon products. General manager, R. H. Combs; sales manager, Alex MacKenzie. Main office, Hillcrest Park, Toronto, Ont. Factories, Toronto, Ont., and St. Boniface, Man., Can. Branch office, Winnipeg, Man., Can.

CANADIAN PORCELAIN CO., LTD.—Hamilton, Ont., Can. Manufacturer of electrical porcelain. John Alden, manager.

CANADIAN SEAMLESS WIRE CO., LTD.—198 Clinton St., Toronto, Ont., Can. Manufacturer of brass and copper tubing, silver solder, wire, etc. Treasurer and general manager, E. H. Fairbrother.

CANADIAN SIROCCO CO., LTD.—Windsor, Ont., Can. Manufacturer of electric ventilating fans and blowers. R. T. Park, manager. Main office and factory, Windsor, Ont. Branch offices, Montreal, Que.; Toronto, Ont.; Winnipeg, Man.; Calgary, Alta.; Vancouver, B. C., Can.

CANADIAN S K F CO., LTD.—83 King St., W., Toronto, Ont., Can. Manufacturer of ball and thrust bearings, etc.

CANADIAN STEEL FOUNDRIES, LTD.—Montreal, Que., Can. Manufacturer of steel castings, track switches and track work, etc. President, W. W. Butler.

CANADIAN WESTINGHOUSE CO., LTD.—Hamilton, Ont., Can. Manufacturer of electrical instruments, lightning arresters, controllers, cooking and heating appliances, generators, motors, locomotives, pumps, testing outfits, switching apparatus, etc. Business established 1903. President, Paul J. Myler; vice-presidents, L. A. Osborne; F. A. Merrick; N. S. Braden; secretary, W. E. Sprague; treasurer, George R. Kerr; general manager, H. U. Hart; sales manager, H. M. Bostwick. Main office and factory, Sanford & Myler Sts., Hamilton, Ont. Branch offices and warehouses, Halifax, N. S.; Montreal, Que.; Toronto, Ont.; Calgary, Alta.; Winnipeg, Man.; Vancouver, B. C. District offices, Fort William, Ont.; Edmonton, Alta.; Ottawa, Ont.

CANAL RAYS.—Rays similar to alpha rays. They are often called anode rays. See Anode rays.

CANDEE.—Trade name for rubber insulating tape manufactured by the Ackurate Rubber Co., Inc., 253 Broadway, N. Y.

CANDELEBRA FIXTURES. — Electric lighting fixtures designed to imitate candles. Two or more lamps are usually employed. The tallow candle is imitated by a cylinder of white opal glass or porcelain. Candelabra lamp sockets are used into which small candelebra lamps are placed. These candelabra lamps may be of a shape to imitate the candle flame, although spherical lamps are also used to some extent in candelabra fixtures.

Manufacturers:

Art Craft Fixture Co., 85 Academy St., Newark, N. J.
B. & W. Specialty Mfg. Co., 100 Boylston St., Boston, Mass. "B. & W."
Bauman & Loeb, Inc., 138 Bowery, N. Y. "B. & L."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Burschaell, J. W., 357 Ellis St., San Francisco, Cal.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H. & H."
Highlands Mfg. Co., Muncie, Ind.
Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-7.)
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
New York Art Works, 328-330 Seventh Ave., New York, N. Y.
New York Lighting Fixture Co., 67-69 Spring St., New York, N. Y. "Nylco."
Parch-O-Light Co., 74 E. Roosevelt Rd., Chicago, Ill.

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Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
Polly Mfg. Co., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Villmont & Co., Peter S., 20 W. 22nd St., New York, N. Y.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

C & H.—Trade name for integrating wattmeters manufactured by the Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.

CANDLE.—The unit of luminous intensity, or density of luminous flux of a light source, maintained by the National Laboratories of France Great Britain, and the United States. This is frequently referred to as the "International Candle," and is also used in many other countries. A light source having an intensity equal to ten candles is rated at 10 candlepower (10 cp.).

CANDLE-FOOT.—A commonly used unit of illumination, representing a luminous flux density equal to that produced at a point on a plane which is one foot distant from a source of one candle, and which is perpendicular to the light rays at that point. If light is looked upon as a flux radiating from a luminous source, just as magnetic flux radiates from a magnet, then a candle-foot is the density of the light flux from a standard candle at a distance of one foot. This flux density or illumination is a measure of the light that a surface receives, but is not a measure of its brightness. A more common name for the candle-foot is "foot-candle."

CANDLE-METER.—A unit of illumination representing an intensity equal to that produced by a source of one candle, at a point on a plane perpendicular to the rays of light and at a distance of one meter from the source. Since 1 meter= 3.28 ft., 1 candle-meter=$1/3.28^2$=1/10.76 foot-candle.

CANDLEPOWER.—A term expressing luminous intensity (or the density of the light flux emitted by a point source of light) measured in terms of the standard candle. It represents the intensity in one direction only, but if the direction is not specified the horizontal direction is usually implied. Thus a lamp of 10 cp. is one that has a light intensity in a horizontal direction equal to that of a concentrated group of ten standard candles. Candlepower may be measured in several directions. If the lamp is rotated about a vertical axis and the horizontal intensity determined, this is said to be the mean or average horizontal candlepower. If the candlepower is measured in all directions about the lamp, as at each point on the inside of a sphere that enclosed the lamp, and an average taken of all readings, the result would be the mean spherical candlepower, abbreviated s.cp. Similarly, the mean hemispherical candlepower is sometimes determined for the lower hemisphere surrounding any lighting unit; this value is designated l.cp., whereas the mean upper hemispherical candlepower is designated u.cp.

CANDLES, ELECTRIC.—Portable lamps made to resemble an old-fashioned candlestick and provided with a small electric lamp imitating a candle. Used chiefly for ornamental effect, also in pairs on dressing tables and the like. The candlestick part is often highly ornamented.

Manufacturers:

Art Craft Fixture Co., 85 Academy St. Newark, N. J.
B. & W. Specialty Mfg. Co., 100 Boylston St., Boston, Mass.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago.
Cincinnati Artistic Wrought Iron Works 2941-43 Eastern Ave., Cincinnati, Ohio.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-7.)
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Parch-O-Lite Co., 74 E. Roosevelt Rd. Chicago, Ill.
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st St., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

CANDLES FOR ELECTRIC CANDELABRA.—Glass or porcelain tubular stems and bobeches, with or without special candle sockets and candelabra lamps, for use on candelabra fixtures or portable electric candles. (Also see Candelabra fixtures; Candles, electric.)

Manufacturers:

B. & W. Specialty Mfg. Co., 100 Boylston St., Boston, Mass.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago.
Bechtold, Edmund E., 1926 S. Wabash Ave., Chicago, Ill. "E. E. B."
BRANDYWINE FIBRE PRODUCTS CO., P. O. Box 122, Wilmington, Del.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-7.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

C. & P. ELECTRIC WORKS, INC.—92 Havden St., Springfield, Mass. Manufacturer of panelboards, conduit caps, boxes and cabinets for electrical purposes. Business established 1914. President, C. W. James, Jr.; secretary, treasurer and general manager, Henry H. Curtis. Sales representatives. Arco Electric Co., 112 W. 42nd St., New York, N. Y.; Craven & Hopkin, 905 Walnut St., Philadelphia, Pa.; George P. Linton, 10 High St., Boston, Mass.

CANDY & CO.—401 Paulina St., Chicago, Ill. Manufacturer of beeswax.

CANEDY-OTTO MFG. CO.—Chicago Heights, Ill. Manufacturer of electric blowers, drills, etc. Business established 1885. President and general manager, C. H. Thomas; secretary and treasurer, J. E. Thomas; sales manager, L. Z. McKee. Main office and factory, Chicago Heights, Ill. Branch office, Grand Central Palace, New York, N. Y.

CANNON BALL ALARM CO.—524 5th Ave., South, Minneapolis, Minn. Manufacturer of electrical burglar alarms. President, R. M. Laird; vice-president, W. C. MacFadden; secretary and general manager, W. E. Jones; sales manager, E. J. H. Bredehorst.

CANOPIES, FIXTURE.—That exterior part of a lighting fixture which fits against the ceiling or wall is usually called the canopy. It is always hollow and serves to cover the connection between the circuit and the fixture wires as well as the outlet, fixture stud, hickey or other mounting members. Being mostly round, the canopy is commonly made of spun brass. Cast brass, composition, and porcelain are occasionally used. For large ceiling fixtures the canopy usually has a different name (see Plates, shower fixture; Rings, ceiling fixture).

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Andresen Co., Jacob, 258 Third Ave., S., Minneapolis, Minn.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago.
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J.
Best Electric Corp., 476 Broadway, New York, N. Y.
Canadian Duplexalite Co., Ltd., 745 St. Catharine St., W., Montreal, Que., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Friedley-Voshardt Co., 733-737 S. Halsted St., Chicago, Ill.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-7.)
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y. "Nylco."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Universal Metal Spinning & Stamping Co., 718-728 Atlantic Ave., Brooklyn, N. Y. "Newport."
Vester Sons, Inc., Alfred, 5 Mason St., Providence, R. I.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

CANTHOOKS.—Tools used in pole-line construction, pole-storage yards, etc. They consist of a wooden handle 4 or 4½ feet long near one end of which a large curved arm and steel hook are mounted. When this arm is placed around a wooden pole the point of the hook digs into the wood, and by applying force to the handle, the proper leverage is obtained to "cant" or turn the pole.

Manufacturers:

Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
HERBST, PAUL W., Chicago, Ill. We specialize in 4½ ft. canthooks with hickory or maple handles. They are fitted with malleable toe ring and clasp and forged hook. A very substantial hook for all around work. See display advertisement on page 1258.)
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. on page 1253.)
Warren Axe & Tool Co., Warren, Pa.

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CANTON.—Trade name for trolley wire splicers and sectionalizing insulators manufactured by the American Mine Door Co., Canton, Ohio.

CANTON GRATE CO.—1706 Woodland Ave., N. W., Canton, Ohio. Manufacturer of rocking and dumping grates. Branch office, 829 Trust Co. of Georgia Bldg., Atlanta, Ga.

CANTON SPECIALTY CO.—Gas & Electric Bldg., Canton, Ill. Manufacturer of distribution and service boxes. President, W. P. Ingersoll; vice-president, F. C. Moran; secretary and treasurer, E. H. Negley.

CAOUTCHOUC.—Trade name for rubber-covered wire and cables manufactured by the Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.

CAPACITANCE.—By capacitance of a conductor or system of conductors is meant the property of holding an electric charge. If a large and a small ball be charged while in contact, they will be at the same potential, but they will not contain equal quantities of electricity; this is explained by saying that one has larger capacitance than the other. Capacitance depends upon the area and shape of the conductors and the dielectric constant or characteristic and the thickness of the dielectric medium separating the conductors. The term "capacity" was formerly used instead of capacitance; unless qualified as electrostatic capacity, it was often confused with load or current capacity and has therefore been replaced by capacitance, which also corresponds in form to resistance, inductance, conductance, etc. The capacitance is measured by the ratio of the charge to the potential difference. The unit of capacitance is the farad, which see.

CAPACITANCE CHANGE WITH FREQUENCY.—Closely associated with absorption of dielectrics is the variation of the capacitance of condensers with frequency of charge. The capacitance of a condenser decreases as the frequency increases.

CAPACITANCE, CONCENTRATED.—When conductors are symmetrically arranged so that they occupy a comparatively small space and have a relatively large capacitance, as in a condenser, the capacitance is said to be concentrated.

CAPACITANCE, DISTRIBUTED.—The capacitance of a system of conductors that extend over a wide territory, so that an appreciable interval of time intervenes between the charging of the first and last elements, is said to be distributed. A transmission line is a good example of a distributed capacitance; likewise an extended radio antenna has distributed capacitance.

CAPACITANCE, MUTUAL AND REGULAR, IN TELEPHONY AND TELEGRAPHY.—Mutual capacitance is that which is measured between the two wires of a pair. Regular capacitance is that which is measured between one wire and all the other wires in the cable joined together and grounded on the sheath. Mutual capacitance is most used in telephony, because all the lines are made of pairs of wires. Regular capacitance is most used in telegraphy, because the lines return by way of earth, and it is the capacitance of one wire to earth and to others in the lead cable that governs the actions.

CAPACITANCE OF TRANSMISSION LINES.—Since the wires of a transmission line are separated by air, a dielectric, they possess all of the elements of a condenser. The capacitance between wire and neutral of a single-phase two-wire line and of a three-phase line whose wires are placed at the vertices of an equilateral triangle is given by: $C=0.0388/(\log d/r)$ microfarads per mile, where d is the distance between wires and r is the radius of the wire. Both d and r must be expresed in the same units. For unsymmetrical spacing, the calculation of the capacitance is much more complicated.

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CAPACITY.—A term indicating "capability of an electrical machine or circuit, except where specifically qualified. The different senses in which the word is used sometimes lead to ambiguity. It is, therefore, recommended in the A. I. E. E. Standardization Rules that the descriptive term "power capacity" or "current capacity" be used, and when referring to the electrostatic capacity of a device the term "capacitance" be used. See Capacitance.

Power capacity or current capacity therefore, refer to the power or current which a device or circuit can safely carry. The capacity of an electrical machine is usually expressed in terms of the available output. Also see Capacity of a machine; Capacity of a storage battery.

CAPACITY OF A MACHINE.—This is the load which a machine can carry, usually continuously, without in any way being damaged. The load is generally limited by the maximum temperature which its insulation can withstand, the temperature rise of the machine being due to losses in it appearing in the form of heat. The maximum safe temperature depends upon the kind of insulation, for example, 105° C. is considered the maximum for impregnated cotton, paper and silk. The capacity of a machine for momentary loads is limited, not by its temperature rise, but by some other characteristic, as commutation or breakdown torque.

CAPACITY OF A STORAGE BATTERY.—The output of a storage battery on discharge is termed its capacity. It is almost invariably measured in ampere-hours; when the watt-hour capacity is referred to it is always so specified. The capacity is usually the rated or normal capacity on a normal discharge. A normal discharge is one at constant current for 8. 5 or 4 hours, depending on the service for which the battery is designed. For stationary batteries the 8-hour discharge is normal; for electric vehicle and other portable uses either the 5 or 4-hour discharge is rated as normal. For central-station standby or reserve batteries the 1-hour discharge has been the rated capacity in many cases. It is important to specify the length of the assumed rated complete discharge, because the discharge rate affects the capacity greatly; in general, the long-time discharge gives the highest capacity and the rapid discharge the lowest capacity. In no case is the discharge assumed to be carried to complete exhaustion or zero e. m. f., but is terminated when the terminal voltage has dropped 10 per cent to about 30 per cent, depending on the discharge rate and the nature of the battery, whether lead or nickel-iron type, and the service for which it is designed. Consequently the normal or rated capacity is always less than the theoretically ultimate capacity. The actual output on any individual discharge is sometimes spoken of as its capacity for that discharge, but this should not be confused with the rated capacity of the cell.

Although on rating tests constant-current discharges are used to standardize and simplify determination of the actual capacity, in general practice the discharges are seldom at constant current. An accurate determination of the output under variable discharge currents can be made most readily by an ampere-hour meter.

CAPAX.—Trade name for push button switches manufactured by the Bryant Electric Co., Bridgeport, Conn.

CAPILLARY.—Trade name for storage battery separators manufactured by the Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.

CAPITALIZATION.—The capitalization of the entire electrical industry of the United States at the beginning of 1921 was about $25,000,000,000, divided as follows: Utilities, $13,000,000,000; manufacturing, $550,000,000; mercantile, $175,000,000; isolated plants and miscellaneous, $11,275,000,000.

CAPITAL NOVELTY CO.—138 N. 12th St., Lincoln, Neb. Manufacturer of electric vibrators, sterilizers and perforating machines. Business established 1910. George P. Elmen, sole owner.

CAPITOL.—Trade name for electric ironing machines manufactured by the Barnett Foundry & Machine Co., Lyons Ave. & Coit St., Irvington, N. J.

CAPITOL.—Trade name for brass and bronze castings, bushings, valves, etc., manufactured by the Capitol Brass Works, Detroit, Mich.

CAPITOL.—Trade name for power transmission belting manufactured by the Jewell Belting Co., Hartford, Conn.

CAPITOL BRASS WORKS.—Detroit, Mich. Manufacturer of brass and bronze castings, bushings, valves, etc.

CAPS, CONDUIT OR PIPE END.—Threaded fittings used to close the ends of conduits or pipes. They seal the conduit which is installed during the "roughing-in" construction of a building, so that dirt, dust and other foreign matter will not get in during the plastering and other later operations before the wire is drawn in. When the plastering is completed the caps are removed and the wires pulled in and connected to switches, receptacles, fixtures, etc. One form of cap consists of a standard bushing in which a closing disk is inserted before it is screwed on the pipe. When it is desired to remove the cap the bushing is removed, the disk taken out and then the same bushing may be put back in place or used elsewhere.

Manufacturers:

C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass. "J. C. P."
GILLETTE-VIBBER CO., New London, Conn. "Gee-Vee."
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo. "Electrolet."
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
PARKER & SON, INC., J. H., Parkersburg, W. Va. Service caps for meter loops, motor installations and all classes of combination work.—Adv.
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
WALKER BROS. & HAVILAND, Otis Building, Philadelphia, Pa. "Bushettes." (See descriptive advertisement under Bushings, conduit, box and cabinet.)

CAPS, ELECTRIC, BLASTING.—See Detonators, electric blasting.

CAPS, FUSE.—The end caps of knife-blade cartridge fuses; they serve merely as an end cap for the fiber enclosing tube and as a means for securing the knife-blade terminal contacts which extend longitudinally from the ends of the caps. In the ferrule type the corresponding end caps are called ferrules and serve also as the terminal contacts. In high-tension fuses, which usually are of special construction, the fuse caps sometimes serve also as contacts. The term fuse caps is also used to refer to the caps used in detonating blasting charges; for this type see Detonators, electric.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave. Chicago, Ill.
Bryant Electric Co., The., 1421 State St., Bridgeport, Conn. "Bryant."
CRESCENT ELECTRIC CO., Mountain Grove, Mo.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
New York Blasting Supply Co., 11 Broad way, New York, N. Y. "NuYork."
PATTON-MAC GUYER CO., 31 Mathewson St., Providence, R. I.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

CAPS, GROUND PIPE.—Where ground connections are made by driving a pipe into the earth, means must be provided by which a good connection is made from the ground wire to the ground pipe. A malleable iron ground pipe cap provides a secure connection without soldering and at the same time serves as a protection to the top of the pipe while it is being driven. Other forms are screwed to the pipe and a soldered connection is made after the pipe is driven.

Manufacturers:

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Garton-Daniels."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

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G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
LINE MATERIAL CO., S. Milwaukee, Wis. (See display advertisement on page 1278.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CAPS, LAMP.—A close fitting cap or cover for the hemispherical tip of an incandescent lamp. Such caps when made of glass may be either for the purpose of coloring the light which reaches the eye, or for diffusing the glare. The opal lamp cap of white opal diffusing glass is most used on gas-filled incandescent lamps which have intensely bright and glaring filaments, where the use of the lamp cap shields this filament from the eye to some extent. Another type of cap of polished metal is used for the purpose of reflecting the light upward to provide totally indirect lighting. Colored lamp caps are principally used on electric signs where the lamp filament is viewed almost entirely from the tip of the lamp. In this case the effect is to make the electric sign appear colored. (Also see Eye shields, lamp.)

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.
Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."

CAPS, LAMP, FOR TELEPHONE SWITCHBOARDS.—A glass disk placed over a switchboard lamp to diffuse the light. It often carries symbols to designate the kind of line or signal, and sometimes is colored.

Manufacturers:

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)

CAPSTANS, CABLE-PULLING.—Where underground cable is drawn into the ducts by man power, this is conveniently applied by the use of a capstan on which the pulling cable is wrapped. Several men are usually required to furnish the necessary power.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

CAPTIVE FORCE.—Trade name for storage batteries manufactured by the Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.

CAPTOR.—Trade name for storage battery plates manufactured by the Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.

CAR LIGHTING EQUIPMENTS, RAILWAY, COMPLETE.—Pullman parlor and sleeping coaches are now almost universally electrically lighted, and on many steam railroads the day coaches, dining and mail cars as well. Three systems of electric car lighting are in use on steam roads: the straight-storage system, the head-end system, and the axle-generator system.

The power for the lamps in the straight-storage system is obtained from storage batteries mounted in a box below the car. The batteries are charged at the end of the run. Due to uncertainties of regular operation and maintenance this system is not much in use.

In the head-end system the apparatus used consists of a generator, driven by a small steam turbine or engine, together with the necessary indicating, regulating and controlling devices, all usually installed in the first baggage car next to the locomotive; line wires run the length of the train with flexible jumpers between the cars; sometimes storage batteries are placed below the cars to supply the lamps when the car is cut off the train, and lamp regulators are then installed in the cars to maintain constant voltage on the lamps.

The axle-generator system is the one now most commonly used. The generator is mounted on the trucks or on the under side of the car body and driven by belt from the axle. A storage battery is also mounted under the car, the generator and battery being connected through an automatic control system. As long as the generator speed, and consequently its voltage, is below a certain value the load is carried by the batteries. When with increasing speed the generator voltage has reached the predetermined value a solenoid control throws it in parallel with the battery, and it carries the load and also charges the battery. Proper charging current is maintained by a solenoid acting on a compression rheostat in the generator field. The life of the battery is decreased by irregular charging; to prevent this damage, an ampere-hour meter control is sometimes included in the circuit. This measures the charge and discharge; when the amount of charge has reached the proper value in relation to the preceding discharge the control affects the generator voltage, causing the latter to fall to the battery voltage value. To decrease the variation in the brightness of the lamps, due to the difference in the generator charging and the battery voltages, a lamp regulator is connected in series with the lamp circuit; this regulator is usually a solenoid-controlled resistance device.

Manufacturers:

American Pulley Co., The, 4200 Wissahickon Ave., Philadelphia, Pa. "American."
Brill Co., The J. G., 62nd St. and Woodland Ave., Philadelphia, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Head-end charging equipment, including turbine generators, for installation in baggage car and switchboard equipment for control. Terminal charging equipment consisting of switchboards, generator sets, transformers and customary substation accessories for charging batteries operating on straight storage systems and for emergency charging of batteries on axle-generator systems. See adv. pages 1203-1223.—Adv.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."

CARBIC MFG. CO.—Duluth, Minn. Manufacturer of oxy-acetylene welding and cutting equipment. President, C. A. Duncan; secretary, Oscar Mitchell; general manager, D. C. Duncan. Main office and factory, Duluth, Minn. Branch offices, 111 W. Washington St., Chicago, Ill.; 141 Centre St., New York, N. Y.

CARBO.—Trade name for carbo-hydrogen gas cutting and welding apparatus manufactured by the Carbo-Hydrogen Co. of America, Benedum-Trees Bldg., Pittsburgh, Pa.

CARBO-HYDROGEN CO. OF AMERICA.—Pittsburgh, Pa. Manufacturer of hydrogen generators, lead burning outfits and other carbo-hydrogen and carbo equipment. Incorporated 1915. President, J. C. Trees; vice-president and general manager, J. R. Rose; secretary and treasurer, William J. Provost; sales manager, W. N. McCutcheon. Main office, Benedum-Trees Bldg., Pittsburgh, Pa. Factories, Chicago, Ill.; Cleveland, Ohio; Columbus, Ohio; Pittsburgh, Pa.; Bayonne, N. J. Branch offices, 104th St. and Torrence Ave., Chicago, Ill.; Oak and Hobart Sts., Bayonne, N. J.; Center and Hemlock Sts., Cleveland, Ohio; 1725 Sansom St., Philadelphia, Pa.; 4th and Thorn Sts., Coraopolis, Pa.; Pittsburgh, Pa.; Buffalo, N. Y.; Toledo, Ohio; Cincinnati, Ohio; Detroit, Mich.

CARBOLINEUM, WOOD PRESERVATIVE.—Commercial name for a widely used high-grade creosote compound used for preservation of wood products. Also see Creosote; Wood preservation.

Manufacturers:

Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Dielectric Mfg. Co., St. Louis, Mo. "Phenoleum."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

CARBOLON.—Trade name for electrically produced abrasives manufactured by the Exolon Co., Blasdell, N. Y.

CARBOLON REFRACTORY.—Trade name for refractories and cements manufactured by the Exolon Co., Blasdell, N. Y.

CARBON.—A nonmetallic element occurring either in crystalline form (diamond and crystalline graphite) or amorphous form (amorphous graphite, charcoal, lampblack, coal, coke, etc.). It is a constituent of all organic compounds and many inorganic. Its symbol is C; at. wt. 12. Pure carbon melts at 4400° C. under 8 atmospheres pressure; it sublimes at atmospheric pressure at 3700° C. It is of great importance in the electrical industry as an electrode for arc lamps, certain welding processes, and primary batteries; as a commutator brush material and as a resistor. In the electrochemical industry it is used as an electrode material and as a reducing agent in electric-furnace operations. It combines readily with oxygen with evolution of heat to form the gases carbon dioxide and carbon monoxide, the former when the reaction takes place at ordinary temperatures, the latter at extremely high temperatures, and mixture of the two at moderately high temperatures.

CARBON, AMORPHOUS.—Carbon which shows no outward crystalline form and no crystalline structure under the microscope. It includes ordinary forms of carbon, such as coke and coal, lamp black and charcoal.

CARBON BISULPHIDE.—(CS_2); produced electrothermally in the Taylor furnace.

CARBON BRUSHES.—See Brushes, carbon and graphite.

CARBON CELL.—A type of primary cell in which it was proposed to consume carbon, thus converting its chemical energy directly into electrical energy. Several attempts have been made in this direction, but none has proved a success.

CARBON DIOXIDE.—A colorless gas, symbol CO_2, that does not support combustion and is not itself combustible. It is heavier than air. Carbon dioxide is formed by the combustion of carbon or compounds, such as fuels containing carbon. The percentage of carbon dioxide present in the flue gases of a power plant is very often determined as an indication of the completeness of the combustion, especially when determining the boiler efficiency. While this measurement is not itself sufficient to determine the furnace efficiency, it is an important factor in the more complete flue-gas-analysis and temperature records that are kept. Carbon dioxide is popularly known as carbonic acid gas. (For carbon-dioxide measuring and recording instruments, see Recorders, combustion and CO_2; also Flue-gas-analysis instruments.)

CARBON DISK TRANSMITTER.—One form of telephone transmitter having a diaphragm made of a thin sheet of carbon. See Transmitters, telephone.

CARBON, GRANULAR, FOR TELEPHONE TRANSMITTERS.—Pure carbon as used in the microphone cell of a telephone transmitter. It is made of selected hard coal, fired in a crucible to drive off volatile material, crushed, and screened to size.

Manufacturers:

Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CARBON PACKING RINGS.—Used in sealing of steam turbines. For details and manufacturers, see Packing, cylinder, piston, turbine, valve, etc.

CARBON PRODUCTS CO., THE.—Lancaster, Ohio. Manufacturer of dry and storage batteries, carbons, etc. Business established 1919. President and general manager, Edmund Dickey; vice-president, Walter E. Gunion; secretary, Herbert Crumbaker; treasurer and sales manager, Albert Steiner. Branch office, 220 Broadway, New York, N. Y.; 180 N. Dearborn St., Chicago, Ill.

CARBON STEEL CO.—Pittsburgh, Pa. Manufacturer of electric furnace steel, sheet steel for electrical purposes, etc. President, Charles McKnight; vice-presidents, D. R. Wilson and C. F. Blue, Jr.; secretary and sales manager, W. W. Noble; treasurer, D. R. Wilson; general manager, C. F. Blue, Jr. Main office, 32nd St. & A.

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V. Ry. Branch offices, Cameron Bldg., New York, N. Y.; Williamson Bldg., Cleveland, Ohio; Railway Exchange Bldg., Chicago, Ill.; Penobscot Bldg., Detroit, Mich.; Kohl Bldg., San Francisco, Cal.

CARBON TETRACHLORIDE.—A non-inflammable liquid having a boiling point of about 75° C. and a freezing point around —23° C. It contains a fractional part of 1% of carbon disulphide and is largely used in the preparation of fire extinguisher liquids. Carbon tetrachloride has a cleaning but slightly corrosive action on most metals, and it is therefore combined with other liquids to neutralize the corrosive action and still be noninflammable. When used as a fire extinguisher it spreads over the flame a heavy cloud of noncombustible gas, principally carbon dioxide, which chokes out the fire. It is very useful around electrical apparatus as it will not damage either insulation or apparatus and it is nonconducting and may be used on live apparatus, where water cannot. It may also be used for cleaning contacts and other apparatus, as it eliminates the fire hazard of benzine and is just as satisfactory. Carbon tetrachloride is also used in high-tension chemical fuses and certain types of high-tension switches and lightning arresters as an arc-extinguishing medium.

Manufacturers:

Dow Chemical Co., The, Midland, Mich.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Mallinckrodt Chemical Works, St. Louis, Mo.

CARBONA PRODUCTS CO.—302 W. 26th St., New York, N. Y. Manufacturer of fire extinguishers. President, E. C. Klipstein; secretary, E. Walter Beebe; treasurer, A. Wineburgh.

CARBONATORS, ELECTRIC.—Apparatus for charging water with carbon dioxide, consisting of a motor-driven tank-agitating mechanism and a float or other automatically operated switch for controlling the motor. The gas is kept under pressure in a tank and is released into the water, where the combination of the pressure and the breaking up of the water particles by the paddles or other agitating device assures a highly charged solution. Most carbonators are made in small sizes for use at a soda fountain, where the motor operates only when the supply falls to a certain value. Larger sizes are made for commercial charging where charged water is furnished in tanks instead of the gas being furnished.

Manufacturers:

Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Mueller Mfg. Co., Rud., 4310 N. California Ave., Chicago, Ill. "Unity."

CARBONITE.—Trade name for silicon carbide abrasive manufactured by the General Abrasive Co., Inc., College Ave., Niagara Falls, N. Y.

CARBONIZE.—To reduce to a residue of carbon by fire or by subjecting to intense heat in a closed vessel. This method is used in preparing the filament for carbon lamps. The term also refers to impregnating and combining with carbon and to the destructive distillation of organic matters as in the manufacture of gas from coal, charcoal from wood, etc.

CARBONS, ARC LAMP AND SEARCHLIGHT.—The electrodes, pencils, or tips, between which the electric current jumps to form the arc light in certain kinds of arc lamps. From 1880 to 1905 nearly all of the arc lamps in common use employed electrodes of nearly pure carbon between which the arc was formed. The carbon arc lamp, however, has been largely superseded for street and interior lighting by other electric illuminants not employing carbon. The carbon arc lamp is, however, still used at this writing for some special purposes, such as projection apparatus, that is, searchlights, for which there are several special types, and motion-picture machines and stereopticons. Arc lamps now used for street lighting largely employ metallic electrodes rather than carbons. Flame arc carbons are impregnated with salts which increase the light of the arc flame. (Also see Lamps, arc.)

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Carbon Products Co., The, Lancaster, Ohio. "C. P. C."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia," "Silvertip."
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill. (Blueprint.) "Peerless."
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Speer Carbon Co., St. Mary's, Pa.
Stackpole Carbon Co., St. Mary's Pa.
Standard Carbon Co., 488 Mills Bldg., San Francisco, Cal. "Standard."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. 1395-1402.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

CARBONS, BATTERY.—Battery carbons are used in a large number of types of primary batteries. Several forms of carbons are used, among them round and square rods, cylinders, cups, plates, etc. The largest use now is in dry batteries, in which a round or corrugated rod is used in the center of the cell as the positive terminal. For this purpose several sizes are furnished, as there are a number of standard and special sizes in the miniature or flashlight batteries and also in the larger sizes. For the wet type primary batteries, the form and size of the carbon for the various makes are quite different.

Manufacturers:

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Carbon Products Co., The, Lancaster, Ohio. "C. P. C."
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. "Champion."
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
PURE CARBON CO., Wellsville, N. Y.
Speer Carbon Co., St. Marys, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Standard Carbon Co., 488 Mills Bldg., San Francisco, Cal. "Standard."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.

CARBONS, BRUSH.—These are different from carbon brushes in that they consist of plates of carbon of various thicknesses. They are supplied to manufacturers in this form and are cut up by them to the proper size brush and beveled for the particular motor or generator they are to be used on. Motor repairmen who handle a great variety of motors sometimes cannot keep a stock of brushes for all the various sizes and makes repaired and they often buy carbon in this plate form and cut the brushes themselves to suit requirements.

Manufacturers:

MORGANITE BRUSH CO., INC., 519-523 W. 38th St., New York, N. Y. (See descriptive advertisement under Brushes, carbon and graphite.)

CARBONS, ELECTRIC FURNACE.—See Electrodes, furnace.

CARBONS, RESISTANCE.—Carbon is often used as a resistance material. One of the most common forms when used for this purpose is a plate or rather series of plates that are arranged in a pile or row. They are connected in series in the circuit and a clamping device is arranged so that by tightening up the plates the resistance may be decreased between the terminals of the rheostat. Very high resistances are also produced in some cases by having a fine fiber or strip of carbon resting on an insulating block and connected to suitable terminals. Resistors of this nature are used for protective and testing purposes.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Carbon Products Co., The, 220 Broadway, New York, N. Y. "C. P. C."
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. "Champion."
Corliss Carbon Co., P. O. Box 377, Bradford, Pa.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill.
Speer Carbon Co., St. Mary's, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.

CARBONS, WELDING.—Welding carbons are used as electrodes in arc welding or cutting processes. They serve in d-c. equipments as the negative electrode and the work to be welded is connected to the positive side of the generator. The arc is drawn between the two. The size of the carbon depends upon the rate at which the weld or cut is to be made. They range in size from ¼ to 1½ ins. in diameter and from about 6 to 12 ins. in length.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. "Champion."
Electric Arc Cutting & Welding Co., 152-58 Jelliff Ave., Newark, N. J.
Electric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
PURE CARBON CO., Wellsville, N. Y.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Speer Carbon Co., St. Marys, Pa.
Stackpole Carbon Co., St. Marys, Pa.
Standard Carbon Co., 488 Mills Bldg., San Francisco, Cal. "Standard."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CARBORUNDUM CO., THE.—Niagara Falls, N. Y. Manufacturer of abrasive materials. Business established 1891. President, F. J. Tone; vice-president and secretary, George R. Rayner; treasurer, F. H. Manley; general manager, C. H. Greenwood; sales manager, W. W. Sanderson. Main office, Niagara Falls, N. Y. Factories, Niagara Falls, N. Y.; Perth Amboy, N. J. Branch offices, Boston, Mass.; New York, N. Y.; Pittsburgh, Pa.; Chicago, Ill.; Milwaukee, Wis.; Cleveland, Ohio; Detroit, Mich.; Cincinnati, Ohio; Grand Rapids, Mich.; Philadelphia, Pa.

CARBOSAND.—Trade name for refractory sand manufactured by the Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y.

CARBOSOTA.—Trade name for creosote oil manufactured by the Barrett Co., 17 Battery Pl., New York, N. Y.

CARBOY ROCKERS OR INCLINATORS.—Carboy rockers or inclinators are used to hold a carboy of acid or other liquid chemical and permit it to be rocked or inclined to pour out the acid. There are several forms of rockers or inclinators. One type is a wooden box suspended between two uprights attached to the base. The carboy is placed in the box and clamped in position and may then be inclined to any desired angle. Other forms consist of steel rod or wire frames or rockers. The carboy is held in place and may then be rocked or rolled until the acid will pour out. Several other somewhat similar rockers or inclinators have been made.

They are used widely in storage-battery factories and repair shops for handling

sulphuric and other acids. A great saving is effected by their use as the spilling of acid is practically eliminated and it is a much safer method for the workmen. One man can handle the carboy while without a rocker two are usually required. Safety features are included in some types so that the rocker is locked in place when not in use and when being used is so balanced that if released the carboy will return to the locked position.

Manufacturers:

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

McCORD & CO., INC., H. M., 1019 Lumber Exchange, Minneapolis, Minn. Manufacturers of the "Union" carboy inclinators. This safety appliance is in daily use by thousands of companies for pouring acids, etc. Here are its salient points: Can be operated in perfect safety by one man, saving the time of another; reduces time of emptying to a minimum; facilitates



"Union" Carboy Inclinator

pouring and prevents spilling; requires no space to roll and tilts in its own space; prevents breaking of carboys; requires less energy and makes pouring easy; prevents accidents; returns to upright position when released—locked while idle; simple and substantial—90 per cent wood; cannot rust or get wobbly; practically acid-proof; always ready for instant use—no attachments required; holds any size carboy or medium size steel drum. Recommended by compensation insurance companies. Write for further particulars and see display adv. page 1256. —Adv.

Munning & Co., A. P., Church St., Matawan, N. J.

CARCEL STANDARD.—A lamp formerly used as the standard of light in France. It burned colza oil. Its light intensity was designated by the term "carcel," which was equal to 9½ British candles.

CARDINAL.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CARD MFG. CO., S. W.—Mansfield, Mass. Manufacturer of dies, stocks, etc. President, J. A. McGregor; vice-president, S. McKay; secretary, W. B. McSkimmon; treasurer, J. H. Drury. Main office, Mansfield, Mass. Branch office, 62 Reade St., New York, N. Y.

CARLETON CO.—170 Summer St., Boston, Mass. Manufacturer of gasoline and alcohol torches.

CAREL.—Trade name for automobile wrenches manufactured by the M. W. Robinson Co., 296 Broadway, New York, N. Y.

CAREW.—Trade name for end cutting nippers manufactured by the M. W. Robinson Co., 296 Broadway, New York, N. Y.

CARLETON CO., THE.—170 Summer St., Boston, Mass. Manufacturer of generators, blow torches, cylinder lubricators, etc. Business established 1906. F. B. Carleton, sole owner.

CARLILE & DOUGHTY, INC.—2530 N Broad St., Philadelphia, Pa. Manufacturer of storage batteries and parts, die castings, insulating paints and compounds, etc. Business established 1906. President, Leon A. Doughty; vice-president, Edward Booth; secretary and treasurer, Frank S. Carlile; sales manager, P. F. Riley.

CARLIN MACHINE CO., JOHN H.—Sandusky & Lacock Sts., Pittsburgh, Pa. Manufacturer of electric hoists. Business established 1861. Sole owner, John H. Carlin.

CARLING TURBINE BLOWER CO., INC.—104 Harding St., Worcester, Mass. Manufacturer of electric and turbine-driven blowers. Vice-president and secretary, A. W. Carlson; treasurer, E. B. Moore; general manager, George A. Teeling. Sales representatives, Vincent Gilson Engineering Co., 30 Church St., New York, N. Y.; Arrow Engineering Co., 1235 Old Colony Bldg., Chicago, Ill.; F. W. Schmidt, Bourse Bldg., Philadelphia, Pa.; W. C. Green Specialty Co., 310 Provident Bank Bldg., Cincinnati, Ohio; Standard Valve & Supply Co., Guardian Bldg., Cleveland, Ohio; Fred P. Upson, 683 Asylum St., Hartford, Conn.; Richman Crosby Co., 223 S. Front St., Memphis, Tenn.; J. F. Pritchard & Co., Long Bldg., Kansas City, Mo.

CARLSBAD.—Trade name for electric light baths manufactured by Frank S. Betz Co., Hoffman St., Hammond, Ind.

CARLTON, YOUNG & CATLIN, INC.—Grand Central Palace, New York, N. Y. Manufacturer of farm lighting and power plants. Business established 1920. President, Wilbur H. Young; vice-president and general manager, Harry Carlton; treasurer, George L. Catlin.

CARMICHAEL PROCESS.—An early attempt at the hydroelectrolytic extraction of copper.

CARNAUBA.—Trade name for insulating wax manufactured by the Strohmeyer & Arpe Co., 139-141 Franklin St., New York, N. Y.

CARNEGIE STEEL CO.—Pittsburgh, Pa. Manufacturer of structural steel, plates, rails, wheels, axles and other steel products. President, Homer D. Williams; vice-president and sales manager, W. G. Clyde; vice-president and secretary, W. W. Blackburn; treasurer, W. C. McCausland. Main office, Carnegie Bldg., Pittsburgh, Pa. Branch offices and warehouses, 120 Franklin St., Boston, Mass.; Rockefeller Bldg., Cleveland, Ohio; 30 Church St., New York, N. Y.; Widener Bldg., Philadelphia, Pa.; Third National Bank Bldg., St. Louis, Mo. District offices, Brown-Marx Bldg., Birmingham, Ala.; Marine Trust Co. Bldg., Buffalo, N. Y.; 208 S. La Salle St., Chicago, Ill.; Union Trust Bldg., Cincinnati, Ohio; First National Bank Bldg., Denver, Colo.; Ford Bldg., Detroit, Mich.; Maison Blanche, New Orleans, La.; Pioneer Bldg., St. Paul, Minn. Sales representatives, United States Steel Products Co., Hudson Terminal, New York, N. Y.; United States Steel Products Co. (Pacific Coast Dept.), Jackson St. & Central Ave., Los Angeles, Cal.. Selling Bldg., Portland, Ore., Rialto Bldg., San Francisco, Cal., 4th Ave., S. & Connecticut Ave., Seattle, Wash.

CARNEY & CO., B. J.—Grinnell, Iowa. Manufacturers of cedar poles. Business established 1907. President and general manager, E. B. Brande; vice-president, M. P. Flannery; secretary, R. Coutts. Main office, Grinnell, Iowa. Branch offices, 349 Peyton Bldg., Spokane, Wash.; 519 Adams Express Bldg., Chicago, Ill.; 117 West St., New York, N. Y.

CAROLINA CROSS ARM CO., INC.—P. O. Box 122, Elkin, N. C. Producer of pole brackets, crossarms and insulator pins. Business established 1916. President, J. C. Kerley; vice-president, W. M. Evans; secretary, treasurer and general manager, J. F. Carter.

CAROLINA MINERAL CO., INC.—Penland, N. C. Manufacturer of insulating mica. Vice-president, E. A. Dibbell; manager, John V. Cox; treasurer, C. G. Chevalier.

CAROLUS MFG. CO.—Sterling, Ill Manufacturer of wire clippers, bolt cutters and nut splitters. President and treasurer, W. B. Carolus; vice-president, E. F. Carolus; secretary and general manager, L. L. Carolus.

CARPENTER & CO., GEORGE B.—440 N. Wells St., Chicago, Ill. Manufacturers of cotton waste, etc.

CARPENTER TAP & DIE CO., THE J. M.—Pawtucket, R. I. Manufacturer of taps, dies, die-stocks, etc. Business established 1870.

CARPET CLEANERS.—See Vacuum cleaners.

CARPET WASHERS, ELECTRIC.—Motor-driven portable appliances consisting of scrubbing brushes and tanks together with water-pumping and suction attachments. They are very largely used for cleaning carpets in hotels, clubs, banks, carpet and rug-cleaning establishments, etc. In many cases they may be used without taking up the rug or carpet. The water and cleaning compound may be spread on the carpet just ahead of the brushes, which loosen up the dirt and thoroughly scrub the carpet. The soiled water and most of the remaining moisture are then removed by the suction apparatus.

Manufacturers:

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y. "International" carpet washer outfit is portable and electrically operated, used for washing rugs and carpets on the floor both by carpet cleaning factories and by hotels. Equipment consists of two machines, an electrically operated scrubbing brush and a vacuum machine, this last machine being used for removing the soap suds from the carpet. By the use of this outfit the carpet of an average size hotel can be washed in 20 minutes and will be thoroughly dry inside of two hours.—Adv.

KELLEY ELECTRIC MACHINE CO., 111-119 Dearborn St., Buffalo, N. Y.

LANDERS, FRARY & CLARK, New Britain, Conn. "Connersville."

CARPO.—Trade name for protective paints manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

CARRARA.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

CARRICITE CO., THE.—5436 Ferdinand St., Chicago, Ill. Manufacturer of welding compounds for heating elements. General manager, Noel Carrico.

CARRICK ENGINEERING CO.—538 S Clark St., Chicago, Ill. Manufacturer of regulators for dampers and mechanical stokers. Business established 1918. President and general manager, G. S. Carrick; treasurer, John G. Hollmeyer.

CARRIER AIR CONDITIONING CO. OF AMERICA.—Buffalo, N. Y. Manufacturer of air washers, humidifiers and dehumidifiers, heating and ventilating equipment. Business established 1908. President and general manager, H. W. Wendt, Sr.; vice-president and treasurer, E. F. Wendt; vice-president and secretary, H. W. Wendt, Jr.; vice-president and sales manager, C. A. Booth. Main office and factory 490 Broadway, Buffalo, N. Y. Branch offices, 562 W. Washington Blvd., Chicago, Ill.; Philadelphia, Pa.; Cleveland, Ohio; Pittsburgh, Pa.; Los Angeles, Cal.; St. Louis, Mo.; Cincinnati, Ohio; Boston, Mass. Sales representatives, Coon De Visser Co., Detroit, Mich.; W. P. Nevins Co., Minneapolis, Minn.

CARRIER SYSTEMS, CASH AND PARCEL.—These are motor-driven systems in which an endless belt, chain or cable moving over a definite path or course is made to carry cash containers, boxes, baskets, bags, or packages from one point to another. They are used largely in department stores, postoffices, shipping or packing rooms, etc. Time and energy usually required in running from one place to another are saved and put to better advantage by giving attention to some other patron, item or article while the carrier system is in operation. The number of employees needed is considerably reduced by their use.

Manufacturers:

Baldwin & Co., James Co., 358 W. Madison St., Chicago, Ill. "Baldwin."

Lamson Co., The, 100 Boylston St., Boston, Mass.

Universal Tube Co., 321 W. Ohio St., Chicago, Ill.

CARS AND VELOCIPEDES, TRACK CONSTRUCTION AND INSPECTION.—In the construction and maintenance of electric railway systems it is often necessary for construction and operating crews, officials and inspectors to make trips over sections of the road. Cars and velocipedes of standard-gage construction, operated either by a hand mechanism or by a gasoline engine are mostly used. They frequently carry the necessary tools and equipment to be used in repairing and examining switches, signals, etc., and in lighting signal and other lamps, which is done by hand in some cases. For inspection and signal work light-weight and speedy three-wheel velocipedes are generally employed. All such cars and velocipedes must be of such construction as to be readily placed on or removed from the track, so as to prevent interference with normal traffic.

Manufacturers:

Buda Co., The, Harvey, Ill.

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CARS, CABLE-STRINGING.—A seat carried by a light frame and two wheels, which are designed to run on the messenger wire which supports a telephone cable. A man sits on this seat and works on the cable, either attaching cable hangers or making repairs.

Manufacturers:

Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "Aero."

CARS, ELECTRIC, MISCELLANEOUS.—Electric cars are used for a number of purposes other than passenger and freight hauling. In the maintenance of street and interurban electric railway systems, construction material, track ballast, new ties and rails and other equipment must be transported over the system, and this is usually accomplished by electric cars. Dump cars are also used to a large extent both on systems of this type and for industrial purposes where coal and ash are handled by cars. Trolley cars of special construction equipped with a dumping or tilting and righting mechanism are used for this purpose. Other cars, which are practically movable machine shops, are used in the repair of tracks or in grinding the rail surface and rail joints, making welds, installing bonds, etc. Also see Sprinkling cars, electric railway; Snow plows and sweepers, electric railway; Excavators or shovels, electric.

Manufacturers:

Differential Steel Car Co., Findlay, Ohio. (mine and baggage).

CARS, ELECTRIC RAILWAY, BATTERY.—Self-contained vehicles comprising body and trucks running on rails used for transportation chiefly of passengers, and propelled by electric motors mounted on the axles of the trucks. The motor derives its power from storage batteries carried on the car. Such cars are used on light feeder lines where trolley equipment is not permitted. The battery compartments are often so arranged that the discharged battery can readily be exchanged for a freshly charged one at the terminal station or other convenient point along the route.

Manufacturers:

Brill Co., The J. G., 52nd St. & Woodland Ave., Philadelphia, Pa.
Pressed Steel Car Co., 307 5th Ave., Pittsburgh, Pa.
Railway Storage Battery Car Co., 50 Broad St., New York, N. Y.

CARS, ELECTRIC, STREET AND INTERURBAN, TROLLEY.—Trolley cars for street railway and interurban service are substantially built cars comprising a car body, generally enclosed, and the running gear or trucks, propulsion motors and braking equipment. They are used chiefly for the transportation of passengers and are equipped with seats, heaters, lights and other equipment for the convenience of the passengers. Modern cars are generally constructed with a steel underframe and use very little wood as structural members.

There are two general types of cars depending upon the length of the car body and the method of mounting on the trucks. Car bodies up to about 35 or 40 ft. are mounted on single trucks and those 40 ft. and longer are carried on double trucks. The motors are suspended from the trucks and there are generally two for a single truck. The power for the motors is obtained from an overhead trolley wire, through a trolley wheel, harp, pole, base and suitable interior wiring and control equipment. Interurban cars are sometimes provided with auxiliary current-collecting shoes for use in sections having a third rail instead of overhead trolley wire.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa. "Peter Witt," "Birney."
McGuire-Cummings Mfg. Co., 111 W. Monroe St., Chicago, Ill.
Pressed Steel Car Co., 307 5th Ave., Pittsburgh, Pa.
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.

CARS, ELEVATED AND SUBWAY.—These cars are universally of double-track design and provided with air brakes. The motors obtain power through a shoe sliding on a rail usually located outside of and parallel to one of the track rails; this rail is insulated from ground and is universally called the "third rail." Occasionally such cars are also equipped with trolley devices so that they can operate over sections of track having overhead trolley. Multiple-unit operation is common; it provides one-half or more of the cars of a train as motor cars but permits control from any car that happens to be at the front, whether it is a motor car or not. Trains of up to 10 cars are so operated. Doors at the middle as well as at the ends are often provided to facilitate loading and unloading. All cars were formerly of composite construction, but modern types are built of steel throughout.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Pressed Steel Car Co., 307 5th Ave., Pittsburgh, Pa.

CARS, GAS-ELECTRIC. — Self-propelled cars used to a limited extent on railroads where traffic is so light as to require only a few cars a day, as on feeders for steam and electric railroads where trolley-line construction would not be justified by the meager income. They have a gasoline or oil engine with direct-connected generator mounted in the motorman's cab or in a compartment close to it. The generator supplies power for the driving motors and for the lights, sometimes in conjunction with a storage battery. The battery may be charged at light loads and serves to aid the generator set on hills or other heavy loads, thus providing a more uniform load for the engine and therefore also enabling a smaller engine to be used. This type of car has advantages over the ordinary gasoline-propelled car, because of greater flexibility of control and the higher efficiency of transmission of power to the driving wheels. The use of this type of car is largely dependent upon a cheap fuel; cars have been used in interurban service that consume about 0.4 gal. of gasoline per car-mile.

Manufacturers:

Brill Co., The J. G., 62nd St., & Woodland Ave., Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1233.)
Pressed Steel Car Co., 307 5th Ave., Pittsburgh, Pa.

CARS OR BUSSES, TRACKLESS TROLLEY.—Electrically propelled passenger vehicles comprising chassis and body running on the street or roadway. They resemble the ordinary automobile bus in construction and service. Power for the motors is obtained from an overhead wire, by means of a swivel trolley so designed that the car or bus can maneuver considerably under the wire and yet not lose contact with the source of power. Since they do not run on tracks, such vehicles can pass each other and pass around other vehicles on the road. They have been used to a limited extent for extensions to street railways into sparsely settled suburban districts.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.

CARS, POWER HOUSE, INDUSTRIAL RAILWAY, ETC.—Various types of small cars are used around a power house or large industrial plant for handling coal, ashes, construction material and various finished products. These are often steel dump cars that run on a narrow-gage track. They are sometimes pushed by hand or hauled by a special electric car or small locomotive. Various forms and sizes, with different dumping and scooping arrangements, are made, depending on the material to be handled.

Manufacturers:

Differential Steel Car Co., Findlay, Ohio.
Easton Car & Construction Co., Easton, Pa.
Lakewood Engineering Co., Cleveland, Ohio.
Ramapo Iron Works, Hillburn, N. Y. "Ramapo."

CARS, ELECTRIC, TOY.—Miniature electric cars designed to run on light pressed metal tracks and operated by a small low-voltage series motor from battery circuits. Can also be operated from house lighting circuits through a small transformer.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Lionel Corp., The, 48-52 E. 21st St., New York, N. Y. "Lionel."

CARSPRING.—Trade name for axle generator belts for car lighting equipments manufactured by the New Jersey Car Spring & Rubber Co., Inc., Jersey City, N. J.

CARTER, J. W.—Abilene, Tex.—Manufacturer of cord adjusters.

CARTER-CRANE CONTROLS.—122 S. Michigan Ave., Chicago, Ill. Manufacturer of motor-operated door opening and closing devices. Business established 1915. President and general manager, O. M. Carter; vice-president, R. L. Benson; secretary and treasurer, A. F. Bordwell.

CARTONS, CORRUGATED FIBER.—Cartons made of corrugated fiber are sometimes used for enclosing electrical appliances, especially those having a number of component parts that are shipped and stocked unassembled, such as push-button switches with flush plates, necessary screws, etc. They are also used on some of the larger and heavier articles, such as electric irons, vibrators, telephone parts, etc., because of the strength of the carton; also for lamp shades, candle stems, and other breakable articles. The corrugated fiber is usually the center ply of a three-ply sheet, the outer one having the manufacturer's name in many cases an ornamental design to assist in improving the appearance of the dealer's shelves when the material is stocked. Cartons of this type are often packed in corrugated fiber boxes for shipping. Also see Boxes, corrugated fiber, packing and shipping.

Manufacturers:

Gair Co., Robt., Brooklyn, N. Y.
HINDE & DAUCH PAPER CO., THE, 311 W. Water St., Sandusky, Ohio. "Climax." (See display adv. page 1322.)
Sefton Mfg. Co., 1301 W. 35th St., Chicago, Ill.

CARTONS, FLASHLIGHT. — Flashlight cartons are generally made of cardboard, for the purpose of shipping and stocking flashlights and flashlight parts. Attractive designs and colored displays are generally used so that a stock of flashlights on the shelf will attract the attention of customers in the store. They also serve to protect the flashlight cases from corrosion and scratching and from becoming dusty and dirty, and they provide a much easier way of handling large quantities of flashlights.

Manufacturers:

Campbell Paper Box Co., South Bend, Ind.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Sefton Mfg. Co., 1301 W. 35th St., Chicago, Ill.

CARTONS, INCANDESCENT LAMP.—Cartons made of cardboard provided to protect the lamp during shipment and stocking and to provide an easy means of handling several lamps. They are made to contain several lamps in the smaller sizes, the lamps being separated and protected from each other by corrugated cardboard cylinders. Larger sizes of lamps, generally 100-watt or above, are furnished in individual cartons, although a larger container may also be used to hold several lamps. The cartons are usually of attractive appearance and add to the appearance of the dealer's shelves when in stock. Millions of these cartons are used annually.

Manufacturers:

Campbell Paper Box Co., South Bend, Ind.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Sefton Mfg. Co., 1301 W. 35th St., Chicago, Ill.

CARTONS, MISCELLANEOUS.—Cartons are used in shipping many small electrical devices and parts that are to be kept in stock on a dealer's shelf. Some of these are switches, fuses, attachment plugs, sockets, flush plates, electric irons, and various other appliances. In general, cartons are designed so as to attract attention, as well as to facilitate stocking of the devices together with mounting screws and

other accessory parts in the same carton, and to protect the articles from corrosion, loss, etc.

Manufacturers:

Campbell Paper Box Co., South Bend, Ind.
Dunbar, Hubert C., 53 W. Jackson Blvd., Chicago, Ill.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
National Folding Box Co., New Haven, Conn.
Sefton Mfg. Co., 1301 W. 35th St., Chicago, Ill.

CARTS, LINEMEN'S TOOL AND SUPPLY.—Carts used by linemen for carrying tools and various supplies are made both as hand push-carts and as horse-drawn or trailer carts. They are provided with compartments for holding the tools, etc., and usually with a hinged cover, sometimes in the shape of a roof, so as to shed water readily. In some cases a reel for paying out and rewinding wire is mounted on the cart, although usually this is on a separate cart.

Manufacturers:

Dicke Tool Co., The, Downer's Grove, Ill.

CARTY, JOHN J.—An electrical engineer, born at Cambridge, Mass., 1861. After completing the course at the Cambridge Latin School, he entered the employ of the Telephone Dispatch Co., of Boston, in 1879. In 1887 he was placed in charge of the cable department of the Western Electric Co., in New York, and in 1889 he entered the service of the New York Telephone Co., of which he was made chief engineer. In 1908 he was appointed chief engineer of the American Telephone & Telegraph Co., and in 1919 one of its vice-presidents. Colonel Carty invented a test system for multiple switchboards, and installed the first metallic-circuit multiple switchboard. He has made many other improvements in the design and installation of telephone cables and switchboards. Among the important achievements accomplished under his direction are: The transcontinental telephone line, 3,400 miles long, which was formally opened for commercial use on Jan. 25, 1915, connecting San Francisco and New York; the underground telephone cable between Boston and Washington, D. C.; the establishment of radio telephone communication from the naval radio station at Arlington, Va., to the Hawaiian Islands and to the Eiffel Tower at Paris, France. He received the Longstretch medal from the Franklin Institute in 1903; the Franklin medal in 1916, and the Edison medal from the American Institute of Electrical Engineers in 1918. During the World War he was commissioned major in the Signal Officers' Reserve Corps in January, 1917, and was ordered to active service in April, 1917. In August, 1917, he was promoted to colonel in the Signal Corps. For his service in France he received the D. S. M. (U. S. A.), Officer of the Legion of Honor (France), and the Order of the Rising Sun and Order of the Sacred Treasure (Japan). In 1915-16 he was president of the American Institute of Electrical Engineers.

CARY SPRING WORKS.—240-242 W. 29th St., New York, N. Y. Manufacturers of spring wire and springs for all purposes. President, Edward M. Cary; secretary, P. H. Hill; treasurer, F. R. Cary.

CASCADE.—An electrical connection in which a winding of one machine is connected to a different winding of another machine, as the secondary of an induction machine to the primary of another or to the armature of a synchronous converter. The object in such a case is to reduce the speed or the frequency. It is also called a tandem or a concatenated connection.

This term is also applied to a series connection of condensers. When they are connected in this manner the equivalent capacitance of the combination is reduced. See Condensers, static, parallel and series.

CASCADE TIMBER CO.—Tacoma, Wash. Manufacturer of cedar poles and railway ties.

CASCO.—Trade name for leather belting and belt lacing manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

CASES, FLASHLIGHT.—Flashlight cases are made in a number of forms and sizes. The most common forms are the cylindrical and vest-pocket form, which is similar to a cigarette case. The cases are commonly made of vulcanized fiber or of sheet metal, which is enameled or nickel-plated. Special forms are made, such as candles, fountain pens, pencils, pistols, lanterns, etc., and these are made of the same materials. Attractive silver-plated cases are also made in special designs. The case always provides protection for the battery and a switch of some sort and also provides a mounting for the reflector, lens and lamp socket, together with the battery contacts.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y.
Bright Star Battery Co., 310 Hudson St., New York, N. Y.
Burgess Battery Co., Madison, Wis.
Comet Battery Co., The, 1362 E. 3rd St., Cleveland, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Diamond Electric Specialties Corp., 101 S. Orange Ave., Newark, N. J.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
French Battery & Carbon Co., Madison, Wis.
International Battery Co., Inc., 453-455 Broome St., New York, N. Y.
Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y. "Niagara."
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless."
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display advertisement on page 1327.)
Stuart Products Corp., 665 Washington Blvd., Chicago, Ill.
Usona Mfg. Co., The, 1 Hudson St., New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Wilmington Fibre Specialty Co., Wilmington, Del. "Wilmington Fibre."

CASES, INSTRUMENT-CARRYING.—Cases designed to protect and enclose portable instruments when not in use. They are used on various instruments, such as voltmeters, ammeters, wattmeters, testing sets, fault finders, and other portable instruments of a similar character. Both wooden and leather cases are used. The wooden cases are often made of cherry or mahogany, so as to give a good appearance, as well as strength. They are generally provided with a leather carrying handle. Leather cases are usually neater than the wooden case and less bulky. They are nearly always provided with a long shoulder strap and are used to enclose meters and other instruments used by inspectors, trouble men, etc.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

CASES, TRANSFORMER.—An iron case or tank for holding and protecting the core and coils of the transformer. The case also holds oil which circulates throughout the coils. Cast iron is used in making many of the tanks. The bottom and sides are cast as one piece to prevent oil leakage. In some cases the sides are of sheet iron set in a cast iron base. Many cases are of corrugated construction for cooling purposes, as this increases the radiating surface. In larger sizes this is carried still farther by providing radiators or tubes in which the oil may be cooled. These are placed entirely around the circumference of the case.

Manufacturers:

American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa. "Spare'a."
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Ormsby Co., Ltd., The A. B., 48 Abell St., Toronto, Ont., Can.
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."

CASH CO., A. W.—Decatur, Ill. Manufacturer of valves.

CASING, FIXTURE.—Fixture casing or tubing is generally made of brass. It is made in several sizes and several forms, such as plain round, square, reeded round, oval, rope and batwing. It is made in sizes up to about one inch in diameter in nearly all shapes and up to two inches for plain round casing. Six-foot lengths are generally furnished and the fixture manufacturer then cuts it to the proper length. Seamless tubing or brazed-seam casing is the best grade, although casing having the edges crimped or locked together on the inside is also satisfactory for many purposes and is much cheaper. This is also made of steel, copper, zinc, etc.

Substitutes for brass have been used in a number of cases to give special coloring or moisture and corrosion-resisting properties. White metals containing zinc in large proportion and other special alloys which when polished have the appearance of nickel or silver plate, but are much more free from tarnishing, are used in many cases.

Manufacturers:

Andresen Co., Jacob, 258 Third Ave. S., Minneapolis, Minn.
Best Electric Corp, 476 Broadway, New York, N. Y.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

CAS-O-LUX.—Trade name for desk and table lamps, lighting fixtures and lighting units manufactured by Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y.

CASSIDY CO., INC.—15-21 Wilbur Ave., Long Island City, N. Y. Manufacturer of lighting fixtures and desk lamps. President, treasurer and general manager, G. W. Cassidy; secretary, C. G. McCarthy; sales manager, W. R. McCoy.

CASSIDY-FAIRBANK MFG. CO.—6128 S. La Salle St., Chicago, Ill. Manufacturer of sheet metal stampings and wood handles.

CASTINGS, ALUMINUM, BRASS, BRONZE, COPPER, ZINC.—Cast aluminum is the lightest metal in common use. The ease with which it can be attractively finished makes it very popular for table and kitchen ware, casings for household vacuum cleaners, covers for electrical instruments, etc. Aluminum castings as heavy as 480 lbs. have been made, but castings 200 lbs. are considered large ones. Aluminum is seldom used pure in castings, as it is too soft and porous. It is commonly alloyed with zinc, and less commonly with copper. Most aluminum castings change their characteristics at normal temperature after casting. This is called "aging," and increases the tensile strength and decreases the elongation.

Brass castings are of various copper-zinc alloy composition, often with a small percentage of lead added, depending on the special purposes for which the brass is needed. The alloy is usually prepared by melting the proper metal ingredients in a furnace and then casting the molten brass in molds; scrap brass is often remolten, however. Several types of furnace are used. The oldest still in service is the floor type furnace, using coke fuel and a crucible; there are also various forms of tilting or continuously rolling furnaces mounted on pedestals and using oil or gas for fuel; the most modern type is the electric brass melting furnace, which is either tilting or rolling furnace using the electric resistance or arc principles for heating the charge. In fuel-fired furnaces, in order to prevent burning the zinc, the copper is usually melted first and the zinc and lead then added. (For details and advantages of electric brass melting furnaces, see Furnaces, electric, brass melting.) The temperature of the charge is often checked by a thermocouple thrust directly into the charge. Brass castings are especially desirable where lightness and strength are desired, in combination with nonrusting and ornamental qualities. Most cast parts forming conducting parts of an electrical appliance are of brass.

In many cases in which a high copper alloy is desired, especially where both high conductivity and toughness are necessary, bronze castings are used. The more copper used in the alloy the higher its conductivity. Trolley wheels illustrate a pronounced demand for both toughness and high conductivity. The foundry methods used in making bronze castings are practically as used in making brass. For spe-

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cial purposes, phosphorus is added in stick form to the melted charge to give phosphor-bronze, manganese to give manganese bronze, aluminum for aluminum bronze, etc. Manganese bronze with a tensile strength as high as 90,000 lbs. per sq. in. and an elongation of 30% is obtained. A bronze containing from 16% to 25% of tin is used in bells, gongs, whistles, etc., where resonant quality is desired. Bronze with a tin content of about 11% and a maximum of 0.2% phosphorus is much used for the worm gears of motor-truck axles.

Copper castings are used where the best obtainable electrical conductivity is demanded, where resistance to the action of certain substances is necessary, or where a high ornamental finish is required. Many high-grade lighting fixtures, especially for table use, are of copper castings. Fuse and switch clips, heavy cable terminal lugs, busbar connectors, brush-holder parts, etc., are nearly always of pure copper castings. The preparation of copper castings is much the same as that of bronze or brass except that by careful addition of small amounts of certain other metals the castings can be made more tough without much sacrifice in conductivity.

On account of its porosity and structional weakness the use of pure or unalloyed zinc in castings is comparatively limited. Probably the most extensive use to which zinc castings are put in electrical work is as electrodes of primary batteries.

Electrical manufacturers often find it of advantage to have castings of these various metals and alloys made by founders who have extended experience in and special facilities for their production.

Manufacturers.

Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont., Can.
American Foundry Co., Inc., The, Springfield Ave. & S. 11th St., Newark, N. J.
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.
Bayer Foundries Co., 4057 Park Ave., St. Louis, Mo.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Bronze Metal Co., 30 Church St., New York, N. Y. "Vim Metal."
Buckeye Tempered Copper & Brass Co., Mansfield, Ohio. (Brass and copper.)
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass. (Brass for fixtures.)
Capitol Brass Works, Detroit, Mich. "Capitol."
Champion Brass Works, Coldwater, Mich.
Champion Hardware Co., Geneva, Ohio.
Chickasaw Machine & Foundry Co., Memphis, Tenn. (Brass.)
Clarksville Foundry & Machine Works, Red River St. & L. & N. R. R., Clarksville, Tenn.
Cleveland Crane & Engineering Co., The, Wickliffe, Ohio.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio (brass).
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y. (brass).
Doehler Die-Casting Co., Court & Huntington Sts., Brooklyn, N. Y. (aluminum, brass, bronze, tin, lead, zinc), "Do-Di" brass and bronze.
Dominion Steel Products Co., Ltd., Brantford, Ont., Can.
Dow, Inc., L. B., Keene, N. H.
Eagle Smelting & Refining Works, Ltd., 41-45 Prince St., Montreal, Que., Can. (brass and bronze).
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind. (brass, bronze, copper).
Electric Materials Co., The, North East, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Empire Brass Mfg. Co., Ltd., London, Ont., Can. (brass for electric fixtures).
Faries Mfg. Co., Decatur, Ill.
Fischer-Sweeny Bronze Co., Inc., 1301 Grand St., Hoboken, N. J.
Flour City Ornamental Iron Co., 27th St. & 28th Ave. S., Minneapolis, Minn.
Franklin Die-Casting Corp., Magnolia & Gifford Sts., Syracuse, N. Y. (aluminum).
Graham Co., James, 293 Wooster St., New Haven, Conn.
Griffiths & Son, James A., 1315-1317 Buttonwood St., Philadelphia, Pa.
Hall Switch & Signal Co., Garwood, N. J.
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Harley Co., The, Page Blvd., Springfield, Mass.
Harris & Co., Arthur, 212 Curtis St., Chicago, Ill.
Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
L. A. Brass Foundry, 1539 E. 16th St., Los Angeles, Cal. (brass).
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Loeffelholz & Co., 170-182 Clinton St., Milwaukee, Wis.
Lough Bros., 90 West St., New York, N. Y. (brass, bronze and aluminum).
Lumen Bearing Co., Buffalo, N. Y. "Old Genuine."
LUMINOUS UNIT CO., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo. (See display advertisement on pages 1276-7.)
Lunkenheimer Co., The, Cincinnati, Ohio.
Marine-Hardware-Equipment Co., South Portland, Me. (bronze).
McClave-Brooks Co., Poplar St. & Park Pl., Scranton, Pa. (aluminum, brass, bronze).
Meyerberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Munning & Co., A. P., Church St., Matawan, N. J.
National Bronze & Aluminum Foundry Co., The, Cleveland, Ohio. "Nabralco."
National Electric Co., 302 Kanawha National Bank Bldg., Charleston, W. Va.
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
North American Smelting Co., 9th & Thompson Sts., Philadelphia, Pa.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Parker White Metal & Machine Co., South Erie, Pa.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Pennsylvania Pump & Compressor Co., Easton, Pa. (brass). "Pennsylvania."
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
Reading Brass Works, Reading, Pa. (brass).
Reeves & Co., Inc., Paul S., 1415-25 Catharine St., Philadelphia, Pa. "Niagara."
Rempis & Gallmeyer Foundry Co., 524 Front Ave., N. W., Grand Rapids, Mich. (brass and aluminum).
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Rome Mfg. Co., Rome, N. Y. "Rome."
St. Catharines Brass Works, The, George St., St. Catharines, Ont., Can.
ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (brass, bronze).
Sani Products Co., 209 W. Randolph St., Chicago, Ill.
Sherman, Eugene M., Bellevue, Wash. (brass).
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Termaat-Monahan Mfg. Co., Oshkosh, Wis. (cast iron).
Thompson Machinery Co., Ltd., Grand Bay, N. B., Can.
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y. (pure copper).
United Metal Mfg. Co., Inc., 27 Shipping St., Norwich, Conn.
Universal Bearing Bronze Co., Winsted, Conn. (brass and aluminum).
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Watson, Frye Co., Ltd., 213-223 Front St., Bath, Me. (brass and bronze).
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

CASTINGS, DIE.—Die castings are made in automatic machines handling carefully finished metal molds, into which the molten metal is forced under pressure. The alloys used are such as will stand quick cooling and give clean, sharp outlines. Zinc-base alloys use 88% zinc, 8% tin and 4% copper. Tin-base alloys used 86% tin, 6% copper and 8% antimony. Lead-base has 83% lead and 17% antimony. One of the most useful alloys for die casting is the aluminum base, 92% aluminum and 8% copper. Manganese bronze having a tensile strength of 60,000 lbs. per sq. in. and a melting point of 1,800°F. is die-cast so accurately that only a few thousandths of an inch need be removed in finishing.

The uses to which die castings are commonly put are very numerous; in general, they include practically all small parts in which it is desired to secure both strength and quite accurate dimensions with little or no subsequent machining or finishing work. Among these are parts of appliances, instruments, meters, automotive electrical equipment, etc. The die-casting process is especially suited to production in large quantities, and under these conditions gives high quality as well as quantity at relatively low cost. The process requires special equipment and skill and gives best results when the castings are made by founders who are specialists in this line. Such companies are usually prepared to give estimates based on detail drawings and specifications and in many cases can make suggestions for improvement of designs.

Manufacturers:

Acme Die Casting Corp., 87 35th St., Brooklyn, N. Y. "Alumac."
Alemite Die-Casting & Mfg. Co., 341-51 W. Chicago Ave., Chicago, Ill.
BARNHART BROS. & SPINDLER, Monroe & Throop Sts., Chicago, Ill. "Superior." "Tenso." (See display adv. page 1329)
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Doehler Die-Casting Co., Court & Huntington St., Brooklyn, N. Y.
Franklin Die-Casting Corp., Magnolia & Gifford Sts., Syracuse, N. Y.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Legler-Ellerman Co., The, Dayton, Ohio.
Lough Bros., 90 West St., New York, N. Y.
Milwaukee Die Casting Co., 297 4th St., Milwauke, Wis.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Lead Co., 111 Broadway, New York, N. Y.
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
Rome Mfg. Co., Rome, N. Y. "Rome."
Stewart Mfg. Corp., 4538 Fullerton Ave., Chicago, Ill.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Twin City Die Castings Co., Talmage & 33rd Aves., S. E., Minneapolis, Minn.
Veeder Mfg. Co., Sargeant & Garden Sts., Hartford, Conn.

CASTINGS, ELECTRIC STEEL.—Electric steel castings are those made from steel that has been molten in an electric furnace. The furnaces used are either of the arc or resistance types. The advantages of electric steel castings are numerous, among these being the following: The steel is much more uniform in composition and more homogeneous throughout any casting; it has been found in general average practice that electric steel is uniformly better for castings by a very high percentage; it is practically free from blowholes or other defects and consequently, the percentage of rejections in castings is very much reduced; electric steel can be poured at a much higher temperature in a still or dead condition and it has, therefore, become possible to produce intricate thin-section castings with regularity and without a high percentage of rejections. As a result of these and other advantages electric steel castings are now used for many purposes not available heretofore for steel castings. It has permitted meeting the demand for quality products of various kinds. Comparisons between electric steel and open-hearth steel have shown the former to be invariably superior in tensile strength, purity and homogeneity. The tonnage of electric steel castings produced in the United States in the last few years has rapidly increased. In 1914 the total electric steel prdouction was 24,009 tons, whereas in 1918 it was 511,364 tons.

Unless the manufacturer has sufficient need for electric steel castings to warrant installation of an electric furnace for their

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production, he should have these castings made in a foundry that has electric furnace equipment. Founders who have made a specialty of producing electric steel castings have made a careful study of the methods for securing the best results and have equipment available for securing electric steel of various compositions to meet any special requirements.

Manufacturers:

Belle City Malleable Iron Co., 1500 Kewanee St., Racine, Wis.
Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.
Chicago Steel Foundry Co., 3720 S. Kedzie Ave., Chicago, Ill.
Crucible Steel Casting Co., Lansdowne, Pa.
Falk Co., The, Milwaukee, Wis.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
McConway & Torley Co., The, Pittsburgh, Pa.
Pressed Steel Car Co., 307 5th Ave., Pittsburgh, Pa.
Racine Steel Castings Co., Racine, Wis.
Wharton, Jr., C. Co., Inc., William, Easton, Pa.

CASTINGS, MALLEABLE IRON.—Malleable cast iron has physical properties between those of gray iron and steel castings. Its tensile strength varies between 40,000 and 60,000 lbs. per sq. in. with an elongation of from 2½% to 5½%. Malleable iron is preferred to ordinary gray iron for uses involving twisting or bending stresses, impact, etc. Owing to the method of its manufacture, malleable castings should be used as nearly as possible in their original condition. Malleable iron lends itself to the manufacture of the light sections so often necessary in electrical work, such as brackets, steps, covers, cable and pipe racks, clamps, switchboard and other fittings, etc.

Malleable castings have a majority of the carbon content in combined form. They are annealed at a temperature of 625 to 875°C for about 60 hours. The combined carbon is reduced to graphite and occurs in finely powdered form. The skin or coating of the metal has all of the carbon eliminated, leaving minute cavities. Very thin pieces when annealed can have all of the carbon removed. If the casting is annealed in lime or fireclay the carbon is deposited as temper carbon instead of being removed.

Manufacturers:

Acme Steel & Malleable Iron Works, Inc., 245 Military Rd., Buffalo, N. Y.
Badger Malleable & Mfg. Co., South Milwaukee, Wis.
Belle City Malleable Iron Co., 1500 Kewanee St., Racine, Wis.
Eastern Malleable Iron Co., The, Naugatuck, Conn.
Franklin Machine Co., Providence, R. I.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Lough Bros., 90 West St., New York, N. Y.
Malleable Iron Fittings Co., Branford, Conn.
Marion Malleable Iron Works, The, Box 568, Marion, Ind. "Marion."
Mesta Machine Co., West Homestead, Pa.
Moline Malleable Iron Co., St. Charles, Ill.
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Standard Steel Works Co., 500 N. Broad St., Philadelphia, Pa. "Standard."
Trenton Malleable Iron Co., Trenton, N. J.

CASTINGS, MISCELLANEOUS, IRON AND STEEL FOR MOTORS, GENERATORS, ETC.—In the construction of motors, generators, synchronous converters and other electrical machinery, castings are frequently required. Although many manufacturers of such machinery have their own foundries, in many cases it is found advantageous to have the castings made in an outside foundry, and there are founders who have made a specialty of making castings for the frames of motors and generators, for bases, bearing pedestals, spiders for large armatures and revolving fields, and other parts. For the field frames it is important that iron or steel of special magnetic quality should be used. This is particularly true of a.-c. machines in which the hysteresis loss can be materially reduced by using metal of special quality.

Manufacturers:

Bayonne Steel Casting Co., Bayonne, N. J.
Crucible Steel Casting Co., Lansdowne, Pa.
Detroit Steel Casting Co., Detroit, Mich.
National Car Coupler Co., Attica, Ind.
Parker White Metal & Machine Co., South Erie, Pa.

CASTINGS, SPECIAL ALLOY.—Special alloys are often used in making castings to be used in electrical machines and appliances. There are a number of such alloys used, such as so-called "white metals" which have an appearance similar to nickel and silver. Many of the alloys are specially made to resist corrosion of acids, etc., and others to combine strength and lightness or to give other desirable properties for which the commoner alloys, such as brass and bronze, are not specially suited.

Manufacturers:

Aterite Co., Inc., John & William Sts., New York, N. Y. "Sterite" noncorrosive alloy.
Crucible Steel Casting Co., Lansdowne, Pa.
Erie Forge & Steel Co., Erie, Pa.
Parker White Metal & Machine Co., South Erie, Pa.

CASTLE.—Trade name for fire extinguishing liquid manufactured by James M. Castle, Inc., 1210-12 Arch St., Philadelphia, Pa.

CASTLE.—Trade name for electric sterilizers manufactured by the Wilmot Castle Co., 1155 University Ave., Rochester, N. Y.

CASTLE CO., WILMOT.—1155 University Ave., Rochester, N. Y. Manufacturer of electric sterilizers and bacteriological apparatus. Business established 1883. President and treasurer, Wilmot Castle; vice-president, Arthur Castle; secretary and general manager, Wilmot V. Castle.

CASTLE, INC., JAMES M.—Philadelphia, Pa. Manufacturer of fire extinguishers. Business established 1913. President, C. B. Ford; secretary and treasurer, E. C. Moore. Main office, 1210-12 Arch St., Philadelphia, Pa. Branch offices, 108 South St., Baltimore, Md.; 220 N. 4th St., Newark, N. J.

CASTNER CELL.—One of the early electrolytic alkali-chlorine cells. It consisted of a slate box 4 ft. square and 6 ins. high, divided into three equal compartments by vertical partitions, which did not quite reach the bottom of the cell. The bottom was covered with a layer of mercury, which could thus pass from one compartment to the other, and which was made to circulate by rocking the cell slowly by means of a pivot at one end and a small eccentric at the other. In the two outer divisions graphite anodes entered the brine electrolyte and chlorine escaped through outlets in the cover, the mercury being cathode. In the inner compartments the mercury as anode discharged sodium into an alkali solution, an iron grid being the cathode. The mercury was thus being alternately charged and depleted of sodium. As the efficiency of charging was less than that of discharging, it was necessary to shunt 5% to 10% of the current so that it passed through the brine compartment only and not through the alkali, otherwise the mercury anode became free of sodium and was oxidized.

CASTNER-KELLNER CELL.—A modification of the Castner cell in which no current passes through the alkali compartment. Usually accomplished by having the iron electrode in this compartment dip directly into the amalgam, causing it to be discharged by local action and not by the generator current.

CASTNER PROCESS.—Sodium is produced from molten sodium hydroxide by this process, which is carried on at Niagara Falls. The cell is a cast iron pot with a cylindrical extension at the bottom through which enters an iron cathode. The anode suspended at the top is a nickel ring. Sodium liberated at the cathode is prevented from reaching the anode, where it would be redissolved, by a cylindrical screen with extension of fine wire gauze surrounding the cathode. The molten sodium is ladled out by perforated spoons which retain the sodium and allow the hydroxide to pass through. The temperature must be kept just above the melting point of the electrolyte, that is, at about 315 to 320°C. Above 325° the yield of sodium becomes practically zero.

CASWELL-RUNYAN CO., THE.—Huntington, Ind. Manufacturer of portable electric lamps. President, Winfred Runyan; vice-president, John A. Snyder; secretary and treasurer, J. W. Caswell.

CATALYST.—A substance whose presence favors the combination of other substances, without itself entering into the products of the reaction. For example, finely divided platinum facilitates or accelerates the union of hydrogen with oxygen. Such substances are extremely useful in synthetic chemistry.

CATAPHORESIS.—Electric osmose or tendency for a liquid to pass from an electrode through a porous medium and mix with other liquids on the other side. It is sometimes used in medicine to introduce drugs into the human body or to remove injurious matter.

CATARACT.—Trade name for electric washing machines manufactured by the 1900 Washer Co., 215 Clinton St., Binghamton, N. Y.

CATCHERS AND RETRIEVERS, TROLLEY.—Compact devices to hold the trolley pole from flying up and damaging the overhead wires when from any cause during the operation of the car the trolley wheel leaves the wire. The main features are large, flat spiral springs, dogs, cams and ratchets connected to the barrel on which the trolley rope is wound and so arranged that, in the catcher, a jerk on the rope caused by the wheel leaving the wire will hold the trolley pole in a fixed position. In the retriever, the same action on the rope causes the mechanism to wind the rope, and pull the pole down clear of the overhead wires. Catchers are adapted to slow-speed cars and retrievers to high-speed or interurban cars.

Manufacturers:

Earll, Charles I., York, Pa.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. Keystone trolley catchers are strong and durable and are unique in that they consist of few parts. They catch the trolley pole almost immediately after the pole leaves the wire, the action of the centrifugal pawls making them extremely sensitive. They are made to withstand long wear and rough usage.—Adv.
OHIO BRASS CO., THE, Mansfield, Ohio. The O-B catcher, for city cars, stops the wheel when it leaves the wire and permits no stepping up. O-B retriever, for high speed service, pulls the pole below the span wire. Both are sturdy and simple.—Adv.
Trolley Supply Co., The, Massillon, Ohio. "Ideal" catcher, "Knutson" retriever.

CATENARY.—The curve assumed by a perfectly flexible, uniform, inextensible, fine strand in equilibrium under tension and gravitational forces when supported between two points. This is exemplified approximately by a chain, rope or flexible cable supported freely between two points of about the same level. Its application to the electrical industry is in the catenary system of trolley line construction used for high-speed electric railway lines. It is also approximately the curve obtained in transmission line spans, although in this case the shape is not of material importance.

Applied to trolley line construction it consists in its simplest form of steel messenger cable supported on insulators, thus forming a catenary curve. The trolley wire is suspended below the messenger cable by means of hangers at short intervals and of such lengths as to give a straight line without sag. There are also used compound catenaries which in one form consist of a track messenger strand supported by insulators that are suspended from a main grounded messenger supported on cross bridges, or some similar combination. The catenary construction permits the use of higher voltage trolley lines and also higher speeds or better current collection at high speeds.

CATENARY FITTINGS, MISCELLANEOUS.—There are a number of miscellaneous fittings used in catenary construction for trolley lines not listed elsewhere. Special supporting brackets for pole mounting are required to support the tee bracket arm. The messenger insulator pins for mounting the porcelain insulators are made of malleable iron usually and are of special shape. Where duplex construction is used, i.e., one copper trolley used as a feeder and one steel contact wire supported below

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it, special clamps and hangers, etc., are required. For ordinary construction on curves pulloff hangers or pullovers are required to pull the trolley and messenger into position. These are special forms of hangers or are entirely separate articles in other cases.

To prevent side sway in the wind or when a car is passing underneath, steady strains or "steadies" are used. These are special malleable iron fittings for fastening to a special guy wire or cross-span cable, to clamp the trolley wire and prevent side motion but still give the vertical flexibility. Sometimes cross-span catenary construction is used and this requires another type of steadies, hangers, clamps, etc. Feeder connectors for catenary construction are also made special.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Hamilton, Ont., Can.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CATENARY HANGERS.—Catenary hangers are used to suspend the trolley wire from the messenger strand giving the catenary curve. In the flexible type of construction the hanger is loosely looped over the messenger to permit a free movement of the trolley vertically and is gripped to the trolley wire. In rigid construction the hangers are rigidly attached to both the messenger and the trolley. One common form of hanger for this latter construction consists of a two-piece malleable iron clamp fastened to a steel hanger rod by tightening a nut on the clamping bolt, with a messenger clip or means for fastening rigidly to the messenger wire. There are numerous modifications of the messenger clips and also of the clamping member, for which trolley ears are very often used. For the flexible construction the same types of trolley clamps or trolley ears are used. In the simplest forms a steel rod fastened to the clamp has its upper end formed into a small loop which is shipped open. This is hooked over the messenger wire and the loop closed with a hammer. Others have a steel strap which has a loop in it with spring action and designed to snap over the messenger. Other types have open loops of steel strap or rods, extending from the trolley ear or clamp to the messenger wire and fastened under the bolt which holds the clamping members together. There are also modifications of these types and other methods are also used.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Hamilton, Ont., Can.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CATHODE.—The plate or terminal by which electricity (conventionally) leaves an electrolyte. The electrode towards which current is assumed to flow in an electrolytic cell. The electrode which is connected to the negative pole (— pole) of a d-c. generator or storage battery, or to the zinc pole of a primary cell, or its equivalent.

CATHODE RAYS.—These rays are produced when an electric discharge is passed through a vacuum tube in which the gas pressure is 0.01 mm. of mercury or less. By passing a narrow beam of these rays through an opening in a metal plate and applying an electric or a magnetic field at right angles to the direction of the beam it will be deflected from its path. This can be seen by the motion of a spot of light produced where the cathode rays fall upon a fluorescent screen. The direction of deflection indicates that the rays are negatively charged particles. By measuring the deviation produced by electric and magnetic fields of known intensity, J. J. Thomson was able to determine the velocity of the rays. This he found to be about one-tenth the velocity of light, or more than 18,000 miles per second. He also showed that the mass of the particles was about 1/1800 of the mass of a hydrogen atom and that it was the same no matter what gas was present in the tube. The charge carried by each particle has been found to be 4.77×10^{-7} electrostatic units, or about 1.6×10^{-19} coulombs.

Cathode rays produce fluorescence in many bodies. Glass, precious stones and numerous other substances show different colored fluorescence. If the cathode is curved, the rays are brought to a focus and a thin metal plate placed at the focus may be heated to redness or even to white heat by the energy of the impacts. When the cathode rays are stopped by striking a target of heavy metal, such as platinum or tungsten, X-rays are produced.

CATHODES, MISCELLANEOUS.—Cathodes for electrolytic processes vary considerably depending upon the purpose for which the process is used. If it is for an electroplating cell, the cathode consists of the article, part or product upon which the deposit is desired. For purifying and electrolytic refining of metals, such as copper, the cathode is made of the metal to be refined. Cells in which metals are deposited that are difficult to obtain in a solid or plate form frequently require the use of an iron or other metallic cathode which is prepared in some manner so that the deposit may be easily removed. In most of these processes the cathode takes the form of a sheet or grid of metal. Special processes for the production of bleach liquor, chlorine products alkali, gases, etc., frequently use molten lead or mercury cathodes.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
International Nickel Co., 43 Exchange Pl., New York, N. Y. "Inco."
Munning & Co., A. P., Church St., Matawan, N. J.

CATHODIC REDUCTION.—The use of a chemical compound as a cathode in an electrolytic cell, whereby it is subjected to the reducing action of the current, and may be reduced to a lower compound or to the metallic state. For example, in the Salom process lead sulphide, to be reduced, is used as cathode in a sulphuric acid electrolyte; on passing current it is reduced to spongy, metallic lead, the sulphur passing off as hydrogen sulphide gas.

CATHOLYTE.—That portion of the electrolyte in contact with the cathode and which is kept from mixing freely with the anolyte by a porous partition or capillary tube or siphon. The catholyte is subjected to the reducing influence of the cathode, but not to the adducing influence of the anode.

CATION.—That part of the electrolyte which is liberated, or tends to be liberated, by the action of an electric current at the cathode. Sometimes erroneously applied to these parts of compounds before electrolysis is attempted, but the term has no meaning until an electrolyzing current is applied, since cations are brought into existence only by the electrolytic action of the current at the cathode.

CAUSTIC ALKALI.—See Alkali, electrolytic.

CAUSTIC POTASH.—Common name for commercial potassium hydroxide or hydrate.

CAUSTIC SODA.—Common name for commercial sodium hydroxide or hydrate. See Sodium hydroxide.

CAUTERIZATION, ELECTRIC.—The process of cauterizing, searing or burning by means of an electrically heated wire in a special electrode. The wire used is generally platinum and is heated by the current passing through it. Cauterization is used chiefly to remove morbid flesh, as about a poisonous bite.

CAVICCHI POLISHING MACHINERY CO.—3-5 Woodworth St., Neponset, (Boston), Mass. Manufacturer of motor-driven surfacing and polishing machines. Business established 1902. Sole owner, E. Cavicchi.

CAVIN, F. T.—400 W. Ave. 26, Los Angeles, Cal. Manufacturer of grounding devices, conduit switch boxes and cabinets for electrical purposes.

C. A. W.—Trade name for motors manufactured by the Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

C. C.—Abbreviation for cubic centimeter, a metric unit of volume. The form cu.cm. is also used.

CC.—Trade name for packing manufactured by the Crane Co., 836 S. Michigan Ave., Chicago, Ill., and Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

CC.—Trade name for starters manufactured by Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

C. Ç. C.—Trade name for copper-clad wire manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

CD.—The form Cd is the chemical symbol for the metallic element cadmium.

C. D. & E. B.—Trade name for safety switches and electrical boxes manufactured by the Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can.

CEACO.—Trade name for electric temperature regulators for electrical appliances manufactured by the Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

CEAG.—Trade name for electric miners' safety lamps manufactured by the Concordia Electric Co., 389 Union Arcade Bldg., Pittsburgh, Pa.

CEC.—Trade name for tube scraping device manufactured by the Combustion Engineering Corp., 11 Broadway, New York, N. Y.

CEDAR RIVER LUMBER CO.—914 Plymouth Bldg., Minneapolis, Minn. Producer of cedar poles and ties. L. C. Paulson, general manager.

CEDERGREN.—Trade name for medical batteries manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

CEETEECO.—Trade name for pliers made by the Crescent Tool Co., Jamestown, N. Y.

CEFCO.—Trade name for lamp coloring compound manufactured by C. E. Franche & Co., 440 Orleans St., Chicago, Ill.

CELCOTE.—Trade name for waterproofing compound manufactured by the Celite Products Co., 1134 Van Nuys Bldg., Los Angeles, Cal.

CELESTIALITE.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

CELITE PRODUCTS CO.—Los Angeles, Cal. Manufacturer of waterproofing and heat insulating materials. Business established 1912. President, August Fitger; Vice-presidents, Arnold K. Fitger and R. J. Wig; secretary, George T. Gillette; treasurer, Arnold K. Fitger; general manager, H. S. Thatcher; sales manager, Thomas G. Lee. Main office, 1135 Van Nuys Bldg., Los Angeles, Cal. Branch offices, 11 Broadway, New York, N. Y.; Monadnock Bldg., Chicago, Ill.; Oliver Bldg., Pittsburgh, Pa.; Monadnock Bldg., San Francisco, Cal.; Detroit, Mich.; Cleveland, Ohio; St. Louis, Mo.

CELL.—The combination of an electrolyte, an anode and a cathode, all electrically conducting. If such a combination generates electromotive force, it is a primary cell or battery; if it absorbs e. m. f., it is an electrolytic cell; if it is reversible, absorbing e. m. f. when outside voltage is impressed on it, and generating e. m. f. in the reverse direction when left to itself, it is a secondary cell or storage battery.

CELL, SELENIUM.—See Selenium cells.

CELL, STANDARD.—See Standard cells.

CELLO.—Trade name for electrical specialties for automobiles and motor boats, manufactured by the A. S. Campbell Co., 161 Prescott St., East Boston, Mass.

CELLS, ELECTROLYTIC.—An electrolytic cell is one composed of an electrolyte, an anode and a cathode, and which absorbs electrical energy supplied from an external source. This definition is not intended to cover either primary or storage battery cells. There are a great number of distinctive electrolytic cells in use, their purpose being to effect chemical changes in the materials composing the cell. They serve the purpose of purifying and refining many of the metals, such as copper, silver, gold, lead, nickel, zinc, iron, bismuth, cad-

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mium, cobalt, chromium and many others. They are also used to deposit the metal from its salts, this process being applied in many forms and known as electrodeposition and electroplating. Numerous chemical compounds, gases, etc., are also produced by using electrolytic cells, chief among these being various alkali products and chlorine compounds.

The construction of the cell depends upon the material to be produced and the special process used for its production. The manufacturers listed below make cells for one or more electrolytic processes.

Manufacturers:

Electro Chemical Co., The, 111 W. Court St., Dayton, Ohio.
Electrolytic Engineering Corp., 501 5th Ave., New York, N. Y.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

CELLULOID, INSULATING. — Celluloid is a highly inflammable material composed essentially of soluble guncotton (pyrolin) and camphor. It is made to imitate various materials, such as amber or tortoise shell, but in its original state it resembles ivory in color and texture. Celluloid has a dielectric strength of from 9800 to 27,500 volts per mm. at ordinary temperatures, and its resistivity is from $2x10^{10}$ to $8x10^{10}$ ohm-cm. It is slightly hygroscopic and can be molded into any form by softening in boiling water.

CELLULOID ZAPON CO.—New York, N. Y. Manufacturer of metal enamels and lacquers. Business established 1889. President and general manager, Dr. W. A. Jones; secretary and treasurer, Leonard Richards, Jr.; sales manager, N. E. Dabolt. Main office, 200 5th Ave., New York, N. Y. Factory, Stamford, Conn. Branch offices and warehouses, 122 W. 45th St., Chicago, Ill.; Los Angeles, Cal. District office, New Haven, Conn.

CEMCO.—Trade name for wiring devices manufactured by the Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn.

CEMENT, COMMUTATOR.—A cement used in repairing pitted commutators. This is sometimes accomplished without removing the commutator from the machine. The cement is usually furnished as a powder with the proper mixing liquid. It is an insulating compound. One important use is on motors or machines that are difficult to keep clean and free from oil. When the commutator is slotted, the dirt, etc., sometimes causes short-circuits. By filling the slots with cement, many of the advantages of slotting are obtained without having the danger of short-circuit.

Manufacturers:

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display advertisement on page 1320.)
Early Co., Edward E., 1120 5th St., N. W., Canton, Ohio.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Perfection Supply Co., 98 Park Pl., New York, N. Y. "Porce-Lute."
Plas-Mica Co., The, 26th St. & Andrews Place, Yonkers, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CEMENT, LAMP-BASE SEALING.—This is a cement composed largely of plaster of paris, that is used to fill the space between the brass shell of the base and the center terminal and seal up the neck of the bulb. It usually has some other material added to make the seal more firm.

Manufacturers:

Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.

CEMENT, METAL-MENDING. — Metal-mending cement is used to repair cracks or breaks and stop leaks in lead and iron pipes, boilers, water jackets, steam lines, etc., of low or moderate pressure. It is usually a cement furnished in dry form and mixed with liquid to a putty-like consistency and then plugged into and around the leak.

Manufacturers:

Leak-Cure Metal Cement Co., 110 Fulton St., New York, N. Y. "Leak-Cure."
Smooth-On Mfg. Co., Jersey City, N. J.

CEMENTS, MISCELLANEOUS, INSULATING AND SEALING.—Various kinds of cement are used for insulating or sealing electrical products. A number of these used for specific purposes are defined under Cements and Compounds, which see. There are other cements used, however, for miscellaneous purposes, a few examples being cements used to fill up and repair holes or chipped surfaces on panels or switchboards of various kinds. Asbestos cement is sometimes used as both a thermal and electrical insulator in various places. Other products, such as some types of condensers and special induction coils, etc., are also sealed with a special insulating cement. The ingredients of these cements depend on the purpose for which they are to be used.

Manufacturers:

Du Pont de Nemours & Co., E. I., Wilmington, Del.
Hays Corp., The Joseph W., Michigan City, Ind. "Bestix."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

CEMENT, PORCELAIN.—In the construction of large insulators it is necessary to build together several units or petticoats. This is done by cementing them together with porcelain cement. The porcelain cement in many cases is a very good grade of Portland cement. The parts are fired separately and then cemented together to form the complete unit and maintained under water or steam for several hours without being disturbed. Synthetic insulating compounds are also used in cementing porcelain parts.

Manufacturers:

Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.

CEMENT, SCREW AND BOLT-HEAD SEALING.—Screws and bolts used in many small electrical appliances and parts, such as sockets, receptacles, switches, attachment plugs, etc., are recessed into the porcelain body and sealed in place with a special cement. In porcelain parts the screws and metal pieces cannot be inserted or anchored as they can in a molded compound. The cement used is largely wax with other substances added to increase its melting or softening point.

Manufacturers:

Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Dielectric Mfg. Co., St. Louis, Mo., "Mica-Asbest."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Williams, Fred M., 919 E. 13th St., Brooklyn, N. Y.

C. E. M. F.—Abbreviation for counter electromotive force. The form "counter e. m. f." is also used and is, in fact, preferable.

CENTER CHECKING.—An arrangement of party-line apparatus in a manual telephone system which forces each subscriber to call central even on reverting calls.

CENTER FIRE.—Trade name for spark plugs manufactured by the Milwaukee Auto Specialty Mfg. Co., Inc., 711 Chestnut St., Milwaukee, Wis.

CENTER OF DISTRIBUTION, ELECTRICAL.—In arranging the mains in an a-c. general distributing system it is customary to establish a feeder terminal at a point near the center of the district supplied, in order to give an even distribution of pressure. This is termed a center of distribution.

CENTIGRADE THERMOMETER. — A thermometer having 100 equal degrees or divisions between 0°, the temperature of melting ice, and 100°, the boiling point of water, each at a normal pressure of one atmosphere. It is used for scientific work in nearly all countries and used entirely for temperature measurements in a few. The 0° and 100° points on the centigrade scale correspond to the 32° and 212° values on the Fahrenheit. Thus 100 centigrade degrees=180 Fahrenheit degrees, or one degree F.=5/9 of one degree C. Centigrade temperatures may be converted to Fahrenheit by the equation $F°=9/5C°+32$. Fahrenheit is changed to centigrade by the relation $C°=5/9(F°-32)$.

CENTIMETER.—One-hundredth part of a meter, the unit of length in the metric system; 1cm.=0.3937 inch.

CENTIMETER - GRAM - SECOND SYSTEM.—A system of units widely used in scientific investigations. It is based on the use of the centimeter, gram and second as the fundamental units of length, mass and time. Commonly abbreviated C. G. S. system. See Units, systems of.

CENTRAL ARMATURE WORKS.—417 S. Racine Ave., Chicago, Ill. Manufacturers of fractional horsepower motors and armatures.

CENTRAL BLACK.—Trade name for rigid metallic, conduit, elbows and couplings made by the Central Tube Co., First National Bank Bldg., Pittsburgh, Pa.

CENTRAL CHANDELIER CO.—224 Centre St., New York, N. Y. Manufacturer of lighting fixtures.

CENTRAL CHEMICAL CO.—4200 S. Marshfield Ave., Chicago, Ill. Manufacturer of sulphuric and nitric acids.

CENTRAL CUT GLASS CO.—1114 E 63rd St., Chicago, Ill. Manufacturer of portable electric lamps and chandeliers. President and general manager, O. W. Eckland; secretary, B. C. Pierce; treasurer, W. W. Collins.

CENTRAL ELECTRIC CO.—316 S. Wells St., Chicago, Ill. Manufacturer of reflectors and receptacles. Business established 1887. President, George A. McKinlook; secretary, C. E. Brown; sales manager, J. R. Olsen.

CENTRAL FLATIRON MFG. CO.—Johnson City, N. Y. Manufacturer of electric household irons. Business established 1909. President, general and sales manager, H. G. Heckmann; vice-president, E. P. McKinney; secretary and treasurer, W. H. Morse. Sales representative, Everts & Zuver, 200 Fifth Ave., New York, N. Y.

CENTRAL LIGHTING FIXTURE CO.—2110 N. 16th St., Philadelphia, Pa. Manufacturer of lighting fixtures. Louis Silberman, owner.

CENTRAL MFG. CO.—2525 Montgomery St., St. Louis, Mo. Manufacturer of electric washing machines. President, M. Cohen.

CENTRAL NUT LOCK CO.—332 S. Michigan Ave., Chicago, Ill. Manufacturer of conduit locknuts. President, Harry A. Smith; treasurer, H. F. Rohrer; secretary, F. K. Hosler; general sales manager, Paul W. Wendt. Factory, Hammond, Ind.

CENTRAL OFFICE, TELEPHONE.—A telephone exchange with one switchboard, or a portion of an exchange with a separate switchboard. See Office, central, telephone.

CENTRAL SCIENTIFIC CO.—460 E Ohio St., Chicago, Ill. Manufacturer of electrical and other laboratory instruments and apparatus. President, A. H. McConnell; vice-president and treasurer, H. C. Arms; secretary and sales manager, J. M. Roberts.

CENTRAL SPECIAL.—Trade name for rigid metallic conduit, elbows and couplings made by the Central Tube Co., First National Bank Bldg., Pittsburgh, Pa.

CENTRAL STATION.—In the electrical industry a central station is an electrical establishment operated as a unit for distributing electrical energy to public or private customers for light, power, heat, traction or other purposes. In the early days of the industry a central station was usually centrally located and served as a generating station; this was because of the limitations of direct-current generation and the modest beginnings of the electricity supply business which made every central station independent of every other.

At present a central station need be neither central nor a generating station. It is now an organized system doing a public utility business in supplying a community (or only a portion thereof, or sometimes a group of communities) with electrical energy for practically every purpose. Its generating plant need not necessarily be centrally located with respect to the principal community served because alternating-current generation permits location of the plant where fuel and water

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or water power are advantageously available. One plant frequently serves several towns, whereas in a very large city several large interconnected plants may serve the entire community more economically than either a single gigantic plant or a large number of small plants. The central station now frequently purchases energy in bulk from another central station (often a hydroelectric system) and distributes it locally to its own customers. If it has no generating station it usually has one or more substations which receive the purchased power and distribute it locally.

Central stations are either quasipublic or private corporations, firms or individuals or municipal or other public bodies. In the latter case they often distribute energy for street and public building lighting and for other municipal purposes only. Central stations are clearly distinguished from isolated plants, which are usually private plants supplying electric power and lighting to factories, mills, mines, railroads, office buildings, hotels, educational or other institutions, etc., this power being used exclusively or practically so by the owners of the plant and distributed only to their industrial works, institution or building and possibly to a few employees living close by.

CENTRAL-STATION ELECTRICITY SUPPLY.—All public utilities are based on public requirements, and will continue to exist so long as the necessity for them exists. With "service" as their watchword, they seem to be permanencies of civilization. In the case of the electricity-supply utility, which is the central feature of the whole electrical industry, the public necessity served is a development of modern life. Electricity is a form of energy which was not distributed from central stations as an agent for supplying light, heat and power until well along in the last quarter of the nineteenth century. With the exception of telegraphy and the art of electroplating, practically all the marvelous accomplishments of Applied Electricity have been witnessed within the last 45 years. In this short space of time electricity and electrical devices have become indispensable in all highly civilized and progressive nations.

Electric lighting on a commercial scale and electric power distribution had to await the invention of dynamoelectric machinery, or electric generators and motors as we call them today. Arc lighting came into public view about 1877 and was quite firmly established by the end of 1880, Charles F. Brush of Cleveland being a pioneer in this work. The arc-lighting system had a great vogue, and was used extensively for street lighting companies were established, but at It grew very rapidly for a number of years, first as series arc lighting and then as modified by the enclosed arc. Arc lamps are still used to a considerable extent, but have been largely superseded by the modern incandescent lamp. Numerous arc lighting companies were established, but at first they were simply devoted to electric lighting at night, and it remained for Thomas A. Edison to develop the general electric central-station idea of furnishing electrical energy from one central station for all purposes, both day and night.

Edison not only invented the first practically useful incandescent electric lamp in 1879, but he also took a tremendously important step in advance by creating a system of electrical distribution of such a character that both electric lamps and electric motors could be supplied from it and turned on or off without affecting the operation of the others. He also devised switching mechanisms, measuring instruments and many other accessories. His first central-station system, installed for the purpose of demonstration, was put into service in the winter of 1880-1881 at Menlo Park, N. J. From a central generating plant it supplied energy by means of underground conductors for electric lamps, electric motors and an electric railway. The service was good.

The Pearl Street (New York City) generating station of the predecessor of the present New York Edison Co., planned by Mr. Edison, was put into operation on Sept. 4, 1882, and was a technical and commercial success from the start. The Western Edison Light Co. of Chicago, chartered in May, 1882, sold the machinery for a small water-power-driven central station which was put into operation in Appleton, Wis., on Oct. 15, 1882. This was the second Edison central-station system in the United States.

The central-station idea grew slowly at first, owing to the amount of capital required, but Edison's three-wire invention of 1882 and 1883 and the later rise of the alternating-current system gave a great impetus to it. The early arc-lighting and Edison systems employed direct current, but early in the eighties George Westinghouse foresaw the possibilities of the alternating current, and, with the aid of the important inventions of Gaulard and Gibbs, William Stanley and Nikola Tesla, he pushed the a-c. system to a commercial success. Nearly all central-station electrical energy is now generated as alternating current, although much of it is later changed into direct current, which is very serviceable for many purposes.

Great changes have been witnessed in the electricity-supply utility since the early days. Energy is transmitted electrically for distances up to 200 miles, at pressures of 150,000 volts or more, from hydroelectric or other economical sources of power supply. Boilers are larger and steam pressures are higher. Generators have increased perhaps five thousand times (say, from 10 to 50,000 kw.) in maximum rating. Transformers have been bettered, and switching and wiring devices and accessories have been wonderfully developed. The incandescent lamp has been very greatly improved, both in character of light and in efficiency.

Perhaps the most important central-station engineering advances in the last quarter-century have been (1) the introduction of the synchronous-converter substation system of distribution, with storage-battery auxiliaries, about 1895-1900, (2) the introduction of the steam turbine in generating stations about 1903-1908, and (3) the introduction of the tungsten-filament incandescent lamp about 1907-1911. The Fisk Street generating station of Chicago, which marked a turning point in central-station operation, was put in service in 1903. It was the first all-turbine electric generating station in the world. With a rating of 230,000 kw., this is now probably the largest individual central-station generating plant in existence. During recent years, it may be added, there has been a great expansion in the use of automatically controlled machines and processes.

In 1885 two influential societies were formed—the National Electric Light Association and the Association of Edison Illuminating Companies. The former, originally established by electrical manufacturers and supply dealers, is now, with its 12,000 members, the great representative electric central-station organization of the United States. The latter, of limited membership, includes the larger electric service companies, which, in early days, were drawn together in the fellowship of Edison patents. In the year mentioned there were about 400 electric lighting companies in the country, and probably not more than 80 of them were engaged in the business of selling electrical energy for all purposes twenty-four hours a day. The investment in central-station systems was then probably not more than $10,000,000. Today the number of establishments is about 6,000, the estimated capitalization is $4,500,000,000 and the estimated gross annual revenue is $900,000,000. The central-station output of the country is no less than 40,000,000,000 kw-hr. annually.

According to 1920 reports, 62% of the central-station electrical output of the country was produced by the consumption of fuels and 38% by water power. Probably less than 20% of the possible water powers of the United States have been developed, but it is not likely, owing to engineering and economic conditions, that it will ever be practicable to utilize all of the potential water-power resources of the country. However, the passage of the Federal Water-power Act, signed by President Wilson on June 11, 1920, will no doubt do much to encourage the building of hydroelectric plants.

Electricity is used not alone for lighting, for operating factory machinery and railways, and for heat, as in the familiar electric flatiron, but for a wide variety of purposes. Over 3,000 applications have been listed. Central-station power helps with the week's washing, pulls a train over the Rocky Mountains or milks the farmer's cows with equal facility. It is believed that ultimately every industrial process as well as most domestic services will be performed by the aid of electricity. The future development of the electric-power industry is incalculable.

In central-station history the serious study of economic relations was not taken up in the early years; electrotechnical problems were then overshadowing; the dominant part which electricity was to play in modern life was not foreseen. But since the early nineties, say, central-station executives have had a very thorough course in the School of Experience, and one of their greatest tasks of today is to endeavor to impart to the public something of what they have learned.

Rates for service have been studied scientifically; they are now usually based on the character of the demand made on the facilities of the central station. The downward tendency was very marked until increasing costs of production during and after the World War caused many companies to apply for increases in self-defense. Rates may vary considerably in different localities owing to local conditions.

Whether this important utility shall be privately operated or municipally or publicly operated has been the cause of a great deal of discussion, sometimes with more heat than light. Actually, however, electrical advancement in the United States is almost wholly due to private enterprise, and, while there are numerous street-lighting municipal plants, the general electric-service utility has been built up by the careful management, continuity of management and individual initiative which go with private ownership and operation. This situation will continue, doubtless, for many years. It is now generally held that the electricity-supply utility should be operated as a "natural monopoly" in the area served, and experience seems to have shown that this "monopoly" should be privately operated to obtain the benefits of private initiative. But, so important is this service, that state-commission regulation by quasijudicial arbiters has been established in five-sixths of the states of the Union. As a rule, these tribunals, with broad outlook, holding the public interest paramount, strive to conserve the strength of the utilities for public service at the lowest rates that will effect that purpose.

Centralization of electrical production and distribution over areas as large as can be served economically is a distinct modern tendency. Large generating stations are more economical than small ones, and one network of electrical distribution can utilize the diversity of demand (that is, of light and power, railway, mining, transportation, agricultural and other energy requirements) better than a number of individual systems. This improves the load-factor, or the using of generating and distributing plant to the greatest extent during the 24 hours of each day throughout the year, and so makes for economy. Further, the large systems can buy more cheaply and can afford to employ better brains for executive, engineering and commercial staffs. These advantages apply also to holding companies, which may direct operating companies in many localities.

Large amounts of capital are required by the utilities, and this capital is turned over slowly—in from four to seven years. Thus every dollar of income bears an interest charge, at 7%, of say, 35 cents; and for every dollar of new business obtained, about five dollars of capital must, in general, be secured from some source. With fair rates and prudent management, reasonable profits are sure. If the central station, like the manufacturer, could refuse new business, simply take care of existing business, it would effect large economies and could increase its net income materially. But such a course, unless in time of war or great emergency, would be contrary to public policy.

During the World War and after, production costs of the utilities mounted rapidly, whereas the rates for their services were fixed and could not be increased without the consent of regulatory bodies, which moved slowly in many cases. Furthermore, the demand for capital from other sources was tremendous and, in most cases, the utilities could not increase the pre-war rate of return offered for capital without the consent of the regulatory bodies. At this time many companies turned to their own employees, customers and townspeople, selling their securities directly "over the counter," with good results, both financially

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and in emphasizing the complete co-operation that should exist between the utility and the community it serves. Local ownership of public-utility securities is in every way desirable, and this form of financing will no doubt be continued indefinitely, in addition to the raising of money through the usual channels, for the demand for new capital is great and constant.

The electric utility is close to the average man and the average home. It is a faithful servant which is becoming better understood, and its prospects were never brighter.

CENTRAL-STATION FACTS AND FIGURES.—Data from various reliable sources place the number of electric central-station operating companies and municipal plants in the United States during 1920 at 5,578, with a total valuation of about $4,500,000,000, a gross annual income of about $900,000,000, an installed generating capacity of 13,500,000 kilowatts and an annual output of about 44,000,000,000 kilowatt-hours. These central stations rendered service in cities, towns and other localities in which no less than 60% of the entire population of the country lived, there being a total of over 8,520,000 individual customers of all classes. Other interesting facts, together with further analysis of the foregoing data and of the growth of the American central-station business, are given below:

Prior to 1902 no exact record was kept of this industry, but in that year the Bureau of the Census took its first general census of the electrical utility industries of the United States and obtained accurate data as to the status of central-station service. The census was again taken in 1907, 1912 and 1917. The figures covering the period from 1902 to 1917, given herewith, are taken from these census reports. The estimates for 1920 are for the most part based upon statistics of the industry which have been published from time to time by the technical press.

The growth of central stations has been very rapid. From 3,620 in 1902, the total number of operating companies and municipal plants had grown to 6,542 in 1917. Estimates published for 1920 give a total of 5,578 operating companies and municipal plants, which would indicate that a considerable number of consolidations or mergers and cessation of operation of many of the smaller, less efficient and poorly located plants had taken place during and since the war. This is further borne out by the fact that in 1917 there were 5,952 generating stations, whereas only 5,766 were estimated in 1920. The 1917 figures also show that 1,418 operating companies purchased all of their current from other operating companies. A better figure for indicating the true growth of central stations is total generating capacity and output. In 1907 the capacity was 2,709,000 kw., generating in that year 5,862,277,000 kw-hr., and in 10 years this had increased to a capacity of 8,994,000 kw., generating 25,438,303,000 kw-hr., making an increase in output of 330%. Estimates for 1920 place the capacity at 13,500,000 kw.; the annual output, as given by the United States Geological Survey, was 43,900,000,000 kw-hr.

The value of the plants and equipment together with the gross and net income and expenses are given in the table below. The "value" of the plant and equipment is given in place of the capitalization, since this aggregate includes municipal plants and as they issue no stock their capitalization cannot be determined. It is generally true that the value is somewhat less than the cost of the plant and equipment, and therefore, less than the capitalization or capital investment.

VALUE OF PLANT AND EQUIPMENT. INCOME AND EXPENSES (IN MILLIONS)

Year	Total Value	Gross Income Amt.	Pct. of Value	Net Income Amt.	Pct. of Value	Expenses
1920	4,500.0	900.0	20.0	.....	....	.....
1917	3,060.4	526.9	17.2	100.3	3.3	426.6
1912	2,175.7	302.3	13.9	67.7	3.1	234.6
1907	1,096.9	175.6	16.0	41.4	3.8	134.2
1902	504.7	85.7	17.0	17.6	3.5	68.1

Central stations may be divided into two classes according to ownership—commercial or privately owned, and municipal. The majority of the latter serve only a restricted area, generally within the municipality and a few (74 in number in 1917) supply light and power for municipal purposes exclusively. Dividing the plants according to the size of the population group served discloses that current furnished by municipal plants is chiefly for lighting purposes and that for groups of population under 10,000 the municipal plants furnish more lighting energy per capita than do commercial plants. In the largest population groups, over 500,000, the commercial stations have a marked lead in this respect. The output for power of the commercial stations is in every population group far in advance of the municipal plants. Of the 6,542 stations operating in 1917, 2,318 or 35% of all stations were municipal; however, the output of these stations represented only 4% of the total for all central stations. The total number of stations, given by the population groups served and showing the division of load, is given in the table below. The discrepancy between the number of stations given here and the figure 6,542 given elsewhere is because of the fact that 42 commercial stations sold current to other operating companies only, and 11 other stations served a small indeterminate population with power and some light. Their total output when added to the figures given make a total of 18,287,344,226 kw-hr. sold for light and power.

CENTRAL STATIONS ACCORDING TO POPULATION DISTRICTS SERVED IN 1917

Pop. Group	No. of Stations	Pop'n. S'v'd in Th's'ds	Kw-hr. in Mil'ns For L't.	For P'r.
Under 1000	2,221	1,185	52.1	269.9
1,000-2,000	1,455	1,841	94.6	202.2
2,000-5,000	1,363	3,740	218.9	354.4
5,000-10,000	576	3,366	226.0	361.8
10,000-25,000	408	5,111	346.9	1,332.1
25,000-50,000	181	4,724	349.1	946.3
50,000-100,000	100	4,731	345.4	1,270.4
100,000-200,000	69	7,182	460.2	1,304.1
200,000-500,000	51	9,935	811.4	2,134.9
Over 500,000	65	21,099	2,207.8	4,409.7
Total	6,489	62,919	5,112.4	12,586.0

Data showing the extent of the service of central stations and its relation to the population of the country as a whole are interesting. In 1917 the country's population was estimated at 104,444,303 and of this number 62,919,662 were in localities served by central stations. This group, representing 60.2% of the total population, contained 7,178,703 central-station customers. Figures for 1920 show that the number of customers has increased to 8,520,400. The annual per capita consumption for the population actually served in 1917 was 81.3 kw-hr. for lighting and 200 kw-hr. for power. For 1920 this was estimated at 294 kw-hr. for lighting and 398 kw-hr. for power.

The power load in 1920 included about 1,161,400 industrial motors representing a connected load of 12,930,000 hp. The other connected power load which includes industrial heating, electrolytic processes and furnaces, electric railways, electric vehicles, etc., represented a connected load of about 1,869,000 hp. The total energy consumed by the power customers of all kinds is estimated at 25,242,500,000 kw-hr. The lighting load both commercial and residential, consists of 8,193,500 customers. The total kw-hr. consumption during the year was 18,657,500,000.

While the central stations serve approximately 60% of the population, only 31% of the dwellings in the country are wired for electric service. Of the 20,481,700 dwelings, 14,190,540 have not yet been wired and of this number 4,993,490, or 24.4% of the total unwired, are in territories covered by central-station service.

The number of central-station customers classified according to the nature of the load are given in the table below. In this table, which is taken from the Electrical World of July 24, 1920, commercial lighting customers include stores, offices, churches, halls, amusement parks and in some cases manufacturing plants.

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CENTRAL STATION CUSTOMERS IN 1920

State	Resid'l Lighting	Com'l Lighting	Power	Total
	In Thousands			
Alabama	54.0	7.9	2.37	64.2
Arizona	12.1	1.9	0.11	14.0
Arkansas	48.3	11.2	1.90	61.4
California	570.0	134.6	42.20	746.8
Colorado	103.0	13.6	4.52	121.1
Connecticut	123.0	31.4	7.40	161.8
Delaware	9.3	2.7	0.44	12.4
Dist. of Col.	30.3	10.5	0.28	41.6
Florida	68.0	14.2	0.90	83.1
Georgia	84.0	17.5	3.39	107.8
Idaho	38.5	11.8	1.12	51.4
Illinois	640.0	160.5	35.60	836.1
Indiana	191.8	39.9	12.10	243.8
Iowa	110.0	22.8	7.30	140.1
Kansas	150.0	24.3	4.71	179.0
Kentucky	91.0	20.7	3.06	114.8
Louisiana	45.5	9.3	1.62	56.4
Maine	78.5	20.3	6.08	106.2
Maryland	53.2	15.6	2.61	71.4
Massachusetts	338.9	52.0	15.30	406.2
Michigan	320.0	96.0	12.58	428.6
Minnesota	192.0	48.8	7.66	248.5
Mississippi	35.8	10.4	0.66	46.9
Missouri	212.0	92.7	12.34	317.0
Montana	52.0	11.8	1.56	65.4
Nebraska	90.0	27.5	3.98	121.5
Nevada	14.5	1.5	0.25	16.2
New H'pshire	30.0	6.8	1.90	38.6
New Jersey	220.0	55.3	9.50	284.8
New Mexico	13.3	2.1	0.25	15.6
New York	480.0	209.5	19.35	708.9
N. Carolina	50.0	16.7	3.41	70.1
North Dakota	42.3	11.5	1.12	54.9
Ohio	385.0	86.9	23.40	495.3
Oklahoma	61.0	11.2	1.84	74.0
Oregon	82.0	11.2	4.72	97.9
Pennsylvania	385.0	159.2	22.10	566.3
Rhode Island	42.5	9.5	2.79	54.8
S. Carolina	51.0	9.3	1.38	61.7
South Dakota	39.3	10.7	1.44	51.4
Tennessee	57.0	11.6	3.49	72.1
Texas	220.0	35.6	7.44	263.0
Utah	69.0	9.1	2.35	80.5
Vermont	36.5	9.2	1.83	47.5
Virginia	92.0	21.0	5.10	118.1
Washington	204.0	27.9	7.68	239.6
W. Virginia	38.0	8.3	1.70	48.0
Wisconsin	150.0	38.0	11.50	199.5
Wyoming	13.6	4.2	0.54	18.3
United States	6,517.6	1,675.9	326.84	8,520.4

Some central stations furnish heat, water, gas, etc.; as well as electricity. In 1917 there were 2,665 of these composite stations, divided as follows: 1,328 electricity and water; 238 electricity and gas, or gas and water; 35 electricity, street railway, and gas, or gas and water; 1,064 miscellaneous, doing heating, manufacturing ice, etc. These composite stations represent 40% of all central stations. In addition to the above classes there are those which do electrical contracting or retail electrical merchandising. In 1920 there were 1,793 stations doing contracting and 3,139 retailing electrical merchandise.

Many central stations purchase all or part of their energy. Stations which purchased more than half of their energy increased 146% from 1912 to 1917. In 1917 there were 1,631 of these stations. In the same year the primary power equipment of generating stations totaled 12,936,755 hp., divided according to type of prime mover as follows: 5,788 steam engines developed 13% of the total output; 1,699 steam turbines, 52%; 3,374 water wheels and turbines, 33%; 2,934 internal-combustion engines, 2%. In the decade 1907-17 the number of steam engines decreased 25%, steam turbines increased 351%, water wheels and turbines increased 36%, internal-combustion engines increased 534%.

The majority of commercial stations are owned by corporations, though there were in 1917 a total of 1,306 stations owned by individuals, firms and partnerships. The number of incorporated commercial stations was 2,918. They employed 105,541 people in 1917, an increase since 1902 of 248%.

Within recent years great changes have been made in the attitude of most central stations toward the public they serve. Nearly all operating companies have endeavored to better their relations with the public and many have sold stock and other securities to their customers and employees to the end that these stockholders will desire to see their company prosper and will develop a new attitude toward public utilities in general. So many companies have held and are holding campaigns for this purpose that it is difficult to state the value of securities sold, but it is estimated that over 150,000 individual customers alone now

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hold $100,000,000 in central-station securities. Reports from about 45 companies that have conducted sales campaigns within the last year or two indicate that over $50,300,000 has been disposed of to 76,000 subscribers.

The foregoing figures relate only to stock purchases by customers of the central stations in recent years. Estimates prepared by the National Electric Light Association show that, taking the country as a whole, the securities of the electric light and power companies are owned by some 1,450,000 citizens. These represent the savings of customers, employees and other citizens, together with investments by insurance companies, estates and banks. It is further estimated that hundreds of millions of dollars have been loaned to these central station companies by 27,000 banks of the country having 29,000,000 depositors. These figures give a much better conception of the widespread financial interest in the welfare of the central-station business.

CENTRAL STEEL & WIRE CO.—119-127 No. Peoria St., Chicago, Ill. Manufacturer of welding and armature binding wire and sheet steel for electrical purposes. President, H. R. Curran; secretary and treasurer, Mandel Lowenstine.

CENTRAL TUBE CO.—Pittsburgh, Pa Manufacturer of rigid metallic, conduit, elbows and couplings. President, Alex Loughlin, Jr.; vice-president, W. F. Hart; treasurer, P. C. Pease; sales manager, W. F. Ingals. Main office, First National Bank Bldg., Pittsburgh, Pa. Factory, Economy, Pa. Branch offices, 10 High St., Boston, Mass.; 1213 Race St., Philadelphia, Pa.; 1415 Pine St., St. Louis, Mo.; 1124 Metropolitan Bldg., Minneapolis, Minn.; 307 First Ave., Seattle, Wash.; 523 Mission St., San Francisco, Cal.; 1220 Dime Savings Bank Bldg., Detroit, Mich.; 63 Vesey St., New York, N. Y.; 122 S. Michigan Ave., Chicago, Ill.

CENTRAL WHITE.—Trade name for rigid metallic, conduit, elbows and couplings made by the Central Tube Co., First National Bank Bldg., Pittsburgh, Pa.

CENTRAL WISCONSIN SUPPLY CO.—Beaver Dam, Wis. Producer of cedar poles. M. K. Grant, manager, Cedar Dept.

CENTRIFUGAL FAN CO.—9-16 17th Ave., Newark, N. J. Manufacturer of motor-driven exhaust fans.

CENTRIFUGALS, SUGAR, MOTOR-DRIVEN.—Centrifugals are machines used to effect the mechanical separation of solids from liquids, or of liquids of different specific gravity. In the sugar industry they are used to wash and dry the sugar and separate out all the moisture. A perforated metal cylinder or basket is placed within an outer casing and rotated at a high speed. As the basket revolves the material to be separated is thrown against the perforated sheet by centrifugal force and the liquid flows through the fine perforations while the solids remain inside.

Motor drive has been found to be very efficient for these machines. A vertical motor, usually of the induction type, is mounted above the basket and connects to its shaft by means of a clutch which protects it from excessive strain. The motor and the basket spindle both run on ball bearings.

Manufacturers:

Hepworth Co., S. S., 2 Rector St., New York N. Y. "Mackintosh."

CENTRIFUGES, ELECTRIC.—Devices for separating solutions, or material in solutions, of different specific gravity by centrifugal force. The device consists of a small electric motor, under the shaft of which are mounted hinged buckets which contain the solution, and at a very high speed effect the separation. Other types have a small vertical universal motor with a horizontal balanced arm on the top of the shaft. Hinged test-tube holders are mounted at the ends of the arm and the liquid to be separated is placed in the test tubes, which take a horizontal position when in motion.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.

Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill.

Hepworth Co., S. S., 2 Rector St., New York, N. Y. "Mackintosh."

Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Watters."

International Equipment Co., 352 Western Ave., Boston, Mass.

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."

Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."

Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa. "W. B. & E."

CENTURY.—Trade name for electric fans and motors manufactured by the Century Electric Co., 1827 Pine St., St. Louis Mo.

CENTURY.—Trade name for armature and field coil testers manufactured by the Century Electrical Co., 102 Randall Ave., Syracuse, N. Y.

CENTURY.—Trade name for electric oil pumps manufactured by the Century Pump Co., 715-719 6th Ave., Brooklyn, N. Y.

CENTURY.—Trade name for hacksaws manufactured by the Century Tool & Metal Co., 180 N. Market St., Chicago, Ill.

CENTURY.—Trade name for radio buzzers manufactured by the Federal Telephone & Telegraph Co., Buffalo, N. Y.

CENTURY ELECTRIC CO.—St. Louis, Mo. Manufacturer of electric fans and motors. Business established 1903. President, E. S. Pillsbury; vice-president, Senter M. Jones; vice-president and secretary, R. J. Russell; treasurer John Herget; sales manager, J. L. Woodress. Main office and factory, 1827 Pine St., St. Louis, Mo. Branch offices and warehouses, Boston, Mass.; 56 W. Randolph St., Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Des Moines, Iowa; Detroit, Mich.; Kansas City, Mo.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Rochester, N. Y. Sales representatives, Fulton Electric Co., Atlanta, Ga.; W. C. Teas, Chattanooga, Tenn.; Gus Sachs, Dallas, Tex.; Mountain Electric Co., Denver, Colo.; Greensboro Supply Co., Greensboro, N. C.; R. J. Davis, Los Angeles, Cal.; T. W. Findley, Minneapolis, Minn.; Lyman C. Reed, New Orleans, La.; R. R. Poppleton, Portland, Ore.; S. S. Stevens, Salt Lake City, Utah; R. J. Davis, San Francisco, Cal.; R. R. Poppleton, Seattle, Wash.; Nixon Kimmel Co., Spokane, Wash.; Rudel Belnap Machinery Co., Montreal, Que.; Jones & Moore Electric Co., Toronto, Ont.; Rankin & Cherril, Vancouver, B. C.; Great West Electric Co., Ltd., Winnipeg, Man., Can.

CENTURY ELECTRICAL CO.—102 Randall Ave., Syracuse, N. Y. Manufacturer of armature and field coil testers. Vice-president, L. C. Willson; secretary, L. B. West; treasurer and general manager, J. B. West.

CENTURY MFG. CO.—Detroit, Mich. Manufacturer of electric vehicles.

CENTURY MFG. CO., INC.—Elizabethtown, Pa. Manufacturer of electric signs and heaters. Business established 1907. President, Milton S. Rohrer; vice-president, Justus Bard; secretary, treasurer and general manager, E. M. Miller.

CENTURY PUMP CO., THE.—715-719 6th Ave., Brooklyn, N. Y. Manufacturer of electric pumps. Business established 1905. President and treasurer, William L. Gass; vice-president, Louis Gass; secretary, Guy A. Smith.

CENTURY SPECIAL.—Trade name for tungsten lamps manufactured by the International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J.

CENTURY TOOL & METAL CO.—180 N. Market St., Chicago, Ill. Manufacturer of welding compounds and hacksaws. General managers, E. L. Mayer and E. Mayer.

CERTAIN-TEED PRODUCTS CORP.—St. Louis, Mo. Manufacturer of insulating papers, paints, varnishes, etc. Business established 1917. President, G. M. Brown; vice-presidents, C. C. Collins; J. C. Collins, Joseph W. Wear, D. C. Cale; secretary and treasurer, R. M. Nelson.

CESCO.—Trade name for aisle lights for theaters and electrically operated curtain and door openers, manufactured by the Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.

C. G.—Trade name for friction tape manufactured by the St. Louis Rubber Cement Co., St. Louis, Mo.

C. G. E.—Trade name for motors, generators, electrical instruments, wiring devices and other electrical specialties manufactured by the Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

C. G. M.—Trade name for oilless bearings manufactured by the Massachusetts Oilless Bearings Co., 518 Main St., Worcester, Mass.

C. G. R.—Trade name for conduit and outlet bushings manufactured by Charles G. Robin, 47 Warren St., New York, N. Y.

C. G. S.—Abbreviation for centimeter-gram-second system of units.

C-H.—Trade name for electric controlling and heating devices manufactured by the Cutler-Hammer Mfg. Co., 12th St. & St. Paul Ave., Milwaukee, Wis.

CHADBURN SHIP TELEGRAPH CO. OF AMERICA, INC.—Troy, N. Y. Manufacturer of CO_2 recorders. Exclusive distributor, Yarnall Waring Co., Philadelphia, Pa.

CHAFING DISHES.—See Dishes, chafing, electric.

CHAIN BELT CO.—Milwaukee, Wis. Manufacturer of coal and ash handling machinery, power transmission chains and water intake screens. Business established 1891. President, W. C. Frye; vice-president and general manager, C. R. Messinger; secretary, W. C. Sargent; treasurer, C. L. Pfeifer; sales manager, Clifford F. Messinger. Main office and factory, 736 Park St., Milwaukee, Wis. Branch offices, 50 Church St., New York, N. Y.; 403 Ford Bldg., Detroit, Mich.; 1018 Corn Exchange National Bank Bldg., Chicago, Ill.; Citizens National Bank Bldg., Pittsburgh, Pa.; 337 Boatmen's Bank Bldg., St. Louis, Mo.

CHAIN PRODUCTS CO., THE.—Cleveland, Ohio. Manufacturer of chains and chain products. Business established 1886. President and treasurer, Fred G. Hodell; vice-president, Howard H. Hodell; secretary, William F. Schneider. Main office and factory, 3924 Cooper Ave., Cleveland, Ohio. Branch offices, 150 Chambers St., New York, N. Y.; 208 N. Wabash Ave., Chicago, Ill.; 60-62 8th St., San Francisco, Cal.; 1417 Chemical Bldg., St. Louis, Mo.; 439 Endicott Bldg., St. Paul, Minn.

CHAINS, ARC AND OTHER LAMP SUSPENSION.—Chains are sometimes used for suspending heavy arc lamps or incandescent lamps from a bracket or mastarm, or cross-span suspension in a street. They are made of wire formed into links and clinched or welded, or are formed out of sheet metal and linked together. A hot galvanized finish is generally given the chain so that it will resist corrosion. Chain is used in preference to cordage where the load or weather conditions are especially severe. Also see Cord or cordage, braided.

Manufacturers:

American Chain Co., Bridgeport, Conn. "Oneida."

Bridgeport Chain Co., Bridgeport, Conn. "Triumph."

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Chain Products Co., The, 3924 Cooper Ave., Cleveland, Ohio. "Hodell."

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Columbus McKinnon Chain Co., The, Columbus, Ohio. "Columbus."

Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Everett," "Tipton," "Wyatt."

LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)

Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CHAINS, BALL OR BEAD, FOR PULL SOCKETS, ETC.—Ball or bead chains are generally made of brass or they may be finished in nickel or other finishes to correspond to the fixtures, sockets, pull switches, rosettes, etc., they are to be used with. The most common form of this chain consists of a hollow ball formed of sheet brass, having a hole at one end and a round shank at the other end. The shank of one ball or bead fits into the hole of another and is ex-

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panded inside so that it cannot be withdrawn. Other chains are made with wired beads and various other modifications of these principles. A larger ball or acorn is placed at the lower end. Also see Acorns, pull chain; Links, insulating, pull chain; Links, splicing, pull chain.

Manufacturers:

American Ball Chain Works, 12 Wooster St., New York, N. Y.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BEAD CHAIN MFG. CO., THE, Bridgeport, Conn. "Bead Chain." Brass chain consisting of a series of spherical beads joined together by miniature dumbbells, the head of each dumbbell being enclosed within the bead. Standard equipment on all pull sockets and pull switches throughout the country. —Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hatheway Mfg. Co., The, Bostwick Ave., Bridgeport, Conn. "Duplex."
Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Everett," "Tipton," "Wyatt."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

CHAINS, CHANDELIER OR FIXTURE.—These chains are made to correspond in design and finish to the chandeliers or fixtures. Brass is by far the most common material used in their construction, although steel links, brass-plated, are also used in making up the chains. Several forms of links are used, such as round, oval, square, and various other special forms. They are often formed of solid brass wire or steel wire, although tubing is also used in some of the larger link chains, to reduce the weight. They are not welded together but merely bent to form so that the links may be opened up after the fixture or chandelier is in place, in case it is necessary to change the length of the chain or attach it to a fixture ring or loop.

Manufacturers:

American Chain Co., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., 306 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Best Electric Corp., 476 Broadway, New York, N. Y.
Bliss Co., A. H., 136 Hospital St., Providence, R. I.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Columbus McKinnon Chain Co., The, Columbus, Ohio. "Columbus."
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Highlands Mfg. Co., Muncie, Ind.
Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Everett," "Tipton," "Wyatt."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Guaranteed Chain."
National Chain Co., 8th St. & 3rd Ave., College Point, N. Y. "Unxld," "National."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
STANDARD ELECTRIC & MFG CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y. (Crystal glass.)
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

CHAINS, POWER-TRANSMISSION.—The requirements of chains for power transmission are so varied as to necessitate a great number of types of chains. They are used for a number of purposes, and in connection with electrical machinery are the means of connecting a motor to its load or of driving a small generator in many cases. They are most efficiently applied to any place where the driver and driven wheels are close together or differ greatly in size. A belt used under such conditions would have excessive slip. Other examples of power transmission by means of chains are also quite common.

In general the chains consist of a series of links and rollers designed to run over sprocket wheels. This includes rough heavy chains designed to run on cast tooth wheels and smaller, more accurate links that are designed to run on cut wheels and give a smoother and more uniform transmission. The links in these types generally consist of two rollers rotating on hardened steel pins which are held securely in link plates on either side. Two such links are joined together and accurately spaced by another link plate which passes over the pins and is prevented from coming loose by cotter pins. This general type is made in several sizes and modified forms and also as duplex or multiple chains having a series of links joined together to give a wide chain.

Manufacturers:

Abell-Howe Co., 332 S. Michigan Ave., Chicago, Ill.
American High Speed Chain Co., 401 S. Illinois St., Indianapolis, Ind.
Baldwin Chain & Mfg. Co., The, Worcester, Mass.
Chain Belt Co., 736 Park St., Milwaukee, Wis. "Rex."
Columbus McKinnon Chain Co., The, Columbus, Ohio. "Columbus."
Diamond Chain & Mfg. Co., 502 Kentucky Ave., Indianapolis, Ind. "Diamond."
Duckworth Chain & Mfg. Co., 41 Mill St., Springfield, Mass.
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.
Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Everett," "Tipton," "Wyatt."
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio. "Peerless," "Hercules," "Reliance."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Metallic Mfg. Co., 544 W. 35th St., Chicago, Ill.
New England Chain Works, 12 Pearl St., Boston, Mass.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y. "Warwick."
Philadelphia Gear Works, E. Vine St., Philadelphia, Pa. "Diamond."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
United States Chain & Forging Co., Union Arcade, Pittsburgh, Pa. "XX."
Webster Mfg. Co., Tiffin, Ohio.

CHAINS, POWER-TRANSMISSION, SILENT.—Silent chains for power transmission are of quite different construction from ordinary power-transmission chains. In most of these the separate links are much smaller and they do not run over or fit around the teeth of a sprocket wheel, but rather fit into accurately cut grooves on both the driving and driven wheel. For this reason some means must be provided for keeping the chain on the wheels when running and they are usually made with a flange. The chains ordinarily consist of a number of steel leaves or plates. These are joined together with a hardened steel pin and in some cases have a hardened steel liner or bushing in which the pin rests.

Silent chains are used for a number of purposes where electric drive is used. They are employed on both large and small motors, the extremes ranging from about ¼ hp. to 500 hp. or larger. They are highly efficient and give a very uniform, smooth and quiet drive. Paper mills have been large users of the electric drive through silent chains.

Manufacturers:

American High Speed Chain Co., 401 S. Illinois St., Indianapolis, Ind.
LINK-BELT CO., Philadelphia, Chicago, Indianapolis. The Link-belt silent chain for high speed power transmission, is as flexible as a belt, as positive as a gear, and more efficient than either. It cannot slip, and will run on short centers. It is run slack and therefore, without excessive journal



Link-Belt Silent Chain

friction. There is no dangerous sparking. It transmits power with less loss and operates quietly. It can be run at high speed. There are more teeth in working contact, causing smoother action and less wear. In spite of its positive action, it has great elasticity. Standard speed motors can be used to operate mechanisms at any desired rate of speed. Standard link-belts can be furnished for every purpose in elevating conveying and power transmission. The Ewart detachable link-belt is the standard for power transmission, and simple elevators and conveyors. The New Ewart link-belt is an improved form having greater strength



The Ewart Link

without increase of weight, and runs on standard wheels. Extensive available stock in all sizes, together with a large variety of Ewart links with attachments. Many modifications of the Ewart link-belt are made for special service, including "400" class link-belt, which has the links connected by rivets or detachable pins. "C" class link-belts have great strength and durability, and will withstand severe conditions of service. Sprocket wheels can be furnished for all classes of link-belts. —Adv.

Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

CHAIRS, STEP-RAIL.—Step-rail chairs were formerly extensively used on the low girder-type rails used in street-railway systems and are still employed where those rails remain in service. The size of the rail was such that the paving blocks could not be kept in place, but shifted and worked loose. The use of a more substantial block required that the rail be set higher above the ties than formerly. Step-rail chairs were used for this purpose and were placed under the rail to elevate it to the proper level for the paving. They were malleable iron or steel blocks and had a back or supporting member that held the projection of the girder rail. The name was, therefore, derived from the form of the block.

Manufacturers:

Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

CHALLENGE.—Trade name for motor-driven grinders manufactured by the Challenge Machine Co., Inc., 5116 Sprinfield Ave., Philadelphia, Pa.

CHALLENGE.—Trade name for soldering sticks manufactured by the Highland Electro-Chemical Mfg. Co., Connellsville, Pa. (Exclusive distributor, S. F. Hood Co., Philadelphia, Pa.)

CHALLENGE.—Trade name for measuring tapes manufactured by the Lufkin Rule Co., Saginaw, Mich.

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CHALLENGE.—Trade name for letter boxes manufactured by W. R. Ostrander & Co., 371 Broadway, New York, N. Y.

CHALLENGE.—Trade name for belting manufactured by the Republic Rubber Corp., Youngstown, Ohio.

CHALLENGE.—Trade name for electric iron manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

CHALLENGE CO.—Batavia, Ill. Manufacturer of power transmission appliances and gasoline engines.

CHALLENGE MACHINE CO., INC.—5116 Springfield Ave., Philadelphia, Pa. Manufacturer of electric grinders and grinding wheel dressers. President, J. W. King; vice-president, B. F. Baird; secretary, F. M. King, Jr.; treasurer, F. M. King, Sr.

CHALLENGE MACHINERY CO., THE.—Grand Haven, Mich. Manufacturer of motor-driven paper cutting machines for printers. Main office and factory, Grand Haven, Mich. Branch offices, 124 S. Wells St., Chicago, Ill.; 71 W. 23rd St., New York, N. Y.

CHAMBERLAIN & HOOKHARN METER CO., LTD.—243 College St., Toronto, Ont., Can. Manufacturer of demand and integrating wattmeters and time switches. Business established 1912. President and general manager, S. L. B. Lines; secretary and treasurer, Miss G. Montizambert.

CHAMBERLIN & JOHNSON, INC.—1238-40 Voskamp St., Pittsburgh, Pa. Manufacturer of beeswax and battery sealing compounds. John F. Barckley, manager.

CHAMBERS MFG. CO.—Etna St., Butler, Pa. Manufacturer of farm lighting plants. J. A. Chambers, manager.

CHAMET.—Trade name for special bronze products manufactured by the Chase Metal Works, 236 Grand St., Waterbury, Conn.

CHAMPION.—Trade name for ice cream freezers, refrigerating, ice making and ice breaking machinery, manufactured by the Allman Gas Engine Co., 461 Canal St., New York, N. Y.

CHAMPION. — Trade name for vises manufactured by the Bonney Vise & Tool Works, Inc., Allentown, Pa.

CHAMPION.—Trade name for electric washing machines manufactured by the Boss Washing Machine Co., Cincinnati, Ohio.

CHAMPION.—Trade name for electric forge blowers, exhaust fans, grinders, drills and other portable tools manufactured by the Champion Blower & Forge Co., Lancaster, Pa.

CHAMPION.—Trade name for dry batteries and carbon products manufactured by the Champion Carbon Mfg. Co., 305 1st National Bank Bldg., Cincinnati, Ohio.

CHAMPION.—Trade name for motor-driven foundry riddles manufactured by the Champion Foundry & Machine Co., 2419 W. 14th St., Chicago, Ill.

CHAMPION.—Trade name for motor-driven air compressors made by the Champion Pneumatic Machinery Co., 1402 Michigan Ave., Chicago, Ill.

CHAMPION.—Trade name for spark plugs manufactured by the Champion Spark Plug Co., Toledo, Ohio.

CHAMPION.—Trade name for storage batteries and battery parts manufactured by the Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y.

CHAMPION.—Trade name for oiled papers, cambrics, tapes, plain cotton, friction, rubber, armature, linen tapes, webbing and cotton sleeving manufactured by the Chicago Mica Co., 11-21 Water St., Valparaiso, Ind.

CHAMPION.—Trade name for incandescent lamps manufactured by the Consolidated Electric Lamp Co., Danvers, Mass.

CHAMPION.—Trade name for injectors manufactured by James A. Griffiths & Son, 1315-17 Buttonwood St., Philadelphia, Pa.

CHAMPION.—Trade name for soldering paste manufactured by the Highland Electro-Chemical Mfg. Co., Connellsville, Pa.

CHAMPION.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CHAMPION.—Trade name for boat lighting sets manufactured by Hector C. Mac Rae, 314 St. Paul St., Baltimore, Md.

CHAMPION.—Trade name for electric side and bow lights manufactured by the National Marine Lamp Co., Forestville, Conn.

CHAMPION.—Trade name for boiler feed pump manufactured by the Rumsey Pump Co., Ltd., Seneca Falls, N. Y.

CHAMPION.—Trade name for electric door opener manufactured by the Standard Lock Co., 111-113 Himrod St., Brooklyn, N. Y.

CHAMPION.—Trade name for wrenches, vises and other tools manufactured by the Western Tool & Mfg. Co., Springfield, Ohio.

CHAMPION ACCUMULATOR. — Trade name for storage batteries manufactured by Hector C. MacRae, 314 St. Paul St., Baltimore, Md.

CHAMPION AND CHAMPION JUNIOR.—Trade name for electric dishwashers manufactured by the Hamilton-Low Co., Jersey City, N. J.

CHAMPION BLOWER & FORGE CO. THE.—Lancaster, Pa. Manufacturer of electric blowers, drills, exhaust fans, etc. Business established 1878. President, H. B. Keiper; vice-president and treasurer, C. B. Long; secretary, G. Hammond.

CHAMPION BRASS WORKS. — Coldwater, Mich. Manufacturers of brass and copper rivets, brass, bronze and aluminum castings, fixture fittings and parts and lighting specialties. Business established 1906. President and sales manager, F. E. Chambers; vice-president, Charles A. Pollock; secretary and treasurer, J. L. Curts; general manager, R. C. Ratto.

CHAMPION CARBON MFG. CO., THE.—305 1st National Bank Bldg., Cincinnati, Ohio. Manufacturer of dry batteries and carbon products. Business established 1916. President and treasurer, H. M. Thurnauer; vice-president and secretary, J. E. Peavey. Factory, Loveland, Ohio. Sales representatives, H. M. Chouinard, 739 N. Long Ave., Chicago, Ill.; Sanford Bros., Chattanooga, Tenn.; Collins & Trous Supply Co., Lansdowne, Pa.; Standard Motor Equipment Co., Thoroughfare Bldg., New York, N. Y.

CHAMPION FOUNDRY & MACHINE CO.—2419 W. 14th St., Chicago, Ill. Manufacturer of motor-driven foundry riddles. President, T. J. Magnuson; vice-president, A. V. Magnuson; secretary and treasurer, H. O. Magnuson. Exclusive distributor, Ditty Bros., San Francisco, Cal.

CHAMPION HARDWARE CO.—Geneva, Ohio. Manufacturer of metal castings and stampings. Business established 1883. President, C. S. Chamberlin; vice-president, W. S. Harris; secretary, N. T. Hasenflue.

CHAMPION PNEUMATIC MACHINERY CO.—1402 Michigan Ave., Chicago, Ill. Manufacturer of air compressors and air line specialties. Business established 1918. President and general manager, E. H. Johnson; vice-president, George T. Rayfield; secretary, Fred J. Rayfield; treasurer and sales manager, H. H. Kouka.

CHAMPION SPARK PLUG CO.—Toledo Ohio. Manufacturer of spark plugs. President, R. A. Stranahan; treasurer, F. D. Stranahan. Main office, Toledo, Ohio. Branch offices, 616 S. Michigan Ave., Chicago, Ill.; Grand Central Place, New York, N. Y.; Windsor, Ont., Can.

CHAMPION STORAGE BATTERY CORP.—Poughkeepsie, N. Y. Manufacturer of storage batteries. Business established 1920. President, L. M. Samuel; vice-president, George Davis; secretary and treasurer, L. S. Cohen. Main office and factory, 193 Church St., Poughkeepsie, N. Y. Branch office, 122 E. 32nd St., New York, N. Y.

CHANCE CO., THE.—Centralia, Mo. Manufacturer of guy anchors, lightning arresters, wall brackets, and electric linotype pot heaters. Business established 1905. President, A. Bishop Chance; secretary, I. L. Traughber; treasurer, J. A. Chance.

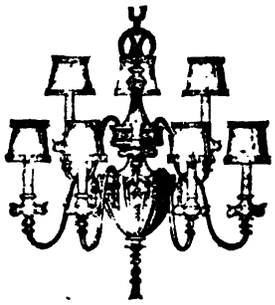
CHANDELIERS, ELECTRIC.—A chandelier is a lighting fixture suspended from the ceiling. The term is frequently used in this broad and loose sense to distinguish ceiling and pendent fixtures from bracket fixtures installed on the side walls. There is a tendency, however, to restrict the term to certain types of pendent fixtures, namely, those having a group of lamps suspended some distance below the ceiling and especially to such fixtures that have a number of arms at the ends of which the lamps are attached. In this restricted sense chandeliers do not include fixtures mounted directly on or quite close to the ceiling, nor shower fixtures with the lamps hanging on parallel cords from a ceiling plate or plate suspended a little below the ceiling, nor dome, ball, bowl or other single-unit fixtures. As a rule chandeliers are more or less ornate and often are designed to simulate the original type of chandelier, one supporting a number of candles. In a few cases chandeliers of the combination type, that is, having both electric and gas lamps, are still called for; but this type is rapidly becoming obsolete. Likewise, the designs based on old gas-fixture practice of having a multiplicity of arms radiating from a central spinning with bare lamps directed upward or down at an angle of 45°. In the best types the lamps are screened by suitable glassware, silk, parchment or other diffusing (and at the same time artistic) shades. In some cases chandeliers with groups of electric lamps have been called electroliers. Those producing candle effects are often called candelabra fixtures, although this name should properly be restricted to brackets, since the original candelabrum was seldom a pendent fixture. Also see general discussion under Fixtures, lighting.

Manufacturers:

Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Artistic Lighting Fixture Corp., 21-25 E. Houston St., New York, N. Y.
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Bridgeton Chandelier Co., Belmont & Oxford Sts., Bridgeton, N. J.
Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y.
Central Cut Glass Co., 1114 E. 63rd St., Chicago, Ill. (cut glass).
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Dale Lighting Fixture Co., 107-9 W. 13th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfecilite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Garden City Chandelier Co., 552 W. Jackson Blvd., Chicago, Ill.
Great Western Electric Fixture Co., 292 Church St., New York, N. Y.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Hendrickson Chandelier Mfg. Co., 4032 11th Ave., S., Minneapolis, Minn.
Highlands Mfg. Co., Muncie, Ind.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
LUMINOUS UNIT CO., DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Manufactures a complete line of electric lighting fixtures for residence, store, office and public building use. See Fixture classifications and display advertisement pages 1276-7.—Adv.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Minnesota Chandelier Co., 369-371 Jackson St., St. Paul, Minn.
MORAN & HASTINGS MFG. CO., 16 W. Washington St., Chicago, Ill.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.

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NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" chandeliers furnished in standard designs or special artistic



"X-Ray" Chandelier

conceptions to meet any requirement and embody principles of correct illumination. See Adv. page 1405.—Adv.
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y. "Nyclo."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Reading Chandelier Works, The, 503 Penn St., Reading, Pa.
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo.
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
Royal Chandelier Works, 12-18 S. Hall St., Allentown, Pa.
Scott-Ullman Co., The, 3311-25 Perkins Ave., N. E., Cleveland, Ohio.
SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y.
Standard Art Glass Co., 237 Lafayette St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa. "Compolite."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y.
Wyle & Bros., Inc., J. J., 18-20 E. 27th St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

CHANDEYSSON ELECTRIC CO.—4092 Bingham Ave., St. Louis, Mo. Manufacturer of motors and generators. President and general manager, P. I. Chandeysson; secretary, A. C. F. Meyer; treasurer, W. C. Forder; sales manager, E. B. Fogelsong.

CHANEY CO., W. G.—Peyton Bldg., Spokane, Wash. Producer of cedar poles and posts. Yards, Ione, Tiger, Cusick, Colville, Wash.

CHANEY MFG. CO., THE.—557-575 E. Pleasant St., Springfield, Ohio. Manufacturer of thermometers, battery testers, barometers and hydrometers. Business established 1903. President, L. F. Chaney; vice-president, J. F. Hoeflich; secretary, W. F. Herold; treasurer and general manager, J. E. Ward.

CHANGERS, FREQUENCY. — Machines for converting the power of an a-c. system from one frequency to another. These are properly called frequency converters (see Converters, frequency).

CHANGERS, LAMP.—Lamp changers are devices which attach to the end of a long pole and make it possible to remove and replace incandescent lamps in sockets or receptacles mounted near or on high ceilings or other inaccessible places. They consist of metallic fingers or grips in the form of spring leaves or bent wire, which open up to pass around a lamp and by pulling a cord close to grip the lamp, which may then be removed by turning the pole. Replacing a lamp is the reverse of this operation. They obviate the necessity of handling long and heavy ladders, with their attendant danger and often interference with normal use of the room.

Manufacturers:

Enterprise Mfg. Co., North West St., Easton, Pa. "Safety First."
McGill Mfg. Co., Valparaiso, Ind. "Adaptable."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Holdfast."
Morse, Frank W., 289 Congress St., Boston, Mass.

CHANGERS, POLARITY OR POLE, FOR TELEPHONE CIRCUITS.—A device for producing alternating telephone ringing current out of direct current. It consists of a vibrating part which reverses the current periodically. It can also be used to make pulsating current.

Manufacturers:

Cameron Appliance Co., 48 Waters Ave., Everett, Mass. "Roberts."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CHANGERS, WAVE-LENGTH, RADIO.—Clips and switches used with the coils of a radio oscillation transformer to enable a rapid change from one wave length to another; also see Transformers, oscillation.

Manufacturers:

Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Simon, Emil J., 217 Broadway, New York, N. Y.

CHAPIN CO., CHARLES E.—201 Fulton St., New York, N. Y. Manufacturer of commutator brushes. Business established 1892. Vice-president, J. H. Chapin; secretary, F. G. Chapin; sales manager, R. S. Purvis.

CHAPIN CO., E. T.—Spokane, Wash. Producer of western red cedar poles. E. T. Chapin, president. Main office, Spokane, Wash. Manufacturing and treating plant, Bovill, Idaho. Yards, Minneapolis, Minn. Branch offices, 127 N. Dearborn St., Chicago, Ill.; 611 Walker Bank Bldg., Salt Lake City, Utah.

CHAPLIN FULTON MFG. CO., THE.—28-34 Penn Ave., Pittsburgh, Pa. Manufacturer of ejectors, feed water regulators and other power plant equipment.

CHAPMAN.—Trade name for receptacles manufactured by the Bryant Electric Co., Bridgeport, Conn.

CHAPMAN.—Trade name for armature winding machines manufactured by the Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill.

CHAPMAN.—Trade name for lightning arresters for telephone and telegraph lines and boring machine manufactured by the Minnesota Electric Co., 309 2nd Ave., S., Minneapolis, Minn.

CHAPMAN ELECTRIC NEUTRALIZER CO.—Portland, Me. Manufacturer of static electricity neutralizers.

CHAPMAN, P. E.—10th & Walnut Sts., St. Louis, Mo. Manufacturer of armature winding machines.

CHARACTERISTIC.—A curve showing the relation between two properties of an electrical machine or apparatus. Characteristics are of many kinds, depending on the machine and the properties considered. A few typical ones are: Compound generator characteristic, showing the relation between terminal voltage of a compound d-c. generator and load current; external shunt characteristic—terminal voltage of d-c shunt generator and load current; load characteristic—field current and terminal voltage of a machine load current (usually full load); no-load characteristic—field current and terminal voltage for the condition of no load. The two mentioned last are also called the saturation curve and magnetization curve, respectively. Also see Armature characteristic.

CHARACTERISTIC IMPEDANCE.—See Impedance, characteristic, of telephone and telegraph lines.

CHARCOAL.—Manufactured from wood by destructive distillation, that is, by heating to a high temperature without access of air, which would cause it to burn. By this means the volatile constituents are removed from the wood, leaving the fixed carbon and ash. As the percentage of ash in wood is small, charcoal is nearly pure carbon. It is used in electrochemical processes as a reducing agent or as a source of carbon in making carbon compounds in localities where coal or coke is not sufficiently plentiful, or in processes where the cheaper coal or coke is not of sufficient purity for the purpose.

CHARGE.—In electrical practice, a word referring to the quantity of electricity present. In electrostatics the charge is the amount of electricity that has accumulated in the electrical field (for example, the charge in a condenser) and is measured in coulombs.

In storage batteries the word "charge" is used in a similar sense, but more loosely. It is the quantity of electricity which has been sent through the battery from an external source while the battery was charged. As soon as the battery is charged this electricity disappears as such being converted into chemical energy, which during discharge of the battery is reconverted back to electrical energy. The charge is usually measured in ampere-hours. The charge may be a normal charge, boosting charge or overcharge, but is not equal to the "capacity" of the battery, which is its ampere-hour output on discharge; the discharge capacity is normally less than the charge. The state of charge of a battery is its relative condition compared with the fully charged state.

To "charge" an electrostatic field (such as a condenser) or a conductor is to impress on it a source of e. m. f. To charge a storage battery is to send through it a current in the opposite direction to its own discharge current. To charge a magnet is to magnetize it.

CHARGERS, BATTERY.—See Battery-charging sets.

CHARGERS, MAGNET.—See Magnetizers and remagnetizers.

CHARGING CURRENT.—When an electric condenser is charged, the rate at which the electricity accumulates on the positive plate is called the charging current.

In high-tension lines, the electrostatic capacitance is sufficient to cause the line to act as a condenser and take a charging current. If a transmission line is left open at the receiving end but is connected to a source of e. m. f. at the generator end, a current will flow into the line. This current is known as the charging current; it is a function of the capacitance of the line, the impressed e. m. f. and its frequency. At higher voltages and with the longer lines this current becomes a considerable quantity. Under load it affects the system power-factor favorably, since the charging current is leading and neutralizes the lagging current taken by induction motors.

The term charging current is also applied to storage batteries. It is the current rate at which the battery is charged. Each size and type of storage cell has a normal charging current, which is the current in amperes recommended as best suited for that size and type. See Batteries, storage.

CHARGOMETER.—Trade name for ampere-hour meter manufactured by the Automatic Electrical Devices Co., 120-122 W. 3rd St., Cincinnati, Ohio.

CHARIOT.—Trade name for belting manufactured by the Republic Rubber Corp., Youngstown, Ohio.

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CHARLAND, E. W.—Tilton, N. H. Manufacturer of mica and mica products.

CHARTER.—Trade name for gas engines manufactured by the Charter Gas Engine Co., 9 Wallace St., Sterling, Ill.

CHARTER GAS ENGINE CO.—Sterling, Ill. Manufacturer of gas engines. Business established 1871. President, W. A. Robinson; secretary, A. L. Haglund. Main office, 9 Wallace St., Sterling, Ill. Branch office, Phoenix, Ariz.

CHARTER OAK.—Trade name for power transmission belting manufactured by N. Palmer & Co., Bridgeport, Conn.

CHASE.—Trade name for conduit couplings and nipples manufactured by the Thomas & Betts Co., 63 Vesey St., New York, N. Y.

CHASE ELECTRIC CO.—105 S. Dearborn St., Chicago, Ill. Manufacturer of electric wiring systems and signs. Business established 1903. President and general manager, Charles A. Chase.

CHASE METAL WORKS.—Waterbury, Conn. Manufacturers of brass, bronze and copper rods, tubing, wiring, etc. Business established 1909. President and treasurer, F. S. Chase; assistant secretary and sales manager, R. L. Coe; general manager, R. D. Ely. Main office and works, 236 Grand St., Waterbury, Conn. Branch offices, Boston, Mass.; Rochester, N. Y.; Philadelphia, Pa.; Cleveland, Ohio; 200 5th Ave., New York, N. Y.; 7 S. Dearborn St., Chicago, Ill.

CHASE, ROBERTS & CO.—West Ave. & 5th St., Long Island City, N. Y. Manufacturers of insulating varnish. Business established 1840. President and treasurer, E. M. Roberts; vice-president, G. J. Hahn; secretary, C. H. A. Bungart.

CHASE ROLLING MILL CO.—Waterbury, Conn. Manufacturer of copper, brass and bronze sheets, bars, etc. Business established 1900. President and treasurer, F. S. Chase; assistant secretary and sales manager, R. L. Coe; general manager, R. D. Ely. Main office and works, 236 Grand St., Waterbury, Conn. Branch offices, Boston, Mass.; Rochester, N. Y.; Philadelphia, Pa.; Cleveland, Ohio; 200 5th Ave., New York, N. Y.; 7 S. Dearborn St., Chicago, Ill.

CHASE-SHAWMUT CO., THE.—Newburyport, Mass. Manufacturer of fuses, fuse blocks, fittings, etc. President and treasurer, Sears B. Condit, Jr.; vice-president and general manager, Frank D. Masterson. Sales representatives, W. S. Brown Electric Co., 3 W. 29th St., New York, N. Y.; H. S. Salt, 114 Liberty St., New York, N. Y.; E. M. Scribner, Chicago, Ill.; H. B. Squires Co., San Francisco, Los Angeles, Cal.; Seattle, Wash.

CHASECO.—Trade name for wiring systems manufactured by the Chase Electric Co., 105 S. Dearborn St., Chicago, Ill.

CHATHAM.—Trade name for illuminating glassware manufactured by the U. S. Glass Co., Pittsburgh, Pa.

CHATTANOOGA ARMATURE WORKS.—1-3 Duncan Ave., Chattanooga, Tenn. Manufacturers of armature and field coils. Business established 1890. President, Frank Steffner; secretary, K. M. Schmisrauter; general manager, S. U. Steffner; sales manager, W. H. Elliott.

CHATTANOOGA POLE CO.—Chattanooga, Tenn. Manufacturer of chestnut poles.

CHATTERING, BRUSH.—The vibration, rattling or chattering of a brush upon the surface of a commutator, or collector or slip ring. This may be due to a rough commutator or a brush that is loose in the holder. It tends to cause sparking and pitting of the brush and commutator.

CHECKING OF AMMETERS.—The simplest method of checking a d-c. ammeter is to connect it in series with a variable resistor and standardized ammeter, to a constant source of d-c. e. m. f., such as a storage battery. The two ammeters are read simultaneously and any difference noted. By varying the resistance several points on the scale may be checked.

A-c. ammeters whose readings are influenced by wave form and frequency will give different indications on alternating currents and direct currents. They can not, therefore, be checked on direct currents directly. To check these a hot-wire type ammeter is used as an intermediate, or "cross over" instrument. By means of a double-throw switch the hot-wire ammeter is first checked against a standardized d-c. ammeter, and next it is connected in series with the a-c. ammeter under test and an a-c. source of e. m. f. The readings of the a-c. ammeter are thus indirectly checked against a d-c. standard.

CHECKING OF FREQUENCY METERS.—These are most easily checked by the relation $f=(p/2)\times(n/60)$ where p is the number of poles on an alternator and n is its number of revolutions per minute; n is measured by a tachometer or speed counter and p is counted.

CHECKING OF POWER-FACTOR METERS.—Power-factor meters may be checked by the aid of a standardized phase shifter. This, however, will give only approximate results. A more accurate method is to use a wattmeter, ammeter and voltmeter. From the readings of these three instruments the power-factor may be calculated by the relation

Power-factor=watts/(volts×amperes).

A phase shifter may be used to vary the power-factor and thus obtain checks for different points on the scale.

CHECKING OF VOLTMETERS.—This differs in no essential from the method of checking ammeters, except the voltmeters are connected in parallel instead of series. The Brooks potentiometer is especially well adapted for rapid and accurate checking of d-c. voltmeters. For checking a-c. voltmeters an intermediate standard must be used.

CHECKING OF WATT-HOUR METERS.—For checking house meters on the customers' premises, the rotating test meter is almost universally employed. For approximate results the standardized load box is sometimes used. For laboratory tests and for standardizing the test meter, a standardized wattmeter and stop watch, or preferably a more accurate timing device, is used. When the wattmeter is used it is important that the load remain constant. The accuracy of the watt-hour meter is calculated by the following formula:

$$\text{Meter watts}=K_h\times N\times 3600/T$$

where K_h=watt-hour constant, N=number of rotations of the disk in T seconds.

The ration of the calculated watts to the wattmeter reading gives the per cent registration.

In comparing the number of rotations of a rotating test meter and of the meter under test, the ratio of the watt-hour constants of the two meters must be taken into consideration. If K_1 is the test-meter constant and K_2 the house-meter constant and N_1 and N_2 are the corresponding rotations, then $N_1=N_2K_2/K$.

Polyphase watt-hour meters may be tested on single-phase circuits, each phase separately. Both potential coils must be connected to the circuit during the test. The meter should also be tested for equality of torques of the two elements.

CHECKING OF WATTMETERS.—The electrodynamometer wattmeter can be readily checked on direct current by the aid of a standardized ammeter and voltmeter. The circuits for testing should contain provisions for changing both the current and voltage. A storage battery of many cells is the most convenient source. Induction wattmeters are most conveniently checked by placing them in circuit with an electrodynamometer wattmeter that has previously been standardized. The current coils should be connected in series and the voltage coils in parallel, the connections to the voltage supply being as close together as possible. For more accurate tests than can be made with a commercial wattmeter, a watt-dynamometer may be used.

Each phase of a polyphase wattmeter must be tested separately. It should also be tested for equality of torques of the two elements.

CHECKLOCK.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CHELSEA RADIO CO.—15 5th St., Chelsea, Mass. Manufacturer of radio apparatus and Bakelite products. John Cataldo, general manager.

CHELTEN ELECTRIC CO., THE.—4859 Stenton Ave., Philadelphia, Pa. Manufacturer of switches, receptacles, grounding devices, etc. President, F. E. Swope, Jr.; treasurer, A. M. North; sales manager, H. N. Sheble. Sales representatives, B. J. Aplin, 30 Chuch St., New York, N. Y.; W. C. Rardin, 549 W. Washington Blvd., Chicago, Ill.; Electrical Distributors Co., 419 Frankfort Ave., Cleveland, Ohio; H. Lee Reynolds, 1st National Bank Bldg., Pittsburgh, Pa.; W. H. Beaven, Jefferson County Bank Bldg., Birmingham, Ala.; Wholesale Electric Co., 817 Mission St., San Francisco, Cal.

CHEMELECTRIC CO., THE.—4827 Kenmore Ave., Chicago, Ill. Manufacturer of cutout boxes, lamp adapters, transformer primary and high-tension oil-filled fuses, etc. Exclusive distributor, G. & W. Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.

CHEMICAL AFFINITY.—See Affinity, chemical.

CHEMICALS, BATTERY, MISCELLANEOUS.—Both primary and storage batteries require the use of miscellaneous chemicals in their construction and operation. Because of the large variety of batteries, a considerable number of chemicals are required both for the electrolyte and for the preparation of the electrodes and depolarizing agents. Some of the more common of these chemicals are listed separately; see Ammonium chloride, Copper sulphate, Lead oxides, Manganese dioxide, Sulphuric acid, and Sodium hydroxide. In addition the following chemicals are also used: nickel hydrate, zinc chloride, zinc sulphate, copper oxide, potassium hydroxide, nitric acid, potassium and sodium bichromates, chromic acid, potassium permanganate, and several others for special types of batteries, such as standard cells, etc.

Manufacturers:

Barrett Co., The, 17 Battery Pl., New York, N. Y.
Burgess Battery Co., Madison, Wis.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Merrimac Chemical Co., Boston, Mass.
Roessler & Hasslacher Chemical Co., 100 William St., New York, N. Y.

CHEMICALS, ELECTROPLATING.—The chemicals used in any electroplating process are a solution of a salt of the metal to be deposited, together with any other substances that may be added to increase the conductivity of the solution or to influence the density or texture of the deposit. In nickel plating, nickel-ammonium sulphate is generally used. Benzoic acid, boracic acid or citric acid are often added in small proportions to improve the quality. Silver plating usually makes use of the double cyanide of silver and potassium, although silver nitrate is also used. The double cyanide of gold and potassium is often used for gold plating. Copper plating is accomplished by using either a copper cyanide solution or one of copper sulphate. Other copper salts, such as the acetate and carbonate, have also been used. By using a double salt of copper and zinc or by adding zinc carbonate in varying proportions a brass deposit of any desired color may be obtained. Zinc plating or electrogalvanizing, as it is also known, commonly employs a solution containing zinc sulphate, glauber's salt, zinc chloride and boracic acid.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Burns Supply Co., E. Reed, 21-27 Jackson St., Brooklyn, N. Y.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Green Electric Co., The W., 81 Nassau St., New York, N. Y. "Sal-Hyde." (Salts.)
Hanson & Van Winkle, Newark, N. J.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
Powers-Weightman-Rosengarten Co., Philadelphia, Pa.

CHERRY CO., J. G.—Cedar Rapids, Iowa. Manufacturer of motor-driven ice cream freezers and dairy machinery. Business established 1880. President and general manager, W. L. Cherry; vice-president, H. T. Cherry; secretary, H. H. Cherry; treasurer, E. B. Cameron; sales manager, S. J. Van Kuren. Main office, Cedar Rapids, Iowa. Factories, Cedar Rapids, Iowa; Tama, Iowa, and Peoria, Ill. Branch offices and warehouses, Baltimore, Md.; Philadelphia, Pa.; St. Paul, Minn.; Tama, Iowa; Peoria, Ill.

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CHERRY HEAT.—Trade name for welding compound manufactured by the Cortland Welding Compound Co., Cortland, N. Y.

CHERRY TREE MACHINE CO.—Cherry Tree, Pa. Manufacturer of electric hoists, pumps, coal cutting and mining machines, switches, etc. Business established 1916. President and general manager, H. V. Brown; vice-president, H. J. Meehan; secretary and treasurer, J. C. Cosgrove.

CHESAPEAKE IRON WORKS.—P. O. Box 1123, Baltimore, Md. Manufacturer of electric traveling cranes and steel structures for transmission lines. President and treasurer, F. S. Chavannes; vice-presidents, C. L. Applegarth and I. O. Harper; chief engineer and general manager, R. C. Sandlass; sales manager, C. H. Michel.

CHESTS, ELECTRICIANS' TOOL.—Cases made of wood or sheet metal, having leather or leather-covered steel handles and fitted hinges and lock. Usually divided into compartments for blow torch, pliers, tape and other tools necessary to the electrician or wireman.

Manufacturers:

Arnold Electric Tool Co., Inc., Fort Trumbull Bldg., New London, Conn.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Little Giant Tool Box Co., 32 Beverly St., Boston, Mass.
Pennsylvania Crusher Co., Stephen Girard Bldg., Philadelphia, Pa. "Pennsylvania."
Pilliod Lumber Co., The, Swanton, Ohio.
Union Tool Chest Co., Inc., 103 Mill St., Rochester, N. Y.

CHIC.—Trade name for rotary switches manufactured by the Chelten Electric Co., 4559 Stenton Ave., Philadelphia, Pa.

CHICAGO.—Trade name for electric laundry equipment manufactured by the Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill.

CHICAGO.—Trade name for rubbing and polishing, grinding and scratch brushing machines manufactured by the Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill.

CHICAGO.—Trade name for insulated wires and cables manufactured by the Chicago Insulated Wire & Mfg. Co., Sycamore, Ill.

CHICAGO.—Trade name for lighting fixtures and portable electric lamps manufactured by the Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill.

CHICAGO.—Trade name for telephones and switchboards manufactured by the Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.

CHICAGO.—Trade name for wire rope accessories manufactured by the Chicago Wire Rope Preserver Co., 327 S. LaSalle St., Chicago, Ill.

CHICAGO.—Trade name for electric clothes driers manufactured by the Domestic Laundry Equipment Corp., 224 W. 26th St., New York, N. Y.

CHICAGO.—Trade name for ground clamps manufactured by S. R. Franck & Co., 15 S. Clinton St., Chicago, Ill.

CHICAGO.—Trade name for wire grip stretchers manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

CHICAGO.—Trade name for boiler-tube cleaners manufactured by Seehausen, Wehrs & Co., 179 N. Franklin St., Chicago, Ill.

CHICAGO APPARATUS CO.—701 W. Washington Blvd., Chicago, Ill. Manufacturer of electrical laboratory instruments.

CHICAGO AUTOMATIC SIGNAL CO.—56 W. Randolph St., Chicago, Ill. Manufacturer of automobile signals. Louis J. Du Rocher, sole owner.

CHICAGO AUTOMATIC SWITCH CO.—2336 Wolfram St., Chicago, Ill. Manufacturer of pump controlling switches. President, M. I. Weil; vice-president, A. C. Burdin; secretary and treasurer, N. H. Weil.

CHICAGO BELTING CO.—Chicago, Ill. Manufacturer of power transmission belting, linemen's belts, leather washers and straps. Business established 1888. President and general manager, E. H. Ball; vice-president, C. A. Ball; treasurer, B. T. Lenzarder; sales manager, A. J. Weis. Main office, 113-25 N. Green St., Chicago, Ill. Branch offices and warehouses, Boston, Mass.; New York, N. Y.; Pittsburgh, Pa.; Cleveland, Ohio; New Orleans, La.; Milwaukee, Wis.; Rockford, Ill.; Seattle, Wash.; Portland, Ore.; Los Angeles, Calif.; San Francisco, Calif.

CHICAGO CONCRETE POST CO.—608 S. Dearborn St., Chicago, Ill. Manufacturer of ornamental street lighting units and posts. Business established 1915. President, Ernest Freeman; secretary and general manager, George L. Chamberlain; treasurer, Frank Z. Sweet.

CHICAGO DIE & SPECIALTY CO.—551-557 W. Monroe St., Chicago, Ill. Manufacturer of electric automobile signals. President, S. Kobzy; vice-president, O. E. Aleshire; secretary and treasurer, O. F. Berry.

CHICAGO DRYER CO.—2210 N. Crawford Ave., Chicago, Ill. Manufacturer of electric laundry machinery. President, M. E. Johnson; secretary, C. W. Johnson; treasurer, F. T. Johnson.

CHICAGO ELECTRIC MFG. CO.—2801-2819 S. Halsted St., Chicago, Ill. Manufacturer of automotive lighting equipment. Business established 1903. President, W. T. Jones; vice-president, treasurer and general manager, E. S. Preston; secretary, W. B. Seelig; sales manager, T. J. Kerwin. Sales representatives, Brown & Caine, Inc., Chicago, Ill.; A. J. Picard & Co., New York, N. Y.; Consolidated Sales Co., San Francisco, Calif.

CHICAGO ELECTRIC PRODUCTS CO.—2730 Lincoln Ave., Chicago, Ill. Manufacturer of shade holders. Sole owner, Clarence Rocky.

CHICAGO ELECTRIC SIGN CO.—2219-2229 W. Grand Ave., Chicago, Ill. Manufacturer of electric signs, door openers and box hangers. Business established 1906. A. M. Knauber, secretary.

CHICAGO ENGINEER SUPPLY CO.—68 W. Lake St., Chicago, Ill. Manufacturer of steam traps, steam pressure regulators and other steam specialties. President, treasurer and general manager, R. W. Rowen; secretary, E. M. Lundblom; sales manager, W. J. Selbie.

CHICAGO EXPANSION BOLT CO.—324 W. Washington St., Chicago, Ill. Manufacturer of toggle and expansion bolts, drills, conduit hangers, etc. Sales representatives, Verne W. Shear & Co., Akron, Ohio; Electrical Warehouse, 136 W. Larned St., Detroit, Mich. Raymond L. Lunt, 716 MacKnight Bldg., Minneapolis, Minn. R. S. Peirce, sole owner.

CHICAGO EYE SHIELD CO.—2300 Warren Ave., Chicago, Ill. Manufacturer of art and colored glass sheets, goggles, shields, etc., for industrial purposes. Business established 1903. President, treasurer and general manager, Robert Malcom.

CHICAGO FERRULE & NUT CO.—878-880 Lill Ave., Chicago, Ill. Manufacturer of ferrules, nuts, etc. President, J. E. Kavanagh; vice-president, A. B. Roseboom; secretary and treasurer, Arthur P. Christmann.

CHICAGO FLEXIBLE SHAFT CO.—5600 W. Roosevelt Rd., Chicago, Ill. Manufacturer of electric flat irons, sheep shearing machines, horse and cow clipping machines, automobile polishing, grinding and rubbing machines. Business established 1897. President and treasurer, C. E. Timson; vice-president and general manager, M. W. McArdle; secretary, W. S. Hay. Sales representatives, C. B. Babcock Co., 768 Mission St., San Francisco, Calif.; Lockwood Co., 16 Reade St., New York, N. Y.; Charles F. Wiggs, 224 S. W. Temple St., Salt Lake City, Utah; W. H. Spaar, Stapleton Block, Billings, Mont.; James Stagg, 102 N. 3rd St., Aubuquerque, N. Mex.

CHICAGO FUSE MFG. CO.—Chicago, Ill. Manufacturer of fuses and switch boxes. President, Arthur D. Dana; vice-president, William W. Merrill; secretary and treasurer, George C. Reid. Main office and factory, Laflin & 15th Sts., Chicago, Ill. Branch office, 73 Barclay St., New York, N. Y.

CHICAGO HAND PHONE CO.—511 W. Jackson Blvd., Chicago, Ill. Manufacturer of intercommunicating telephone equipment. E. A. Phillips, owner.

CHICAGO INSULATED WIRE & MFG. CO.—Sycamore, Ill. Manufacturer of insulated wires and cables. Business established 1885. President, A. B. Gochenour; secretary, L. R. Love; treasurer, William M. McAllister. Main office and factory, Sycamore, Ill. Branch office, Monadnock Block, Chicago, Ill.

CHICAGO LAMP & FIXTURE CO.—517 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric lamps and shades. Partnership, William Block, Harry Block and Maurice Block.

CHICAGO LEATHER & MERCANTILE CO.—1848-50 W. 14th St., Chicago, Ill. Manufacturer of leather, rubber, felt and other gaskets and washers. Business established 1902. President, Samuel B. Panama; vice-president, Rose Panama; secretary and sales manager, Herman Panama; treasurer and general manager, S. B. Panama.

CHICAGO MICA CO.—Valparaiso, Ind. Manufacturer of electrical insulating material. Business established 1899. President, A. W. Pickford; secretary, treasurer and general manager, John F. Griffin. Main office and factory, 11-21 Water St., Valparaiso, Ind. Branch offices, 212 W. Austin Ave., Chicago, Ill.; 406 Caxton Bldg., Cleveland, Ohio. Sales representatives, G. H. Downey, 7 S. 17th St., Philadelphia, Pa.; Bells & Beach, Oliver Bldg., Pittsburgh, Pa.; F. G. Scofield, Kent Bldg., Toronto, Ont., Can.

CHICAGO MILL.—Trade name for corrugated fiber shipping boxes manufactured by the Chicago Mill & Lumber Co., Conway Bldg., Chicago, Ill.

CHICAGO MILL & LUMBER CO.—Conway Bldg., Chicago, Ill. Manufacturer of corrugated fiber shipping boxes.

CHICAGO MOTOR & VIBRATOR CO.—163-165 N. Wabash Ave., Chicago, Ill. Manufacturer of electric driers and vibrators. Business established 1910. President, treasurer and general manager, Addison A. Righue; secretary, William N. Sturges.

CHICAGO NUT CO.—2513 W. 20th St., Chicago, Ill. Manufacturer of bolts, nuts, etc. Business established 1902. President, W. S. Quinlan; vice-president and general manager, E. A. Thatcher; secretary and treasurer, S. L. McCune; sales manager, C. C. Brinkerhoff.

CHICAGO PNEUMATIC.—Trade name for motor-driven air compressors manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

CHICAGO PNEUMATIC TOOL CO.—New York, N. Y. Manufacturer of motor-driven air compressors, hammers, drills, grinders, steam and international combustion engines and other portable electric tools, etc. President, H. A. Jackson; vice-presidents, A. E. Goodhue, W. H. Callan, J. L. Price; secretary, H. D. Megary; treasurer, J. L. Price; sales manager, A. E. Goodhue. Main office, 6 E 44th St., New York, N. Y. Factories, Cleveland, Ohio; Franklin, Pa.; Detroit, Mich.; Erie, Pa. Branch offices, 1925 N. 5th Ave., Birmingham, Ala.; 182 High St., Boston, Mass.; 208 Franklin St., Buffalo, N. Y.; 300 N. Michigan Ave., Chicago, Ill.; Pearl & Vine Sts., Cincinnati, Ohio; 109 St. Clair Ave., N. E., Cleveland, Ohio; 95 E. Larned St., Detroit, Mich.; 12th & Cranberry Sts., Erie, Pa.; 6 13th St., Franklin, Pa.; 407 Carter Bldg., Houston, Tex.; 307 E. 3rd St., Los Angeles, Calif.; 5th Ave. & 5th St., South, Minneapolis, Minn.; 853 Carondolet St., New Orleans, La.; 1740 Market St., Philadelphia, Pa.; 12 Wood St., Pittsburgh, Pa.; 307 Railway Exchange, Portland, Ore.; 1004 Mutual Bldg., Richmond, Va.; 117 W. 2nd S. St., Salt Lake City, Utah; 119 Jackson St., Seattle, Wash.; 813 Hempstead St., St. Louis, Mo.; 175 1st St., San Francisco, Calif. Sales representatives, Don A. Carpenter Co., 303 San Francisco St., El Paso, Tex.; Campbell Machinery Co., 308 Wall St., Joplin, Mo.; F. C. Richmond, 117 W. 2nd St., Salt Lake City, Utah.

CHICAGO PULLEY & SHAFTING CO.—40 S. Clinton St., Chicago, Ill. Manufacturer of pulleys and shaftings. General manager, S. A. Ellicson.

CHICAGO PUMP CO.—2320-36 Wolfram St., Chicago, Ill. Manufacturer of electric pumping machinery. Business established 1909. President, M. I. Weil; vice-president, A. C. Durdin, Jr.; secretary, N. H. Weil; treasurer, Benjamin Weil. Sales representatives, Allen Engineering Co., 60 High St., Boston, Mass.; W. G. Culbert, 1503 Sansom St., Philadelphia, Pa.; W. E. Hyland, World Herald Bldg., Omaha, Neb.

CHICAGO RADIO LABORATORY.—Ravenswood & Schreiber Aves., Chicago, Ill. Manufacturer of radio apparatus. Business established 1919. Co-partnership, R. H. G. Mathews and K. E. Hassel. Branch office, K-W Equipment & Supply Co., 108 S. LaSalle St., Chicago, Ill. Sales representatives, Benwood Specialty Co., St. Louis, Mo.; Northern Radio Laboratory, Clyde, Ohio.

CHICAGO RAWHIDE MFG. CO., THE—1301 Elston Ave., Chicago, Ill. Manufacturer of power transmission belting, linemen's belts and straps, gears and other leather products. Business established 1878. President, W. H. Emery; secretary, L. A.

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Ullmann; treasurer and general manager, John T. Emery; sales manager, Burton Greene.

CHICAGO REEDWARE MFG. CO.—780-82 Milwaukee Ave., Chicago, Ill. Manufacturer of lighting fixtures and portable electric lamps. Business established 1913. President, treasurer and general manager, G. H. Wergedahl; vice-president, E. G. Bric; secretary, K. Kozlowski.

CHICAGO SOLDER CO.—4201 Wrightwood Ave., Chicago, Ill. Manufacturer of wire solder. President and treasurer, F. C. Engelhart; vice-president, S. E. Lambert; secretary, M. A. Simpson.

CHICAGO STAGE LIGHTING CO.—112 N. LaSalle St., Chicago, Ill. Manufacturer of stage lighting equipment. Business established 1904. President, George E. Stephenson; secretary and general manager, Fred A. Ferdinandsen; treasurer, William J. Stephenson.

CHICAGO STEEL FOUNDRY CO.—3720 S. Kedzie Ave., Chicago, Ill. Manufacturer of electric furnace steel and electric steel castings. Business established 1906. President and treasurer, David Evans; vice-president, C. M. Lauritzen; secretary and general manager, P. P. Reese; sales manager, C. B. Carter.

CHICAGO STONE CONDUIT CO.—Addison St. & Chicago River, Chicago, Ill. Manufacturer of underground concrete conduit. W. F. Healey, general superintendent.

CHICAGO SURGICAL & ELECTRICAL CO.—314-324 W. Superior St., Chicago, Ill. Manufacturer of surgical instruments and electrical laboratory equipment. Business established 1910. President and general manager, T. Lidberg; vice-president, J. B. Thielen; secretary, J. W. Morsbach; treasurer and sales manager, Mat Kemper.

CHICAGO SWITCHBOARD MFG. CO.—426 S. Clinton St., Chicago, Ill. Manufacturer of switchboards, panelboards and steel cabinets for electric light and power distribution. President, G. N. Jennings; secretary, E. L. Brenk; treasurer, George Meyer, Jr.

CHICAGO TELEPHONE SUPPLY CO.—1142-1228 W. Beardsley Ave., Elkhart, Ind. Manufacturer of telephones and switchboards. Business established 1896. President, A. J. Briggs; vice-president, G. A. Briggs; secretary, treasurer and general manager, F. C. Best; sales manager, E. H. Henderson.

CHICAGO TILE ARCH FURNACE CO.—321 W. Austin Ave., Chicago, Ill. Manufacturer of boilers and tanks for power plants.

CHICAGO WIRE ROPE PRESERVER CO.—327 S. LaSalle St., Chicago, Ill. Manufacturer of wire rope accessories. Business established 1904. President, J. Herbstritt; secretary and treasurer, H. Mottschall.

CHICKASHAW MACHINE & FOUNDRY CO.—Memphis, Tenn. Manufacturer of brass and iron castings. President, T. L. LaMalta; vice-president, Edward Abele; secretary, W. H. Irwin.

CHICORA.—Trade name for square flax packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

CHIEF.—Trade name for refillable fuses manufactured by the Perfect Refillable Fuse Co., Brooklyn, N. Y.

CHIMES, ELECTRIC.—Chimes in which the hammers are actuated by electromagnets whose circuits are controlled by clock mechanism or by a keyboard. They frequently form an auxiliary to a clock, ringing each quarter hour with a distinct code of 4, 8, 12, and 16 strokes, followed in the last case by a deeper-toned chime giving the full hour strokes. Church steeple chimes are often played by means of an electric keyboard in the organist's loft. Each chime has its own single-stroke electromagnet, which, in turn, is governed by its own key, a storage battery of a few cells furnishing the current. Chimes produce a very rich and melodious tone.

Manufacturers:

Deagan, Inc., J. C., 1770 Berteau Ave., Chicago, Ill.
KLAXON CO., Newark, N. J.

CHIMNEYS, POWER PLANT.—Chimneys for power plants are generally made of brick and concrete. Steel is used in many cases, but these are more commonly called stacks; see Stacks, smoke. Brick chimneys may be made of common brick and lined with fire brick to a height of about 30 ft. above the grates. They are always tapered, having a thicker wall at the bottom than at the top. Reinforced concrete, lined part way with fire brick, is also very commonly used. It permits a light chimney with thin walls and has greater strength than brick. It is also quite rapidly built and is commonly poured in sections of from 5 to 6 ft. in height. These chimneys are one of the cheapest and most durable forms.

Manufacturers:

Dover Boiler Works, Dover, N. J.
Heine Chimney Co., 123 W. Madison St., Chicago, Ill.
Heine Safety Boiler Co., 5316 Marcus Ave., St. Louis, Mo.
Keeler Co., E., Williamsport, Pa.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
Rust Engineering Co., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Weber Chimney Co., The, 1452-56 McCormick Bldg., Chicago, Ill.
Weiderholt Construction Co., Bank of Commerce, St. Louis, Mo.

CHINALAK.—Trade name for insulating varnish manufactured by the John C. Dolph Co., 168 Emmett St., Newark, N. J.

CHLORATES.—The potassium and sodium chlorate salts are produced by the electrolysis of the corresponding chloride salts, using a high anodic current density and a high temperature, with platinum anodes and artificial graphite cathodes.

CHLORIDE OF SILVER DRY CELL BATTERY CO.—407-409 N. Paca St., Baltimore, Md. Manufacturer of dry batteries and electrotherapeutic apparatus. President and general manager, M. E. Fuld; secretary, T. J. Bohannan.

CHLORINE.—A heavy greenish-yellow gas of a characteristic odor and an irritating effect on the nose and throat. Symbol Cl; at. Wt. 35.45; sp. gr. at 20° C. (air=1) 2.48. Liquefiable at 15° C. at 4 atmospheres pressure or at —33.6° C. at atmospheric pressure. Chlorine is used in purifying suspicious drinking water, as an oxidizing agent in some industrial processes, in detinning tin scrap by the formation of tin chloride, and in making chlorine compounds. Some of the more important commercial compounds made from chlorine are hydrochloric acid (HCl), bleaching powder (NaOCl), bleach liquor, the solvents carbon tetrachloride (CCl_4) and sulphur chloride (S_2Cl_2), chloroform, phosgene gas, and organic compounds used in the dye industry. Chlorine is produced by the electrolysis of sodium chloride, usually in aqueous solution, in cells designed to carry off the chlorine as it is liberated at the anode. The process is discussed under Alkali, electrolytic, which is produced at the same time at the cathode as a result of the electrolysis.

CHLORION.—The constituent of a chloride salt which is liberated by electrolysis at the anode.

CHLORSIL.—Trade name for electrotherapeutic apparatus manufactured by the Chloride of Silver Dry Cell Battery Co., 407-409 N. Paca St., Baltimore, Md.

CHOKE COILS.—See Coils, choke.

CHOPPERS, MEAT AND FOOD, ELECTRIC.—A motor-driven shaft, upon which are knives, operates these in a revolving bowl so that its contents are brought into contact with the knives. Employed in hotels, restaurants and institutions where large quantities of chopped foods are served. Much labor is saved by these machines.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Braun Co., The, 1615-35 N. 23rd St., Philadelphia, Pa. "Coles."
Brecht Co., St. Louis, Mo. "Crescent."
Deer Co., Inc., The A. J., Hornell N. Y. "Royal."
Enterprise Mfg. Co. of Pa., 3rd & Dauphin Sts., Philadelphia, Pa. "Enterprise."
Holwick, B. C., Canton, Ohio. "Holwick."
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Louisville Machine & Mfg. Co., The, Louisville, Ohio. "Electri-Cut".
Steiner Mfg. Co., 4100 N. 21st St., St. Louis, Mo.
Stimpson Scale & Electric Co., Northville, Mich. "Stimpson."
Street & Co., F. G., 132 Nassau St., New York, N. Y. "Victor."

CHRISTENSEN.—Trade name for air compressors manufactured by the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

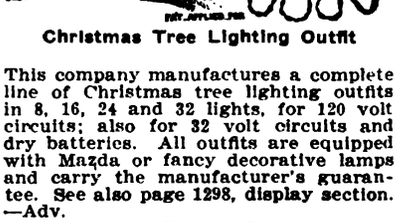
CHRISTIANA MACHINE CO.—Christiana, Pa. Manufacturer of turbines. President, Charles Bond; vice-president, Morgan T. Williams; secretary and treasurer, M. F. Shaw.

CHRISTMAS TREE LAMPS.—See Lamps, incandescent, decorative and tree.

CHRISTMAS TREE LIGHTING OUTFITS.—These lighting outfits are generally constructed with a view to using a set of small low-voltage lamps in series across standard 110 to 120-volt lighting circuits. They usually consist of a string of eight sockets connected in series or of a group of such strings connected in parallel. The objection to series burning is that failure of one lamp puts out the entire series string; to overcome this parallel strings are sometimes made up which are fed through a low-voltage transformer. For use where lighting circuits are not available, battery lighting outfits are made; these usually have miniature lamps wired in parallel and include a dry battery (often placed in a battery box) or an automobile lighting and starting storage battery, and a switch. Candelabra or miniature lamps used with all these small sets are made in a number of colored decorative forms. For larger tree sets the simple dipped sign lamps are used in parallel. Lighting outfits for very large trees used for municipal or social center celebrations are generally made up special and contain medium screw-base multiple sign lamps, or other standard multiple lamps of various wattages.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Diamond Electric Specialties Corp., 101-103 S. Orange Ave., Newark, N. J. "Diamond."
Enterprise Electric Novelty Co., Inc., 603 W. 130th St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Arborlux" eliminates the faults which heretofore have characterized Christmas tree lighting sets by having all the lamps wired in multiple so that the failure of one lamp does not affect any other on the set. Can be used on any 110-volt a-c. circuit. When the tree is not lighted, the transformer used with the "Arborlux" can be used to operate electric toys. The construction of leads, sockets, etc., is unusually sturdy and neat. The "Arborlux" set has a year-round utility in providing decorative illumination for banquet tables, convention halls, stores and store windows, summer houses, pergolas, etc. See adv. pages 1203-1223.—Adv.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
Owl Flashlight Co., Inc., The, 102 Franklin St., New York, N. Y. "Owl."
Propp Co., M., 108 Bowery, New York, N. Y. "Propp."
TRIANGLE ELECTRO TRADING CO., 79 Chambers St., New York, N. Y.



Christmas Tree Lighting Outfit

This company manufactures a complete line of Christmas tree lighting outfits in 8, 16, 24 and 32 lights, for 120 volt circuits; also for 32 volt circuits and dry batteries. All outfits are equipped with Mazda or fancy decorative lamps and carry the manufacturer's guarantee. See also page 1298, display section.—Adv.

Van Antwerp & Co., C. B., 4845 Lowell Ave., Chicago, Ill.
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

CHRISTO MFG. CO., INC.—Richmond, Va. Manufacturer of loom clips. President, Hampton Fleming; secretary and treasurer, J. R. Blackwell.

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CHROMATES.—Various metallic chromates may be made in a manner similar to that for lead chromate (see Chrome yellow.) Soluble chromates, usually Na_2CrO_4 may be used in an electrolytic cell used for an oxidation process, to decrease the reducing action at the cathode.

CHROME YELLOW.—The technical name for lead chromate, $PbCrO_4$; produced electrolytically in a cell using a lead anode in an electrolyte of $NaClO_3$ and Na_2CrO_4. See Luckow process.

CHROMEL.—Trade name for resistance materials manufactured by the Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.

CHROMIUM.—A brilliant grayish metal. Symbol Cr; at. wt. 52.1; sp. gr. 6.9. In the metallic form it is used in making the chromium-cobalt alloy "stellite", and in the form of ferrochromium in making alloy steels. The metal may be produced by reduction of chromite ($FeCr_2O_4$) in electric furnaces; with subsequent refining to remove iron and carbon; or by reducing the oxide, Cr_2O_3 with aluminum or magnesium powder, these metals having a greater affinity for oxygen than has chromium (Thermit process of Goldschmidt). Several unsuccessful attempts have been made at the electrodeposition of pure chromium. This has, so far, been accomplished only on a laboratory scale.

CHRONOSCOPE.—An electrical instrument used to measure the speed of a projectile or other rapidly moving object that requires an accurate measurement of a very short period of time. Chronoscopes can measure time to the one-thousandth part of a second.

CHUCKS, AUTOMATIC DRILL.—Automatic drill chucks are those which grip the drill or taps automatically, making it unnecessary to stop the drill press spindle when a drill is being changed. They also eliminate the use of wrenches and keys and save considerable time in changing any drill. Separate chucks are used for straight and taper-shank drills. They generally do not have a set of jaws similar to other chucks but have hardened steel gripping members so placed that their holding power increases with the resistance on the drill.

Manufacturers:

EASTERN TUBE & TOOL CO., INC., 594 Johnson Ave., Brooklyn, N. Y. "Quictite."

Morse Twist Drill & Machine Co., New Bedford, Mass. "Stetson," "Beach."

Wahlstrom Tool Co., 5520 2nd Ave., Brooklyn, N. Y. "Wahlstrom."

CHUCKS, MAGNETIC.—The magnetic chuck is a device for holding magnetic metal parts while they are being machined. Its chief advantages are its ability to handle a large number of small parts in one operation and the speed with which the chucking operation is accomplished. They are made in the disk form similar to the ordinary chuck except that electromagnets replace the jaws for holding the work; also in flat rectangular plate form for planers, grinders, and similar machines, to take the place of jigs, clamps or bolts in holding the work. There are several types which fasten rigidly to the bed of the machine, but which are pivoted so that the plate of the chuck may be set at any desired angle with the cutting plane.

Manufacturers:

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. D & W Magnetic Chucks include both flat and rotary types. Standard equipment furnished with all chucks includes demagnetizing switches for releasing the work readily and detachable waterproof extension cords. D & W Magnetic Chucks will not operate on alternating current. For customers who have no direct current available the factory is prepared to furnish a small electric generator.—Adv.

Heald Machine Co., The, 10 New Bond St., Worcester, Mass.

Persons-Arter Machine Co., The, 72 Commercial St., Worcester, Mass.

Taft-Pierce Mfg. Co., The, Woonsocket, R. I. "Simmons Unit-Pole."

CHURCHILL CABINET CO.—2119 Churchill St., Chicago, Ill. Manufacturer of electrical cabinets and boxes. Business established 1904. President and general manager, O. Gullichsen; secretary, P. H. Bethke; treasurer, H. T. Wedel.

CHURNS, MOTOR-DRIVEN.—Appliances for agitating or churning cream until the fat globules combine as butter, the agitating mechanism, such as a rotating cylinder, rotating blades or a dash, being driven by a motor. The motors are often geared directly to the operating mechanism, although in the larger sizes they are separately mounted and belt-connected. Small centrifugal or reciprocating pumps, used to pump the cream into the churn, are operated by the same motor.

Manufacturers:

Burrell & Co., Inc., D. H., Little Falls, N. Y. "Simplex."

Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Victor Junior."

Davis-Watkins Dairymen's Mfg. Co., 130 N. Wells St., Chicago, Ill.

Dazey Churn & Mfg. Co., Warne & Carter Aves., St. Louis, Mo. "Dazey."

Holland Mfg. Co., 131 N. Wells St., Chicago, Ill. "Holland."

Piedmont Electric Co., Electrical Bldg., Asheville, N. C. "Peco."

Superior Churn & Mfg. Co., Northville, Mich. "Superior."

Taylor Bros. Churn & Mfg. Co., 2951 N. Market St., St. Louis, Mo. "Reliable."

Vermont Farm Machine Corp., 53 W. Jackson Blvd., Chicago, Ill.

CIGAR LIGHTERS.—See Lighter, cigar, electric.

CIG-R-LITE.—Trade name for electric cigar lighters made by the Electric Automatic Cigar Lighter Co., 556 W. 27th St., New York, N. Y.

CINCH.—Trade name for expansion bolts manufactured by the National Lead Co., 11 Broadway, New York, N. Y.

CINCINNATI.—Trade name for electric drills and grinders manufactured by the Cincinnati Electrical Tool Co., 1501-3-5 Freeman Ave., Cincinnati, Ohio.

CINCINNATI.—Trade name for storage batteries manufactured by the Cincinnati Storage Battery Co., Moormann Ave., near Madison Rd., Cincinnati, Ohio.

CINCINNATI ARTISTIC WROUGHT IRON WORKS.—Cincinnati, Ohio. Manufacturer of electric candles and portable lamps. Business established 1900. President, B. Schaefer. Main office, 2941-43 Eastern Ave., Cincinnati, Ohio. Branch offices, 500 5th Ave., and 19 W. 25th St., New York, N. Y.; 17 S. Wabash Ave., Chicago, Ill. Sales representatives, George Baryfeldt & Co., New York, N. Y.; H. C. Gray Co., New York, N. Y.; Kindt Katz Co., New York, N. Y.; Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.

CINCINNATI ELECTRICAL TOOL CO., THE.—Cincinnati Ohio. Manufacturer of portable electric drills and grinders. Business established 1902. President, Louis J. Goldman; vice-president and general manager, Joseph Wolf; secretary, B. L. Heidingsfeld; treasurer, J. A. Goldman. Main office and factory, 1501-3-5 Freeman Ave., Cincinnati, Ohio. Branch office, 50 Church St., New York, N. Y.

CINCINNATI SPECIALTY MFG. CO., INC.—Cincinnati, Ohio. Manufacturer of automatic extension reels for electric lamps. Business established 1892. Vice president and general manager, T. T. Oakley; secretary, J. B. Grause; treasurer, Wm. Marschheuser. Main office 1907-21 Powers St., Cincinnati, Ohio. Branch office, 39-41 Cortlandt St., New York, N. Y.

CINCINNATI STORAGE BATTERY CO., THE.—Moormann Ave., near Madison Rd., Cincinnati, Ohio. Manufacturer of storage batteries. Business established 1914. President, treasurer and general manager, Albert H. Luhrman; vice-president, Henry Luhrman; secretary, W. T. Foley; sales manager, E. C. Edgell.

CINCINNATI TIME RECORDER CO., THE.—Cincinnati, Ohio. Manufacturer of automatic time recorders, cost systems and signaling systems. Business established 1903. President, C. H. Gamble; vice-president, C. H. Fisher; secretary-treasurer and general manager, W. L. Campbell; sales manager, W. E. Baker. Main office, 1733 Central Ave., Cincinnati, Ohio. Branch offices, 477 Hudson Terminal Bldg., New York, N. Y.; 326-327 Munsey Bldg., Washington, D. C.; Stephen Girard Bldg., Philadelphia, Pa.; 816 Austell Bldg., Atlanta, Ga.; 9 Huntington Bank Bldg., Columbus, Ohio; Builders' Exchange Bldg., Minneapolis, Minn.; 431 S. Dearborn St., Chicago, Ill.; 513 New York Life Bldg., Kansas City, Mo.; 416 Fullerton Bldg., St. Louis, Mo.; 452-454 Transportation Bldg., Indianapolis, Ind.; 85 Shelby St., Detroit, Mich.; 316 Sloan Bldg., Cleveland, Ohio; 136 Federal St., Boston, Mass.; 615 Lyceum Bldg., Pittsburgh, Pa. Sales representatives, Los Angeles Rubber Stamp Co., 131 S. Spring St., Los Angeles, Cal.; Converse Co., 421 Union St., Seattle, Wash.

CINCINNATI TOOL CO.—Norwood, Cincinnati, Ohio. Manufacturer of linemen's tools. President, J. M. Hargrave; vice-president, Johnette M. Hargrave; secretary, J. A. Gardner; treasurer, H. H. Hargrave.

CINEMATOGRAPH.—The European name for motion-picture machine. A machine for projecting on a screen a series of pictures succeeding one another so rapidly as to produce the illusion of continuous motion or an animated scene. These machines are generally lighted electrically and may be driven by a small motor. See Motion-picture machines.

CIR. MIL.—Abbreviation for circular mil.

CIRCLE.—Trade name for armored cable and non-metallic conduit manufactured by the Circle Flexible Conduit Co., Inc., 188 21st St., New York, N. Y.

CIRCLE-D.—Trade name for flexible metallic conduit and armored cable manufactured by the A. Dewes Co., 199 Lafayette St., New York, N. Y.

CIRCLE DIAGRAM.—A diagram in which a part of a circle shows the locus of the end of the current vector for an induction motor as the load changes from zero to blocked rotor. The diagram, when complete, gives data for the calculation of a number of the motor's characteristics, such as efficiency, power-factor, torque, slip, etc.

CIRCLE F.—Trade name for wiring devices manufactured by the E. H. Freeman Electric Co., 803 E. State St., Trenton, N. J.

CIRCLE FLEXIBLE CONDUIT CO., INC.—188 21st St., Brooklyn, N. Y. Manufacturer of armored cable and flexible metallic conduit. Business established 1920. President and vice-president, Harry Sena; secretary, treasurer and general manager, Joseph Rand; sales manager, Mr. Mode.

CIRCLE H.—Trade name for fire alarm and burglar alarm apparatus and systems manufactured by the Metropolitan Electric Protective Co., 130 W. 26th St., New York, N. Y.

CIRCLE STAMPING & MFG. CO.—241 Cortlandt St., Belleville, N. J. Manufacturer of metal washers.

CIRCLE T.—Trade name for switches and wiring devices manufactured by the Trumbull Electric Mfg. Co., Plainville, Conn.

CIRCUIT BREAKER.—A circuit breaker is a device (other than a fuse) constructed primarily for the interruption of a circuit under infrequent abnormal conditions—(A. I. E. E. Standardization Rules). A circuit breaker differs from a switch in that it always is provided for automatic opening. If also arranged for manual or remote-control opening, it may also serve as a switch, since it is always arranged for manual or remote-control closing. A circuit breaker differs from a fuse in that it can be reclosed without replacing any part or element. Circuit breakers are more expensive in first cost than fuses, however, and are used in preference to fuses where replacing of the latter would likely involve objectionable delay or considerable expense as well as delay (if quite frequent), or where fuses cannot be used because of very large currents or high voltages.

The earliest circuit breakers were essentially knife switches with automatic features, but the rapid burning of the main contacts led to the use of auxiliary carbon contacts to take the final arc. After passing through different steps of development the modern air circuit breaker was evolved with its stationary contacts of copper blocks mounted vertically one over the other on the face of a panel or base with studs projecting through to the connections on the rear. The moving contact is made of a brush of laminated copper and provision is made for practically hinging it at the lower end, obtaining the break in the circuit between the upper end of the laminated brush and the upper stationary contact. A carbon block, suitably pivoted, is attached to the stationary block and another to the movable brush, and the final arc occurs between these carbon blocks after the main contacts have parted a considerable distance. This type of breaker has practically superseded all other types for d-c. service up to 750 volts and is used a great deal on low-voltage a-c. service. It has been built in capacities up to 24,000 amperes and can be made for hand operation or for power operation.

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An early contemporary of the carbon type breaker was the magnetic-blowout type, which had the main contacts of the brush type shunted by an auxiliary contact that opened in a very intense magnetic field that quickly extinguished the arc on the auxiliary contacts. As d-c. railway systems grew in size it was found that the magnetic-blowout design was not adapted to handle the very heavy short-circuit currents as well as the carbon type and it has been practically superseded for that service. For high-voltage railway service where an extremely quick-acting breaker is necessary to prevent the d-c. units from flashing over, a more modern design of magnetic-blowout breaker has been found to be better than any other type for securing very high speed of opening and effective suppression of the arc.

On a-c. circuits where circuit breakers are used to interrupt current at voltages over 600, the types described above are not generally applicable because of the excessive arcing. This difficulty has been overcome by having the arc occur between contacts immersed under oil where the arc is put out both by the cooling action and the pressure of the oil. This practice has led to the classification of circuit breakers according to the medium in which the circuit is interrupted, as "air" circuit breakers and "oil" circuit breakers.

Most oil circuit breakers are arranged with a heavy spring to provide a rapid acceleration of the moving parts when opening and have the contacts maintained in the open position by gravity. The contacts are usually of the self-cleaning type, maintained under high pressure, and provided with auxiliary renewable arcing contacts for the final breaking of the circuit. The oil is contained in strong steel tanks which in the smaller sizes enclose all poles of the circuit breaker. The larger sizes have each pole in a separate tank. Oil circuit breakers are used for practically the same purposes as oil switches, and as their construction and installation are identical, a description of these features may be found under Switches, oil.

With the development in recent years of the large generating units and interconnected power systems that are now relatively common, there has arisen the necessity for extreme care in the selection of switching apparatus, as well as in the design of buses and connections, to make possible the successful handling of the excessive currents that may be expected under short-circuit conditions.

In general, the selection of an oil circuit breaker for a given service depends primarily upon four factors: (1) The voltage of the circuit upon which the breaker is to be used; (2) the normal current carrying capacity in r.m.s. amperes; (3) the maximum initial rush of current to be expected under short-circuit conditions; (4) the r.m.s. value of current that must be opened by the breaker in case of short circuit.

Of these factors, it is evident at first glance that the voltage and normal current-carrying capacity must be considered. In regard to the third, the short-time current-carrying capacity of an oil circuit breaker is determined by two considerations, either one of which may be the limiting feature for any given breaker, (a) the ability of the breaker to withstand the mechanical stresses imposed by the short circuit, and (b) the maximum current which the breaker will carry for a short time without excessive heating. The fourth factor in the selection of the proper breaker depends on the time interval that will elapse between the instant of short circuit and the parting of the breaker contacts. This involves a study of the characteristics of the relays that are to be used.

The short-circuit current that may be expected on any system depends on a number of elements, of which might be mentioned the conneeted kilovolt-amperes in synchronous machines, the reactance in circuit between the machines and the point of short circuit, and the point on the voltage wave at which the short circuit occurs, and a number of other factors, including the use of voltage regulators. Ordinarily, in making short-circuit calculations it is assumed that the reactance of a circuit is equal to the impedance since the ohmic resistance is usually quite low. It is customary to base all calculations on the most severe conditions, assuming that all machines are on the line, fully loaded, and with an unsymmetrical short circuit.

The principal demand for a circuit breaker is for one that will give overload protection. Breakers are also built for underload conditions to open on a minimum current, for undervoltage or overvoltage, when a departure from normal is apt to cause trouble, and for reversal to open the circuit if the power flows in the wrong direction. Breakers may be provided with instantaneous trip or with time-limit trip, either definite or inverse. It is, of course, possible to combine several of these features in the same breaker. With an air circuit breaker special attachments are usually provided to secure these different features, while with oil circuit breakers relays are usually employed.

These relays are used to give the circuit breaker other characteristics than straight overload, and they can provide protection against phase reversal, unbalance, ground, excessive temperature and other similar troubles in addition to the conditions mentioned above. By the use of the relays breakers can also be properly interlocked or tripped in certain sequence or made to perform other functions that a plain breaker cannot do.

Most of the builders of high-grade air circuit breakers can supply these arranged for solenoid control. The solenoid is usually equipped with a dashpot device to take up the jar of closing while still allowing the breaker to close quickly. D-c. solenoids are employed almost exclusively as being simpler, better, and cheaper than those for a-c. service.

Certain circuit-breaker builders arrange their breakers for motor control, pneumatic control, or electropneumatic, depending on the operating conditions. Breakers of the solenoid-control tvpe can be furnished for automatic reclosing, after they have come out on an overload and the condition of overload no longer exists on the line. Such breakers are particularly useful for feeders in a network, or for sectionalizing circuits and they can be arranged to take care of the many contingencies that arise in an automatic substation or a plant where the class of attendance is poor.

Makers and general details of the principal types of breakers classified chiefly according to the release mechanism are given below:

CIRCUIT BREAKERS, AIR, OVERLOAD.—Circuit breakers in which the circuit is opened or broken in air in the event of overload or excessive current, and which are more widely used than any other type of circuit breaker. Their operation depends merely upon the amount of current in the main circuit. Ordinarily an overload circuit breaker will respond instantly to any current in excess of that value at which it is set to operate, and will open the circuit even if the excess current is only of momentary duration. While this action is desirable in many cases, there are also many cases where an overload of momentary duration should be sustained and still have the breaker operate on a moderate overload if it is continuous. Applications of this requirement are in circuit breakers for power and lighting feeders, for generators, and for motors where the starting current is excessive. This condition is met by time-limit attachments, usually inverse in their action so that they respond much more quickly to heavy overloads than to moderate or slight overloads. In fact, the response is inversely proportional to the percentage of overload. This attachment consists of a time-limit relay or a dashpot filled with oil in which a disk connected to the armature of the tripping mechanism moves. The pull on the armature increases with the current in the main circuit and as the oil in the dashpot requires a definite amount of work to be done at all times, a very heavy current will do the work much more quickly than a smaller one. As the armature is attracted to its poles it strikes a restraining latch and allows the contacts to separate.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
GENERAL ELECTRIC CO., Schenectady, N. Y. See Circuit Breakers, Air, Underload, for information on complete line.—Adv.
Kelman Electric & Mfg. Co., 1650 Naud St., Los Angeles, Cal.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display advertisement on page 1278.)
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PACIFIC ELECTRIC MFG. CO., 827-833 Folsom St., San Francisco, Cal.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CIRCUIT BREAKERS, AIR, UNDERLOAD, NO-VOLTAGE, REVERSE-POWER, REVERSE-PHASE, ETC.—Circuit breakers are used more as a protection against overload than any other abnormal condition, but it is sometimes desirable to protect against other conditions or to combine other features with the overload. Where the source of current supply is liable to occasional interruption, circuit breakers for motor protection are provided with a no-voltage release feature, which trips the breaker and thus prevents the heavy flow of current through the stationary motor which would otherwise occur when the power came on again. An automatic underload attachment is used on some circuit breakers where it is desirable to open the circuit if the load decreases. Perhaps the largest use of this type is for storage-battery charging, where the breaker is tripped if the charging current falls below a predetermined value. Reverse-power relays are also used largely in connection with storage-battery charging and with d-c. generators operating in parallel. When the battery voltage exceeds that of the generator for any reason, it starts to send power back into the generator and at a certain value the circuit will be opened. With generators operating in parallel an unbalance or difference in generator voltage circulates power from one generator to the other until the breaker trips. On d-c. circuits these are usually called reverse-current breakers. For a-c. work, especially in the protection of polyphase motors, it is very desirable to have a breaker that will open the circuit if one of the phases becomes reversed so that the direction of rotation is not changed; this is used largely on elevator motors. The tripping mechanisms on many of these types operate by the abnormal condition unbalancing a magnetic equilibrium which is maintained by a combination of shunt and series coils. This releases the restraining latch and permits the opening of the contacts.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
GENERAL ELECTRIC CO., Schenectady, N. Y. The satisfactory operation in all kinds of railway, industrial and building service is an indication of the quality and excellent design of the G-E air circuit breaker. The advantage of purchasing them mounted on a G-E switchboard ready for immediate operation is obvious. All G-E air circuit breakers will carry full rated loads continuously with a temperature rise not in excess of 30 degrees C. For d-c.

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systems the use of air circuit breakers is universal as an automatic device for taking care of abnormal conditions on machine or feeder circuits. For a-c. systems above 650 volts, air circuit breakers are less commonly employed, since the oil circuit breaker covers the larger part of this field. The hand-operated air circuit breaker is the type most commonly used, but with remote control breakers the station wiring can very often be laid out to better advantage, resulting in a large saving of cable. For such conditions G-E electrically operated breakers are available, self-contained, up to 3,500 amp., alternating current, and up to 6,000 amp., direct current. Have built units up to 20,000 amp. The following bulletins describing different types are available: Light duty up to 300 amp. single and double pole, No. 47520; heavy duty, triple pole, for a-c., No. 47540; medium capacity, up to 1,200 amp., No. 47530; solenoid operated, No. 47550. See adv. pages 1203-1223.—Adv.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CIRCUIT BREAKERS, AUTOMATIC RECLOSING.—Automatic reclosing circuit breakers are designed to put power back on the circuit as soon as the abnormal conditions causing the opening have disappeared. Some of the applications of these breakers, which are generally of the air-break type, are for the protection of generator circuits, for independent feeder circuits and for feeders in a network which is supplied by power from more than one source. They are especially useful in automatic substations or those in which the attendance is irregular or not continuous, as in mine and certain industrial substations. These breakers are solenoid-operated breakers in which the main contacts are maintained in closed position by action of a solenoid. When an overload, short circuit, voltage failure, etc., occurs on the line the tripping mechanism causes the breakers to open. A trip coil with a dashpot arrangement assures that the breakers will remain open for a definite time, at the end of which, if the line is cleared of the short circuit or other trouble, the contacts for the operating solenoid are closed and this acts to reclose the breaker. As long as the overload, short-circuit or other abnormal condition is on the line the breaker does not reclose.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th & Wesley Aves., Columbus, Ohio. An electromagnetically operated circuit breaker having the following operating characteristics: (a) Breaker is closed by means of an electromagnet. (b) Opens automatically in case of overload or voltage failure. (c) Remains open a definite time interval, regardless of cause of opening. (d) In case circuit breaker is opened by a short circuit, the breaker makes no attempt to reclose while short circuit exists, but closes instantly upon removal of short circuit or overload. In the application of automatic reclosing circuit breaker there are three general conditions to be considered, each requiring a different arrangement of control circuits: 1—When breaker controls an independent circuit.



Circuit Breaker, Type A R L

2—When installed in a tie feeder. 3—When installed between generator and station lines. This company's automatic reclosing circuit breakers are suitable for all conditions and made in capacities ranging from 25 to 8000 amperes.—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
PACIFIC ELECTRIC & MFG. CO., 827 Folsom St., San Francisco, Cal.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

CIRCUIT BREAKERS, CAR OR LOCOMOTIVE, ELECTRIC RAILWAY.—Devices placed in the motor circuit to automatically open this circuit when overloaded, and in some cases when the line voltage fails. These devices are very essential elements of railway car equipment and are arranged so that they can be tripped by the motorman whenever he so desires. They are of two general types, manually operated and remote control. The essential parts of both types are the trip coil, holding mechanism and devices for controlling and extinguishing the arc produced when the circuit is interrupted. The automatic opening of these circuit breakers is universally accomplished by means of the magnetic pull produced by electromagnets through which the operating current passes. This magnetic pull is balanced against a spring or gravity or both, and when the current exceeds a predetermined amount the latch or other means holding the main contacts together is released and the contacts are forcibly separated. The arc produced on the separating of the contacts is drawn out by arc tips until it is broken and extinguished by a magnetic field produced by the operating current passing through "blowout" coils. In the manually operated type all of the operating mechanism and electrical elements are compactly arranged in a suitable case having an arc chute and operating handle. The device is mounted conveniently to the motorman so that he can open it, or close it when it is automatically opened by an overload. The remote-control type is usually mounted under the car with the arc chute so placed that the arc will not extend to grounded parts of the car, and is electrically controlled by a suitable trip and reset switch mounted convenient to the motorman.

CIRCUIT BREAKERS, HIGH-VOLTAGE, NONINFLAMMABLE LIQUID TYPE.—Circuit breakers of this type are small compact protective devices, comparatively inexpensive, for use on high-voltage lines up to about 70,000 volts. They are made for either indoor or outdoor mounting. The circuit breakers consist essentially of a movable contact on a spring-actuated operating rod which completes the circuit through a stationary contact at the bottom of a tube filled with a noninflammable liquid. This liquid is very similar to carbon tetrachloride in many of its characteristics but has a higher boiling point.

The protective features are provided by a small relay placed on top of the tube. Under short-circuit or overload the relay operates to release a restraining latch which in turn allows the spring to rapidly separate the contacts. A liquid director on the moving contact directs a stream of the liquid on the contacts as they separate and quickly quenches any arc that is formed. The breaker may then be reset by hand. In some cases these are mounted in fuse clips set on an insulator and may be replaced by chemical fuses during inspection or repairs.

Manufacturers:

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."

CIRCUIT BREAKERS, OIL, OVERLOAD.—Circuit breakers in which the contacts are opened under oil in case of an overload or excessive current in the main circuit. Their functions and usage are in general similar to overload circuit breakers of the air type, except that they are used mostly for a-c. circuits and high currents and voltages. Attachments for tripping are usually mounted on the breaker mechanism and consist of a trip magnet acting on an armature which releases the restraining latch as it is pulled over. When oil circuit breakers are removed from but controlled from a switchboard, they are closed either through a system of bell cranks and rods or by a solenoid or motor. Direct current is used for this control apparatus wherever possible. The tripping mechanism is often connected in the secondary circuit of current transformers and operates either directly or through relays, which are widely used because they may be arranged to combine the time element with other tripping features.

The foregoing description refers especially to oil breakers that are designed primarily to open the circuit under abnormal loads; this was the restricted definition of circuit breakers until recently. The Standardization Rules of the A. I. E. E. now recognize oil switches as circuit breakers when they are designed to function as such in addition to serving as oil switches for normal opening and closing of the circuit. Many oil switches have overload protection and are therefore included in this classification.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. See Circuit breakers, oil, underload, for description of complete line, also adv. page 1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CIRCUIT BREAKERS, OIL, UNDERLOAD, NO-VOLTAGE, REVERSE-POWER, REVERSE-PHASE, ETC.—Oil circuit breakers provided with any or several of these features operate in a similar manner to the air-break type, which see, and are used for similar purposes. With oil circuit breakers, particularly in the larger sizes, it is customary to use relays to obtain the protective features and the actual tripping may be accomplished by d-c. magnets mounted on the cover plate of the circuit breaker. The use of relays permits a longer combination of protective features than is possible where the protective devices are mounted to release the mechanism directly.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of these units to fulfill every requirement, including breakers for service on potentials up to 220,000 volts and in current capacities up to 5,000 amp., as well as industrial type breakers, automatic or non-automatic for use in motor circuits. These have been developed out of a thorough knowledge of circuit conditions based on years of experience in designing and building electrical equipment for transmission and distribution. They have parts accurately constructed in order to insure perfect adaptability of standard units. They can be equipped with circuit-opening and circuit closing auxiliary switches for electrical interlocking, for indicating or for controlling an auxiliary circuit; bell alarm switches; undervoltage devices; and relays for every purpose. Descriptive bulletins are available from G-E sales offices, listed on page 1223.—Adv.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CIRCUIT BREAKERS, SPECIAL AND MISCELLANEOUS, NOT OTHERWISE LISTED.—There are many circuit breakers made with special protective or construction features which are not listed above and which are important. Conditions vary so much in the wide range of circuits to which circuit breakers are applied that special protective features are often required. Some consist of purely mechanical features added to overload or other breakers, such as a double arm which only permits the contacts to be closed in a definite sequence, or a device which prevents a breaker from being closed on an overload. Some of the special applications are double-throw breakers used with generators so that they may be connected to either of two sets of buses. Starting and running switches for synchronous converters are also made in the form of circuit breakers. Field switches for generators, which close an auxiliary contact for inserting resistance in the circuit are another special form of breaker. There are also cases where special breakers are operated by compressed air or some means other than electrical.

Manufacturers:

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E." "U-Re-Lite."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Hartman Electrical Mfg. Co., Mansfield, Ohio.

CIRCUIT, ELECTRIC.—An electric circuit is a path in which an electric current may flow. The term is commonly used to designate a specific part of a complete path, but in reality should refer to a complete circulatory path. When only part of a complete circuit is referred to, as a branch circuit, a derived circuit or a conductor, to avoid misunderstanding the terminals of the path should be specified, or when the whole circuit is referred to it should be called a complete or closed circuit.

CIRCUITS, COUPLED.—Coupled circuits are extensively used in radio work. Energy may be carried from one circuit to another by various kinds of coupling. The two circuits may be directly coupled by having the inductance, capacitance or resistance of one circuit common with the other. Inductive coupling, which is the most used, may be direct, in which case part of the inductance is common to the two circuits, or it may be due to transformer action between two coils. Capacitance coupling is sometimes used in electron tube oscillator circuits. Also see Circuits, radio.

CIRCUITS, DIPLEX, DUPLEX, QUADRUPLEX, SIMPLEX, ETC.—See Circuits, telephone; also Circuits, telegraph.

CIRCUITS, LIGHT AND POWER.—These circuits are classed broadly as series and multiple. The series circuit is operated at a constant current which passes through all lamps or motors on the circuit consecutively, the voltage being varied as the load changes. Multiple circuits are operated at constant voltage and the current in the circuit varies in proportion to the size and number of lamps, motors or other appliances in use.

Series circuits are high-voltage circuits and are not suitable for interior lighting. They are used chiefly for street lighting. Multiple circuits are two-wire in their simplest form. The three-wire Edison circuit, with twice the voltage between the two outside wires that there is between either outer wire and the middle or neutral wire, is made up by combining two two-wire circuits in series and making one wire common to both. All Edison d-c. systems are operated on the three-wire system.

Circuits which carry alternating current may be further classified as single-phase, two-phase and three-phase circuits, the two latter being often called polyphase or multiphase circuits.

Single-phase circuits may be two-wire or Edison three-wire circuits.

Two-phase circuits are inherently two two-wire circuits, but one wire may be used as a common wire for the two circuits making a three-wire two-phase circuit; this is not an Edison three-wire circuit, however.

Three-phase circuits may be made by combining three two-wire circuits. If the two adjacent wires of each circuit are made common the circuit becomes a three-wire, delta-connected circuit, and if the three alternate wires of each circuit are combined into one wire it becomes a four-wire, Y-connected or star-connected circuit, the common wire being called the neutral. Some star or Y-connected circuits use only three wires, the neutral wire being omitted.

Two-phase and three-phase systems are used for general distribution purposes in the outlying parts of large cities, single-phase two-wire branches from these systems being used for lighting and small power. Motors are preferably supplied from a polyphase system in installations of over 5 hp.

The three-phase three-wire system is used exclusively for transmission of power since it requires but 75 per cent as much line copper as the other systems.

Four-wire, three-phase systems are being used for general distribution (at 2300-4000 volts) in the larger cities, because of the economy of feeder copper as compared with the standard 2300-volt distribution.

CIRCUITS, RADIO.—The circuits used in radio stations differ from other electrical circuits in that they are tuned to the operating frequency, i. e., receiving stations using an elevated antenna to receive a frequency of, say, 500,000 cycles per second will have an inductance in series with the aerial so that the value of this inductance taken with the capacitance and inductance of the antenna make the circuit resonant to 500,000 cycles. This circuit is inductively coupled to a secondary circuit, also containing an inductance and capacitance tuned to 500,000 cycles. In transmitting sets the same general type of circuits is used, except that larger amounts of power are used and the flow of energy is in the other direction. (Also see Circuits, coupled.)

CIRCUITS, TELEGRAPH.—Telegraph circuits are in general quite similar to telephone circuits and the two are often operated in conjunction. The most important types of telegraph circuits with their relation to the telephone circuits are described below.

Composited Circuit. In telegraphy and telephony, a two-wire telephone circuit arranged for the superposition on each of the component metallic conductors, of a single, independent ground-return telegraph circuit.

Local Circuit. A circuit within the limits of the telegraph station, usually controlled by a receiving instrument in a main circuit or controlling a transmitter effecting changes in a main line circuit.

Phantoplex Circuit. In telegraphy a superposed circuit operated by alternating current over a simplex, duplex, or quadruplex Morse circuit that is operated from direct-current sources.

Simplex Circuit. The combination of an earth-return telegraph line with a metallic-current telephone line, by a center tap in an impedance coil or a repeating coil at each terminal station. The two wires forming the telephone circuit serve as the insulated half of the ground return telegraph circuit. The telegraph circuit so made up may be duplexed.

CIRCUITS, TELEPHONE.—Telephone circuits in general are subdivided into a large number of circuits depending upon the apparatus being considered, its condition and extent of operation, the place occupied by the circuit or the class of service that may be obtained over the circuit. Some of the most important kinds of circuits and correlated terms are described below.

Composite Circuit. An arrangement whereby each of the two wires of a telephone circuit is made to act as a telegraph line. The telegraph pulsations are smoothed out by condensers and inductive coils so as not to disturb speech. High-frequency ringing current (200 to 250 cycles per second) is used by the telephone, so as not to affect the telegraph instruments. Composite is also used in automatic telephony to dial over toll lines between cities.

Cord Circuit. The electrical connections and apparatus from answering plug to calling plug. It is the unit for connection between two lines on a manual switchboard.

Line Circuit. The electrical circuit which is immediately connected to an outside line, either a subscriber line, a trunk line, or a toll line. It includes the apparatus and wires which are considered as belonging to that line.

Local Circuit. This is a circuit which does not extend outside the central office or telephone instrument.

Non-Ring-Through Cord Circuit. Any arrangement of cord circuit (on a magneto switchboard) which permits the subscriber to ring off without ringing the other subscriber's bell.

Out-of-Order Circuit. Conductors and apparatus to which a line which is in trouble may be plugged so that it may receive attention. This is also known as a "hospital trunk." As soon as the line comes clear, a lamp will light to notify the clerk that it is clear. It is useful for intermittent grounds and short-circuits.

Observation Circuit. This is an arrangement of conductors and apparatus for the purpose of observing what kind of service the subscriber is getting. It is to be attached to any desired subscriber line.

Phantom Circuit. Where two metallic-circuit telephone lines parallel each other, a third (or phantom) circuit may be obtained without adding wires. At each end of the lines a repeating coil is inserted in each physical line (or side circuit). A center tap is taken out of the winding of the coil which goes to line. The phantom circuit extends from the two taps at one end of the lines to the two taps at the other end. The phantom circuit regards the two wires of each physical circuit as one conductor.

Pole Circuit. The circuit of an open wire line which occupies the pole pins.

Side of Circuit. Each wire of a two-wire line is often referred to as a "side" of the circuit or line. For instance, a telephone bell is often spoken of as being bridged from one side of the circuit to the other, meaning that it is attached from one line wire to the other line wire. A series coil or relay is spoken of as being inserted in one side of the line, meaning that it is in series with one wire of the line.

Simplex Circuit. A single telegraph line may be superimposed on a metallic-circuit telephone line by means of a repeating coil or an impedance coil at each end of the line. The telegraph current flows equally and in one direction along both telephone wires and does not enter the telephones at each end or bridged across anywhere along the line. It is used in automatic telephony for dialing on toll lines between cities.

Superimposed Circuit. Any circuit which is formed on or in addition to other circuits carried by a network. See Phantom, Composite, and Simplex circuits above.

Transfer Circuit. The older manual switchboards were made up very largely of a number of 100-line boards placed side by side. When too many of these are to be worked together for the switchboard cords to reach, it is necessary to have a number of transfer circuits, extending from one part of the board to other parts. An operator who receives a call connects the calling subscriber line to a transfer line by means of a pair of cords. Another operator connects the other end of the transfer circuit to the called subscriber line by means of another pair of cords. It causes slow operation, many errors, and is not used today except for a few small boards.

CIRCULAR INCH.—The nominal area of a circle whose diameter is one inch. It is a term used in stating large cross-sections for cables, and is more convenient than using 1,000,000 circular mils. Its actual area is 507 sq. mm. or 0.7854 sq. in. The number of circular inches in any circle is simply the diameter in inches squared, that is, the factor 0.7854 or $\pi/4$ is eliminated for ease of computation. Also see Circular mil.

CIRCULAR LOOM.—Trade name for nonmetallic tubing manufactured by the American Circular Loom Co., 90 West St., New York, N. Y.

CIRCULAR MIL.—The area of a circle whose diameter is one mil or 0.001 inch. Abbreviated cir. mil or C. M.; 1 cir. mil = 0.7854 sq. mil = 0.000,000,785,4 sq. in. The circular mil is used chiefly in giving the areas of wires, which is done by squaring the diameter in mils, thus eliminating the factor π (= 3.1416). Thus the area of No. 36 A. W. G. wire is 25 cir. mils, since the diameter is 5 mils and $5^2 = 25$.

CIRCULATING CURRENT.—The same as circulatory current; see Circulatory current.

CIRCULATION OF ELECTROLYTE.—Mechanical or other means for keeping the electrolyte circulating, either in a cell itself or through a set of cells in series. For cells in series circulation is usually by gravity through the cells arranged in steps, after pumping the electrode to the cell on the highest level. For single cells, pumping the liquid from the bottom and returning it to the top is one method; another is to have mechanical stirrers; or the anode or the cathode, or both, may be

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rotated or agitated; or the cell may be mounted on trunnions and rocked or tilted mechanically. The Frary method rotates the electrolyte magnetically, by the influence of a magnetic field on the elements of current traversing the electrolyte.

CIRCULATORY CURRENT.—A current in the armature windings of a-c. generators, when they are in parallel, due to their generated voltage not being vectorially equal. When the inequality is caused by differences in phase only, the circulatory current produces synchronizing action, giving power to the lagging machines and taking it from the leading machines. When the inequality is due to differences in magnitude of the generated voltage, the circulatory currents, through armature reaction, produce magnetizing and demagnetizing action on the fields of the low and high-voltage machines, respectively, thus tending to equalize the generated voltages.

CISCO.—Trade name for fixture stems and hangers manufactured by the Butler Electric Co., 3531 Cottage Grove Ave., Chicago, Ill.

CISCO.—Trade name for armature binding wire and sheet steel manufactured by the Central Steel & Wire Co., 119-127 N. Peoria St., Chicago, Ill.

C-J.—Trade name for lubricating greases manufactured by the Frazer Lubricator Co., 3921 Normal Ave., Chicago, Ill.

C. J. MFG. CO.—3423 N. 5th St., Philadelphia, Pa. Manufacturer of coal meters.

Cl.—The form Cl is the chemical symbol for the element chlorine.

CLAMERT MFG. CO.—Pittsburgh, Pa. Manufacturer of automobile accessories. President, George W. Emmert; vice-president, A. A. Tirrill; secretary and treasurer, R. H. Duff; sales manager, W. H. West. Factory, Latrobe, Pa.

CLAMPALL.—Trade name for bowl hanger manufactured by the J. H. White Mfg. Co., 111 N. 3rd St., Brooklyn, N. Y.

CLAMPS, BEAM.—Metal clamps engaging the flanges of an I-beam, angle iron or similar structural steel part, and to which conduit or insulators or cleats for carrying wires may be secured. Some of these clamps engage both flanges of an I-beam, to which they are tightened by a right and left-hand threaded connector that carries the insulator support or conduit clamp. Others have a hook-shaped clamp that holds the conduit tight against the beam to whose flange the clamp is held by a set screw; the conduit may be parallel or transverse to the beam. Modified forms of these clamps are used for insulator, knob or cleat supports. Still other clamps are arranged to pass around the conduit with the ends bolted together around a wedge-shaped finger that bears against the top of the beam flange. By some makers these clamps are called conduit hangers, though the latter is more commonly applied to a different type of hanger; also see Hangers, conduit and pipe. Beam clamps are much used in steel mills, foundries, machine shops, train sheds and other enclosures that have steel trusses for roof supports. They can be readily attached to the beam without drilling holes.

Manufacturers:

Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hauer, Inc., J. B., 96-100 Bayard St., Brooklyn, N. Y.
Hill Clutch Co., W. 65th St., & Breakwater Ave., Cleveland, Ohio.
National Co., Cambridge 39, Boston, Mass.
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.
Union Engineering Co., The Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Walworth Mfg. Co., Boston, Mass.

CLAMPS, BUSBAR.—Clamps used in making the joint between copper bars in a bar stack, as for a tap or extension. They generally consist of two rigid clamping plates extending beyond the edges of the bars, and connected by three or four holding bolts which are the means of exerting pressure on the joint. Clamps for d-c. work are made of malleable or cast iron, while for a-c. work nonmagnetic material, such as bronze, is largely used on one side, or for large capacities on both sides. Sometimes the use of nonmagnetic material with iron clamps is sufficient. They obviate the necessity of drilling the busbars, give a better joint than the ordinary bolted joint, and may be changed readily.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.
Electric Motor & Engineering Co., The, 2nd St., S. W. & B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Busbar clamps, made in type "A" three bolt, type "H" four bolt, and type "X" four bolt, for either a.-c. or d.-c. service. See display advertisement on page 1261.—Adv.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Mendell Mfg. Co., Mattapoisett, Mass.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.
Southern Electrical Equipment Co., Charlotte, N. C.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-3.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, CABLE.—Cable clamps are designed for use on transmission lines to relieve the strain on insulators at corners, turns or long spans. They generally consist of a long split cable seat in which the cable is securely held. The clamp is then connected through a strain insulator to the crossarm and there is, therefore, no further strain on the cable at the turn. Cable clamps are also largely used with suspension insulators.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Cameron Appliance Co., 48 Waters Ave., Everett, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Wire Rope Preserver Co., 327 S. LaSalle St., Chicago, Ill. "Chicago."
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. Algor cable clamps for BX-2, 10, 12 and 14. BX-3, 12 and 14; also ⅜ and ½ Greenfield flexible steel conduit, Algor cable clamps, Cat. No. A-106, are supplied with all Algor BX type switch boxes, distribution boxes and outlet plates. Algor cable clamps insure the perfect terminal clamp and bushing for BX conductors wherever used in metal boxes. Algor cable clamps are approved by the Underwriters' Laboratories for use without ferrules. Electric wiring inspectors in cities and towns indorse Algor cable clamps heartily.—Adv.



Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Long Saut," "Diamond."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Matthews."
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Marchand" cable clamps, for the "dead-ending" or anchoring of stranded copper or aluminum conductors, can also be used for supporting feeder cables in wire shafts of high buildings. The seven core wires of the conductor



"Marchand" Cable Clamp

pass through center of tapered plug, as illustrated, and the outer layer or sheath wires are clamped between tapered plug and wall of socket; thus each wire carries part of total strain.—Adv.

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, COLUMN.—Clamps for engaging the flanges of structural steel columns or to encircle cylindrical columns so as to afford a means of fastening conduit or open wiring in place. The former clamps are much like those intended for clamping onto I-beams or girders. Where open wiring is used the column clamps provide means for mounting porcelain cleats, knobs or other appropriate insulators.

Manufacturers:

Cincinnati Tool Co., Norwood, Cincinnati, Ohio. "Hargrave."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Symons Clamp Co., 2116 S. Sawyer Ave., Chicago, Ill. "Symons."

CLAMPS, CONDUIT AND PIPE HANGING.—A sheet steel or malleable iron clamp for hooking more than halfway around the conduit or pipe and holding it against the wall, ceiling or other surface by means of an expansion bolt or shield passing through a hole in the flattened portion at one side. These clamps are also used for supporting armored or other heavily protected cable

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against masonry or concrete walls and ceilings. Conduit clamps differ from pipe or conduit straps in that the latter completely straddle the pipe and are fastened at both sides of it, while conduit clamps are fastened at only one side. On wood or other easily penetrated surfaces conduit straps are used, being easily nailed or screwed in place; on masonry or concrete, also sometimes on metal columns, conduit clamps are preferred because only hole need be drilled for them as a rule. The term conduit clamp is also applied by some makers to clamps for supporting conduit from I-beams or other structural steel; for these see Clamps, beam; also Hangers, conduit and pipe.

Manufacturers:

Acme Pipe Strap Co., 944-50 Harper Ave., Detroit, Mich.
Adapti Co., The, 919-925 West St., Cleveland, Ohio.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
COLUMBIA METAL BOX CO., 226 E. 144th St., New York, N. Y.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Diamond."
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Fee & Mason, 81 Beekman St., New York, N. Y.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-4.)
New Process Specialty Co., 230 Hanover St., Milwaukee, Wis.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Oval-duct."
U. S. Expansion Bolt Co., 139 Franklin St., New York, N. Y. "USE."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, CORD.—Cord clamps are used to clamp or fasten a cord to a ceiling or wall. One example of this is in case a pendent switch is used with a fixture placed close to the ceiling. The cord connecting and supporting the switch will be connected to the lamp circuit in the ceiling outlet box or similar fitting. To relieve the strain at this point and to have the cord clear the fixture, the cord is run out on the ceiling a short distance and clamped to the conduit or ceiling and then allowed to hang down. This clamp consists of a split porcelain bushing with well rounded ends. A metal strap passes around the bushing and the conduit and is drawn together in the center to securely clamp the cord by means of a small bolt.

Manufacturers:

CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."

CLAMPS, DEAD-ENDING.—Dead-ending clamps are designed to be used for dead ending of cables, feeders and jumpers, for corner construction and many other places in heavy wiring construction for power plants or industrial installations. The clamp usually consists of a metallic strap or spring jaw that fits around the cable. In one form this strap is held together by a bolt which slides in a slotted clamping member. This slotted piece is guyed or tied to some rigid pole or beam, a strain insulator being used in the guy wire. The design of the slot and strain member is such that the greater the strain the harder its grip.

Manufacturers:

EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.

CLAMPS, GROUND CONNECTION.—Copper straps which may be tightly fastened by bolting around conduit and pipe and so designed as to secure, mechanically and electrically, one end of the ground wire; the ground wire is now required to be connected to the clamp by soldering or by an approved solderless connector. Ground clamps are used on rigid interior conduits, gas pipes and water pipes to serve as a means connecting the former to water pipes by means of a copper ground wire of not less than No. 10 A. W. G. size. The conduit or piping must first be thoroughly cleaned of paint, scale or rust at the place where the ground clamp is to be applied. Special forms of ground clamps are required to fit armored cable, flexible steel conduit and metal raceway or molding; or the ground wire must be soldered directly to these materials.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Blackburn Specialty Co., East 35th St. & Perkins Ave., Cleveland, Ohio. "Blackburn."
Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
Cameron Appliance Co., 48 Waters Ave., Everett, Mass. "New York."
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "All-In-One," "Vogel."
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Chicago," "Kwikon."
GILLETTE-VIBBER CO., New London, Conn. "Gee-Vee."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Monroe," "Belcher."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Killoch Co., David, 57 Murray St., New York, N. Y. "K K K."
Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Machen Electric Mfg. Co., 4639 E. Thompson St., Bridesburg, Philadelphia, Pa.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Model Products Co., 9th & Venango Sts., Philadelphia, Pa. "Higgins."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv: pages 1302-4.)
Overbagh Co., Cameron, 221 W. Randolph St., Chicago, Ill.
Potter-Acme Mfg. Co., The, 912-920 Champlain Ave., Cleveland, Ohio. "Potter."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display advertisement on page 1323.)
Simpson, Alexander B., 152 E. 53rd St., New York, N. Y. "Simplex."
Standard Electrical Mfg. Co., 220-22 High Ave., S. E., Cleveland, Ohio.
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J. "Tecco."
Utility Fittings Co., The, 1932 E. Westmoreland St., Philadelphia, Pa. "Utility."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J. "Windman."

CLAMPS, GUARD RAIL.—Guard-rail clamps are used on electric railroads in main line track construction to fasten and maintain the guard rails in position and at a definite distance from the main rail. One type of clamp consists of a cast iron or malleable iron yoke which passes under the rails around from the outside of the main rail where it holds a brace in place to the inside of the guard rail, holding a wedge in position there. Two cast iron fillers are placed between the rails and are corrugated and constructed in such manner that they cannot come loose after the wedge is driven in place. Other forms of clamps are also used for the same purpose. With some of these the guard rail is turned on its side and secured in that position by a supporting member on the underneath side and a clamping member which provides ample backing and prevents overturning of the rail. It also clamps the rail securely to the ties by means of heavy bolts. There are various constructions used for these clamps, some being a solid casting and others of ribbed construction.

Guard rails are used on straight track at approaches to and on bridges, viaducts and interlocking crossings and at curves, switches and other special work. They serve effectively to hold the rails in their proper position to each other.

Manufacturers:

Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

CLAMPS, GUY.—In securing guy cables after they have been wrapped about a pole or put through the eye of an anchor rod, a clamp is placed over the cable after the end has been brought back and placed alongside the main cable section. This clamp is bolted securely to hold the end in place.

Manufacturers:

American Hoist & Derrick Co., St. Paul, Minn. "Crosby."
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Chicago Wire Rope Preserver Co., 327 S. LaSalle St., Chicago, Ill. "Chicago."
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Trident," "Diamond X."
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., Pittsburgh, Pa. Hubbard rolled steel guy clamps, hot galvanized, are standard with the A. T. & T. and meet the N. E. L. A. specification.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lamson & Sessions Co., The 2188 Scranton Rd., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Marion Malleable Iron Works, The, Box 568, Marion, Ind. "Marion."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y. "Trident."
Oliver Iron & Steel Co., 10th & Murial Sts., Pittsburgh, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.)
"Marchand" guy wire clamps, designed



"Marchand" Guy Wire Clamp

to meet all conditions of construction and to carry 50% more load than the tensile strength of the strand to be applied.—Adv.
Threadless Pipe Fittings Corp., Newark, N. J. (Exclusive distributors, Rubino & Liebstein, Newark, N. J.)
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wickwire Spencer Steel Corp., Worcester, Mass.

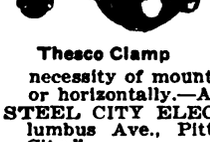
CLAMPS, INSULATOR AND LINE CROSSING.—With the larger sizes of high-tension line conductors, the strength of the attachments to insulators is increased by the use of clamps instead of tie wires. The clamp is secured to the insulator by bolts

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or screws, which are arranged to grip both conductor and insulator. At crossings where special care is taken to prevent the breakage of a wire in the crossing span, the crossarms are made double and the clamps are arranged to securely hold the conductor in case of a break at the insulator.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Coombs & Co., R. D., 30 Church St., New York, N. Y.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
National Co., Cambridge 39, Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B clamps are more than a wire fastening, they protect the insulator and tend to improve operating conditions.—Adv.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
STATES CO., THE, 71 Francis Ave., Hartford, Conn. "Thesco" clamps make it possible to attach a vertical wire to a common line insulator and keep the latter in its correct position. "Thesco" clamps eliminate necessity of mounting petticoat insulator horizontally.—Adv.



Thesco Clamp

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, LAMP.—Lamp clamps are small portable stands or devices for supporting or holding a lamp in a number of positions. They usually have a spiral spring or other spring clamping arrangement so that it may be clamped to a bed, chair, table, etc. Some clamps are also provided with a rubber suction cup so that the lamp may be attached to a mirror, or other smooth flat surface. For lamps complete with such clamping devices see Lamps, clamp, bed or dresser.

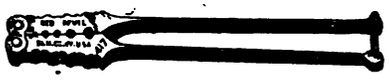
Manufacturers:

Dealers' Electric Lighting Co., 500 E. 40th St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.

CLAMPS, LINEMEN'S SPLICING.—A hand tool used by linemen in making a twist splice. It consists of two jaws hinged at one end and grooved adjacent to the hinged portion. A link is provided in one of the members opposite the hinged end so that when the members are squeezed together they may be locked by this link, thus holding the wires in a clamped position.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbus Handle & Tool Co., The, Columbus, Ind.
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Dicke Tool Co., The, Downers Grove, Ill.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. Makers of the well known line of linemen's splicing clamps, used all over the world. We manufacture these clamps in several sizes and styles; used for twisting wire or sleeves, ranging in sizes from No. 2 to No. 17 gauge wires or sleeves. For individual styles and sizes, write for our catalog. Also see page 1259 for illustrations and further information.—Adv.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."
SMITH & HEMENWAY CO., INC., Irvington, N. J. This connector has round holes which will take all sizes of iron



"Red Devil" Splicing Clamp

wire from 6 to 14 and copper wire from 4 to 12. The reverse side takes copper sleeves 8 to 14. Other kinds also stocked.—Adv.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Marchand."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, LOOM.—A special form of metal clamp or clip for securing flexible tubing or "loom" in place, especially at combination gas and electric outlets. The tubing must be securely held in place for if it slips along the wire it may not protect the latter just where it needs protection most, namely at outlets. Clamping devices for holding tubing in switch boxes, panelboards and cabinets are usually called flexible-tubing fasteners; for these see Fasteners, flexible tubing.

Manufacturers:

Adapti Co., The, 919-925 West St., Cleveland, Ohio.
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. "Algor."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
New Process Specialty Co., 230 Hanover St., Milwaukee, Wis. (Exclusive distributor, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.
PARKER & SON, INC., J. H., Parkersburg, W. Va. "K. B."
Standard Electrical Mfg. Co., 220-22 High Ave., S. E., Cleveland, Ohio.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburg, Pa. "Ovalduct."
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

CLAMPS, MESSENGER.—A clamp used to grip messenger or guy wire while pulling it taut. They are usually strong heavy malleable iron clamps and will withstand the pull of a horse or motor.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dicke Tool Co., The, Downers Grove, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Universal."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

CLAMPS, POLE.—Clamps used with metal poles to securely hold trolley span, messenger or guy wires. They consist of an iron collar or band which grips the pole and a clamping device for receiving 7-wire strand, which has a small wedge-shaped spreader plug to hold the strands against the sides of the clamp.

Manufacturers:

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Marchand."

CLAMPS, RAIL BONDING.—With some types of rail bonds it is necessary to hold the bonds accurately in place during the operation of fastening them to the rail; this is sometimes done by means of clamps which are referred to as rail-bond clamps.

Manufacturers:

Indianapolis Switch & Frog Co., Springfield, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Q & C CO., The, 90 West St., New York, N. Y. "Q & C."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

CLAMPS, ROPE.—Rope clamps are small malleable-iron clamps having an eye at one end and arranged at the other end to readily clamp on any rope up to about ⅝ inch in diameter. The end of a rope to be used in hoisting is inserted in the clamp and secured by turning a screw or bolt. They are used on hoisting ropes for arc lamps, for swinging streetnoods and other high-hung incandescent lamp units.

Manufacturers:

Chicago Wire Rope Preserver Co., 327 S. LaSalle St., Chicago, Ill. "Chicago."
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

CLAMPS, SPAN.—A clamp used in securing the messenger wire to the cross span wire in catenary trolley construction. The common form usually consists of a malleable iron body with suitable U or J bolts.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

CLAMPS, STRAIN.—In high-tension transmission work the common form provides a means of gripping the transmission wire and means for attaching to the strain insulator with provision for carrying the transmission wire away from the insulator so that the transmission wire can pass around the insulator in the form of a jumper, thus obviating the necessity of cutting the transmission wire.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."

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OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pittsburg High Voltage Insulator Co., Derry, Pa.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, SUSPENSION.—A clamp used to support transmission wires from suspension insulators. The best designs provide a smooth curved bearing seat for the wire so that the wire will not be kinked or injured and means for gripping the wire sufficiently for the suspension position without injury to the wire in case the device takes a strain position due to wire failure on one side of the supporting device.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
National Co., Cambridge 39, Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P & S."
Pittsburg High Voltage Insulator Co., Derry, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLAMPS, TABLE (PUSH-BUTTON).—Clamps used for temporary mounting on the edges of dining tables, desks, etc., and provided with one or more push buttons with connecting cord. They are used mostly for signaling maids, waiters, stenographers, etc., and are usually connected as extensions from floor push-button receptacles or floor pushes. They can be readily attached to or detached from the table or desk without marring it.

Manufacturers:

PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

CLAMPS, TELEPHONE LINE TEST.—In order to be able to open a telephone line for test without cutting the line wires, the ends are often dead-ended on the insulators and connected to each other by means of a copper clamp. The repair man can easily open the line by loosening two bolts which hold together the two halves of the clamp. In one type of such clamps two spring clip terminals are provided which are normally connected by a short jumper; this greatly facilitates testing as no bolts have to be loosened. Similar test clamps are provided for telegraph lines. They are sometimes called test connectors.

Manufacturers:

Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Acme."

CLAMPS, TESTING.—Testing clamps are used for making temporary connections in a circuit for meter testing, signal inspecting and various other shop and laboratory tests. They generally consist of two clamping members, each with a series of parallel semicircular grooves graduated in size, held together with a single bolt and wing nut. The series of grooves permits clamping two wires of the same or different sizes together for making a temporary connection.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Alligator-Jaw."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Cutter, Scott C., Oswego, Ill.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "Alligator," "H W W."
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio.

CLAMPS, THIRD RAIL.—Clamps used in third rail or conductor rail construction to grip the third rail for attaching strain insulators in order that the rail may be properly anchored to prevent it from traveling or getting out of position.

Manufacturers:

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

CLAMPS, TROLLEY.—A device used to grip and support the trolley wire from the trolley hanger. The jaws may be actuated by means of flat-head machine screws or mechanically by means of a nut, wedge or similar arrangement. These clamps are sometimes called "clamping ears." They are used mostly in mines and tunnels.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio. "Sure Grip."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B," "Bulldog," "Mansfield," "Premier."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLANCY, J. R.—1000 W. Belden Ave., Syracuse, N. Y. Manufacturer of orchestra lighting reflectors. Business established 1885.

CLANCY PROCESS.—An electrochemical process for the extraction of gold from refractory ores by electrolysis in a cyanide solution.

CLAPP-EASTHAM CO.—139 Main St., Cambridge, Mass. Manufacturer of radio telegraph, electrical and laboratory apparatus. Business established 1908. President, treasurer and general manager, O. K. Luscomb; secretary, F. M. Luscomb.

CLAPPER SWITCH.—See Contactors, magnetic.

CLARINDA LAWN MOWER CO.—Clarinda, Iowa. Manufacturer of electric washing machines. President, A. A. Berry; secretary, F. C. Duff; sales manager, R. E. Moser.

CLARIPHONE.—Trade name for ear cushion for telephone receiver manufactured by the Colytt Laboratories, 565 W. Washington St., Chicago, Ill.

CLARK.—Trade name for expansive bits manufactured by the Kilborn & Bishop Co., Chapel & Lloyd Sts., New Haven, Conn.

CLARK & SON, A. M.—Plainville, Conn. Manufacturers of metal stampings.

CLARK BROS. BOLT CO.—Millidale, Conn. Manufacturer of bolts, nuts, rivets, etc. President, C. H. Clark; secretary and general manager, E. S. Todd.

CLARK-CADLE-HARMON CORP.—1139 University Ave., Rochester, N. Y. Manufacturer of electric washing machines. President, Carl Cadle; vice-president, secretary, treasurer and general manager, Anan B. Harmon; sales manager, Robert W. Barnes.

CLARK CELL.—See Standard cells.

CLARK CO., THE FRED G.—1087 W. 11th St., Cleveland, Ohio. Manufacturer of lubricating oils and water softening compounds. Business established 1882. President and general manager, William E. Wall; vice-presidents, Fred G. Clark and T. E. McArdle; secretary, Sherman S. Clark; treasurer, Thomas H. Sheldon; sales manager, G. J. Stergerwald. Main office, 1087 W. 11th St., Cleveland, Ohio. Branch offices and warehouses, 1031 W. 37th St., Chicago, Ill.; Minneapolis, Minn. District offices, 12 Pemberton Sq., Boston, Mass.; 239 Broadway, New York, N. Y.

CLARK ELECTRIC METER CO.—Oshkosh, Wis. Manufacturer of automobile ammeters. President, B. G. MacMillan; vice-presidents, P. M. Gelett; T. E. Stroup; treasurer, P. M. Gelett; general manager, J. E. Richmond. Main office and factory, Oshkosh, Wis. Branch offices, 239 Railway Exchange, Chicago, Ill.; 51 E. 42nd St., New York, N. Y.; 1330 12th St., Detroit, Mich.

CLARK ENGINE & BOILER CO.—Kalamazoo, Mich. Manufacturer of boilers and engines. President, J. Alex. Gordon; secretary, O. E. Wolcott; treasurer, Fred R. Eaton. Main office and factory, Kalamazoo, Mich. Branch office, 231 Insurance Exchange Bldg., Chicago, Ill.

CLARK-FLANAGAN, INC.—Fair Haven, Vt. Manufacturer of electrical slate. President, N. P. Avery; vice-president, Mrs. K. E. Clark; treasurer and manager, John Flanagan.

CLARK, JR., ELECTRIC CO., INC., JAMES.—520 W. Main St., Louisville, Ky. Manufacturer of electrically driven tools, generators and motors. Business established 1895. President and general manager, James Clark, Jr.; secretary and sales manager, W. S. Clark.

CLARK POLE & TIE CO.—Bemidji, Minn. Manufacturer of cedar poles and railway ties.

CLARKE SANDING MACHINE CO.—320 N. Ervay St., Dallas, Tex. Manufacturer of motor-driven sanding machines. Business established 1920. President and general manager, A. A. Clarke; vice-president, John R. Atkins; secretary and treasurer, A. N. J. Hagen; sales manager, A. M. Hill.

CLARKSVILLE FOUNDRY & MACHINE WORKS.—Red River St. & L. & N. R. R., Clarksville, Tenn. Manufacturer of brass and aluminum castings. T. B. Foust, proprietor.

CLASCO.—Trade name for automobile lamps manufactured by the Canadian Lamp & Stamping Co., Ltd., Ford, Ont., Can.

CLAUSEN ENGINEERING OFFICE.—Bisbee, Ariz. Manufacturer of switches.

CLAXO CO., THE.—Iowa City, Iowa. Manufacturer of air conditioning apparatus, electric driers, humidifiers, heaters, and medicators. Business established 1918. Factory, Chicago, Ill. President, F. O. Loveland; vice-president, Vern Slater; secretary, treasurer and general manager, J. L. Records.

CLAY ELECTRIC CO.—3303 N. 12th St., Philadelphia, Pa. Manufacturer of switches, switchboards and insulating materials.

CLAY PRODUCTS CO., THE.—Brazil, Ind. Manufacturer of underground clay conduit. Vice-president and general manager, G. W. Shoemaker; secretary, R. A. Dandurand; treasurer, W. J. Burke.

CLAYTON & LAMBERT MFG. CO.—1370-1380 Beaubien St., Detroit, Mich. Manufacturer of gasoline fire pots, torches, oil burning appliances and accessories. President, C. R. Lambert; vice-president, B. H. Lawson; secretary, J. E. Lambert; treasurer and general manager, Bert Lambert.

CLEANERS, BILLIARD TABLE.—Usually in cleaning billiard tables a brush is used which scatters the chalk considerably. In order to remedy this trouble an electric billiard-table cleaner may be used to advantage. This consists of a metal suction tool similar to a vacuum cleaner attachment tool which may be passed over the billiard table so as to suck up the chalk and dust as an ordinary vacuum cleaner sucks up the dust from a rug or carpet.

Manufacturers:

WISCONSIN ELECTRIC CO., Racine, Wis. The "Dumore" billiard table cleaner is a distinct labor saver; does its work easily, quickly and thoroughly, and will not injure the nap of the cloth. All dust and dirt are removed by suction and deposited in the dust sack. Cleaner uses a universal motor that operates on either a-c. or d-c. circuits. Each outfit includes a high-grade, specially designed China bristle brush and 15 ft. of reinforced portable cord. Net weight five pounds. See display adv. on page 1311.—Adv.



Dumore Billiard Table Cleaner

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CLEANERS, BOILER AND CONDENSER TUBE.—It is very necessary from the standpoints of efficiency and safety periodically to clean out the tubes of any boiler or surface condenser. Tubes of water-tube boilers, no matter how pure the feed water is kept, will in time have a deposit left in the tube as the water is vaporized. This is a mineral deposit and is very hard and may usually be removed only by scraping and cutting. Boiler cleaners are provided for this purpose and consist of a series of small cutters that rotate and scrape the inside of the tube. There are various forms of the cutters or scrapers, some of which are operated by steam or compressed air and others by water. Still other forms that are applicable to smaller tubes, such as condenser tubes, are operated by hand and do not have as powerful cutting action. Condenser tubes do not have the same kind of deposit as boiler tubes, since they operate at much lower temperatures; it is usually heavy mud that cannot be completely removed by forcing a stream of water through the tubes under pressure.

Cleaning of boiler and condenser tubes effects a large saving in the amount of fuel required, in the case of boiler tubes because the scale is a heat insulator and retards evaporation, while in condenser tubes the mud also is an insulator and retards condensation of the exhaust steam and this means a poor vacuum and poor economy. Also see Scale removers, boiler. For cleaners designed for soot removal from inside the tubes of fire-tube boilers and the outside of the tubes of water-tube boilers, see Soot blowers.

Manufacturers:

Chicago Engineer Supply Co., 68 W. Lake St., Chicago, Ill.
Combustion Engineering Corp., 43-47 Broad St., New York, N. Y. "CEC."
Lagonda Mfg. Co., The, Sheridan Ave., Springfield, Ohio.
Liberty Mfg. Co., Frick Bldg., Pittsburgh, Pa. "Liberty," "Victor," "Bulldog."
Nuhring & Bro., Charles, 1212 Walnut St., Cincinnati, Ohio. "Success."
Pierce Co., The William B., 45 N. Division St., Buffalo, N. Y. "Dean," "Peerless."
Pilley Packing & Flue Brush Mfg. Co., 606-10 S. 3rd St., St. Louis, Mo. "Pilley."
Roto Co., The, Hartford, Conn. "Roto."
Ruggles & Ruggles, Batavia, Ill. "Perfection."
Seehausen, Wehrs & Co., 179 N. Franklin St., Chicago, Ill. "Chicago."
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Favorite," "Dean's."
Worcester Brush & Scraper Co., 26 Southbridge St., Worcester, Mass.

CLEANERS, CONDUIT.—Conduit cleaners are used to clean out or remove any obstructions in a line of conduit before the cable or wire is pulled in. For underground conduit they consist of variously shaped tools, brushes, scrapers, hooks and cutters that may be fastened to a conduit rod to be pushed through or to be fastened to a steel cable and pulled through the duct ahead of the main cable. For the rods used see Rods, duct or conduit cleaning and fishing; also Couplings, conduit rod. For cleaning interior metallic conduit of obstructions that cannot be removed by the fish line that is to draw in the wire, or which prevent fishing the line through the conduit, a home-made gun may be used; see Guns, conduit clearing.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.

CLEANERS, FLOOR. — Motor-operated portable appliances for taking up by suction any loose dirt or similar material from the floor; also made with brushes added to loosen up threads, lint, etc., for the suction to take up. They are practically the same as the ordinary electric vacuum cleaner so much used for carpets and rugs, but have a more powerful suction.

Manufacturers:

Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. "E-Z."
INTERNATIONAL FLOOR MACHINE CO., 149 W. 36th St., New York, N. Y. "International."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

CLEANERS, GRAIN AND SEED.—Machines for subjecting seeds, grain, etc., to the action of motor-driven sieves, shakers and blowers in cleaning operations. Chaff, dust and other light impurities are usually blown out, whereas the larger pieces of wood, twigs and other foreign matter are removed by sifting. Pebbles or slag particles of the same size as the grain or seed are sometimes removed by special machines called stoners.

CLEANERS, HAT, MOTOR-DRIVEN.—Wooden frames upon which hats are placed and rapidly revolved by a small motor as the cleaning fluid, cloths and brushes are applied in the cleaning process. Largely used for cleaning straw hats. A fan motor with extended shaft is used. The same or similar block is also used for hat blocking. Also see Hat-blocking outfits.

Manufacturers:

Apex Electrical Mfg. Co., The, 1067 E. 152nd St., Cleveland, Ohio. (Exclusive distributor, Apex Electrical Distributing Co., 1089 E. 152nd St., Cleveland, Ohio.) See display adv. page facing inside back cover.

CLEANERS, VACUUM.—See Vacuum cleaners.

CLEANEAZY.—Trade name for shade holders manufactured by the John Dunlap Co., Carnegie, Pa.

CLEAN-EZ-PRIME.—Trade name for spark plugs manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

CLEAR.—An expression used to denote telephone apparatus or lines that are not in use. "To clear" is an expression meaning to cause a line or apparatus to be "not busy," so as to be ready for calls.

CLEATS, FIBER.—Cleats made of hard fiber for holding one, two or three wires. They are made with both rectangular and rounded wire grooves and have one or two holes for the fastening screws or nails. Corner cleats hold the wire against a corner in the wall, around doors, etc. Fiber cleats are used largely for telephone circuit wiring, for bell and annunciator wiring, time clock circuits, etc.; the larger sizes are also used for holding voltmeter, synchroscope, pilot circuit, instrument lighting and other small wires on the backs of slate and marble switchboards.

Manufacturers:

American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
BRANDYWINE FIBRE PRODUCTS CO., P. O. Box 122, Wilmington, Del.
Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Standard Electric Mahinery Co., Baltimore, Md. "Standard-Baltimore."
Wilmington Fibre Specialty Co., Wilmington, Del.

CLEATS, MISCELLANEOUS.—For car wiring, stamped strap brass strips curved to receive the wire for which they are designed are sometimes used and are loosely termed "cleats"; they are made in strap form to straddle the wire like pipe straps, also with the ends at right angles to each other to hold the wire in corners. Treated wood cleats with grooves for one or two wires are used to a limited extent for low-tension signal wiring.

Manufacturers:

Blake Signal & Mfg. Co., 221 High St., Boston, Mass. "Blake."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y. (Wood.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Morse, Frank W., 289 Congress St., Boston, Mass. (Brass, car wiring.)
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

CLEATS, PORCELAIN.—Narrow porcelain blocks, either glazed or unglazed, used in pairs and having one, two or three transverse grooves per block for securing light, power and signal circuit wires in place. Cleats are used for open wire runs and serve to separate the wires at least ½ inch from the surface wired over. The sizes of the cleats and their grooves vary according to the wire they are designed to carry; the most common size is the two-wire cleat for No. 14 A. W. G. wire.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Brunt Porcelain Co., The, P. O. Box 493, Columbus, Ohio. "Brunt."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.
DAVIDSON PORCELAIN CO., East Liverpool, Ohio. Also manufacturers of "Eveready" wing assembled porcelain split knobs.—Adv.
Dexter-Reynolds Mfg. Co., Inc., 128 N. Wells St., Chicago, Ill.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display advertisement on page 1260.)
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Findlay Electric Porcelain Co., The, Findlay, Ohio.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. We manufacture standard 1, 2 and 3 wire porcelain cleats. Also



Illinois Porcelain Cleat

special porcelain to conform to any specifications. For further information see page 1301.—Adv.
Imperial Porcelain Works, Trenton, N. J. "Duggan."
Mogadore Insulator Co., The, Mogadore, Ohio.
PARKER & SON, INC., J. H., Parkersburg, W. Va. Standard two and three and single wire cleats. B & D type and all standard types; also special cleats.—Adv.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Star Porcelain Co., The, Trenton, N. J.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenle Porcelain Co., The, P. O. Box 493, East Liverpool, Ohio.
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
Wheeling Tile Co., Wheeling, W. Va.

CLEATS, ROPE.—Rope cleats are small malleable iron cleats having two extending ears for fastening a rope by coiling or winding it around the cleat. The edges of the cleat are well rounded so as not to cut the rope. Cleats of this kind are sometimes used with suspended arc lamps or streethoods to secure the hoisting rope in place.

CLEMENCE BROS.—164 Linden Ave., Irvington, N. J. Manufacturers of outlet boxes and other metal specialties.

CLEMENS ELECTRICAL CORP.—725 Main St., Buffalo, N. Y. Manufacturer of electric soldering tools, fuse plugs and buzzers. Business established 1916. President, R. B. Harris; vice-president and general manager, John G. Clemens; secretary and treasurer, Joseph Neeser, Jr.

CLEMENS ELECTRICAL CORP., LTD.—197 King William St., Hamilton, Ont., Can. Manufacturer of electric heating devices. Business established 1917. President, R. B. Harris; vice-president and general manager, H. W. Jutton; secretary and treasurer, A. Kinoler.

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CLEMENT.—Trade name for electric wall cabinet manufactured by the Electrical Development Co., 534 Bienville St., New Orleans, La.

CLEMENTS MFG. CO.—Chicago, Ill. Manufacturer of electric vacuum cleaners and electric portable blowers. Business established 1911. President, George Clements; vice-presidents, A. A. Breuer and W. J. Clements; secretary and sales manager, A. A. Breuer; treasurer, J. S. Mogenson. Main office, 609 Fulton St., Chicago, Ill. Factories, Chicago, Ill., and Toronto, Ont., Can. Branch offices and warehouses, 42nd St. & Broadway, New York, N. Y.; 45 State St., Detroit, Mich.; 1427 5th Ave., Seattle, Wash. District office, 78 Duchess St., Toronto, Ont., Can.

CLEMSON BROS., INC.—Middletown, N. Y. Manufacturer of hacksaw blades. Business established 1879. President, George N. Clemson; vice-president, Richard D. Clemson; treasurer, William E. Cross.

CLERMONT.—Trade name for clay underground conduit manufactured by the International Clay Products Co., 31 Union Sq., New York, N. Y.

CLERO.—Trade name for push buttons and automobile horns manufactured by the Fitzgerald Mfg. Co., Torrington, Conn.

CLEVELAND.—Trade name for induction motors manufactured by the Cleveland Electric Motor Co., 5213 Windsor Ave., Cleveland, Ohio.

CLEVELAND ARMATURE WORKS, INC.—4732-36 St. Clair Ave., Cleveland, Ohio. Manufacturer of motors and parts and motor-driven grinders. Business established 1895. President and general manager, F. M. Hibben; vice-president, P. Polans; secretary and sales manager, D. Maultin; treasurer, H. K. Barnes.

CLEVELAND BREATHING MACHINE CO.—1833 E. 13th St., Cleveland, O. Manufacturer of respirators. Business established 1918. President, E. H. Lyon; vice-president, E. L. Mehrniger; secretary-treasurer, J. B. Beall. Sales representatives: Triumph Electric Co., Cincinnati, O., American-La France Fire Engine Co., 250 W. 54th St., New York, N. Y.; Pyrene Mfg. Co., 17 E. 49th St., New York, N. Y.; Sharp & Smith, 65 E. Lake St., Chicago, Ill.; R. L. Scherer, Los Angeles, Cal.; M. B. Urquhort Co., Denver, Colo.; Paine Drug Co., Rochester, N. Y.

CLEVELAND CRANE & ENGINEERING CO., THE.—Wickliffe, Ohio. Manufacturer of electric traveling cranes, coal handling machinery, hoists and brass castings.

CLEVELAND ELECTRIC MOTOR CO.—Cleveland, Ohio. Manufacturer of induction motors. Business established 1914. President, H. B. Bole; vice-president, C. S. Dangler; secretary, C. DeWith; treasurer and general manager, L. P. Orr. Main office/ 5213 Windsor Ave., Cleveland, Ohio. Branch offices, New York, N. Y.; Chicago, Ill.; Detroit, Mich.; Boston, Mass.; Philadelphia, Pa.

CLEVELAND FARE BOX CO.—Cleveland, Ohio. Manufacturer of street car fare boxes.

CLEVELAND FROG & CROSSING CO.—6917 Bessemer Ave., S. E., Cleveland, Ohio. Manufacturer of track frogs, crossings, switches, switch stands, etc. General manager, G. C. Lucas; sales manager, George Stanton.

CLEVELAND INSTRUMENT CO., THE.—6523 Euclid Ave., Cleveland, Ohio. Manufacturer of indicating and recording pyrometers. President, E. A. Noel; vice-president and general manager, H. J. A. Hackenberg; secretary, J. R. Snyder; treasurer, C. J. Castle; sales manager, W. B. North. Sales representatives, Herman H. Sticht & Co., 15 Park Row, New York, N. Y.; Longstreth & Vandyke, 1613 Chestnut St., Philadelphia, Pa.

CLEVELAND MAGNETO.—Trade name for electric time detectors manufactured by the American Watchman's Time Detector Co., 3403 Perkins Ave., Cleveland, Ohio.

CLEVELAND PHON-ARM CO., THE.—1265 W. 2nd St., Cleveland, Ohio. Manufacturer of desk telephone, adjustable light and telegraph sounder box brackets. President and general manager, A. J. Lewis; vice-presidents, M. B. Pennell, R. A. Bennett; secretary and treasurer, E. L. Kagy; sales manager, J. F. Goss. Sales representative, Richmond & Backos Co., Detroit, Mich.

CLEVELAND SWITCHBOARD CO., THE.—2925 E. 79th St., Cleveland, Ohio. Manufacturer of switches, switchboards, panelboards, conduit boxes, etc. President, treasurer and general manager, F. C. Hafemeister; vice-president, F. L. Cudmore; secretary, F. F. Hafemeister; sales manager, A. N. Rogers. Sales representatives, J. D. Nelson, Room 201-607 Shelby St., Detroit, Mich.; Star Electrical Co., Erie, Pa.; Electrical Engineering Co., Pittsburgh, Pa.; Sackett Mine & Supply, Columbus, Ohio; E. J. Putzell, Board of Trade Bldg., New Orleans, La.

CLEVELAND TWIST DRILL CO., THE.—Cleveland, Ohio. Manufacturer of drills, reamers and other tools. Business established 1874. President and general manager, J. D. Cox, Jr.; vice-president, F. F. Prentiss; secretary and sales manager, E. G. Buckwell; treasurer, G. F. Kast. Main office and factory, E. 49th St. & Lakeside Ave., Cleveland, Ohio. Branch offices and warehouses, 30 Reade St., New York, N. Y.; 9 N. Jefferson St., Chicago, Ill.

CLEVELAND WROUGHT PRODUCTS CO., THE.—West 58th St., Cleveland, Ohio. Manufacturer of screw machine products, screws, metal stampings, etc. President, C. L. Wasmer; vice-president, G. A. Tinnerman; vice-president and treasurer, C. E. Kramer; secretary, J. C. Wasmer.

CLEVIS, BOLT.—A bolt clevis is used in overhead line construction where a long eye is necessary. One instance is for the support of a suspension type insulator having a hook on the upper unit. The bolt clevis is drop-forged and is wider at one end than the other, one common size tapering from ⅝ inch to 1¼ ins. inside measurements. A hole is provided in the wide end and by means of a machine bolt the clevis is attached to the crossarm.

Manufacturers:

American Equipment Co., Norristown, Pa.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Chain Products Co., The, 3924 Cooper Ave., Cleveland, Ohio.
Eagle Bolt & Forging Co., The, 1435 E. 45th St., Cleveland, Ohio.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Malleable Iron Co., 1801-1825 Diversey Pwkv., Chicago, Ill.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

CLIFTON MFG. CO.—Boston, Mass. Manufacturer of friction tapes, splicing compounds and rigid metallic conduit. Business established 1901. President and treasurer, William M. Tenney; vice-president, D. W. McNair; manager, H. G. Morse. Main office, 65 Brookside Ave., Boston, Mass. Factories, Buffalo, N. Y.; Jamaica Plain, Mass. Branch office and warehouse, Buffalo, N. Y. District office, 26 Cortlandt St., New York, N. Y. Sales representatives, P. S. Ring, Denver, Colo.; Keeler, White & Co., San Francisco, Cal.; D.-E. Distributing Co., 9 S. Clinton St., Chicago, Ill.; Ohio Distributing Co., 222 Lomax Pl., Chicago, Ill.; Edwin S. Brown & Co., 209 S. State St., Chicago, Ill.

CLIMAX.—Trade name for oil and grease cups manufactured by the American Injector Co., 175 14th Ave., Detroit, Mich.

CLIMAX.—Trade name for expansion bolts manufactured by the Brohard Co., Philadelphia, Pa.

CLIMAX.—Trade name for magneto parts manufactured by the Climax Motor Devices, Chagrin Falls, Ohio.

CLIMAX.—Trade name for welding compound manufactured by the Cortland Welding Compound Co., Cortland, N. Y.

CLIMAX.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

CLIMAX.—Trade name for resistance wire manufactured by the Driver-Harris Co., Harrison, N. J.

CLIMAX.—Trade name for corrugated incandescent lamp wrappers manufactured by the Hinde & Dauch Paper Co., 311 W. Water St., Sandusky, Ohio.

CLIMAX.—Trade name for electric sterilizers and disinfectors manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

CLIMAX.—Trade name for power transmission belting manufactured by N. Palmer & Co., Bridgeport, Conn.

CLIMAX MOTOR DEVICES.—Chagrin Falls, Ohio. Manufacturer of magneto parts. G. A. Schanze, general manager.

CLIMBERS, LINEMEN'S POLE.—Linemen require metal spurs or climbers to climb wood poles and on which they can stand while working in various positions on a pole that has no steps. The climbers are steel devices attached by leather straps to the leg and foot of the lineman. There is a strong steel spur at the inside of the foot, which projects inwardly and downwardly, so that the wearer can thrust it into the pole. This enables him to climb a pole readily and with safety.

Manufacturers:

Blakeslee Forging Co., Plantsville, Conn. "Donnelly."
Buckingham, W. H., 8-10 Bronson St., Binghamton, N. Y. "Stephens."
Columbus Handle & Tool Co., The, Columbus, Ind.
Dicke Tool Co., The, Downers Grove, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. The well known Klein's Eastern punched loop climbers are especially constructed for the safety and comfort of the linemen. We furnish them with standard gaffs, curved offset to clear the ankle. Made in lengths from 16 in. to 17 in. by ½ in. variations. For illustrations and further information, see page 1259; also send for complete catalog of construction tools.—Adv.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)
SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 253 "Red Devil" climbers are tested with the greatest



"Red Devil" No. 253

care to protect the lineman. Construction is of solid loop, and the spur is both riveted and welded to the leg iron. —Adv.

CLINE ELECTRIC MFG. CO.—Chicago, Ill. Manufacturer of motors and electric control equipment. Business established 1912. President and treasurer, A. J. Cline; vice-president, Charles A. Dresser; secretary, W. H. Burke. Main office, Fisher Bldg., Chicago, Ill. Branch office and warehouse, 47 W. 34th St., New York, N. Y.

CLINETTE.—Trade name for X-Ray outfits manufactured by the Campbell Electric Co., 17 Stewart St., Lynn, Mass.

CLING-SURFACE CO.—Buffalo, N. Y. Manufacturer of belt dressing and preservatives. Business established 1896. President, Albert B. Young; secretary and sales manager, W. D. Young. Branch offices and warehouses, Jersey City, N. J.; Washington, D. C.; Charlotte, N. C.; Atlanta, Ga.; Cincinnati, Ohio; St. Louis, Mo.; Denver, Colo.; Springfield, Mass.; Chicago, Ill.

CLINICAL.—Trade name for X-Ray outfits manufactured by the Campbell Electric Co., 17 Stewart St., Lynn, Mass.

CLINIX.—Trade name for X-ray tables manufactured by the Campbell Electric Co., 17 Stewart St., Lynn, Mass.

CLINTON METAL LAMP CO.—55 Chrystie St., New York, N. Y. Manufacturer of lighting fixtures.

CLINTON SIGN CO.—134 5th Ave., Clinton, Iowa. Manufacturer of electric signs. Caleb Elliott, proprietor.

CLINTON SIGN LENS CO.—Clinton, Iowa. Manufacturer of sign lenses. Caleb Elliott, proprietor.

CLIP.—Trade name for gate valves manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CLIPPERS, HAIR.—See Cutters, hair, motor-driven.

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CLIPPERS, HORSE, MOTOR-DRIVEN.—Similar to hand-operated horse clippers but operated by a small motor on a stand or with motor enclosed in a metal casing between the clippers and handle. With the former an enclosed flexible shaft conveys the power from motor to the clippers. Much time and labor are saved by this machine.

Manufacturers:

American Shearer Mfg. Co., Nashua, N. H. "Priest's."
Andis Mfg. Co., O. M., 1024 12th St., Racine, Wis.
Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Stewart."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Gillette Clipping Machine Co., 129-31 W. 31st St., New York, N. Y.

CLIPS, BATTERY.—Battery clips are used to make connection to the terminals of a storage battery for charging. They are often similar in construction to testing clips, having two pieces of copper forming a hinge actuated by springs so as to keep two jaws in close contact with anything put between them. Battery connectors, however, are plated with lead to prevent the action of acid on the clip. They are usually made of heavier construction and have a greater current-carrying capacity than ordinary test clips.

Manufacturers:

France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Hartung, Charles F., 802 Higgins Bldg., Los Angeles, Cal. "Peerless," "A-1."
Morse, Frank W., 289 Congress St., Boston, Mass.
Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio. "Universal."

CLIPS, CABLE.—Cable clips are used to fasten an aerial cable to a messenger wire. They consist of a thin metallic strap from 6 to 9 ins. long which passes around the cable and loops over or fastens to the steel messenger strand. The wire in one form of clip is bent to form two hooks with a spring action so that it may be clipped or snapped over the messenger wire. Other forms have a wire loop merely to fasten the strap, and the strap passes around the cable, then around the messenger wire and clips onto the steel wire loop. Other articles are used for the same purpose and are known by various names. For these other types, see Hangers, cable and messenger; also Rings, cable.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Cameron Appliance Co., 48 Walters Ave., Everett, Mass. "Metropolitan."
Chase-Shawmut Co., The, Newburyport, Mass. "Boston."
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Goshen Lightning Rod Co., Goshen, Ind.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

CLIPS, FUSE.—Metal contacts on cutout bases or fuse blocks into which the end terminals of cartridge fuses are inserted in placing them in the circuit. Fuse clips are made in two types: the circular spring clip contacts for receiving fuses having ferrule contacts at the ends, and knife-blade clip contacts for receiving fuses having flat knife-blade contact ends. For high-tension fuses the clips are often of special design; they are listed under Fuse mountings, high-tension.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
American Pin Co., The, Waterbury, Conn. "Ampinco."
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Fuses, cartridge, nonrenewable.)
ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PATTON-MACGUYER CO., 31 Mathewson St., Providence, R. I.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-3.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Manufacturers N. E. C. Standard fuse clips for 250 and 600 volt fuses in capacities from 30 to 1200 amp. A F/C 200 amp. clip with terminal lug is illustrated.—Adv.



T. V. Fuse Clip

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.

CLIPS, LOOM.—Metal fastening collars used on flexible tubing in switch boxes, panelboards and cabinets. Often called fasteners; see Fasteners, flexible tubing.

CLIPS, RAIL.—Rail clips are malleable iron plates, so formed that one end will fit over the base of a rail and the other will rest on the tie or on top of a tie plate. When bolted to the tie, the rail clip holds the rail securely in place. They are used in the construction of electric railway track systems, especially on viaducts or where special tie plates or step-rail chairs are used under the rail.

Manufacturers:

Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

CLIPS, TESTING.—Testing clips are small copper clamping pieces hinged together and controlled by springs so that saw-toothed jaws at the free ends are held in contact with each other or with some conducting material over which they have been placed. The hinge usually permits the jaws to open about ¾ to 1 inch. The test wire is attached to the clip either by a screw or soldered connection. Some forms of clips have a sharp pin that will pierce the insulation on a circuit wire and make connection without opening the circuit or removing the insulation. Other forms are covered with a soft rubber cap to insulate the clip.

Test clips are largely used by telephone men in circuit testing, also for meter or railway signal testing and inspection. They are used with many testing sets and are very handy for general shop or laboratory work where temporary connections have to be made.

Manufacturers:

Cutter, Scott C., Oswego, Ill., "Universal."
Hartung, Charles F., 802 Higgins Bldg., Los Angeles, Cal.
Morse, Frank W., 289 Congress St., Boston, Mass. "Morse Eureka."
Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio. "Universal," "Big Brute."

CLIPS, WIRE ROPE.—Wire-rope clips are used to fasten or secure the end of a wire rope to any object, such as a suspended arc lamp or other street lamp. The clips generally consist of a clamping device to be used with a wire-rope thimble. The rope passes around the thimble and the end is secured to the other strand by the clip, which consists of a "U" bolt with a clamping member that is forced down on the bolt and held in place by the nuts. In one type this clamping member is corrugated to grip the rope and merely decreases the size of the opening as it is forced down. Other types have guide pins that keep the rope between them and thus permit it to be clamped.

Manufacturers:

Chicago Wire Rope Preserver Co., 327 S. LaSalle St., Chicago, Ill. "Chicago."
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill. "Crosby."
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Marion Malleable Iron Works, The, Box 568, Marion, Ind. "Marion."
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Wickwire Spencer Steel Corp., Worcester, Mass.

CLOCK DIAGRAM.—If a line be drawn across the face of a clock joining the 12 and 6-hour marks, and the length of the minute hand as it rotates be projected on this line, the length of this projection will vary as the sine of an angle. That is, it will vary in the same way as a simple alternating current or alternating e. m. f. The clock diagram gets its name from its similarity to the clock. A line, whose length to some scale is equal to the maximum value of an alternating current or e. m. f., is assumed to be rotated about one end at uniform speed. The projection of this line upon a vertical line is equal to the length of the rotating line by the sine of the angle it makes with a horizontal axis. If ω is the angular velocity of rotation and t represents the number of seconds that have elapsed since the rotating line was horizontal, then ωt is the angle it makes with the horizontal axis.

The length of the projection is:

$$a=A\sin\omega t, \text{ or } i=I_m\sin\omega t;$$

if the length of the rotating line represents the maximum e.m.f., then

$$e=E_m\sin\omega t.$$

By platting t as abscissas and the corresponding values of i or e as ordinates, we get the corresponding sine waves of current and e.m.f.

CLOCK MOVEMENTS FOR RECORDING INSTRUMENTS, TIME SWITCHES, ETC.—The movements for driving the charts in graphic recording or curve-drawing instruments are very important parts of the instrument and consequently are often specially designed for that purpose. The purely mechanical movements are spring-driven and wound by hand, usually every seven or eight days. Another form of this movement has an electrical self-winding attachment which maintains a uniform tension on the spring and therefore gives a very accurate record. Nearly all of the movements are arranged with a gear-shifting lever so that by changing the gears or by substituting others a wide range in driving speeds may be obtained. Other instruments which are electrically operated, by having a small synchronous motor drive the chart, give very accurate and also synchronized records when applied to the

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various recording instruments. Time switches usually have an eight-day clock movement with adjustable trips that can be adjusted as on an alarm clock, a separate spring being used to operate the switch. The recording gear movements for watt-hour meters and ampere-hour meters are not clock movements but simple gear trains without springs; for these see Gears and pinions, meter.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Bacharach Industrial Instrument Co., 422 1st Ave., Pittsburgh, Pa.
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
ESTERLINE CO., THE, Lemcke Annex, Indianapolis, Ind.
Foxboro Co., Inc., The, Foxboro, Mass.
International Time Recording Co., 50 Broad St., New York, N. Y.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCK SYSTEMS, ELECTRICALLY SYNCHRONIZED.—Systems in which several clocks are maintained in synchronism or exact agreement and usually controlled by a master or primary clock of close precision. These systems are adaptable to a wide range of time indicating and recording service. Perhaps the most common use is that of master and secondary clocks in a large school institution, mercantile or industrial building, where all of the secondary clocks are kept in exact agreement with the master clock. Another system for a generating station makes use of a master clock to maintain the generator speed at a constant average value, and at the same time drive all the recording instruments at a uniform speed, giving a synchronized record. Other applications are for employees' time-recording clocks, time stamps, bell-ringing or signaling systems, etc. In general, they all operate from a high-grade accurate master clock which sends out impulses once each minute through relays and operates sets of electromagnets in the secondary apparatus.

Manufacturers:

Atlantic Clock Co., 45 India St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Gillette Electric Clock Co., 728 Buckingham Pl., Chicago, Ill.
HOWARD CLOCK CO., THE E., 373 Washington St., Boston, Mass.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
Key Corp., The Andrew, 210 Oliver St., St. Louis, Mo. "Andrew."
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Landis Engineering & Mfg. Co., Waynesboro, Pa.
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
STANDARD ELECTRIC TIME CO., THE, Springfield, Mass. Manufacturers of electric escapements and movements for operating employees time recorders and similar apparatus to synchronize from the master clock or with other time keeping equipment.—Adv.
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Thomas Clock Co., Seth, Thomaston, Conn.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, ALARM.—Ordinary alarm clocks which are set in the usual manner to ring at a certain hour, but instead of ringing the bell on the clock at that time, simply close a circuit, thereby ringing an electric bell or bells in several rooms. These clocks are frequently mounted on a small wooden case which contains the dry cell necessary for the operation of the bell. A switch is sometimes placed on the box or it may be placed in any convenient place. Others have the contact made through the feet of the clock so that it is only necessary to move the clock slightly to stop the alarm.

Manufacturers:

Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Darche Mfg. Co., 643 W. Washington Blvd., Chicago, Ill. "Flashlight," "Searchlight."
Gillette Electric Clock Co., 728 Buckingham Pl., Chicago, Ill.
Jansen Clock Co., F. W., 215 W. Randolph St., Chicago, Ill. "Timelite," "Jansen Reminder."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, MASTER AND SECONDARY.—A master clock is a high-grade clock which may be located at any convenient place and whose functions are usually to wind itself and to control secondary apparatus. The secondary apparatus may be time-recording instruments, program clocks, bell-ringing or whistle-blowing apparatus or secondary clocks. Secondary clocks for indicating the time are placed in the various rooms or shops or even outside of the building and are electrically operated by and maintained in synchronism with the master clock. They generally do not contain delicate clock mechanisms, but operate by electromagnets which receive an impulse from the master clock once each minute or other regular interval. Because of their extreme simplicity and ruggedness, secondary clocks may be placed where dust, vibration and exposure to weather would soon render an ordinary clock useless. The master clocks are usually very accurate time pieces with metal or mecurial compensating pendulums. The self-winding apparatus, which consists of a small electromagnet, receives an impulse once each minute and winds up the spring as much as it has unwound during the preceding minute, thereby mantaining a uniform spring tension, which is highly favorable to close regulation. For complete systems using master and secondary clocks, see Clock systems, electrically synchronized.

Manufacturer:

American Watchman's Clock Co., 150 Nassau St., New York, N. Y.
Atlantic Clock Co., 45 India St., Boston, Mass.
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. The Warren Master Clock, a device which enables an operator to maintain the speed of alternators at a constant average value. It comprises a high grade pendulum clock and a small, self-starting synchronous motor, each of which actuates independently a hand on the clock dial. The operator simply adjusts the alternator speed so that the hands rotate together. This little synchronous motor when connected to the circuit supplied by the alternator can then be used as an accurate time-keeping device and substituted for spring-driven movements in graphic and demand meters, time switches, etc. The resulting advantages and other details about the Warren Master Clock are fully given in Bulletin 46037. See adv. pages 1203-1223.—Adv.



Gillette Electric Clock Co., 728 Buckingham Pl., Chicago, Ill.
HOWARD CLOCK CO., THE E., 373 Washington St., Boston, Mass.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
International Time Recording Co., 50 Broad St., New York, N. Y. "International."
Kaiser Klock Kompany, L. E., 134 W. Fayette St., Baltimore, Md.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Landis Engineering & Mfg. Co., Waynesboro, Pa. "Frick."
Lockwood & Almquist, Inc., 218 E. 42nd St., New York, N. Y.
Magnetic Clock Co., The, 37-39 E. 28th St., New York, N. Y. "Magneta."
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass. "Standard."
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Thomas Clock Co., Seth, Thomaston, Conn.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, MISCELLANEOUS.—Electric clocks are sometimes made for special purposes or for mounting in miscellaneous places where they are not controlled by other master clocks. One example of this is an electric winding clock for use on automobiles. The mainspring is kept at a uniform tension by being wound once each minute. Current for this purpose is drawn from the storage battery and very little is required. Clocks of this nature are very accurate, especially in relation to their size. They are also used for other purposes than automobile mounting and are applicable to almost any of the ordinary uses of a clock.

Manufacturers:

Connecticut Electric Clock Co., 89 Woodbine St., Hartford, Conn. "Connecticut." (automobile)
HOWARD CLOCK CO., THE E., 373 Washington St., Boston, Mass.
Landis Engineering & Mfg. Co., Waynesboro, Pa. "Frick."
Sterling Clock Co., Inc., 220 E. 42nd St., New York, N. Y. (Automobile.) "Sterling."

CLOCKS, ELECTRIC, PROGRAM.—Clocks whose function is to control automatically the ringing of signals, bells, whistles, etc., or the operation of other devices according to predetermined schedules. They are generally secondary clocks, i. e., controlled by a master clock. One form has a long continuous tape of heavy paper run over a set of drums at a rate to complete a cycle in 12, 18 or 24 hours. The tape is perforated to correspond to the time the signals are desired, and at this time passes directly under a contact finger which closes a circuit through the perforation and operates the signal. This type may be arranged for the simultaneous operation of several different schedules in different rooms, or for the different days of the week. Another type consists of a perforated drum which carries adjustable contact fingers in it, which close contacts at the predetermined time. These clocks are used largely in schools to notify teachers and pupils at the beginning and conclusion of the recitation or other periods, and also in factories, large stores, offices, etc., for sounding the starting and stopping whistles or bells.

Manufacturers:

American Watchmen's Clock Co., 150 Nassau St., New York, N. Y.
Atlantic Clock Co., 45 India St., Boston, Mass.
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Hansen Mfg. Co., Princeton, Ind.
HOWARD CLOCK CO., THE E., 373 Washington St., Boston, Mass.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
Kaiser Klock Kompany, L. E., 134 W. Fayette St., Baltimore, Md.
Landis Engineering & Mfg. Co., Waynesboro, Pa. "Frick."
Lockwood & Almquist, Inc., 218 E. 42nd St., New York, N. Y.

When writing to manufacturers please mention the
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Magnetic Clock Co., The, 37-39 E. 28th St., New York, N. Y. "Magneta."
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
STANDARD ELECTRIC TIME CO., THE, Springfield, Mass. The "Standard" master clock automatically winds every minute and furnishes minute impulse for operating secondary clocks, time recorders, time stamps, and kindred apparatus. The "Standard" program clock, furnished either in the master clock case, or in separate case, is fitted with calendar device for automatically silencing the signals, changing program, etc. Complete electric time systems furnished, including storage battery, panel board, automatic charging device, etc., for factories, schools, hospitals, banks, and similar buildings. A product of 35 years experience; known and used throughout the United States.—Adv.


"Standard" Master Clock

Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Thomas Clock Co., Seth, Thomaston, Conn.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, TIME RECORDING, MISCELLANEOUS.—Many secondary clocks are used in conjunction with recording mechanisms for various purposes, such as employees' time recorders, cost-keeping or job-time recorders, etc. In most of these clocks when the impulse is sent out by the master clock once each minute, the secondary clock is actuated and a small type wheel or recording mechanism is changed to show the same time as that appearing on the clock. When a special card or record sheet is inserted in the slot and the printing lever pressed, the type wheel is released and prints the time. The position or column in which the time is printed may be changed from the outside, and as a number of different records may be arranged for by internal changes in the mechanism these instruments may be used for a variety of purposes. Simplified forms of time recorders are often called "time stamps"; for these see Stamps, time, electric.

Manufacturers:

American Watchman's Clock Co., 150 Nassau St., New York, N. Y.
American Watchman's Time Detector Co., 3403 Perkins Ave., Cleveland, Ohio. "Cleveland Magneto."
Atlantic Clock Co., 45 India St., Boston, Mass.
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Gisholt Machine Co., 1241 E. Washington Ave., Madison, Wis.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
International Time Recording Co., 50 Broad St., New York, N. Y. "International."
Kaiser Klock Kompany, L. E., 134 W. Fayette St., Baltimore, Md.
Landis Engineering & Mfg. Co., Waynesboro, Pa. "Frick."
Magnetic Clock Co., The, 37-39 E. 28th St., New York, N. Y. "Magneta."
Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.
Roper Corp., George D., Eclipse Gas Stove Division, 707 S. Main St., Rockford, Ill. "Eclipse."
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass. "Standard."
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, TOWER.—Tower clocks are compact and strong mechanisms used to operate large time indicators mounted in towers, as on railway stations or large buildings, in which cases the dials are usually illuminated at night and may be seen from a great distance. Because of the constant exposure to all sorts of weather conditions, these clocks are nearly always secondary clocks controlled by impulses sent out by a master clock, often the same master clock that controls all the clocks in the building. The mechanism used must be rugged and reliable. Electromagnets are sometimes used to move the hands, but in the larger clocks, the impulse from the master clock starts a small motor which drives the hands forward exactly one minute and then stops automatically. This motor is usually run by a storage battery.

Manufacturers:

Gillette Electric Clock Co., 728 Buckingham Pl., Chicago, Ill.
Kaiser Klock Kompany, L. E., 134 W. Fayette St., Baltimore, Md.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
STANDARD ELECTRIC TIME CO., THE, 89 Logan St., Springfield, Mass. "Standard."
Warren Clock Co., Ashland, Mass. "Telechron."

CLOCKS, ELECTRIC, WATCHMEN'S TIME RECORDING.—There are several electrically operated systems for recording the action of watchmen, each of which requires a slightly different clock. Some of the most common forms have an ordinary clock mechanism often operated by the master clock in a similar manner to the other secondary clocks. A paper dial is usually made to revolve past the recording mechanism and as the signals are sent in by the watchman the time and station are recorded on the dial, either by printing or by perforating a small hole in the dial. The clocks are usually mounted in the office in a locked case so that they may not be tampered with. Also see Detectors, watchmen's time.

Manufacturers:

American Watchman's Clock Co., 150 Nassau St., New York, N. Y.
American Watchman's Time Detector Co., 3403 Perkins Ave., Cleveland, Ohio. "Cleveland Magneto."
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Eco Clock Co., 197 Congress St., Boston, Mass.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Hausberg, E. O., 49 Maiden Lane, New York, N. Y. "Standard."
HOWARD CLOCK CO., THE E., 373 Washington St., Boston, Mass.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.

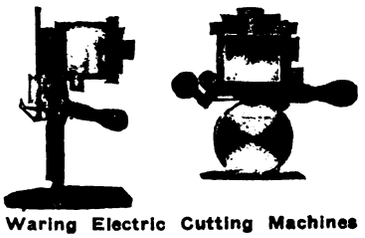
CLOCKWISE.—Motion in the direction that the hands of a clock move. This is commonly called right-hand motion or rotation when referring to a motor or generator or to a vector diagram.

CLOQUET TIE & POST CO.—Cloquet, Minn. Manufacturer of railroad ties, poles and posts. President, R. M. Weyerhaeuser; vice-president, C. I. McNair; secretary, C. I. McNair, Jr.; treasurer, H. J. Hamann. Main office, Cloquet, Minn. Branch office, Duluth, Minn.

CLOTH-CUTTING MACHINES, MOTOR-DRIVEN.—Machines having a vertical, reciprocating, motor-driven cutting blade and motor mounted on a flat metal base so that the base may be pushed under several layers of cloth on the cutting table and the cutting be done with rapidity. A snap switch for controlling the current and a handle for manipulating the machines are mounted on the frame. These machines are much used in tailoring and garment shops where many pieces are cut to the same pattern and size. A great deal of labor, time and expense is saved by their use.

Manufacturers:

AMERICAN ELECTRIC CUTTING MACHINE CO., 149-151 Lafayette St., New York City. The Waring electric cutting machines rapidly and accurately cut garments from any kind of goods. Simple, durable, and scientific in design, these machines are rapidly replacing all other means of cutting in modern manufacturing establishments. The 4-in. American machine is 10 ins. high and weighs 15 lbs. Light trolley permits use on any part of cutting table. Has one-hand control, ball bearings, electric light and knife grinder attachments. High speed circular knife,


Waring Electric Cutting Machines

bevel-gear driven direct from armature shaft, readily follows any pattern or cuts any curve. Made in many sizes.—Adv.

Eastman Machine Co., Washington & Goodell Sts., Buffalo, N. Y. "Midget."
Maimin Co., Inc., H., 247-251 W. 19th St., New York, N. Y. "Maimin."
U. S. Cloth Cutting Machine Co., 414-416 W. Broadway, New York, N. Y. "U. S."
Wildman Mfg. Co., Norristown, Pa. "Ballard," "Hemafa."
WISCONSIN ELECTRIC CO., Racine, Wis. The "Dumore" cloth cutter is a high grade unit that meets the particular needs of clothing manufacturers by being very economical in first cost and operation, and performing certain operations as well as the much heavier cutters. Power is transmitted from the motor to the cutter by a leather belt.


Dumore Cloth Cutting Machine

Any stretch in the belt may be quickly taken up by means of a screw adjustment. A small emery wheel run at right angles to the cutting blade, leaving it hollow ground, gives a keen edge when blade needs resharpening. Case and handle are ebonized; all metal parts are highly polished. Net weight five lbs. See display adv. on page 1311.—Adv.

Wolf Electrical Promoting Co., The, 810 Main St., Cincinnati, Ohio. "Acme," "Paramount," "Peerless Midget," "Star," "Star Junior," "Monarch," "Ohio," "Midget."

CLOTH, INSULATING, MISCELLANEOUS.—Cloth made of cotton, linen or silk fabrics is often impregnated with various compounds for insulating purposes. It gives a good, uniform insulation and at the same time is flexible and may be wrapped or wound to insulate almost any form of conductor or coil. Varnish cloth, (see Cambric, varnished) is one form in which a mixture of boiled linseed oil, resin and benzine is used. Oiled cloths (see Fabrics, oiled, insulating) are also used extensively. Impregnated cloth is similar to both of these, but the fabric is treated with a compound composed of various substances, such as oil, asphalt, paraffin, etc. Some impregnated cloths have dielectric strengths as high as 65,000 volts per mm. Mica and asbestos, which see, are also used in combination with cloth to give flexible heat-resisting insulators.

Manufacturers:

American Mica Co., Newton Lower Falls, Mass. "Puritan."
Asbestos Fibre Spinning Co., North Wales, Pa. (asbestos)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., Valparaiso, Ind. No. 10 Micabond cloth is made with one, two or three layers of best India sheet mica carefully cemented to

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gether with a small amount of bonding material, faced on one side with best muslin and the other with Japanese tissue paper, will not slip or slide under pressure, often used in conjunction with Champion oiled cambric for armature slots, commutator cores, transformers, etc. High grade specially finished Champion oiled cambric cloths and tapes are made of oiled fabrics, coated with films of pure ox-



Micabond Cloth

idized linseed oil, for use where heavy overloads are likely to occur and where rubber insulations fail. For other Chicago Mica Co. products see display advertisement on page 1320.—Adv.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."

Standard Insulation Co., Rutherford N. J. "Sico."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CLOTHEL REFRIGERATING CO.—61 Broadway, New York, N. Y. Manufacturer of motor-driven refrigerators. Factory, Bayonne, N. J.

CLOVER LEAF.—Trade name for X-ray tubes manufactured by Green & Bauer, Inc., 234 Pearl St., Hartford, Conn.

CLUM MFG. CO.—421-437 National Ave., Milwaukee, Wis. Manufacturer of automobile ignition and lighting switches. President, Val. Fina; vice-president, Radcliffe Denniston; secretary and treasurer, Lynn S. Pease.

CLUSTERS, FIXTURE AND SOCKET.—Fixture and socket clusters are connected groups of lamp sockets that may be used in a single socket or as part of a fixture to permit several lamps to be burned simultaneously. They are frequently used for indirect and semi-indirect lighting fixtures or with glass balls or domes. This arrangement breaks up the light source into several smaller units and thus reduces the intrinsic brilliancy; it often gives a more artistic effect than a single lamp. The clusters are frequently arranged for mounting on an iron pipe or fixture stem, and in some forms are made with a plug at one end to screw into a medium-base socket. They are generally arranged so that only two wires need be connected to the cluster. From two to seven lamps are commonly used and the connections may be made so that the lamps are in series or parallel; the series connection is used chiefly for clusters used on 500 to 600-volt electric railway systems. Special forms of clusters are made for domes or other large fixtures having as many as 20 lamps in the cluster, and arranged in various groupings.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin wireless cluster bodies (N. E. C. standard) have numerous advantages in the many cases where it is advisable to group several small Mazda lamps in multiple or series connections. Serviceable for ceiling and pendent fixtures, domes, portable stand lamps, indirect units, street railway and other power circuits on which it is desired to use Mazda lamps in series. Furnished in numerous shapes and sizes for one to six lights. Also furnished with plug for connecting to Edison screw base. Benjamin industrial clusters (N. E. C. Standard) are fixtures made up for use with Benjamin Clusters described above. Furnished with or without reflectors in a large variety of types that meet a variety of industrial needs. Standard and special connections for any voltage or watt capacity. Benjamin adjustable clusters (N. E. C. standard) are used principally in connection with dome fixtures. Their chief value lies in the fact that they permit the adjustment of lamps with reference to the shape of the reflector used. Furnished for connection to fixture stem or with plug for connecting to Edison srcew base.—Adv.

Wireless Cluster Body



Benjamin Adjustable Cluster

Faries Mfg. Co., Decatur, Ill.

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

Manhattan Brass Co., 332 E. 28th St., New York, N. Y.

Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.

SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.

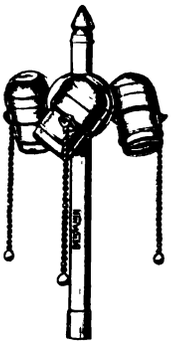
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

CLUSTERS, FLOOR AND TABLE LAMP.—Clusters used in floor and table lamps provide two, three or four sockets of the pull-chain or key types so that the lamps may be burned simultaneously or separately. They differ from ordinary fixture or socket clusters in that the stem used to support the cluster is fastened to the lamp stand and not suspended. Clusters of this type are almost invariably arranged so that the lamps are in parallel and only two wires need be connected to the cluster.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin wireless stand lamp clusters give a close grouping of lamp receptacles in a neat, compact casing, arranged for two or three lights and for control by either one or two pull chains. Illustration at left shows wireless cluster complete with mounting stem and shade support. Also furnished without stem and shade support. Benjamin adjustable stand lamp clusters are equipped with pull chain sockets which are adjustable to any angle between the horizontal and vertical, as required by the contour of the shade. Arranged for two or three lights. Illustration at left shows adjustable cluster complete with mounting stem and shade support.—Adv.





Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.

Metallic Mfg. Co., 544 W. 35th St., Chicago, Ill.

CLUSTERS, OUTDOOR, RAILWAY.—Outdoor clusters are often used on railway passenger and freight platforms, under viaducts, in subways and at crossings, etc. Their advantage for these purposes is that the burning out of a single lamp will not leave the fixture in total darkness, provided the lamps are connected in parallel. Other forms of clusters for use on electric railway systems having a voltage of about 550 are arranged with five lamps in series and they are then connected from the trolley or third rail to the track rails. This type is often placed at crossings where no other lighting circuits are available. The clusters are weatherproof and usually are more completely enclosed than the indoor type; they commonly have porcelain bushings which fit closely around the lamp base.

CLUSTERS, STAGE-LIGHTING.—Stage-lighting clusters are used to illuminate part of the stage from the wings. They have several lamp sockets in a cluster body which is mounted inside of a metal reflector. The clusters are so wired that it is only necessary to connect two wires to the cluster. The lamps are nearly always connected in multiple. Also see Bunches, stage-lighting.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin wireless clusters are used extensively in making up stage lighting fixtures. See entry under Clusters. Benjamin reflectors and other equipment have many advantages in stage wiring.—Adv.

Hallberg, J. H., 25 W. 45th St., New York, N. Y.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" mirror-glass reflectors, fitted with color frames. See other stage lighting classifications; also adv. page 1405.—Adv.

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

CLUSTERS, STREET LIGHTING.—Clusters are sometimes used for street lighting and other outdoor lighting, such as on docks, loading platforms, industrial plant roadways and yards, playgrounds, etc. They consist of weatherproof fixtures, generally with an enameled steel reflector forming a protecting hood for the cluster body. From two to five lamps are commonly used and their connnection (parallel or series) depends upon the voltage of the distribution circuit. These clusters are not the same as cluster-type posts often used for ornamental street lighting; for these see Posts, ornamental and plain street lamp.

CLUTCHES, ARC LAMP.—The part of an arc lamp mechanism used to feed the electrodes together as they burn apart. The clutch acts under the control of the feeding coil to let one or both of the electrodes slip enough to feed together slightly as the arc burns longer, thus keeping the arc at an approximately uniform length.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Hebendahl Co., J. P. 228-232 Broadway, Elizabethport, N. J.

CLUTCHES, FRICTION.—Friction clutches are installed in mechanical power-transmitting apparatus to obtain flexibility. They permit using only part of the equipment when applied to line-shaft work, and also make it possible to start a machine without a load and pick up the load gradually after it gets up to speed. This latter principle is applied to many motor-driven machines where the load is too heavy for the motor to carry at starting or for use with types of motors having little starting torque. They are also applied to line shafts and counter shafts driven by motors or other prime movers where it is desirable to sectionalize the shaft or have individual machines driven from it and started or stopped without affecting the other machines.

Many clutches are of the split type, arranged so that they may be placed on or removed from shafting without tearing it down. There are a number of forms made for the many purposes to which they are applied. In general, they consist of a steel pulley or friction surface on which a clutching shoe or jaw makes contact and grips the surface. This surface may be in the form of a pulley or a disk, hub or cone.

Manufacturers:

Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can. "Bridges."

Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa.

Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.

Brown Clutch Co., The, Sandusky, Ohio.

Brown Co., The A. & F., 79 Barclay St., New York, N. Y.

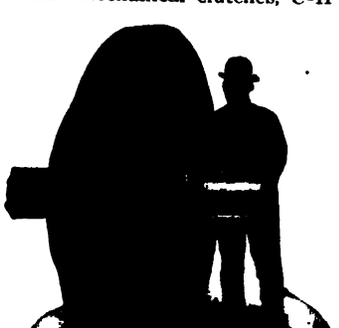
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Brown Engineering Co., 123-127 N. 3rd St., Reading, Pa. "Mule-Pull."
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can. (Leather.)
Conway Clutch Co., The, 1956 W. 6th St., Cincinnati, Ohio.
Edgemont Machine Co., The, Dayton, Ohio. "Edgemont."
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Hill Clutch Co., The, W. 65th St., & Breakwater Ave., Cleveland, Ohio.
Hilliard Clutch & Machinery Co., The, 102 W. 4th St., Elmira, N. Y. "Hilliard."
Johnson Machine Co., The Carlyle, 52 Main St., Manchester, Conn. "Johnson."
Jones Foundry & Machine Co., W. A. 4401 W. Roosevelt Rd., Chicago, Ill. "Lemley."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt," "Twyncone."
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
Moore & White Co., The, Philadelphia, Pa.
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Williams Foundry & Machine Co., The, 56-66 Cherry St., Akron, Ohio. "Akron" or "Akron-Williams."

CLUTCHES, MAGNETIC. — Magnetic clutches are usually made in two pieces of disk-like form. The disks are placed in the same manner as a flexible coupling on the ends of each shaft, the friction plates being barely in contact. The disks each contain an electromagnet winding and when the coils are energized the friction plates are attracted to each other, the force being proportional to the strength of the fields produced. By allowing a slowly increasing current to flow through the coils the load may be thrown on gradually, a characteristic of this clutch which makes it desirable for use with synchronous and squirrel-cage motors.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Magnetic Clutches are well adapted for high-speed drives because they are not affected by centrifugal force as are mechanical clutches. They take up a very little room—not much more than is required for a coupling large enough to transmit the same amount of power. Unlike mechanical clutches, C-H Mag-



C-H Magnetic Clutch (72")

netic Clutches do not transmit axial or radial strains along either the driven or driving shafts. All thrusts and strains are balanced within the clutch itself. C-H Magnetic Clutch construction is simple; two moving parts, an armature and a field, one of which is carried on a spring steel plate. The plate holds the brake surfaces apart until the clutch is magnetized. When an electric current is passed through the field winding, the armature and the field are attracted to each other and force the brake surfaces together. There is no sliding of clutch parts along the shaft; the engagement is accomplished by means of the flexibility of the spring steel plate. The power is transmitted entirely through the friction surfaces, which are held together magnetically. A suitable friction lining with a high coefficient of friction is held in place by an adjustable friction ring. This prevents actual metal-to-metal contact between the armature and field. Clutch control is obtained through suitable switches. The magnetizing current circuit may be opened or closed in accordance with the desired operation of the clutch. The control may be operated from any convenient point, and may be either partially or entirely automatic, if so desired. C-H magnetic clutches are extensively used in rubber mills to protect workmen from injury. For this use the clutch is combined with a brake, the combination being known as a C-H clutch-brake. In stopping machinery promptly in case of accident, safety switches are installed at strategic points. The operation of any one of these safety switches will simultaneously release the clutch and apply the brake. Remarkably quick stopping can be effected by the use of C-H Magnetic Clutch-Brakes. C-H Magnetic Clutches are also used in connection with large synchronous motors and low-torque squirrel-cage motors. They are entirely suitable for all locations where mechanical clutches are used. See display adv. pages 1225-1230.—Adv.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.

CLYDE IRON WORKS.—Duluth, Minn. Manufacturer of electric hoists and derricks. President, C. A. Luster; vice-president, J. R. McGiffert; secretary and treasurer, M. W. Lepp; sales manager, J. H. Crawford. Main office and factory, 29th Ave. W. & Michigan St., Duluth, Minn. Branch offices and warehouses, 414 Carondelet St., New Orleans, La.; 11 S. LaSalle St., Chicago, Ill.; Hill Bldg., Jacksonville, Fla.; 542 1st Ave., S., Seattle, Wash.; 18th & Upshur Sts., Portland, Ore.; 141 Centre St., New York, N. Y. Exclusive distributor, Clyde Iron Works Sales Co.

CM.—Abbreviation for centimeter, one-hundredth part of the meter or metric unit of length.

C. M.—Abbreviation for circular mil; the form cir. mil is also used.

C.M.C.—Trade name for water turbines manufactured by the Christiana Machine Co., Christiana, Pa.

C. M. B. WRENCH CO.—Garwood, N. J. Manufacturer of automobile and ratchet wrenches. Business established 1909. General manager, Williard S. Tuttle.

C.M.M.F. OR COUNTER M.M.F.—Abbreviations for counter magnetomotive force.

CN.—Chemical symbol for cyanogen, or nitrogen carbide.

CO.—The form Co is the chemical symbol for the metallic element cobalt.

COAL AND ASH-HANDLING MACHINERY.—This machinery includes everything used to handle the coal from the time of its delivery, by ship or railroad car, to the removal of ashes. Storage space is generally provided to keep several weeks' supply and the coal is unloaded either by grab buckets or by dumping from the cars. Further handling is accomplished by locomotive or traveling cranes or telpherage systems, usually electrically operated; see these items. Coal crushers, described below, are then used on bituminous coal to obtain a uniform size before it is delivered to the bunkers. This handling is accomplished by conveyors, which are described elsewhere. In many plants the coal is weighed or measured before being stored in the bunkers.

This is done in several ways, one of which has hoppers carried on knife-edge supports which operate standard beam scales. Two sets are required, one to receive the coal while the other hopper is being weighed. In other cases coal meters are supplied for this purpose, acting on the principle of a propeller driven by the coal moving in the pipe downtakes feeding the furnace. These are simple and quite accurate for small sizes of coal. Also see Scales, coal, and Weighing machines, electrically operated.

After the coal is burned the ashes generally fall into a pit or hopper where they may be sprayed with water, and are then raked or dumped into cars that haul the ashes from the plant. Suction conveyors are also used, the suction being provided by a high-speed centrifugal blower attached to the outlet. A 10 or 12-in. cast iron pipe is used to convey the ashes; in this system special provision is necessary to minimize abrasion of the turns and elbows and rapid deterioration of the fan from grit. In many plants the same conveyors that are used to convey the coal into the bunkers over the boilers are also used to convey the ashes into special ash hoppers, from which they drop into cars or motor trucks for final removal.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio. "A-F."
Alvey Mfg. Co., 3200 S. Broadway, St. Louis, Mo. "Amco."
Beaumont Co., Inc., R. H., 315-19 Arch St., Philadelphia, Pa.
Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Brady Foundry Co., James A., 45th & Western Blvd., Chicago, Ill.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Chain Belt Co., 736 Park St., Milwaukee, Wis. "Rex."
Cleveland Crane & Engineering Co., The, Wickliffe, Ohio.
Conveyors Corp. of America, 326 W. Madison St., Chicago, Ill. "American."
Detrick Co., M. H., 155 E. Superior St., Chicago, Ill. "Detrick-Hagan."
Frederick Iron & Steel Co., Frederick, Md.
Gifford-Wood Co., Hudson, N. Y.
Gillis & Geoghegan, 537-539 W. Broadway, New York, N. Y.
Girtanner Engineering Corp., The, 1400 Broadway, New York, N. Y. "Standardized."
Godfrey Conveyor Co., The, Elkhart, Ind.
Green Engineering Co., East Chicago, Ind.
Grindle Fuel Equipment Co., 1901-11 S. Rockwell St., Chicago, Ill. "Grindle System."
Guarantee Construction Co., 140 Cedar St., New York, N. Y. "Airveyor."
Howe Scale Co., The, Rutland, Vt.
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
Koppers Co., The, Union Arcade, Pittsburgh, Pa.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lakewood Engineering Co., Cleveland, Ohio. "Tier-Lift."
LINK-BELT CO., Philadelphia, Chicago, Indianapolis. Specialists in designing and building coal and ash handling machinery, including coal chutes in all styles and shapes. Link-belt screening chutes for automatically delivering screened coal to wagons, power scrapers, car loaders and unloaders. The Peck carrier is the highest development of the conveying art, and is the accepted standard for handling coal, coke, ashes and other materials. By means of the overlapping lips on the buckets, a special feature of construction, a fully loaded bucket can make a complete circuit of the carrier without discharging any of its contents until it reaches its unloading position. Buckets of standard sizes, 18 by 15 ins., 24 by 18 ins., and 24 by 24 ins., and special sizes to suit service requirements. All buckets are cast in one piece, of best refined malleable iron.—Adv.
Maine Electric Co., Inc., The, 35 Commercial St., Portland Me. "Maine."
McMyler-Interstate Co., The, Bedford, Ohio.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill.
Robins Conveying Belt Co., 13 Park Row, New York, N. Y.
Saurmann Bros., 53 W. Jackson Blvd., Chicago, Ill.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
United Conveyor Corp., Old Colony Bldg., Chicago, Ill. "Simplex."
Webster Mfg. Co., Tiffin, Ohio.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

COAL AND ORE BRIDGES.—See Ore and coal bridges, loaders and unloaders.

COAL CRUSHERS.—These are heavy cast iron rolls studded with teeth and geared together in such fashion as to crush the coal to a small size as it passes between the rolls. They are arranged both in pairs or in a group having four or more rolls. As pieces of harder material, such as links of a chain, bars of iron, spikes,

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car couplers, etc., occasionally find their way into the crusher, especially with run-of-mine coal, it must be provided with some relief or spring device that will operate to keep the crusher from being broken.

Anthracite coal does not require crushing, but where bituminous coal is used it is almost always crushed after it comes from storage and before it is delivered to the bunkers.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bartlett & Snow Co., The C. O., Cleveland, Ohio.
Beaumont Co., Inc., R. H., 315-19 Arch St., Philadelphia, Pa.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Fuller-Lehigh Co., Fullerton, Pa.
GRUENDLER PATENT CRUSHER & PULVERIZER CO., 928 N. Main St., St. Louis, Mo. "Gruendler" heavy duty coal crushers and pulverizers are correct in principle, in design and durably



Gruendler Coal Crusher

to stand up under hard usage and to give steady, uninterrupted service with the utmost economy of power and maintenance. The entire machine is sturdily built. The interior construction is of the best steel, the hammers of carbon or manganese steel, and the grate bars of manganese steel. The Hercules collar or ring-oiling type crusher is the final word in engineering skill, as it eliminates all unnecessary parts and saves 40% in power consumption and about 90% in lubricant. A mighty machine, built stationary or portable. Daily capacity, 3 to 300 tons per hour.—Adv.

Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Marion Machine & Foundry Co., Marion, Ind.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill.
Robins Conveying Belt Co., 13 Park Row, New York, N. Y.
Stroud & Co., E. H., 928-934 Fullerton Ave., Chicago, Ill.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
United Iron Works, Inc., Ridge Arcade Bldg., Kansas City, Mo.
Vulcan Iron Works, 730 S. Main St., Wilkes-Barre, Pa.
Webster Mfg. Co., Tiffin, Ohio.
Williams Patent Crusher & Pulverizer Co., 2701 N. Broadway, St., Louis, Mo. "Williams."

COAL CUTTING AND MINING MACHINES, ELECTRIC.—The coal cutting machine most commonly used is the short-wall cutter, which consists essentially of the cutting chain, the device for guiding it and the driving mechanism. The cutting chain, which has small cutting tools mounted close together on the links, travels continuously around an idler at the end of the cutting bar. The driving mechanism is a very rugged motor-driven sprocket and is enclosed in an explosionproof case so that it may be used in an atmosphere containing explosive gases. As they must be sometimes used in very restricted space, the machines are very compactly built. They are employed to undercut the coal, the chain cutting its way in the length of the cutter bar and then moving sideways. There are many other applications of electricity to coal-mining machinery, such as electrically operated shaking and revolving screens for sizing, magnetic separators, hoists of the winch type for hoisting and lowering cars over steep grades, scoop hoists, shovel loaders and conveyors, underground shovels, and also haulage systems other than electric locomotives. Also see Drills, electric, rock; Fans, mine; Hoists, electric, mine; Locomotives, electric, mining; Pumps, electric, mine; Separators, magnetic or iron.

Manufacturers:

Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Cherry Tree Machine Co., Cheery Tree, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Fairmont Mining Machinery Co., 10th St., & Belt Line, Fairmont, W. Va. "Fairmont."
GENERAL ELECTRIC CO., Schenectady, N. Y. Fort Wayne Electric Rock Drills. (See Drills, electric, rock, also adv. pages 1203-1223.—Adv.
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill. "Goodman."
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio. "Arcwall."
Kanawha Mfg. Co., Charleston, W. Va.
Mead-Morrison Mfg. Co., 125 Prescott St., East. Boston, Mass.
Morgan-Gardner Electric Co., 2640 Shields Ave., Chicago, Ill.
Prox Co., Frank, Terre Haute, Ind.
Riverside Iron Works, 410 Riverside Blvd., N. E., Calgary, Alta., Can.
Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill. "Ironclad."

COAL HANDLING IN POWER PLANTS.—Coal handling embraces everything involved from the time the coal arrives at the plant until it is fired into the boiler furnace. Apparatus required depends upon whether the coal comes in by railroad, steamer or wagon; whether the coal is delivered to the boiler room or storage pile; and whether the coal must be elevated before passing by gravity to the fire. The best form of installation is that which accomplishes the task at lowest expense.

Coal storage is advisable against seasonal emergencies and permits buying at low market prices. Ordinarily, space prevents sufficient coal being stored except for the former condition, which in most plants means about 10 weeks' supply. With bituminous coal there is always danger of spontaneous combustion unless the coal is carefully selected and stored by eliminating circulation of air through the pile or else furnishing ample air so that heating cannot occur. Careful storing means using only the same grade of coal in any pile, storing the same size, limiting the pile to about 15 ft. in height and not allowing the lumps to collect at the bottom of the pile. Any coal size above egg is safer than sizes below. Coal that has been exposed to the weather several weeks after mining before storage is unlikely to catch fire.

Underwater coal storage eliminates fire hazards but is expensive. Concrete structures for underwater storage with capacities of 10,000 and above cost about $2 per ton of storage capacity.

Apparatus for handling coal in storage that is, for unloading, storing and reclaiming, should do the work expeditiously with a minimum breakage, as breakage increases the likelihood of heating and increases the waste in burning. For low cost of handling the locomotive crane, the drag line and the portable conveyor are being widely used for the average plant, while the bridge crane and locomotive crane are used for the largest coal piles located along docks. The locomotive crane can handle 240 tons of coal per hour and will unload between 10 and 15 50-ton cars per 8-hour day. The portable conveyor can easily handle 75 tons per hour in moving, loading and reclaiming. This type of conveyor will unload a 50-ton railroad car with one man in 1½ hours. The drag scraper can move a coal pile and reclaim coal at the rate of about 100 tons an hour on level ground and over short distances.

Coal for current use in the boiler room may be unloaded by grab bucket and hoisted to the coal hoppers; it may be dumped into a pit and conveyed by belt or bucket conveyors to the hoppers; or it may be unloaded and moved by some form of portable belt or bucket conveyor. As handling costs money, causes deterioration of the coal and requires space, needless handling should be avoided.

The most advantageous condition with mechanical firing is when the coal hoppers or bunkers are above the boilers, economizing floor space and permitting feeding the stokers by gravity. Such bunkers should be of steel, cement lined to prevent corrosion and erosion, and should have sides that slope with an angle of about 45 degrees so that the coal will slide down without the need of shoveling. Individual bunkers for each boiler prevent the spread of fires, facilitate plant and unit tests, permit the use of different coals and add to flexibility and reliability. Circular bunkers cost considerably less than rectangular ones but have less storage capacity. From the coal bunkers the coal passes to the furnace hopper through one or more spouts. Coal feed is controlled by gates or valves, sometimes being located in the spout as well as at the bottom of the hopper.

One of the first requirements for economy is that the coal input and steam output be measured. These two give the over-all efficiency of the plant or unit. Coal meters should advisably measure the coal consumed by each boiler; coal scales should show the total plant consumption. Coal meters may be installed in the coal-handling system before the coal goes to the bunkers; they may be installed in the spouts, one meter per furnace, and the scale may be of the traveling type, one meter or scale serving the entire boiler room, as when the monorail and telpherage methods of coal handling are used.

The coal crusher, through which all coal passes before it goes to the furnaces, and stoker hoppers is often desirable, especially when coal is received direct from the mine The crusher produces more uniform coal sizes and therefore less waste and higher combustion; it permits the best sizes to be used for storage and the best sizes to be prepared for combustion.

COAL, PULVERIZED.—See Pulverized coal.

COAL SAVERS.—Trade name for asbestos insulation manufactured by R. E. Kramig & Co., 8th St. & Eggleston Ave., Cincinnati, Ohio.

COAL STORAGE BUNKERS, BINS, ETC.—Bunkers or bins are generally placed under the roof of a boiler house to provide a supply of coal sufficient to operate from two to four days. When external storage space is available this supply is sufficient, but in plants not having the space larger bunkers or bins must be provided. They are generally arranged to feed coal to the furnaces by gravity through spouts.

Bunkers are generally made with a steel framing having a concrete lining faced with some hard substance for large plants. Some smaller plants have plate-steel bunkers of the suspended type and lined with concrete, while others have a reinforced concrete construction throughout. Rectangular bunkers are widely used as they have a larger capacity than circular ones, but cost more to build.

Manufacturers:

Downingtown Iron Works, Inc., Downingtown, Pa.
Guarantee Construction Co., 140 Cedar St., New York, N. Y.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Webster Mfg. Co., Tiffin, Ohio.

COATES CLIPPER MFG. CO.—237 Chandler St., Worcester, Mass. Manufacturer of motor-driven drilling outfits, grinding hammers, sheep shearing machines, etc. President and treasurer, George H. Coates; vice-president and general manager, Albert J. Garner; secretary, Charles E. Bieth.

COATESVILLE BOILER WORKS.—Coatesville, Pa. Manufacturers of fire-tube boilers, power plant tanks, etc. Main office and factory, Coatesville, Pa. Branch offices, 30 Church St., New York, N. Y.; Morris Bldg., Philadelphia, Pa.

COBALT.—A white metal with properties similar to nickel. Symbol Co; at. wt. 59; sp. gr. 8.7. The metal is used in making the cobalt-chromium alloy stellite, in making cobaltcrom (a high-speed steel containing cobalt and chromium), and for coloring agents in the ceramic industry. There is also some use made in electroplating, giving a deposit like nickel plating. For this purpose a solution of cobalt-ammonium sulphate or cobalt sulphate saturated with boric acid is used. The principal source of the metal is the cobalt-silver mine district in Ontario; considerable is also produced by the Missouri Cobalt Co. at Fredericktown, Mo. The Canadian output in 1919 amounted to 420 tons of cobalt oxide and sulphate and 76 tons of metal. The metal is worth about $2.50 per lb.

COBB ELECTRIC APPLIANCE CO.—Lanesville Terrace, Boston, Mass. Manufacturer of electric heating devices, urns, vulcanizers, controlling systems. Business established 1920. President, A. B. Cobb; secretary, George L. Ellsworth; treasurer, Alonzo J. Shadman.

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COCHECO.—Trade name for fiber products manufactured by J. Spaulding & Sons Co., Inc., 300 Wheeler St., Tonawanda, N. Y.

COCHRANE.—Trade name for power plant specialties manufactured by the H. S. B. W. Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.

COCHRANE CHEMICAL CO.—432 Danforth Ave., Jersey City, N. J. Manufacturer of insulating and sealing compounds, cements, paints, etc. Business established 1887. Samuel Cochrane, sole owner.

COCHRANE MFG. CO., F. W.—5829 S. Vermont Ave., Los Angeles, Cal. Manufacturer of electric razor blade resharpening machines. W. D. Nix, secretary and treasurer.

C. O. D.—Trade name for current indicators manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

CODD CO., E. J.—700-708 S. Caroline St., Baltimore, Md. Manufacturer of tanks. President, Thomas D. Penniman; vice-president, Henry H. Wiegand.

CODE SIGNALING SYSTEMS.—See Signaling systems, code calling.

CODES, ELECTRICAL.—There are several codes of rules in use in the United States relating to installation and operation of electrical equipment. These are described under their respective titles. See National Electrical Code; National Electrical Safety Code; Factory Mutual Code; Millers' Code; Rules for electrical equipment in coal mines. Also see State electrical rules; Municipal electrical rules; Insurance safety standards.

CODES, SIGNALING.—Signaling by means of wire telegraph or radio telegraph instruments involves the use of a code, which is merely an arbitrary arrangement of signals used to represent letters or for the sake of brevity to indicate groups of letters, words or groups of words. The Morse code is generally employed in this country for telegraph purposes and the Continental code is used for radio communication and for wire telegraph communication in Europe.

COE MFG. CO., W. H.—Providence, R. I. Manufacturer of bronze powders, etc.

COERCIVE FORCE.—The value of the magnetizing force necessary to reduce residual magnetism to zero is called coercive force. (See Residual magnetism.)

COES WRENCH CO.—1 Coes Sq., Worcester, Mass. Manufacturer of screw wrenches. Business established 1840. President and treasurer, F. L. Coes; vice-president, F. C. Smith, Jr.; secretary, M. E. Robbins; general manager, Frederick Searle; sales manager, L. Coes. Sales representatives, J. C. McCarty & Co., 29 Murray St., New York, N. Y.; J. H. Graham & Co., 113 Chambers St., New York, N. Y.

COFFEE GRINDERS, PERCOLATORS, ROASTERS, URNS.—See Grinders, electric, coffee; Percolators, coffee, electric; Roasters, coffee, electric; Urns, coffee, electric.

COFFER DAM.—Coffer dams are used for making submerged areas accessible for construction purposes, such as for the foundation of a power plant, permanent dam, tunnel intake, etc. For low coffer dams frames covered with gravel or sand bags carefully piled in rows have been used. For high dams, interlocking sheet steel piling or a double row of wooden piling with a puddled clay filling are the most common forms in use.

COFFIELD WASHER CO., THE.—Dayton, Ohio. Manufacturer of electric washing machines. President, J. L. Coffield, Sr.; vice-president, Frank Reeves; secretary and treasurer, R. E. Coffield; general manager, W. G. Stowell; sales manager, W. J. Skelton.

COFFIELD WASHER CO. OF CANADA, LTD.—121 S. James St., Hamilton, Ont., Can. Manufacturer of electric washing machines. President, Harry Bloom; vice-president, Walter C. Brittain; secretary and treasurer, Albert E. Trimble.

COFFMAN, THE ORIGINAL.—Trade name for electric hair cutters, driers and vibrators manufactured by the Barbers' Electric Specialty Co., 4204 Troost Ave., Kansas City, Mo.

COHERER, CARBON-MERCURY.—A form of detector used in radio communication which consists of a globule of mercury held in light or imperfect contact with carbon electrodes. This type does not require tapping to restore it to the sensitive condition after current has passed and for this reason is sometimes called an autocoherer.

COHERERS AND DECOHERERS.—A coherer is a device used in the early days of radio communication for detecting radio signals. It consists of a tube containing iron and nickel filings with an electrode inserted at each end. The presence of a weak high-frequency current changes the conductivity of the filings which in turn changes the current in a local relay circuit. The effect produced by the high-frequency current continues after the current has ceased so a vibrator is supplied which continually taps the glass tube, thereby restoring the filings to their normal state after the high-frequency pulse has ceased. This vibrator is called a decoherer.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

COHN & BOCK CO., THE.—Princess Anne, Md. Producer of wood pole steps.

COIL ANTENNA.—See Antenna, radio.

COIL, ARMATURE.—A coil consisting of one or more turns of a conductor which are grouped together, insulated as a group from adjacent coils and from the armature core, and formed to fit accurately into the armature slots usually provided for receiving them.

COIL, DRAINAGE.—A coil bridged across a telephone line with its exact electrical center tapped to ground. It is to permit static electricity to escape to earth before enough accumulates to jump across the gap in the arrester. The latter makes a noise which at times interferes with talking.

COIL, DUMMY ARMATURE.—A coil put on an armature to fill up a space but not connected into the armature circuit. Such a coil is sometimes used with wave or series windings.

COIL, FIELD.—A coil placed on a pole core through which a current is passed to magnetize the core and thus produce the magnetic field of a motor or generator. In high-speed turbogenerators the field coils are generally wound one turn at a time in slots milled into the surface of a solid steel rotor body.

COIL, HOLDING.—This is an impedance coil which may be switched across a telephone circuit to prevent the disconnect signal from being shown. It is used only on common-battery lines and is useful when a subscriber or an operator desires to get off the line for a short time. It may easily cause trouble, however, if the user forgets to cut it off.

COIL, IMPEDANCE OR RETARDATION.—A coil whose duty is to prevent or reduce the flow of alternating current, while permitting direct current to pass. It usually has a complete magnetic circuit in iron. These coils are often used on telephone lines.

COIL PRESS.—A press for accurately and compactly forming a coil to desired dimensions. See Presses, armature, field and transformer coil.

COIL PRESSES.—Coil presses are machines used to form coils that have been wound on a coil-winding machine to the proper shape and size to fit over the core. Field coils for motors and generators are often pressed into shape, small changes being made to make them conform more closely to the cross-section of the pole piece. This is also true of transformer coils and coils for lifting magnets and other purposes. Also see Armature coil-forming machines.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.

COIL-TAPING MACHINES.—These machines are used to put insulating and binding tape on various forms of coils, such as field coils, transformer coils, armature coils, and torroidal coils of various kinds, including loading coils, repeating coils, retardation coils, etc. They generally have a bobbin on which sufficient tape for the coil is wound. The bobbin runs on a split guide ring and the coil to be taped is placed over the open guide ring so that when it is closed the ring and coil are linked together. The bobbin then rotates on the ring, passing in and out of the coil at each revolution. A turn of tape is put on at each revolution and springs on the bobbin so control its action that a uniform tension is maintained on the tape while it is being applied.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.
Chattanooga Armature Works, 1-3 Duncan Ave., Chattanooga, Tenn.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Segur."

COIL TESTING SET.—A special form of transformer for testing the insulation of wound coils. See Transformers, high-tension testing.

COIL, TORROIDAL.—This is a coil wound on a closed magnetic circuit which is in the form of a circular ring. It has less external field than other forms. Torroidal coils are much used in telephony and may be either impedance, loading or repeating coils, depending on their winding. They are often constructed with an iron core made of very fine iron wire covered with a thin insulation of cellulose or enamel to reduce eddy-current losses. In some of the more recent forms, electrolytic iron, compressed into rings under hydraulic pressure has been used with success. The desirable properties in the iron core are high permeability, high resistivity and low hysteresis and eddy-current losses.

The windings depend upon the type of coil and are almost always wound directly over the core (by means of a coil-winding machine) with fine magnet wire, often enameled.

COIL, TRANSFORMER, PANCAKE.—A coil wound in the form of a thin disk, often of only one layer of copper ribbon, the turns being separated by asbestos insulating tape or other suitable insulation. Also see Coils, transformer.

COIL-WINDING MACHINES.—Coil-winding machines are made in a number of forms because of the great variety of coils that may be machine-wound. For winding armature coils a distinct type of machine is used; see Armature winding machines. Many winding machines resemble a lathe, although for small coils a very simple machine is adequate. These consist merely of a horizontal spindle to which the coil core may be fastened and rotated either by foot or by a small motor. A spool of the wire to be used is placed in a holding device and the wire is guided onto the core either by hand or through a special guide. Various modifications and improvements are made on this principle to get the automatic features and permit larger coils to be wound. Some forms of radio coils have a honeycomb arrangement of the wire that is provided by a special guiding device. Some very large coils, such as those made of copper strap or heavy copper wire or rod, are wound on heavy lathes and other similar machines for that special purpose.

Torroidal coils require another type of machine, which is very similar to the coil-taping machines described above. The bobbin in this case is filled with wire to be used instead of tape.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Armature Works, 77 Washington St., N., Boston, Mass.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Dominion Steel Products Co., Ltd., Brantford, Ont., Can.
Eisler Engineering Co., Charles, 15 Kirk Pl., Newark, N. J.
Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York, N. Y. "Contineolis."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. The Segur line of armature coil winding tools, present a line of apparatus designed for the practical manufacture of armature coils in an accurate manner and with a minimum labor cost. The complete line consists of the following: Hair-pin loop winder, coil

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spreader, armature coil, taping machine, coil winding lathe head, magnet wire reel rack and tension device, com-



Segur Armature Coil Winder

mutator screw press, field and magnet wire taping machines, armature copper bar bender.—Adv.

Electrical Manufacturers Equipment Co., 713 Postal Telegraph Bldg., Chicago, Ill. "Segur."
Peerless Equipment Co., Hanover, Pa. "Segur."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
UNIVERSAL WINDING CO., 95 South St., Boston, Mass. "Leesona." (See display adv. page 1317.)

COILING MACHINES FOR FINE WIRES AND FILAMENTS.—These machines are used to coil resistance wire used in making various kinds of heating elements and also for coiling lamp filaments. The object of coiling is to get a long length of fine wire into a small space and, in the case of lamp filaments for gas-filled tungsten lamps, to concentrate the filament. The machines consist of a special mandrel upon which a continuous helix of the fine wire is wound. Some resistance coils are not in the form of a helix but are wound on special machines to have a zigzag form like that obtained by flattening out a spiral coil.

Manufacturers:

Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass.

COILS, ARMATURE AND FIELD.—Many electrical manufacturers, especially those having a seasonal demand, find it an advantage to buy windings instead of wire, i. e., buy their armature and field coils already wound and formed. The armature coils are wound on adjustable forms or machines which are made to represent the armature or stator slots for which the coil is being formed and which pull the coil into its proper shape. The coils are then removed, carefully taped and varnished. Field coils are also wound over special forms and then taped and varnished or impregnated. Large users of motors, such as electric railways or steel mills, often purchase an extra supply of armature and field coils of motors that have been adopted by them as standard equipment; thus replacing of burned out coils is greatly facilitated.

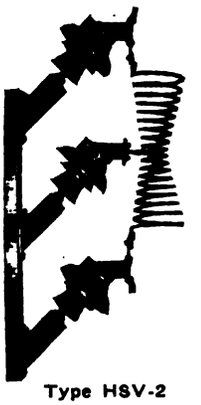
Manufacturers:

ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. (See display adv. page 1248.)
Air-Way Electric Appliance Corp., Toledo, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Beckley Machine & Electric Co., Beckley, W. Va.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Armature Works, 77 Washington St., N., Boston, Mass.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chattanooga Armature Works, 1-3 Duncan Ave., Chattanooga, Tenn.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Doubleday-Hill Electric Co., 719-21 Liberty Ave., Pittsburgh, Pa.
Doyle-Dacosta Mfg. Co., Easton, Pa.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Motor & Engineering Co., The, 2nd St. S. W. & B. & O. R. R., Canton, Ohio.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Elliott-Thompson Electric Co., The, 203-205 St. Clair Ave., E., Cleveland, Ohio.
Gee Electric Co., Wheeling, W. Va.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hall Switch & Signal Co., Garwood, N. J.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Leacock Co., A. M., 291-5 Cortlandt St., Belleville, N. J.
Major Electric Co., M. E., Wilkes-Barre, Pa.
Munning & Co., A. P., Church St., Matawan, N. J.
POCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stimple & Ward Co., 520 Sandusky St., Pittsburgh, Pa.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, CHOKE.—Air-core reactors inserted between the lightning arresters and the transformers or other apparatus to be protected, to choke back surges of high frequency or steep wave front due to lightning or other cause, thus allowing the arrester to discharge with maximum effectiveness and minimum strain on the station apparatus. These coils offer little impedance to the normal-frequency power current, but very substantial impedance to high-frequency currents which do not readily pass through them. The most common forms are braced cylindrical coils made of heavy copper, copper clad or aluminum wire or rod. The hour-glass type, tapering in towards the middle, is also used for high voltages, while for lower voltages flat or "pancake" coils and oil-immersed coils are used. Where very high voltages are employed, the choke coils are often mounted on post insulators outside of the building, the mounting being of the same type as for choke coils designed for outdoor substations.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Choke coils for indoor and outdoor service, including upright, inverted and 45° types. Either cylindrical or hour glass shapes. For flat or pipe mounting. See display advertisement on page 1261.—Adv.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
GENERAL ELECTRIC CO., Schenectady, N. Y. Made for indoor and outdoor service, for all a-c. circuits above 1,000 volts. Coils are either cylindrical, hour-glass, or the suspension type. (Bulletin 1584.) See adv. pages 1203-1223.—Adv.
HI-VOLTAGE EQUIPMENT CO., 3305 Croton Ave., Cleveland, Ohio. "Hi-Voltage."
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Leacock Co., A. M., 291-5 Cortlandt St., Belleville, N. J.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill. "Royal" indoor and outdoor choke coils are made in numerous types for all voltages from 6600, upward, and for any style of mounting. Type HSV-2 (illustrated) is a standard outdoor design, and is furnished in 100, 200 and 300-amp. capacities, for 13,200, 22,000, 33,000, 44,000 and 66,000 volts. All coils are wound



Type HSV-2

from solid copper wire. Insulators are of the interchangeable type with non-cement attachments, thus avoiding loose parts on account of cement. All metal parts, except coil, are hot galvanized. Five other outdoor models, with flat steel bases for vertical, and horizontal (upright or inverted) mounting are supplied in 100, 200 and 300-amp. capacities, for voltages ranging from 6600 to 66,000, or higher, if desired. "Royal" indoor choke coils are supplied in five types, the varied sizes in each type having capacities of 100 to 600 amps. at 6600, 13,200 and 22,000 volts. All choke coils are of the hour-glass type, assembled to give maximum rigidity, and wound of solid copper wire. They will carry rated load indefinitely without undue heating. Cylindrical coils are furnished where desired. Each type can be supplied in combination with fuse or switch, or both. Send for our catalog. It contains engineering data, illustrations and other interesting information of "Royal" products.—Adv.

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.
Southern Electrical Equipment Co., Charlotte, N. C.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, COOLING, TRANSFORMER.—In large oil-immersed transformers, the radiating surface provided is found inadequate for properly limiting the temperature rise. One method of overcoming this, in transformers of 100 kv-a. capacity and over, is to provide a coil of pipe, immersed in the oil, through which water, at a temperature many degrees below the oil temperature, is passed. Every precaution is taken in the construction of the cooling coil to insure that water cannot get into the oil. The coils are made from seamless tubing 1 to 2 ins. in diameter; they have no joints within the tank and are kept wholly below the surface of the oil.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Cox, J. Fillmore, Bayonne, N. J.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
National Pipe Bending Co., The, River & Lloyd Sts., New Haven, Conn.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

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COILS, ECONOMY, ARC LAMP.—A reactance coil used with enclosed a-c. arc lamps wired in multiple, to reduce the line voltage (110 to 120 volts) to the arc voltage (70 to 80 volts.) The name "economy" is given because the reactance merely reduces the power-factor and does not occasion a large wattage loss as would a series resistor. These coils are practically obsolete, due to the decreasing use of multiple arc lamps except for picture projection and similar service.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, IGNITION OR SPARK.—Induction coils, or transformers with open magnetic circuits, which operate with pulsating direct current in the primary, giving a sufficiently high voltage in the secondary to produce a hot spark. The primary winding consists of a few turns of coarse magnet wire wound over a core consisting of a bundle of soft iron wires. The secondary, having a large number of turns of small magnet wire, usually consists of two or more sections which are mounted on a tube over the primary. The coils are wound evenly in layers separated by sheets of paper of other insulation, by means of automatic machinery and are then treated with paraffin or some other impregnating and insulating compound. Ignition or spark coils are much used for automotive engine ignition and also for stationary internal-combustion engine ignition. (Also see Igniters.)

Manufacturers:

ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. (See display adv. page 1248.)
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Bosch Magneto Corp., Springfield, Mass. "Bosch."
American Radio & Research Corp., 21 Park Row, New York. N. Y.
Apollo Magneto Corp., Kingston, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Coil Co., Ltd., Walkerville, Ont., Can. "Canadian."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Detroit Coil Co., 439-447 Fort St., E., Detroit, Mich. "Detroit."
Doyle-Dacosta Mfg. Co., Easton, Pa. "Bushkill."
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eastern Parts Mfg. Co., Inc., 135 Soring St., New York, N. Y. "Pemko."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Eisemann Magneto Corp., 32 33rd St., Brooklyn, N. Y.
Fansteel Products Co., Inc., North Chicago, Ill.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
Gray-Heath Co., 544 N. Parkside Ave., Chicago, Ill. "Sturdy."
Hercules Mfg. Co., 2122 Northwestern Ave., Indianapolis, Ind.
J & B Mfg. Co., 65 Eagle St., Pittsfield, Mass. "J & B."
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Kokomo Electric Co., Kokomo, Ind. "Kingston."
K-W Ignition Co., The, E. 30th St. & Chester Ave., Cleveland, Ohio. "K-W."
Lemke Electric Co., 509-513 Cedar St., Milwaukee, Wis.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Marion Electrical Mfg. Co., 24 Cliff St., Jersey City, N. J.
Miller & Johnson Auto Electric Co., 1406 W. Pico St., Los Angeles, Cal. "Miller Hi-Speed."
New York Coil Co. of Penna., Inc., Mont Clare, Pa.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Quick Action Ignition Co., South Bend, Ind. "Quick Action."
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
Remy Electric Co., Anderson, Ind.
SAMSON ELECTRIC CO., Canton, Mass.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

COILS, INDUCTANCE, RADIO.—Inductance coils for radio circuits have been made in a number of forms. They are used in tuning, to so change the constants of a circuit that it will be in resonance with another circuit to which it is coupled and between which energy is transferred. Coils in which the self-inductance may be changed by using more or less of the turns are often used, while for very large changes several coils may be connected in series, with one variable coil to give the proper small variations.

Both cylindrical coils and flat spirals are used. The cylindrical coils or drum coils, as they are also called, are made in the variable form by having sections with taps brought out and connected to a clip. Sliding contacts are also used in many cases. Coils that are not to be varied are often wound in several layers having a honeycomb construction. Flat spiral coils are generally made of bare copper strap. The changes in inductance are made by means of a clip that may be moved to any place on the spiral. Various other forms, such as open-ring coils, cylinders that turn inside of other cylinders, etc., are also made.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin, Chicago, Ill.)
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Coto-Coil Co., 87 Willard Ave., Providence, R. I.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest, Inc., Lee, 451 3rd St., San Francisco, Cal. "Honeycomb," "Duo-Lateral."
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y. "Honey Comb."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I. "Duo-Lateral."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Parkin Mfg. Co., San Rafael, Cal.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass. "Sorala."

COILS, INDUCTION, ELECTROTHERAPEUTIC.—Electrotherapeutic or medical induction coils, as they are sometimes called, are merely induction coils having a vibrator at one end and a removable magnetic core that may be moved in or out to vary the secondary voltage to suit conditions. Electrodes designed to be held in the hand or applied to other parts of the body are usually furnished with the coils. They are provided with a switch so that the primary circuit need not be disconnected when not in use. These coils also form a part of Medical batteries, which see.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kendrick & Davis Co., Lebanon, N. H. "K. & D."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
McINTOSH BATTERY & OPTICAL CO., 217-223 N. Desplaines St., Chicago, Ill. Bristow faradic coil, voltage induction apparatus operated by dry batteries, for diagnosis and treatment.—Adv.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Vulcan Electric Co., 239 So. Los Angeles St., Los Angeles, Cal. "Vulcan."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

COILS, INDUCTION, MISCELLANEOUS.—An induction coil is a transformer with an open magnetic circuit which operates with pulsating direct current in the primary winding. These coils are used in laboratory work, radio telegraphy and telephony, internal-combustion engine ignition, electrotherapeutics, telephony, lighting of gas burners, stimulating plant growth, etc. They are useful wherever high e. m. f. and little power are wanted from a d-c. source, but are not used as extensively as formerly because direct current is not so frequently available and a-c. transformers are far more efficient and powerful. The pulsating current for the primary is obtained by means of an interrupter that breaks and makes the direct current rapidly. A condenser is usually shunted across the interrupter to minimize sparking at its contacts. The secondary winding is carefully insulated because of the high tension developed therein.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Packard Electric Co., Warren, Ohio.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Stimple & Ward Co., 520 Sandusky St., Pittsburgh, Pa.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

COILS, INDUCTION, TELEPHONE.—These coils are a type of telephone transformer, usually with a straight laminated iron core with magnetic return in air. They have either two or three windings and perform the function of a stepup transformer. They are generally used in the transmitting circuit of a telephone set and transmit to the line impulses or waves of higher potential than those produced in the transmitter circuit. They are always used with local-battery sets, but not with all types of common-battery telephones. The primary of the coil is usually wound over the bundle of iron wires or laminated coil and then the secondary wound over that. The ratio is often in the neighborhood of one to four. The primary coil may have a resistance of from less than one to ten ohms and the secondary from 20 to 150 ohms. It is important that the particular type and size of coil that was designed for the transmitter be used with it. Induction coils are also used in other places in a telephone exchange.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

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Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

COILS, MISCELLANEOUS.—These are coils principally for electromagnets, solenoids or relays that are to form part of some electrical equipment. Many manufacturers of products in which such coils are a relatively unimportant part of the device find it more convenient to purchase these coils from some one specializing in coil winding. Specially constructed coils that cannot be wound on simple coil-winding machines are often purchased for similar reasons.

Manufacturers:

Coto-Coil Co., 87 Willard Ave., Providence, R. I.
Doyle-Dacosta Mfg. Co., Easton, Pa.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.
Locomotive Superheater Co., 30 Church St., New York, N. Y. "Elesco."

COILS, PUPIN.—See Loading coils, telephone, Pupin.

COILS, REACTANCE.—A form of stationary induction apparatus used to supply reactance or to produce phase displacement; correctly called reactors. They are used for almost innumerable specific purposes, such as compensating for leading currents in long-distance telephone circuits (Pupin coils), economy and current-limiting coils, power-limiting and protective devices, split-phase starting devices, etc. Some have air cores, others iron cores or even a complete iron magnetic circuit, depending on the amount of reactance desired. Some reactors, such as choke coils, introduce very little reactance into the circuit under normal conditions, but considerable reactance under abnormal conditions or to abnormal currents. See Reactance; also see Coils, choke; Reactors, power limiting.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1233.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Packard Electric Co., Warren, Ohio.
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, REPEATING.—Repeating coils are a type of telephone transformer, commonly with a one-to-one ratio though often it is different. It is used to join a metallic circuit to a ground-return line, to isolate a noisy part of a line, to feed battery current to common-battery telephones, and to make phantom circuits. It nearly always has a complete magnetic circuit in iron. A ring-through repeating coil is one which will transform ringing current.

Phantom Repeating coil. This is a repeating coil designed for use in installing phantom circuits (which see). The line winding has a center tap which is exactly in the electrical center (the balancing must be very exact) and the physical circuit can ring through the coil as well as talk.

Manufacturers:

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

COILS, RESISTANCE.—Resistance wire or ribbon in coil form, used for the operation, protection, control or measurement of a circuit or circuits; properly called resistors. In resistance boxes used as test sets accurately wound noninductive coils of fine wire are used. Rheostats are sometimes constructed of coils wound over insulated frames, or imbedded in porcelain, or some molded compound. Coils made of bare metallic ribbon are compact and strong and often used. The present tendency is to make resistance coils into removable units, by the use of molded compounds. These are made in various forms, some fitting standard sockets, and are used in battery charging, loading banks, testing outfits, signal circuits, sometimes as heating units, etc.; for this type see Units, resistance, miscellaneous. This classification does not include certified or standard resistance coil units for precision measurements; see Units, resistance, standard or precision. For noncoiled types of resistors, see Resistors, carbon, iron, etc.; also Grids, resistance; Carbons, resistance. The following manufacturers can furnish resistance coils for specific or varied purposes independently of the apparatus with which they are to be used.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. To meet such exacting conditions as high temperatures, hard usage, and moisture, units of various forms have been designed. These units have been used successfully in connection with electric devices, such as contactor coils, meters, instruments, etc., and also in connection with railway and fire alarm signal systems, time clock systems, under voltage release attachments, and small battery charging equipments. See adv. pages 1203-1223.—Adv.
General Radio Co., 11 Windsor St., Cambridge, Mass.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Leacock Co., A. M., 291-5 Cortlandt St., Belleville, N. J.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Leich Electric Co., Genoa, Ill.
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, SHADING.—Shading coils are used on single-phase electromagnets to obtain quiet operation. The flux and therefore the pull passes through zero twice each cycle and the magnet tends to chatter. The shading coil usually consists of a short-circuited turn of wire which encloses part of the iron circuit at the point where the clapper or plunger seals against the magnet frame. The shading coil causes a local flux to be set up out of phase with the main flux and in this way prevents chattering.

COILS, SNEAK.—Coils of fine wire used on distributing frames to protect telephone apparatus; also called heat coils. See Heat coils, telephone.

COILS, SPARK.—See Coils, ignition, also Igniters.

COILS, SPARK, RADIO.—Inductance coils with vibrators and d-c. primary current supply, used with auxiliary apparatus in short-wave radio telegraphy to produce high-tension sparks at the spark gap in the oscillating circuit. See Spark coils, radio.

COILS, TESLA, RADIO.—An oscillation transformer used to produce very high voltage of radio frequency. In use a condenser is charged by a high voltage and allowed to discharge through the primary of the Tesla coil which contains a small number of turns of heavy wire. The discharge of the condenser is oscillatory and induces a very high voltage in the secondary of the Tesla transformer, which contains a large number of turns of fine wire. Many interesting experiments may be performed with such a transformer.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

COILS, TRANSFORMER. — Transformer coils are generally wound by the manufacturers of transformers. In a few cases where only a small number of a certain type are to be made or for an extremely high voltage, as in a testing transformer, the manufacturer will have the coils wound by some one specializing in coil winding or better equipped to handle the work than himself. Testing laboratories and laboratories in schools frequently design transformers to be built and used for some special purpose and coils for these are purchased complete to insure care in winding that is given by skilled specialists in that line.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. (See display adv. page 1248.)
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Transformer Co., 178-182 Emmett St., Newark, N. J.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Doyle-Dacosta Mfg. Co., Easton, Pa.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Harris & Co., Arthur, 212 Curtis St., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Packard Electric Co., Warren, Ohio.
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Simon, Emil J., 217 Broadway, New York, N. Y.

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Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COILS, TUNING.—See Coils, inductance. radio; also Couplers, loose, radio.

COIN COLLECTORS, TELEPHONE STATION AND TOLL.—Devices used in connection with pay stations which have no attendant. The operator can direct the deposit of coins and can tell whether the right ones are put in. Coin collectors are of several forms. In the "nickel first" models the coin is deposited to signal the operator and is held in a runway until the call is completed or until the operator finds the line busy, etc. In other models the operator can be signaled but a coin must be dropped before she will complete the connection. By pressing the proper key the coin is either returned through one runway or deposited in the coin box. In other types signals on the board indicate when the coin is dropped, while others have no electrical connection whatever, but rely upon the sound transmitted to distinguish between the coins dropped. Collectors used in automatic exchanges are often arranged to collect or refund without the care of an operator.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Gray Telephone Pay Station Co., 16-30 Arbor St., Hartford, Conn.

COIN COUNTING MACHINES.—Machines used in banks, stores, other cashier's offices where large amounts of coin are counted. They consist of motor-driven sorting, tabulating and totaling mechanisms. Large quantities of mixed coins are fed into the machine and by it automatically sorted, grouped, counted and recorded. They are more accurate and much more rapid than even experienced tellers or clerks.

COINOLA.—Trade name for electrically operated pianos made by the Operators Piano Co., 16 S. Peoria St., Chicago, Ill.

COKAL STOKER CO.—1029-31 N. Clark St., Chicago, Ill. Manufacturer of boiler furnaces and hand-operated stokers. Business established 1915. President and treasurer, George A. Kohout; secretary, L. D. Cessna; sales manager, F. A. Moreland.

COKE.—Coke is made by the distillation of coal. It is used in the electrical industry as a raw material in the manufacture of electrodes for electric furnaces; also as a reducing agent in some electric furnace processes.

COKE-DRAWING AND LOADING MACHINES.—These are machines consisting of two principal parts; an extractor for drawing coke out of the ovens and a conveyor for screening and loading it into cars. Most of these machines are motor-driven, having separate motors for the two parts. A series motor of about 20 hp. drives the extractor and a smaller one the conveyor. A steel ram and cast iron shovel are carried into the oven underneath the coke by a steel pinion. When the travel is reversed a shovel load of coke is withdrawn and dumped on the conveyor. A swinging carriage permits the shovel to reach all parts of the oven.

The screening and conveying are carried on simultaneously. One section of the conveyor has overlapping slats which carry all the coke dumped onto them. This section transfers the coke to a second conveyor with slats having openings between them, which allow the dust and ashes to fall through and only convey the large clean coke to the cars. These machines are usually run on a track passing in front of a long battery of ovens and are supplied with power by means of a trolley wire and trolley. They save a great deal of hard work.

Manufacturers:

Beaumont Co., Inc., R. H., 315-19 Arch St., Philadelphia, Pa.
Covington Machine Co., Covington, Va.
Koppers Co., The, Union Arcade, Pittsburgh, Pa.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

COLBY FURNACE.—One of the early types of electric induction furnace for the production of electric steel.

COLD LIGHT MFG. CO.—Denver, Colo. Manufacturer of luminous compounds and attachments. Business established 1916. President, V. C. Thorne; vice-president and general manager, K. L. Kithil; secretary and treasurer, J. W. Thorne. Main office, 18th & Blake Sts., Denver, Col. Branch office, 50 Union Square, New York, N. Y.

COLDSPLICE.—Trade name for solderless connectors for fixture and circuit work manufactured by Alexander B. Simpson, 152 E. 53rd St., New York, N. Y.

COLE & CO., HENRY.—54 Old Colony Ave., Boston, Mass. Manufacturers of weatherproof sockets and molded insulations.

COLE CO., THE H.—Columbus. Ohio. Manufacturer of blueprint frames, drawing tables and other drawing material.

COLE MFG. CO.—Kent St., Lindsay, Ont., Can. Manufacturer of lighting fixtures and portable lamps. Business established 1913. General manager, W. G. Cole.

COLE MFG. CO., R. D.—Newnan, Ga. Manufacturer of boilers, boiler settings, steel tanks. steel towers for transmission lines, etc. Business established 1854. President, R. D. Cole; vice-president, E. G. Cole; secretary and treasurer, R. N. Cole.

COLE METAL PRODUCTS CO.—401 E. 23rd St., New York, N. Y. Manufacturer of cutout boxes and cabinets. Business established 1918. President and general manager, L. W. Cole; secretary, H. J. Vorsimer; treasurer, Mark Levin.

COLE STORAGE BATTERY CO.—Chicago, Ill. Manufacturer of storage batteries. Business established 1917. President and general manager, P. C. Cole; secretary and treasurer, T. A. Bartlett. Main office, 2437 Indiana Ave., Chicago, Ill. Branch office, 414 Locust St., Evansville, Ind. Sales representatives, Auto Tire Sales Co., 1106 Harmon Pl., Minneapolis, Minn.; Cate's Battery Service, 117 S. Court St., Rockford, Ill.

COLEMAN LAMP CO.—Wichita, Kans. Manufacturer of foot ammeter for electroplating purposes and gasoline lighting equipment. Business established 1901. President and general manager, W. C. Coleman; vice-president, J. H. Graham; secretary-treasurer and sales manager, C. E. Parr. Main office, 220-224 St. Francis Ave., Wichita, Kans. Factories, Wichita, Kans., and Toronto, Ont., Can. Branch offices and warehouses, Hunter & Madison Sts., Atlanta, Ga.; 213-217 N. Desplaines St., Chicago, Ill.; 409 N. Akard St., Dallas, Tex.; 120 S. Los Angeles St., Los Angeles, Cal.; 282 E. 6th St., St. Paul, Minn.; 1005 Summit Ave., Toledo, Ohio.

COLES.—Trade name for electric meat and food choppers, bone, coffee and laboratory grinders and meat slicers manufactured by the Braun Co., 1615-35 N. 23rd St., Philadelphia, Pa.

COLGAN CO., W. H.—West Newton, Mass. Manufacturer of outlet boxes and ceiling plates. Business established 1900. President, W. H. Colgan; secretary and treasurer, R. Knealand.

COLLECTOR RING.—A contact ring mounted on a rotating part, such as an a-c. armature or field structure or turntable, upon which ring one or more brushes bear so that an electrical connection is made to the circuits on the rotating part. Collector rings are now more commonly called slip rings, although the former term is still widely used. especially in connection with revolving-armature a-c. generators and inverted synchronous converters in which the collector rings are actually used to collect the alternating current produced. See Slip rings.

COLLECTOR RINGS, TEMPERATURE LIMIT OF.—The temperature of collector rings or slip rings is not permitted to exceed at any spot a value dependent on the insulation employed, either in the collector rings themselves or in adjacent insulation. This value, which varies with the character of the insulation, is generally about 125°C.

COLLECTORS, CURRENT, THIRD-RAIL.—See Shoes, third or contact rail.

COLLECTORS, MISCELLANEOUS, OVERHEAD TROLLEY.—Switching locomotives or cars and mining locomotives very often are equipped with special collectors that do not require the attention and time that a trolley wheel would in changing from one trolley wire to another. They usually provide a long bow contact which slides on the trolley wire and will allow considerable movement laterally. Because the contact area in this type is rather small they are not adapted to collection of very large currents. The collector is supported by two poles joined together and so constructed as to act like a single trolley pole. For controlling crossing signals, station signal bells and sometimes block signals, special contactors are occasionally provided alongside the trolley wheel to close the signal circuit as the wheel passes a contact and open it on passing another one. For heavy and high-speed service pantograph collectors are used; see Pantographs, trolley collector.

Manufacturers:

Nachod Signal Co., Inc., 4771-4777 Louisville Ave., Louisville, Ky.

COLLECTORS, PANTOGRAPH.—See Pantographs, trolley collector.

COLLEGES OF ELECTRICAL ENGINEERING.—A list of American and Canadian colleges and technical schools that have courses in electrical engineering for students in attendance is given under Education, electrical.

COLLINS-WAGNER MFG. CO.—122 W. 43rd St., New York, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1912. President, Charles Wagner; secretary, treasurer and general manager, A. V. Collins. Factory, 37 9th Ave., New York, N. Y.

COLLINSON-HOLLAND CO.—253 Medford St., Malden, Mass. Manufacturer of electrical boxes, outlet plates and cable clamps. Business established 1917. President and general manager, Gordon F. Holland; vice-president, Alfred E. Collinson; secretary, Ernest H. Johnson; treasurer, Virgil C. Gates.

COLLOID.—A state intermediate between solution and suspension. The particles of a colloid are too fine to settle and pass through filters, yet they are composed of molecular aggregates larger than single molecules. Such suspensions never crystallize, but give amorphous deposits when water is driven off. They prevent the crystallization of other salts from solution. Glue or gelatine are typical colloids when suspended in water, but there are colloidal forms of many metallic salts and even of the metals themselves, for example, the gold coloring in Venetian ruby gold glass.

COLLYER INSULATED WIRE CO.—249 N. Main St., Pawtucket, R. I. Manufacturer of insulated wires. Business established 1902. President. H. W. Fitz; secretary, D. S. Davis; treasurer and general manager, R. C. Moeller.

COLONEL.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

COLONIA.—Trade name for boudoir lamp manufactured by J. M. McDowell, Inc., 222 E. 42nd St., New York, N. Y.

COLONIAL.—Trade name for motors, generators, motor-generators, exhaust fans, etc., manufactured by the Colonial Fan & Motor Co., Warren, Ohio.

COLONIAL.—Trade name for incandescent lamps manufactured by the Colonial Electric Division, National Lamp Works of General Electric Co., Warren, Ohio.

COLONIAL.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Inc., Parkersburg, W. Va.

COLONIAL.—Trade name for illuminating glassware manufactured by the U. S. Glass Co., Pittsburgh, Pa.

COLONIAL ART GLASS CO.—Meriden, Conn., Manufacturer of portable lamps and art glass domes. President, Leon J. Rainaud; treasurer, John J. Girard. Sales representatives, Casey, Sheidon, Foster, Inc., 165 High St., Boston, Mass.; 200 5th Ave. Bldg., New York, N. Y.; Manheim Bros., 109 Broad St., New York, N. Y.; Federal Sales & Supply Corp., 1024 Farmer St., Detroit, Mich.

COLONIAL CHANDELIER WORKS, INC., 122-130 Centre St., New York. N. Y. Manufacturer of lighting fixtures. Business established 1905. President and general manager, H. W. Grossman; vice-president, Frank M. Byrne.

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COLONIAL COPPER CLAD.—Trade name for copper-covered steel wire manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

COLONIAL CREOSOTING Co.—Louisville, Ky. Producer of creosoted poles, posts, ties and underground conduit. Main office, 401 W. Main St., Louisville, Ky. Branch office, Bogalusa, La. Plants, Manville, N. J.; Paterson, N. J.; Rome, N. Y.; Toledo, Ohio; Indianapolis, Ind.; Bloomington, Ind.; Russell, Ky.; Marion, Ill.; Kansas City, Mo.; Springfield, Mo.; Hugo, Okla.; Shreveport, La.; Deridder, La.; Bogalusa, La.; Brunswick, Ga.; Trenton, Ont., Can.

COLONIAL ELECTRIC DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Warren, Ohio. Manufacturer of incandescent lamps. Douglass Wood, general manager.

COLONIAL FAN & MOTOR CO., THE.—Warren, Ohio. Manufacturer of motors, generators, motor-generators, fans, etc. President, George H. Jones; vice-president and treasurer, W. C. Ward; secretary and treasurer, C. R. Siegfried.

COLONIAL LAMP.—Trade name for portable lamps manufactured by the Colonial Art Glass Co., Meriden, Conn.

COLONIAL SIGN & INSULATOR CO.—Akron, Ohio. Manufacturer of electrical porcelain. President, James R. Hemphill; vice-president, R. E. Armstrong; secretary and treasurer, W. H. Motz.

COLOR CODE.—An arrangement of colors used on the insulation of telephone switchboard cables by means of which the pairs and individual wires may be identified without testing. The following colors form the basis of most codes; blue, orange, green, brown, slate. White and red are combined with those of the series so as to obtain a very large number of wires and pairs, if desired.

COLOR FADE-OMETER.—Trade name for color testing outfits manufactured by the Atlas Electric Devices Co., 366 W. Superior St., Chicago, Ill.

COLOR-MATCHING LAMPS AND OUTFITS.—Special lamps used for color matching in places where it is important to see colors as they would appear in daylight. Where extreme refinement of definition is required it is necessary to define what kind of daylight is to be taken as standard, as midday sunlight, north skylight, and late afternoon or early morning sunlight differ in the relative amount of different colors of the spectrum.

The Moore tube light filled with carbon dioxide gives daylight color values without the use of light filters. This is one form of color-matching light formerly used. The present generally used forms consist of gas-filled tungsten lamps, equipped with globes or filter glasses, which filter out and absorb the excess of red and yellow in the tungsten lamp spectrum, and give as a result a light closely approaching daylight. A common form of such units is a reflector in which the lamp is placed, and a glass filling the mouth of the reflector, through which all the light must pass. This glass is of the proper bluish color to absorb the proper amount of red and yellow light to permit only sufficient light of the various colors to pass through to give daylight. A less accurate method of obtaining daylight in common use is to color the lamp bulb, as in the Mazda C-2 lamp. Inasmuch as the correction of the tungsten lamp color to the daylight of a north sky causes considerable loss by absorption, the colored lamp bulb on the market at present only contains enough color to give the resultant light a color approaching afternoon sunlight. Another unit for approximating daylight consists of an ordinary tungsten lamp placed in a color-absorbing reflector, the resulting light being the sum of the direct and reflected light. For stores, retail and wholesale, and for manufacturers of materials for wearing apparel and other colored objects that are likely to be observed as much under artificial light as under daylight, units which give both ordinary artificial and daylight are made. With this equipment high intensities are furnished, so that booths, cabinets, etc., are not found necessary.

Color-matching lamps and outfits are of service not only in dry goods stores and other mercantile establishments, but in textile mills, dye houses, color printing rooms, paint works, etc. Their use permits much saving of time over the former practice of waiting for a fairly bright day. Their color is much more constant than that of ordinary daylight, especially in districts where cloudiness often prevails. In some industrial establishments all color selection and matching is done under the light of such special artificial units, an entire room being not infrequently so equipped exclusively and ordinary daylight entirely barred from it.

Manufacturers:

ARTIFICIAL DAYLIGHTING CO., INC., 227 W. 17th St., New York, N. Y. Manufacturers of Macbeth daylight lamps and Macbeth color indentification lamps. Designed in close cooperation with the users from the standpoint of seeing color truthfully anywhere at any time. Daylight reproduction is guaranteed; exactly like daylight in its effect on colored objects. Used since 1915 in hundreds of locations for color or critical eye taxing examinations. Furnishes high intensities of both daylight and ordinary artificial light for observation of outdoor and indoor color effects. This is the only method by which matches and harmonizing combinations can be proven satisfactory or rejected, as different base dyes will show different colors matching under one light and not under another. Booths and cabinets not necessary. All filters are glass with the colors in the glass. Are guaranteed against heat breakage, fading, or change in the color of light. Daylight reproduction graded over two hundred points from sunlight to clear north skylight, to produce any specified color or intensity. More than twenty sizes and styles of fixtures available for different uses. Using clear glass incandescent lamps on any service 110- to 125- volts, 220- to 250- volts, d-c. or a-c. Fixtures keep cool, fully ventilated to reduce the radiant heat below the fixtures and to conform with the National Board of Fire Underwriters' rulings that exterior parts "shall not exceed 200° F."—Adv.

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "Dalite." (See display adv. pages 1231-1234.)

Bradford & Co., I. L., 178 W. Jackson Blvd., Chicago, Ill. "Bradlite."

Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.

GENERAL ELECTRIC CO., Schenectady, N. Y. Outfits which provide a low-priced illuminant that shows colors in their true values. Used in dyeing and finishing plants, dyestuff plants, paper mills, and general testing and research laboratories. Furnishes practically the same light as comes from a clear north sky. Can be furnished for operation on 110- or 220-volt a-c. or d-c. circuits. See adv. pages 1203-1223.—Adv.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "Truda," "Trudalight." (See display adv. page 1405.)

Turnbull Electric Mfg. Co., Inc., 1237 Atlantic Ave., Brooklyn, N. Y.

COLOR-TESTING OUTFITS.—This apparatus is used to determine the lasting qualities of colors used in paints, varnishes, dyes, lacquers, etc. Ordinarily tests are made by subjecting the samples to bright sunlight, but this can only be done for relatively few hours at a time with occasional long cloudy intervals between with little sunlight and, of course, the regular nights intervening also. The color-testing outfits relieve this uncertainty by providing a lamp, in some cases a "daylight" lamp, which will burn continuously for a considerable period of time and at a very nearly constant candlepower and color value. The samples are arranged around the lamp at uniform distances from it and are kept in this position for some time. Accelerated comparative tests are thus made possible. Dyed materials are very often tested in this manner to see how long they will resist the action of light without fading.

Manufacturers:

Atlas Electric Devices Co., 366 W. Superior St., Chicago, Ill. "Color Fade-Ometer."

COLORADO.—Trade name for mine signaling systems manufactured by the Flint Electric & Mfg. Co., 1412 Delgany St., Denver, Colo.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION.—President, Charles A. Semrad, general manager, Western Light & Power Co., Boulder, Colo.; secretary, Miss M. B. W. Baker, Denver Gas & Electric Light Co., Denver, Colo.

COLORING OR FROSTING COMPOUNDS, INCANDESCENT LAMP.—Specially prepared lacquers or coloring compounds into which lamps are dipped to give various colors. The compounds are made in a number of forms, some drying in a very few minutes and others requiring several days to dry. They generally are furnished in liquid form and merely require thinning in some cases. The lamps may be dipped in the can and then set aside to dry. Frosting compounds are usually applied in a similar manner, although they are sometimes furnished in powder form and require mixing.

Colored lamps are widely used to give pleasing color effects in theaters, signs, restaurants, show windows, homes, etc. Frosting is used to aid diffusion of the direct light from the filament. In recent practice permanently colored bulbs, in which the glass itself is colored instead of having color externally applied, have come into considerable use for outdoor service especially. A white-enameled bulb has also been introduced to serve in places of applied frosting.

Manufacturers:

Arts Electrical Co., 25 Grand St., Troy, N. Y. "Safety Frost."

Barrett & Co., M. L., 233 W. Lake St., Chicago, Ill.

Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal. "Epco."

Franche & Co., C. E., 440 Orleans St., Chicago, Ill. "Cefco," "Franco," "Orleans," "Permacolor" coloring, "Puritan" lamp frosting.

Frostol Chemical Co., Inc., 799 Greenwich St., New York, N. Y. "Frostol."

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

Hallberg, J. H., 25 W. 45th St., New York, N. Y.

Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Frost-On."

McGill Mfg. Co., Valparaiso, Ind. "Crescent."

Technical Color & Chemical Works, 382 Hudson St., New York, N. Y. "Red Devil."

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Signaloid."

Waukegan Chemical Co., Waukegan, Ill.

COLORLENS.—Trade name for color lighting equipment manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

COLOR-RAY.—Trade name for color lighting equipment manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

COLT'S PATENT FIRE ARMS MFG. CO.—Hartford, Conn. Manufacturer of electric dishwashers. Exclusive distributors, Couch & Dean, 1480 Broadway, New York, N. Y.

COLUMBIA.—Trade name for ammeters, voltmeters, connectors and batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

COLUMBIA.—Trade name for incandescent lamps manufactured by the Columbia Lamp Division, National Lamp Works of General Electric Co., St. Louis, Mo.

COLUMBIA.—Trade name for electrical cabinets, cutout boxes and safety switches manufactured by the Columbia Metal Box Co., 224-228 E. 144th St., New York, N. Y.

COLUMBIA.—Trade name for armored cable and flexible metallic conduit manufactured by the Columbia Metal Hose Works, 540-550 W. 58th St., New York, N. Y.

COLUMBIA.—Trade name for electrical dental instruments manufactured by the Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y.

COLUMBIA.—Trade name for batteries, pocket ammeters and voltmeters, carbons and other carbon products manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

COLUMBIA.—Trade name for watt-hour meters manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

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COLUMBIA.—Trade name for gages manufactured by the Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y.

COLUMBIA.—Trade name for electric dumbwaiters manufactured by J. G. Speidel, Reading, Pa.

COLUMBIA GRAFONOLA.—Trade name for electrically operated phonographs manufaotured by the Columbia Graphophone Co., Woolworth Bldg., New York, N. Y.

COLUMBIA GRAPHAPHONE CO.—New York, N. Y. Manufacturer of electric dictating systems and phonographs. President, Van Horn Ely; vice-president, secretary and treasurer, C. W. Wooddot; vice-president and general manager, H. L. Willson. Main office, Woolworth Bldg., New York, N. Y. Factory, Bridgeport, Conn. Branch offices, Akron, Ohio; Atlanta, Ga.; Baltimore, Md.; Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Des Moines, Iowa; Grand Rapids, Mich.; Hartford, Conn.; Indianapolis, Ind.; Kansas City, Mo.; Los Angeles, Cal.; Minneapolis, Minn.; Montreal, Que., Can.; New Haven, Conn.; New Orleans, La.; New York, N. Y.; Pittsburgh, Pa.; Philadelphia, Pa.; Portland, Ore.; Providence, R. I.; Rochester, N. Y.; Salt Lake City, Utah; San Francisco, Cal.; Seattle, Wash.; Spokane, Wash.; Springfield, Mass.; St. Louis, Mo.; St. Paul, Minn.; Toledo, Ohio; Toronto, Ont., Can.; Washington, D. C.; Worcester, Mass.

COLUMBIA HOIST & CRANE CO.—Borden & Van Pelt Aves., Long Island City, N. Y. Manufacturer of electric cranes and hoists. Business established 1916. President and treasurer, L. U. La Caur; vice-president and general manager, S. J. Devoe; secretary, E. V. Vorm; sales manager, S. Lawrence.

COLUMBIA HOT SHOT.—Trade name for ignition batteries manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

COLUMBIA LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—St. Louis, Mo. Manufacturer of incandescent lamps. A. C. Garrison, general manager. Main office, 706 Chestnut St., St. Louis, Mo. Branch offices, 492 Philadelphia Bourse, Philadelphia, Pa.; 200 Devonshire St., Boston, Mass.; 316-326 S. Wells St., Chicago, Ill.

COLUMBIA MACHINE WORKS & MALLEABLE IRON CO.—Brooklyn, N. Y. Manufacturer of electric railway car equipment and tools. Main office, Atlantic Ave. & Chestnut St., Brooklyn, N. Y. Branch office, 50 Church St., New York, N. Y. Sales representatives, J. L. Whittaker, 141 Milk St., Boston, Mass.; E. Allison Thronwell, 1026-7 Atlanta Trust Bldg., Atanta, Ga.

COLUMBIA METAL BOX CO.—New York, N. Y. Manufacturer of cutout boxes, safety switches, steel cabinets, etc. Business established 1908. President, treasurer and general manager, A. E. Blackman; vice-president, A. A. Parmet, M. J. Karp; secretary, J. Freidman. Main office, 224-228 E. 144th St., New York, N. Y. Branch offices, 10 High St., Boston, Mass.; 1111 Keystone Bldg., Pittsburgh, Pa.; 1160 Monadnock Block, Chicago, Ill.; 568 1st Ave., S., Seattle, Wash.

COLUMBIA METAL HOSE WORKS.—540 W. 58th St., New York, N. Y. Manufacturer of armored cable.

COLUMBIA STEEL CO., THE.—Elyria, Ohio. Manufacturer of sheet steel for electrical purposes. Business established 1902. President, C. D. Smith; vice-president and general manager, Charles E. Lozier; secretary, E. J. Scott; treasurer, W. L. Smith. Sales representatives, Edgar F. Ward's Sons Co., Boston, Mass., Philadelphia, Pa., Newark, N. J., 1455 W. 37th St., Chicago, Ill.; Pittsburgh Shafting Co. of Detroit, Detroit, Mich.

COLUMBIA X-RAY & ELECTRIC CORP.—Austin Pl. & E. 144th St., New York, N. Y. Manufacturer of electrical dental instruments. Business established 1917. President and general manager, B. L. Spitzer; vice-president, R. Spitzer; secretary, treasurer and sales manager, F. A. Spolane.

COLUMBIAN HARDWARE CO., THE.—Cleveland, Ohio. Manufacturer of switch boxes.

COLUMBUS.—Trade name for chains manufactured by the Columbus McKinnon Chain Co., Columbus, Ohio.

COLUMBUS.—Trade name for insulating paints, varnishes, compounds, etc., manufactured by the Columbus Varnish Co., 264 Cozzins St., Columbus, Ohio.

COLUMBUS HANDLE & TOOL CO., THE.—Columbus, Ind. Manufacturer of linemen's tools. Business established 1890. President and general manager, H. Lee Bassett; vice-presidents, William F. Bassett and Jesse E. May; secretary, Herbert W. Bassett; treasurer, C. S. Way. Sales representative, Surpless Dunn & Co., Chicago, Ill., and New York, N. Y.

COLUMBUS-McKINNON CHAIN CO.—Columbus, Ohio. Manufacturer of chains. Business established 1900. President and general manager, C. M. Wambaugh; vice-presidents, George J. Armstrong, Daniel Carroll; secretary, A. R. Markel; treasurer, L. E. McKinnon; sales manager, J. M. White. Main office, 5th & Merritt Sts., Columbus, Ohio. Branch offices, 30 Church St., New York, N. Y.; Union Bank Bldg., Pittsburgh, Pa.; Railway Exchange Bldg., Chicago, Ill.; 1310 Pioneer Bldg., St. Paul, Minn.; Southwestern Life Bldg., Dallas, Tex.; 401 Wells Fargo Bldg., San Francisco, Cal.

COLUMBUS VARNISH CO., THE.—264 Cozzins St., Columbus, Ohio. Manufacturer of insulating paints, varnishes, compounds, etc. Business established 1892. President, treasurer and general manager, W. S. Hanna; vice-presidents, S. W. Hanna; J. H. Bryant, J. B. Hanna; secretary, W. K. Soheer; sales manager, S. W. Hanna.

COLYTT LABORATORIES.—565 W. Washington St., Chicago, Ill. Manufacturers of telephone mouthpieces and ear cushions for telephone receivers. Business established 1914. Frederick A. Watkins, proprietor. Sales representative, Standard Circulation Co., 324 Perry Bldg., Philadelphia, Pa.

COMBAT.—Trade name for storage batteries manufactured by the Commercial Battery Co., 759 Boston Ave., Chicago, Ill.

COMBER.—Trade name for leather belting manufactured by George Rahmann & Co., 31 Spruce St., New York, N. Y.

COMBINATION ENGINE & COMPRESSOR CO., INC., THE.—15 Leon St., Bradford, Pa. Manufacturer of gas and gasoline engines. Business established 1895. President, R. A. Dresser; vice-president and general manager, C. F. Watriss; secretary and treasurer, Howard Whitling.

COMBS.—Trade name for gyratory foundry riddle made by the Great Western Mfg. Co., Box 813, Leavenworth, Kans.

COMBS, ELECTRICALLY HEATED.—A comb equipped along and within the back with an insulated heating element which is connected to electrical supply wires through the comb handle; it is fitted with flexible cord and attachment plug for connection to a lamp socket or receptacle. Such combs take only 40 or 50 watts and are useful in drying the hair after a shampoo. Combs are also made for attachment to electric curling irons; the back of the comb is hollow and can be slipped snugly over the round nickeled rod of the curler so that the heating element in the latter heats the comb.

Manufacturers:

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

COMBUSTION ENGINEERING CORP.—New York, N. Y. Manufacturer of mechanical stokers and furnace equipment. President, George E. Learned; vice-presidents, J. V. Santry, J. S. Skelly; secretary, M. P. Talmadge; treasurer, G. H. Hansel. Main office, 43-47 Broad St., New York, N. Y.; Factories, Pottsville, Pa.; Coshocton, Pa.; Frederick, Md.; Galt, Ont., Can. Branch offices, Philadelphia, Pa.; Hazleton, Pa.; Pittsburgh, Pa.; Albany, N. Y.; Boston, Mass.; Detroit, Mich.; Milwaukee, Wis.; Birmingham, Ala.; Salt Lake City, Utah; Denver, Colo.; 38 S. Dearborn St., Chicago, Ill.; 521 Candler Bldg., Atlanta, Ga. Sales representatives, L. S. Pollard Co., Minneapolis, Minn.; Omaha, Neb.; Taylor Engineering Co., Vancouver, B. C., Can.; John T. Farmer, Montreal, Que., Can.

COME IN ON THE LINE.—An expression which means that a person connects a telephone set across the line so that he can hear and talk. Sometimes spoken of as "Getting" in on a line.

COME-ALONG.—Trade name for wire grips manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

COMEALONG.—A name much used among linemen for a type of wire grip. See Grips, wire.

COMET.—Trade name for generators, magnetos, marine lighting sets, ignition sets and truck and tractor lighting sets manufactured by the Comet Electric Co., 1237-1241 St. Paul St., Indianapolis, Ind.

COMET.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

COMET BATTERY CO., THE.—1362 E. 3rd St., Cleveland, Ohio. Manufacturer of flashlight batteries and cases. Business established 1918. President, Martin C. Krogh; vice-president, DeMott Modisette; secretary, treasurer and sales manager, R. G. Youngmeyer; general manager, William Underwood. Sales representatives, Stocker & Stott, 180 N. Market St., Chicago, Ill.; Arlington Specialty Co., 307 Slaughter Bldg., Dallas, Tex.

COMET ELECTRIC CO., THE.—1237-1241 St. Paul St., Indianapolis, Ind. Manufacturer of generators, marine lighting sets, magnetos and truck and tractor lighting sets. Business established 1920. President and treasurer, Paul H. White; vice-president, Edgar H. Evans; secretary and sales manager, B. E. Avey. Sales representatives, John L. Madsen, 120 Liberty St., New York, N. Y.; F. M. Cobbledeck & Co., San Francisco, Cal.

COMFORT.—Trade name for electric heating pads and air medicators manufactured by the Comfort Electric Atomizer Co., 959 1st Ave., New York, N. Y.

COMFORT ELECTRIC ATOMIZER CO., THE.—959 1st Ave., New York, N. Y. Manufacturer of electric heating pads and air medicators.

COMFY.—Trade name for electrically heated blanket manufactured by F. H. Hainert & Son, Minneapolis, Minn.

COMMERCIAL.—Trade name for electric sewing machines manufactured by the Commercial Electrical Supply Co., Broadway & Spruce Sts., St. Louis, Mo.

COMMERCIAL.—Trade name for enclosed fuses manufactured by the Commercial Enclosed Fuse Co., 1317 Willow Ave., Hoboken, N. J.

COMMERCIAL.—Trade name for square flax packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

COMMERCIAL.—Trade name for ball bearings manufactured by the Schatz Mfg. Co., Poughkeepsie, N. Y.

COMMERCIAL BATTERY CO.—759 Boston Ave., Chicago, Ill. Manufacturer of storage batteries. Proprietor, J. C. Mohr.

COMMERCIAL ELECTRICAL SUPPLY CO.—Broadway & Spruce Sts., St. Louis, Mo. Manufacturer of electric sewing machines, friction tape and motor-generators for battery charging. President and treasurer, William H. Nolker; vice-president and secretary, Robert E. Nolker.

COMMERCIAL ENCLOSED FUSE CO.—1317 Willow Ave., Hoboken, N. J. Manufacturer of enclosed fuses. Business established 1908. President and treasurer, F. J. Rooney; vice-president, J. Rooney; secretary, Jerome C. Jackson.

COMMERCIAL EXCELITE CO., INC.—312 N. Eutaw St., Baltimore, Md. Manufacturer of commercial lighting fixtures. President, Louis M. Rubin; treasurer, Harry Rubin; secretary, Irving Rubin.

COMMERCIAL LIGHTING WORKS, INC.—154 W. Lake St., Chicago, Ill. Manufacturer of lighting fixtures. Business established 1919. President and general manager, Louis Goldberg; vice-president and secretary, Harry Schaeffer; treasurer, Fanny Goldberg. Sales representatives, O'Connell Bros., 110 W. 34th St., New York, N. Y.

COMMERCIAL RESEARCH CO., THE.—18 E. 41st St., New York, N. Y. Manufacturer of molybdenum wire and contact points.

COMMERCIAL UTILITIES MFG. CO.—160 N. Wells St., Chicago, Ill. Manufacturer of electric signs. President, A. W. Fiege; vice-president and general manager, A. M. Tufts; secretary and treasurer, A. W. Rimke.

COMMERCIAL SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION.—Chairman, M. S. Seelman, Jr., Brooklyn Edison Co., Inc., Brooklyn, N. Y.; secretary, R. H. Tillman, new business manager, Consolidated Gas, Electric Light & Power Co. of Baltimore, Baltimore, Md.

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COMMERCIAL TRUCK CO.—Philadelphia, Pa. Manufacturer of commercial electric trucks. Business established 1906. President, E. R. Whitney; vice-president, H. S. O'Brien; secretary-treasurer and general manager, F. E. Whitney; sales manager, R. K. Merrick. Main office, 27th & Brown Sts., Philadelphia, Pa. Branch office, 405 Lexington Ave., New York, N. Y. Sales representatives, M. I. Stone, Eastern Electric Vehicle Co., 179 W. 1st St., Boston, Mass.; J. A. Sterrett, 1358 "D" St., Washington, D. C.; J. E. Fagan, 256 Main St., Buffalo, N. Y.; Arthur McNall, Lawrence St. & East Ave., Rochester, N. Y.; J. & M. Electric Co., 26 Bank Pl., Utica, N. Y.; Willis M. Thayer, 266 Pearl St., Hartford, Conn.

COMMON SENSE.—Trade name for electric washing machines manufactured by the Schuyler Electric Co., Berkeley, Cal.

COMMUTATE.—To reverse by mechanical means the direction of a current, as through a commutator on a d-c. generator. In machines provided with commutators the reversal of the current takes place successively in the armature coils while the commutator segments to which a coil is connected are passing under the brushes. The self-inductance of the coil opposes the reversal of the current so that, if the change is not completed when the segments leave the brushes, a spark occurs. This may be prevented by having the coils cut a "commutating field" which develops an e.m.f. approximately equal and opposite to the e.m.f. of self-inductance. Such a field is often provided by a series winding on an auxiliary pole, called an interpole or commutating pole.

COMMUTATING POLE.—A small pole placed between the main field poles of d-c. machines and provided with a series winding so as to produce a commutating field proportional to the load current. Also called interpole. Such poles are very commonly used on d-c. generators, adjustable-speed d-c. motors, d-c. railway motors, and synchronous converters. They practically eliminate sparking.

COMMUTATION.—The act of commutating, or reversing a current by mechanical means. The term is most commonly employed to denote the reversals which are produced by means of commutators on electric generators and motors.

COMMUTATOR.—In general, a device that reverses the direction of a current; more commonly, a multisegmented structure attached to the armature of a dynamoelectric machine, which serves to reverse the direction of the current in the armature coils as the commutator bars or segments, to which these coils are connected, pass under the brushes that bear on the commutator. In a d-c. generator or motor, the commutator maintains the current in the external circuits practically constant while that in the armature conductors alternates as they pass from one pole to the next. In a-c. motors, the commutator causes the current in the armature coils to reverse independently of the reversals in the entire circuit. The primary object of the commutator in d-c. machines and in some a-c. motors is to control the relative directions of the current inside and outside the armature. In other a-c. motors, the object of the commutator is to assist in providing a means for controlling the speed or for modifying the power-factor of the motor.

Commutators are generally built of bars or segments of copper insulated from each other by mica and assembled to form (usually) cylindrical surfaces on which the brushes make electrical contact. The bars are electrically connected to the armature conductors directly or through commutator risers. The usual cylindrical type of commutator lengthens the armature shaft considerably. In some machines this additional length of shaft is objectionable where the space available for the machine is very cramped; in such cases the commutator is built as a plane circular ring with flat radial bars or segments; in this radial or disk type the brushes bearing against the bars are parallel or nearly parallel with the shaft.

COMMUTATOR BARS.—The conducting bars constituting the contact parts of a commutator. For details and manufacturers see Bars, commutator.

COMMUTATOR BUILDING RING.—A ring provided with movable segments and adjusting screws for holding and clamping a commutator while it is being assembled.

COMMUTATOR CO.—125 1st St., N., Minneapolis, Minn. Manufacturer of commutators and commutator parts. Business established 1896. President, R. D. Boneu; vice-president, M. C. Boneu; secretary, R. E. Hutchins.

COMMUTATOR FILLING.—The completely assembled set of commutator bars, insulating segments and all insulating rings and sleeves is sometimes called the commutator filling. The filling is usually compressed and baked before it is assembled into the commutator shell.

COMMUTATOR INSULATING SEGMENTS, RINGS, COLLARS AND SLEEVES.—The insulation between the sides of the commutator bars is almost always made of mica plates or sheets, often called commutator insulating segments. All insulation between the ends of the assembled commutator bars and the ends of the supporting shell is usually made of mica or mica composition rings, properly called commutator insulating rings. These rings are of several shapes; flat rings that fit against the square lower ends of the bars; plain or straight taper rings, curved taper rings, tapered band rings and V-rings, or double-taper rings that fit into the V or constricted parts of the bars. V-rings are made solid for small commutators and sectional for large ones such as exceed about 24 ins. in diameter; the sectional rings are made in two layers with overlapping joints. Taper and V-rings are sometimes called commutator collars. Below the commutator bars and separating them from the shell is an insulating sleeve usually made of mica or mica composition. Fiber and Bakelite or similar molded insulations are often used for the small commutators in place of mica.

Manufacturers:

AMERICAN BRASS CO., THE, Waterbury, Conn. Straight bars of commercial lengths, multiples of a given length, and in the form of segments sawed or punched to size. The conductivity of commutator copper is maintained fully up to the standard of hard drawn copper wire of the highest grade. (For location of mills and factories, see alphabetical listing under firm name.)—Adv.

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Bridgeport Brass Co., Bridgeport, Conn.

Cameron Electrical Mfg. Co., 205 Main St., Ansonia, Conn. (Segments.)

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

CHICAGO MICA CO., Valparaiso, Ind. Micabond commutator rings and segments are manufactured in all sizes and kinds from the smallest vacuum cleaner motor to the largest types of special motors, furnished in any style, complete "V" ring, bands and tapers, cones or sets. Segments furnished to any desired drawing of finest quality plate. For other Chicago Mica Co. products see display adv. page 1320.—Adv.



Micabond Commutator Ring

Commutator Co., 125 1st St., N., Minneapolis, Minn.

Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.

Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."

Doubleday-Hill Electric Co., 719-21 Liberty Ave., Pittsburgh, Pa.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Eureka Co., North East, Pa.

Fillion, Inc., S. O., 68 Murray St., New York, N. Y.

Gee Electric Co., Wheeling, W. Va. (Segments.)

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."

Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.

Mica Insulator Co., 68 Church St., New York, N. Y. (Rings and segments.)

Mica Insulator Co., Ltd., Victoriaville, Que., Can.

Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Phonograph Appliance Co., 174 Wooster St., New York, N. Y.

ROME BRASS & COPPER CO., Rome, N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry. See display adv. page 1247.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.

Tar Heel Mica Co., The, Plumtree, N. C.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMMUTATOR PITCH.—See Pitch, commutator.

COMMUTATOR RING.—An insulated metal ring or band, usually of steel, placed around a commutator for the purpose of holding the bars securely in place. These rings are used only on high-speed commutators to prevent the commutator bursting to pieces on account of high centrifugal force.

COMMUTATOR RISER.—The electrical conductor, extending usually radially, from a commutator bar to the armature winding. In small machines the terminal wire of each armature coil is connected directly to the commutator bar, but in large machines commutator risers serve as a connection between the winding and the commutator. The outer end of the riser is often notched to facilitate soldering the wire.

COMMUTATOR SHELL.—The complete metal support into which the commutator filling is assembled. It consists of several parts, varying in number with the size and design of commutator. These parts may include a hub, clamping rings or followers, clamping bolts or studs. The shell of the completed commutator is usually keyed to the armature shaft, sleeve or spider.

COMMUTATOR SLOTTING.—Commutator slotting consists of removing the mica insulation between bars to a slight depth, usually $\frac{1}{32}$ to $\frac{1}{16}$ in. below the surface of the commutator. It permits the use of a hard low friction brush without abrasive action. The use of this kind of a brush not only gives a longer brush life, but will make the commutator outwear the rest of the machine. It also reduces about 70% of the power loss caused by high-friction brushes, which is quite a factor in raising the efficiency of many machines. High mica is usually the result of sparking which burns away the copper bars, leaving the mica protruding; this condition continues to grow worse if once started and produces flat spots, further sparking, glowing of the brushes, heating of the commutator, etc., all of which are obviated by undercutting the mica. Where the commutator cannot be kept free from oil and greasy dirt, it is well to undercut it and fill up the slots with cement, paint or air-drying varnish. The use of a commutator stone or undercut commutators is important, as even fine sandpaper will leave scratches which the nonabrasive brush may take weeks to wear down.

COMMUTATOR SLOTTING FILES AND DEVICES.—Outfits for removing the mica insulation between commutator bars for a short distance below the outside surface. These are usually small hand-operated devices which may be used without removing the armature. One common form is a sharp tipped three-cornered file which cuts a "V" slot. They are also used to clean out the slots after they have been undercut by some other slotting machine. Modifications of hacksaws are sometimes used, also occasionally knife blades; these require greater care and are not so rapid as the special slotting files.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

GREEN EQUIPMENT CORP., 53 W. Jackson Blvd., Chicago, Ill. "Aurand."

Martindale Electric Co., The, 11737 Detroit Ave., Cleveland, Ohio.

Thompson Mfg. Co., Meadville, Pa.

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COMMUTATOR SLOTTING MACHINES.—Machines for removing the insulation between commutator bars for a short distance below the outside surface. These machines are generally designed to be used on armatures after they have been removed from the motor or generator and mounted in a lathe, shaper, or special stand. In general, they consist of a small milling saw (about 0.005 in. larger than the width of the mica), which is mounted in an adjustable pedestal and moved along the slot. Specially ground tools placed in a shaper are also used.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Electrical Devices Co., Mt. Vernon, N. Y. "Burke."
GREEN EQUIPMENT CORP., Monadnock Block, Chicago, Ill. The "Aurand" commutator slotter, a motor-driven, hand-operated portable tool, weighing only ten pounds, hence easily operated.



"Aurand" Commutator Slotter

Carries a 1½" saw, guide, depth shoe, et cetera, assuring perfect operation. Including a universal motor for operation at either 110- or 220-volt service. —Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMMUTATOR STONES.—An abrasive stone, either natural or artificial, for removing inequalities on the surface of a commutator resulting from the wear of the brushes. Application of such stones with a moderate pressure against the commutator smooths it much more effectively than the old method of using sandpaper on a wooden block, which often left the commutator seriously scratched though generally more even than before the paper was applied. Commutator stones are of several grades of fineness; the coarse grades are used on badly worn commutators, then finer grades are applied for finishing and finally polishing.

Manufacturers:

ACME ABRASIVE CO., 2221-23 Orchard St., Chicago, Ill. "Acme."
Boston Armature Works, 77 Washington St., N., Boston, Mass.
Canadian Aloxite Co., The, Niagara Falls, Ont., Can.
Carborundum Co., The, Niagara Falls, N. Y.
GREEN EQUIPMENT CORP., Monadnock Block, Chicago, Ill. "Acme" commutator stone is an abrasive block (type UF below), made in different types, sizes and grades to meet the various sizes and speeds of commutators and collector rings. The coarse grade



"Acme" Commutator Stone

grinds down flat spots, ridges, high mica, et cetera. Finer grades for finishing and polishing. Acme stones reduce sparking and needless wear on brushes, insuring perfect commutation. Thousands use Acme stones as a preventative after they have cured their troubles.—Adv.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

Hallberg, J. H., 25 W. 45th St., New York, N. Y.
IDEAL COMMUTATOR DRESSER CO., 3229-31 Sheffield Ave., Chicago, Sole Manufacturers Ideal Commutator Resurfacer. A manufactured abrasive stone that removes all mica and high spots from commutators or rings. It is not necessary to remove them from



Ideal Commutator Resurfacer

motor or generator. Simply apply the Ideal while the armatures are rotating and stop sparking and loss of power immediately. The Ideal is nonmetallic and therefore does not cause short-circuiting. It will not fill up with copper dust.—Adv.

Martindale Electric Co., The, 11737 Detroit Ave., Cleveland, Ohio. "Imperial," "Handy."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

COMMUTATOR, TEMPERATURE LIMIT OF.—The temperature limit at which a commutator may operate is set only to protect the insulation of the commutator or of adjacent parts and does not indicate the limit of successful commutation. The value depends upon the character of the insulation and in general is about 125°C.

COMMUTATOR TRUING TOOLS AND DEVICES.—Outfits for removing, usually by a cutting tool, the more serious irregularities in the surface of a commutator that are produced by nonuniform wear of the brushes. Some outfits consist merely of a tool holder like that of a lathe; the commutator of the motor or generator is revolved at moderate speed without removing the armature from the frame and by moving the tool along the commutator a light cut is taken. Other outfits consist practically of a lathe structure to which the armature is removed and a cut taken off the commutator by the cutting tool just as in a lathe. The latter type is used where there are many commutators of the same general type and size to be trued, as in an electric railway shop. Where only a few commutators are occasionally treated and where the wear has not been very severe, it is now more customary to use commutator stones, which see. Even with the cutting tools mentioned above, fine stones are often used for finishing.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. A device for truing commutators without removing the armature from its bearings. Made in three types, shaft, pedestal, and yoke, described in Bulletin 49001. See adv. pages 1203-1223.—Adv.
Jordan Bros., Inc., 74 Beekman St., New York, N. Y. "Jordan."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMMUTATORS, COMPLETE.—A commutator is made by many small parts, each of which must be of carefully selected materials, suitably shaped and treated, and then properly assembled to make a complete unit structure of such design and strength as will meet all the requirements of the machine on which it is to be used. Manufacturers of motors and generators in some cases have not the requisite facilities for properly building the commutators of their d-c. machines. To meet their needs other manufacturers that have made a specialty of commutator construction and have adequate facilities for their production are prepared to build commutators in quantity in accordance with almost any designs and specifications. Such commutators, as a rule, are completely assembled and ready to be keyed to the shaft and connected to the armature windings. In some cases the designs submitted can be improved on and special features introduced to the advantage of the purchaser.

Manufacturers:

Bissell Co., The F., Toledo, Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio.
Boston Armature Works, 77 Washington St., N., Boston, Mass.
BURKE ELECTRIC CO., 12th & Cranberry St., Erie, Pa.
Cameron Electrical Mfg. Co., 205 Main St., Ansonia, Conn.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chattanooga Armature Works, 1-3 Duncan Ave., Chattanooga, Tenn.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Commutator Co., 125 1st St., N., Minneapolis, Minn.
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Elliott-Thompson Electric Co., The, 203-205 St. Clair Ave., E., Cleveland, Ohio.
Fox Electric & Mfg. Co., A., 397 W. Broadway, New York, N. Y.
Gee Electric Co., Wheeling, W. Va.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
Heinze Electric Co., The, Lowell, Mass. "Heco."
Homer Commutator Co., The, 4748 Hough Ave., N. E., Cleveland, Ohio.
J & B Mfg. Co., 65 Eagle St., Pittsfield, Mass. "J & B."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Munning & Co., A. P., Church St., Matawan, N. J.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Toledo Standard Commutator Co., 2242 Smead Ave., Toledo, Ohio. "Standard."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMPARATOR.—An instrument used to calibrate a-c. instruments by comparing the indications on alternating current to those of the d-c. standard. These are usually instruments that have been calibrated by such direct comparison and are then used as a secondary standard against which the a-c. instruments may be checked. See Ammeters, precision, calibrating or laboratory standard; likewise Voltmeters, etc.

COMPARISON LAMP.—A lamp of constant but not necessarily known candlepower, against which a working standard and test lamps are successively compared in a photometer.

COMPASS, MAGNETIC.—An instrument consisting of a magnetic needle pivoted on a fine point, which usually bears against a jewel, and enclosed in a suitable case. A card graduated in degrees and having all the cardinal points clearly marked is placed below the needle so that the movement of the needle (which always points toward the earth's magnetic north pole) will indicate the bearing of any object. Magnetic compasses are used mostly on ships; their mounting is called a binnacle. They are used in electrical work to test the polarity of magnet poles and of electromagnets and to indicate the presence of a magnetic field.

COMPASSES, GRYOSCOPIC.—These outfits consist usually of two master compasses located in or near the central station, which is placed near or below the water line at the center of the ship, a number of repeater compasses used at the navigating station and a pelorus repeater for each end of the bridge used for taking bearings and sun azimuths. The master compass contains the gyro element and the necessary mechanisms for operating the repeaters. The principle upon which the gyroscopic compass operates is that any wheel freely suspended and rotating at a high speed, when placed upon a larger wheel also, rotating, will place its axis in the same direction as the axis of the larger wheel. The earth is utilized as the larger

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rotating wheel. Two small twin gyroscopic wheels in the compass are spun at a high speed by means of an electric motor and the force of the earth's rotation combines with the force of the rotating wheels, with the result that the small wheels turn their axes parallel with the earth's north and south meridian. The power supply to the gyro motor or motors in the master compass is taken from special motor-generators. The world's navies have employed the gyroscopic compass for many years, about 1100 now being in operation. The demand for this service has been so great that the merchant field has only been entered recently, but over twenty lines are now equipped with them.

Manufacturers:

Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.

COMPASSES, RADIO.—Radio compasses are a combination of antenna and receiving apparatus having directional characteristics which make it possible to determine quite accurately the position of the receiving station with respect to other transmitting stations. By means of these, two or more fixed stations can locate exactly any other transmitting station; or a ship can determine its position anywhere in midocean by radio alone by receiving signals from two fixed stations whose location is known. In addition to these features, the radio compasses may operate for ordinary reception of signals in close proximity to powerful transmitters or under atmospheric static conditions that would make the reception of signals by ordinary receivers impossible.

The compass consists of a loop or coil antenna wound on a narrow rectangular frame, which is pivoted in the center and free to rotate. A circular guide ring around the outside, which is of such size as to show the angle through which the antenna frame has been turned, is accurately divided into degrees and fractions of degrees. An indicator on the antenna moves over this scale. The receiving apparatus, which is merely a sensitive radio receiver, is generally placed in the center of the loop. When the plane of the antenna is in line with the sending station the signals received will be the loudest, and the indicator will tell the direction within one-half degree. These outfits are sometimes called direction finders. Also see Direction finding, radio.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Simon, Emil J., 217 Broadway, New York, N. Y.
Wireless Specialty Apparatus Co., C. & Fargo Sts., Boston, Mass.

COMPENSATING WINDING.—A winding placed on a machine to counteract or neutralize some undesired effect, as the windings in the pole faces of a d-c. machine to neutralize armature reaction or similar windings on a a-c. series motor to balance the self-inductance of the armature winding.

COMPENSATOR, CURRENT.—See Compensators, incandescent lamp; also Transformers, series.

COMPENSATOR, DIRECT-CURRENT.—Two or more similar d-c. machines, usually with shunt or compound excitation, directly coupled to each other and connected in series across the outer conductors of a multiple-wire distribution system, for the purpose of maintaining the potentials of the intermediate wires of the system, which are connected to the junction points between the machines. These are more commonly called balancers. See Balancer sets.

COMPENSATOR, VOLTMETER.—A special type of current transformer used with a specially wound switchboard voltmeter, which indicates the voltage at the end of a feeder. The voltmeter has a differentially wound coil which is connected to the compensator secondary. Several taps are provided to adjust for the resistance and reactance drop in the feeder. The primary of the compensator, designed for 5 amperes, is in series with the feeder, or it may be in the secondary circuit of a current transformer, the primary of which is in the feeder. As the load is increased more current flows through the differential coil in the voltmeter and thus tends to make the meter read lower. Also see Compensators, line drop.

COMPENSATORS, INCANDESCENT LAMP.—When incandescent lamps are used for community street lighting they are generally operated on a series circuit. Equipment for such circuits is standardized for the following currents: 4, 6.6, 7.5 and 10 amperes. It is often desirable to use larger and more rugged lamps than those of the same current rating as the circuit; this may apply to only part or the whole of the circuit. Lamp conpensators are then used to adapt the circuit current to that of the lamps to be used. These compensators, which are small autotransformers, are used at each lamp and usually placed in the lamp housing or fixture; the primary is connected in the series circuit and the lamp across the secondary circuit. In this manner the proper values of current and voltage for the lamps are obtained, without losing the advantages of a standard small current in the series circuit.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMPENSATORS, LINE-DROP.—Induction voltage regulators are frequently used to compensate for line drop in a lighting feeder and to maintain normal voltage at some predetermined point on the feeder distant from the station. In order to accomplish this it is necessary to provide a line-drop compensator. This consists essentially of an adjustable reactance and resistance in series and is used to reproduce in miniature the resistance drop and the reactance drop of the feeder to this predetermined point, designated as the center of distribution, when a current proportional to the load current is sent through it. The line-drop compensator may then be used to indicate the voltage at the distribution center or, when used with a feeder-voltage regulator, it permits the regulator to maintain a predetermined voltage at the center of distribution for all conditions of supply voltage, load and power-factor within the limits of the regulating equipment.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMPENSATORS, MOTOR-STARTING.—See Autostarters, motor.

COMPENSATORS, PROJECTING ARC LAMP.—Arc-lamp compensators are used largely with a-c. arcs for motion-picture projection. These lamps operate at about 35 volts, while the energy supplied to the theater may be at 110 or 220 volts or even higher. It is, therefore, necessary to reduce the voltage to the proper value and this is accomplished by the compensator. This is usually an autotransformer with adjustable secondary taps arranged so that the voltage may be varied by moving a handle. Compensators are made to be used with either one arc lamp or two in series. Small motor-generator sets to furnish direct current at the proper voltage for the more desirable d-c. arcs are sometimes specially designed to maintain a constant current and compensate for the difference in voltage and are also caller compensators. They may be driven from either an a-c. or d-c. source, but furnish d-c. energy at 55 to 60 volts for one arc or 120 volts when two are connected in series.

Manufacturers:

Barlow Electrical Specialties Co., Yonkers, N. Y.
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hallberg, J. H., 25 W. 45th St., New York, N. Y. "4 in 1."
Kentucky Electrical Co., 817 Lewis St., Owensboro, Ky. "American."
McAuley Mfg. Co., J. E., 30 N. Jefferson St., Chicago, Ill. "Peerless."
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)

COMPETITION.—Trade name for annunciators manufactured by the Partrick & Wilkins Co., 51 N. 7th St., Philadelphia, Pa.

COMPLEX IONS.—Constituents of a complex electrolyte which are liberated at the electrodes as complex groups, instead of simple atoms. Examples: SO_4 ion from sulphates: AuC_2N_2 ion from aurocyanides.

COMPODISK.—Trade name for valves manufactured by the Penberthy Injector Co., Ltd., Windsor, Ont., Can.

COMPOLITE.—Trade name for lighting fixtures manufactured by the Voigt Co., 1741—47 N. 12th St., Philadelphia, Pa.

COMPOLUX.—Trade name for composition lighting fixtures, brackets, floor and table lamps manufactured by the Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.

COMPONENT, ACTIVE OR IN-PHASE.—See Active component.

COMPONENT CURRENTS OR ELECTROMOTIVE FORCES.—The several separate currents or e.m.f.'s into which any single current or voltage may theoretically be separated. These separate component currents or voltages when acting jointly on a circuit would give precisely the same effect as the single one considered.

COMPONENT, REACTIVE OR QUADRATURE.—See Reactive component.

COMPOSITE EYE LENS.—Trade name for shields for electric welders manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

COMPO-SITE, INC.—207-215 Astor St., Newark, N. J. Manufacturer of molded insulation. Business established 1910.

COMPOSITE LINE.—This is a term used in reference to telephone or telegraph lines consisting of a plurality of successive sections having different linear electrical constants. An example of this is an underground cable section joined to an overhead open-wire section.

COMPOUND, CLARK'S.—An insulating compound used to impregnate jute yarn wrapping for use on the outside of armored submarine cable. It consists of 60 parts of mineral pitch and 40 parts of finely ground sand.

COMPOUNDS, BATTERY SEALING.—A compound which is used in sealing dry batteries and storage batteries. It is generally some kind of an asphaltum-base compound which does not soften or "run" below temperatures of about 125°F. Dry cells must be sealed to prevent evaporation of the small amount of moist electrolyte they contain and also to exclude dust and dirt. Storage cells of any portable type must be sealed to prevent splashing or spilling of the electrolyte when they are being moved about; the covers on such cells usually fit well enough to minimize evaporation and to exclude dirt, but spilling of electrolyte would occur around the edges of the cover were a sealing compound not used. This compound must soften at or below 212°F., by steaming or electric heating in an oven, to permit removal of the cover for inspection, cleaning and repair of the cell.

Manufacturers:

Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C".
Atlas Mineral Products Co., Mertztown, Pa. "G-K."
Barber Asphalt Paving Co., The, Land Title Bldg., Philadelphia, Pa. "Genasco."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill. "Besco."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian National Carbon Co., Ltd., Hillcrest Park., Toronto, Ont., Can.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
Chamberlin & Johnson, Inc., 1238-40 Voskamp St., Pittsburgh, Pa.

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CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Dicks-Pontius Co., 123-131 Wayne Ave., Dayton, Ohio. "Pontius."
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
Dolph Co., John C., 168 Emmett St., Newark, N. J.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Ferry Mfg. Co., 2113 S. 4th St., St. Louis, Mo.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo, "Lion."
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display adv. page 1320.)
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
McGill Mfg. Co., Valparaiso, Ind.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B"
Special Chemicals Co., Highland Park, Ill. "Speco."
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
Trotter & Co., E. T., 576-602 Johnson Ave., Brooklyn, N. Y.

COMPOUNDS, BRAZING.—See Brazing compounds.

COMPOUNDS, CABLE, JUNCTION BOX, POTHEAD AND TRANSFORMER FILLING AND SEALING.—The exclusion of moisture from joints and terminals of cables, such as junction boxes and potheads, also from small transformers, etc., is accomplished by filling them with molten insulating compound which fills the air spaces and, when cool, hardens into a solid mass. The degree of hardness varies with the composition, some mixtures being so hard as to be brittle and others being sufficiently plastic to be self-healing when cracked. The plastic compounds are desirable for use with potheads and high-tension work generally, but it is sometimes necessary to put on a layer of hard "capping" compound to prevent dripping. Most compounds for power cable jointing have an asphaltic base. The compounds most used become fluid at moderate temperatures. Paraffin or wax compounds are used somewhat in telephone cable jointing, but have not been found satisfactory for power cable work. Paraffin is a better insulator than asphaltum, but it has a lower melting point and a greater coefficient of expansion. Both types of compounds are acid and moisture-resisting. Bell-ringing, toy and other small, low-tension transformers with sealed cases have their cases filed with compounds similar to those used for power cable jointing.

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
Dolph Co., John C., 168 Emmett St., Newark, N. J.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display adv. page 1320.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
McGill Mfg. Co., Valparaiso, Ind.
Mica Insulator Co., 68 Church St., New York, N. Y. "Conduline."
Mica Insulator Co., Victoriaville, Que., Can.
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
Roebling's Sons Co., John A., Trenton, N. J.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B."
Standard Asphalt & Refining Co., 208 S. La Salle St., Chicago, Ill. "Sarco."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Ozite."
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Trotter & Co., E. T., 576-602 Johnson Ave., Brooklyn, N. Y.

COMPOUNDS, CHATTERTON.—Chatterton's compound is an insulating material used chiefly in submarine cable construction to fill the interstices between the strands of the cable conductors before the gutta-percha covering is applied. It is composed of three parts by weight of gutta-percha, one part of resin and one part of Stockholm tar.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Clifton Mfg. Co., 65 Brookside Ave., Boston, Mass.
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
McGill Mfg. Co., Valparaiso, Ind. "Crescent."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B."

COMPOUNDS, COMMUTATOR LUBRICATING.—A lubricant for the commutators of electrical machines. It is sometimes required to prevent scratching or scoring of the commutator when it is necessary to use a hard brush. These compounds either contain graphite or a mineral oil, such as vaseline, or some other hydrocarbon. Recent brush improvements have included the addition of lubricating compounds in the brush itself.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen."
American Oil Corp., 172 S. Water St., Jackson, Mich. "American," "Amolico," "Amoco."
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CHICAGO MICA CO., Valparaiso, Ind. For bearings difficult to lubricate or that run hot use Mica Flake Lubricant. Reduces friction. Cools hot journals while running and saves oil. A supply of Mica Flake on hand has proven a cheap insurance against loss of time due to hot journals. Mixes freely with oil and is especially effective in filling worn bearings. For other Chicago Mica Co. products see display adv. page 1320.—Adv.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Doe Electrical Device Co., Kent, Ohio.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Franklin Oil Works, Franklin, Pa. "Penngold," "Franklyne," "Keystone."
Goldmark Co., The James, 83 Warren St., New York, N. Y. "Trotters."
Hanson & Van Winkle, Newark, N. J.
Harris Oil Co., A. W., 326 S. Water St., Providence, R. I. "Harris."
Hart & Co., 124 N. Main St., Fostoria, Ohio. "Red Cross."
McLENNAN & CO., K., 1751 W. 35th St., Chicago, Ill. Sole manufacturers Gale's Commutator Compound. Prevents cutting of commutators and sparking; will not gum the brushes. Puts that high gloss on commutators that you have so long sought. Saves wear and



labor. Known and used all over the world for over 30 years. For sale by all supply houses. Write today for free sample stick. Also see display adv. page 1310.—Adv.
Ohio Grease Co., The, Loudonville, Ohio. "Triangle."
Trotter & Co., E. T., 576-602 Johnson Ave., Brooklyn, N. Y.
Walsh Co., John F., 170 North St., Pittsfield, Mass. "Anti Spark."

COMPOUNDS, COLORING AND FROSTING.—See Coloring and frosting compounds, incandescent lamp.

COMPOUNDS, CUTTING AND EXTRUDING.—Many machine-tool operations require the use of a cooling and lubricating compound to aid in lengthening the life of the tools used and to carry away the chips and particles of metal. With various punching, drawing and extruding processes the compound serves as a lubricator to reduce friction. Often rust preventive substances are included in the compound as a protection to newly cut surfaces not having a protecting scale.

The nature of the compound depends upon the work to be done. Mineral and lard oil and various substitutes are used in processes involving turning, tapping, drilling, milling, threading, automatic machine work, etc. Other compounds which are usually dissolved in water produce a milky white soapy or oily solution that flows freely and may be made in a number of proportions according to the work it must do and the hardness of the metal.

Manufacturers:

American Oil Corp., 172 S. Water St., Jackson, Mich.
Conversion Products Corp., 149 Broadway, New York, N. Y. "Bullite."

COMPOUNDS, IMPREGNATING.—Compounds used to saturate cloth, paper, braided wire, coils, etc., to improve their insulating properties and to make them resist the action of moisture, acid, gases, etc. There are many compounds used for this purpose, most of them having an asphaltic base, although paraffin and other waxes, gum, etc., are also used as a base. The requirements for such a compound are that it shall be a tough, pliable compound with a high melting point, that it is thin enough when applied so that it can saturate every part of a coil, and after hardening will not soften due to heating of the machine. When used with the vacuum process of impregnating, a heavier compound may be used and can be forced into every crevice of the coil. These compounds are made with many different melting points and for a number of special purposes. Some compounds that are used on transformer coils are oil-resisting and possess good heat-conducting properties to help maintain a low coil temperature.

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York, N. Y.
Benolite Co., Inc., 331 4th Ave., Pittsburgh, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa. "Cope."
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."

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Dolph Co., John, 168 Emmett St., Newark, N. J. "Vaculite."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa "Flexible Compound."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL PAINT CORP., St. Louis, Mo "Inco," "Insulite." (See display adv. page 1320.)
Leacock Co., A. M., 291-5 Cortlandt St., Belleville, N. J.
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "P & B."
Robertson Chemical Co., Cleveland, Ohio.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B."
Standard Insulation Co., Rutherford, N. J. "Sico."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."

COMPOUNDS, INSULATING, MISCELLANEOUS.—Special insulating compounds are frequently used to obtain special characteristics, such as a high melting point, extreme elasticity, oil resistance, heat conductivity, very high specific gravity, good adhering properties, etc. They are used for many purposes, a few being as follows: For cementing transformer leads into bushings; for sticking paper, fullerboard or coil forms together; for boiling out cable forms and cores; for reinsulating and amalgamating with rubber; for making weatherproof wire, etc. In addition there are many insulating compounds that are used in molded forms; see Bakelite; Condensite; Insulation, molded, miscellaneous.

Manufacturers:

Atlas Mineral Products Co., Mertztown, Pa.
Barber Asphalt Paving Co., The, Land Title Bldg., Philadelphia, Pa. "Glisonite."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Benolite Co., Inc., 331 4th Ave., Pittsburgh, Pa.
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Continental Fibre Co., Newark, Del. "Bakelite-Dilecto."
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa. "Cope."
Dielectric Mfg. Co., St. Louis, Mo. "Dielectric."
Dolph Co., John C., 158 Emmett St., Newark, N. J.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
Flintkote Co., Inc., The, 88 Pearl St., Boston, Mass. "Rex."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite" (See display adv. page 1320.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Mogul Co., 41 W. 39th Ct., New York.
PITTSBURGH TRANSFORMER CO., Pittsburgh, Pa. "Aerio."
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Ruberoid Co., The, 95 Madison Ave., New York, N. Y. "P & B."
Schenectady Varnish Co., Schenectady, N. Y.
Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio. "Ajax."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Insulation Co., Rutherford, N. J. "Sico."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Ozite."
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Toch Bros., 320 5th Ave., New York.
Trotter & Co., E. T., 576-602 Johnson Ave., Brooklyn, N. Y.
Vaughn Machinery Co., The, Cuyahoga Falls, Ohio.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COMPOUNDS, LUMINOUS.—Luminous compounds are used on clocks, watches, switch push buttons, bell push buttons, acorns on pull chains, gages, instruments, flashlight cases and a number of other similar articles, to enable persons to see and use them in the dark. The compounds are generally applied to the object in the form of a paste and harden without requiring baking or other special treatment. A phosphorous compound is used in some cases, while the more lasting and more expensive compounds contain a very small amount of radium. This is sometimes mixed with zinc sulphide in the ratio of about one to 10,000, giving a crystalline substance that is applied with a special liquid adhesive.

Manufacturers:

American Luminous Products Co., Huntington Park, Cal.
Cold Light Mfg. Co., 18th & Blake Sts., Denver, Colo. "Marvelite," "Wonderlite."
Radium Ltd., U. S. A., 2 W. 45th St., New York, N. Y.
Radium Luminous Material Corp., 58 Pine St., New York, N. Y. "Undark."

COMPOUNDS, SOLDERING.—See Soldering compounds or flux.

COMPOUNDS, WATER-TREATING.—Much of the water used for boiler feed in power plants has a corrosive action on the tubes and other metal it comes in contact with because of mineral substances and other impurities it contains. Even rain water which is free from mineral substances is very corrosive in its action under certain conditions. The impurities present in the water vary considerably, some river waters containing muriatic, sulphuric and other acids due to the decomposition of organic matter. Other impurities often found in varying quantities are carbon dioxide, air and dissolved oxygen, carbonates of lime and magnesia and chlorides of the same elements. Many boiler feed waters are very nearly pure when introduced into the boiler but after condensation when they again enter it may contain fatty acids, etc., which are corrosive.

Many compounds and chemicals are provided to counteract the corrosive action of these impurities and they are mixed with the feed water. Some of the chemical houses make a practice of determining the nature and amount of impurities found in the water and then developing a special compound for the particular need of that plant. These are often called "boiler compounds." For equipment designed to treat large quantities of water see Water-softening apparatus.

Manufacturers:

Bird-Archer Co., The, 90 West St., New York, N. Y
Clark Co., The Fred G., 1087 W. 11th St., Cleveland, Ohio. "Watersoft."
Dearborn Chemical Co., 332 S. Michigan Ave., Chicago, Ill.
Globe Chemical Co., 727 Ridgway Ave., Cincinnati, Ohio.
Hays Corp., The Joseph W., Michigan City, Ind. "Spizzerinktum."
Nuhring & Bro., Charles, 1212 Walnut St., Cincinnati, Ohio. "O-K."
Perolin Co. of America, The, 2010 Peoples Gas Bldg., Chicago, Ill.
Russell-Kinkaid Co., 3028 S. LaSalle St., Chicago, Ill. "Russell."

COMPOUNDS, WELDING.—See Welding flux.

COMPRESSED WOOD PRESERVING CO.—Winton Bank Bldg., Cincinnati, Ohio. Manufacturer of creosote oil, railroad ties and paving blocks. President, John H. Goyert; secretary and treasurer, George W. Frey.

COMPRESSOR GOVERNORS.—See Governors, compressor or pressure pump.

COMPRESSORS, AIR BREAK, MOTOR-DRIVEN.—A compact efficient machine comprising in one unit an electric motor driving (through special gearing) a two-cylinder single-acting air compressor, the principal and essential element of electric-railway air-brake equipment. This unit is ordinarily mounted underneath the car, hence it has to be of the enclosed type, to keep out dust, water, etc., and also must be very rugged. It is generally only on electric locomotives or cars with large cabs for the motorman that the compressor is mounted in the cab where it can have attention. The starting and stopping of the motor is usually controlled automatically by a pressure switch so as to maintain a uniform pressure in the storage reservoir. These sets are made in several capacities suitable to the various types, sizes and operating requirements of electric railway cars or trains.

Manufacturers:

Automatic Straight Air Brake Co., 210 11th Ave., New York, N. Y.
Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Center gear type compressers designed after a careful study of the exacting requirements of modern electric railway service. In use on hundreds of systems and have demonstrated their superiority over types previously used. Their tee-bolt suspension is becoming increasingly popular as railway men become familiar with this design. The important points gained are reduction in weight, ease of removal from the car, and the self-aligning characteristics of a 3-point method of support. Other advantages are described in Bulletin 44591A, mailed on request. Compressors with cradle suspensions can be furnished whenever desired. See adv. pages 1203-1223.—Adv.
National Brake & Electric Co., Belleview Pl., Milwaukee, Wis.
Westinghouse Traction Brake Co., Pittsburgh, Pa.

COMPRESSORS, AIR, MOTOR-DRIVEN, MISCELLANEOUS.—The wide application of compressed air to the various industries has called for simple, reliable compressors that require a minimum of attention. This need has been met largely by motor-driven compressors, which are made in both the portable and stationary types. They consist essentially of a motor, either a-c. or d-c., which is connected to the compressor, usually by means of a herring-bone gear and pinion and generally to a single-acting piston-type compressor. Compressors of the direct-connected centrifugal or blower type are used to some extent where a large volume of air at a rather low pressure is required. For ordinary pressures, up to about 150 lbs. per sq. in., the compressors are of the duplex piston type, the two cylinders being combined into a single unit. Higher pressures up to about 350 lbs. are generally obtained by using a compound compressor, comprising either two or three

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cylinders in tandem. The three-cylinder or triplex type is used to obtain the highest pressures where a constant delivery of air is required. The motors used for heavy-duty compressors are either d-c. series type or a-c. induction motors, usually two or three phase.

Motor-driven compressors are used very largely in mines to operate various drills, cutting and mining machinery, hoists, etc., and for ventilating purposes. They are also used in power houses for blowing air through the windings and ventilating ducts of electrical machines, etc., for cleaning. Railroads use them for switch and signal operation at interlocking switching towers, in railroad yards, etc. In tunnels they are used for ventilating purposes in normal service and for air locks and drills during construction. The applications to industry in general are varied, some of them being for paint sprayers, riveting machines, air drills, air hoists, sandblasting machines, for cleaning castings, patterns, etc., and for many other similar purposes. For compressor control equipment, see Controllers, compressor and pump, automatic.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis. "Christensen."
Au-to Compressor Co., The, 233 Mulberry St., Wilmington, Ohio "Oro."
Bastian Auto Engineering Works, 134 W. Tabor Rd., Olney, Philadelphia, Pa. "Bastian."
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can. "Sentinel."
Black & Decker Mfg. Co., The, Towson Heights, Baltimore, Md. "Lectro-flater."
Brunner Mfg. Co., Broad & Gilbert Sts., Utica, N. Y.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St, Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Champion Pneumatic Machinery Co., 1402 Michigan Ave., Chicago, Ill. "Champion."
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Chicago Pneumatic."
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill. "Gardner-Rix."
GENERAL ELECTRIC CO., Schenectady, N. Y. A small reciprocating compressor, such as used to supply air brakes on electric street cars and particularly applicable for blowing out machinery in industrial plants. Built with either induction or d-c. motors of any commercial frequency or voltage. Furnished either portable or stationary, complete with automatic pressure governor, reservoir, line switch and fuses and pressure gauge. The motor and compressor are built so as to form one unit. (Bulletin 48610.) Large volume G-E compressors are described under Blowers, motor-driven. See adv. pages 1203-1223.—Adv.
Globe Mfg. Co., Battle Creek, Mich. "Globe."
Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio. "Hale."
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."
Hope Forge & Machine Co., The, Mount Vernon, Ohio. "Reeves."
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Imperial."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
JANETTE MFG. CO., 56 W. Monroe St., Chicago, Ill. "National."
Kellogg Mfg. Co., 3 Circle St., Rochester, N. Y.
Lipman Refrigerator Car & Mfg. Co., Beloit, Wis.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Miller, Charles E., Anderson, Ind. "Miller-Anderson."
National Brake & Electric Co., Belleview Pl., Milwaukee, Wis. "National."
National Regulator Co., The, 208-12 S. Jefferson St., Chicago, Ill.
Norwalk Iron Works Co., South Norwalk, Conn.
Olson-Boettger Electric Mfg. Co., 413 N. Franklin St., St. Paul, Minn.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Pro-Mo-Tor Fabricating Corp., 182 Locust Ave., New York, N. Y. "Minimax."
Refrigo Corp., 18th St. & Forest Home Ave., Milwaukee, Wisc.
Schramm & Son, Inc., Chris. D., West Chester, Pa.
Sorensen Co., Inc., C. M., 177 E. 87th St., New York, N. Y. "Tankless."
Spencer Turbine Co., The, Hartford, Conn. "Spencer."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. "Usaco."
Utility Compressor Co., The, 355-363 Harper Ave., Detroit, Mich.
Vulcan Mfg. Co., 1511 Cypress Ave., Kansas City, Mo. "Faultless."
Westinghouse Traction Brake Co., Pittsburgh, Pa.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

COMPRO.—Trade name for safety switches manufactured by the Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

COMPTON.—Trade name for electrometers manufactured by the Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.

COMPUTING MACHINES, MOTOR-DRIVEN.—Equipment for use in offices consisting of plain or combination adding, tabulating or computing mechanisms operated by small electric motors with or without automatic control. Motor drive not only increases the speed, but makes the work less arduous than hand lever operation.

Manufacturers:

Burroughs Adding Machine Co., Detroit, Mich. "Burroughs."
Dalton Adding Machine Co., 122 S. Michigan Ave., Chicago, Ill. "Dalton."
Elliott-Fisher Co., Harrisburg, Pa.
Ensign Co., Brighton District, Boston, Mass. "Ensign."
Sunstrand Adding Machine Co., Rockford, Ill. "Sunstrand."
Wales Adding Machine Co., Wilkes-Barre, Pa. "Wales."

COMRECO.—Trade name for contact points manufactured by the Commercial Research Co., 18 E. 41st St., New York, N. Y.

CONCATENATE.—To connect a winding of one machine to a different winding of another machine, as the secondary of an induction machine to the armature or the primary of another machine. Such a connection is sometimes made with two induction motors for the purpose of reducing the speed below that given by one motor alone. It is also used in the cascade converter where the secondary of an induction machine is connected to the armature of a synchronous converter. Such arrangements are also called tandem, or cascade, connections.

CONCATENATION.—The act of or state of being concatenated; see Concatenate.

CONCEALITE.—Trade name for lighting units manufactured by the Luminous Unit Co. Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

CONCENTRATION.—Chemically applied to the number of gram equivalents of a salt in a liter of solution. A gram equivalent is a number of grams equal to the weight of a chemical equivalent of the compound or element. The chemically equivalent weight is the weight equivalent in chemical terms to one gram of hydrogen. Example: 49 is the weight of a chemical equivalent of sulphuric acid; 49 grams of this acid in a liter of solution gives a normal solution, with concentration normal. If twice that weight were present to a liter, the concentration would be twice normal (2n.), if half that weight, half normal (½n).

CONCENTRATOR, TELEGRAPH. — A traffic-distributing device by means of which a number of telegraph circuits and connections to operating instruments are brought together at one point to facilitate interconnection.

CONCENTRATORS, MAGNETIC.—Magnetic concentrators are used to separate ores containing magnetic iron compounds, giving a concentrated ore in one pile or bin and another pile of ore not containing magnetic material. The usual form consists of a belt on which the ore is placed. It passes over a steel drum at one end and then back underneath to the other roller or drum. The steel drum is strongly magnetized so that the finely crushed magnetic ore is all attracted by the magnet and tends to adhere to the belt as it passes around and under the drum. The other ore falls off the belt as it passes over the drum so that with a dividing screen placed below the drum, the iron-bearing ore is concentrated on one side and the remainder on the other side.

Manufacturers:

Ding's Magnetic Separator Co., 800 Smith St., Milwaukee, Wis.

CONCENTRATORS, ORE, ELECTRIC.—These concentrators differ from the magnetic machines described above in that they employ an electrostatic separating principle. They separate or concentrate the ores mechanically by utilizing the difference in electrical conductivity of minerals and rocks. Most minerals are fair conductors of electricity while rocks or gangues are very poor conductors.

The ore is crushed and permitted to go through the concentrator by gravity. A charged electrode is placed near the ore as it passes over a revolving roll. The good conductors or minerals are given a charge and separate from the rock, being pulled over toward the electrode. A dividing screen is so placed as to catch all of the rock on one side and mineral on the other. Several such electrode sets are used in a series arrangement so that ore passing from one separator goes through the next one, etc., passing through as many as 18 units, the number depending on the quality of the ore and the degree of separation desired. The electrical apparatus consists of a rather small generating unit, either motor or steam-engine-driven and transformers.

Manufacturers:

Huff Electrostatic Separator Co., Box 66, Arlington, Mass. "Huff."
Mine & Smelter Supply Co., The, Denver, Colo. "Wilfley."

CONCORD.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

CONCORDIA ELECTRIC CO.—389 Union Arcade Bldg., Pittsburgh, Pa. Manufacturer of electric safety lamps. President, Emil Winter; vice-president, W. F. McCook; secretary, P. B. Mossman; treasurer, James M. Anderson.

CONDENSER AUXILIARIES. — Steam condenser auxiliaries may be steam-driven or motor-driven. The auxiliaries required are the pumps for handling the circulating or cooling water, the hotwell or condensate pumps and the vacuum or air-extraction pumps. Which form of drive to use depends upon the economy, reliability and flexibility desired. Interruption of the electrical supply to motor-driven auxiliaries may shut down a condenser when it is most needed. For this reason, both forms of drive are often used, thus giving an economical heat balance as well as reliability.

With steam drive the question of returning heat to the boiler feed is an important one. About 90% of the heat supplied to the auxiliaries will be returned to the feed water provided sufficient water is available for absorbing it. This depends upon the load on the prime mover so that at light loads there may tend to be an excess of steam and at heavy loads a deficiency. Combination motor and steam drive by which the steam drive is used during heavy loads and electric drive during light loads makes for economy as well as reliability and improves what is called the heat balance.

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Where the economizer is used the colder the water the more work done by the economizer, so that excessive amounts of exhaust steam from auxiliaries should be avoided, as by using motor-driven auxiliaries. An intermediate stage in the turbine permits reclaiming much of this steam when it is not needed for boiler feed. By changing from steam to motor drive, a heat balance can be maintained.

The air pump used for fairly low vacuums may be an engine-driven rotative or flywheel type of pump or a reciprocating pump. For vacuums above 28.5 in. the reciprocating dry vacuum pump is largely used, being economical of space and power. The LeBlanc and other turbo and hydraulic air pumps are being largely used because economical of space, flexible of allotment, simple of operation, although large users of power. The steam jet is also finding wide application.

Condensate pumps may be of the wet vacuum type, handling both air and condensate; may be a single or two-stage centrifugal pump, with independent air pump; or a duplex pump with sealed glands and automatic control to keep the pump always supplied with water.

Circulating pumps are almost invariably of the centrifugal type. For the surface condenser the efficiency will be between 75 and 80%. For the jet type the efficiency will, however, be around 50 and 60% due to the low water velocity entering the pump.

CONDENSER, ELECTRIC.—An electric condenser is an arrangement of conductors separated by a dielectric for securing relatively high capacitance. The dielectric may be air, paper, mica, oil, glass, etc. Electric condensers are usually constructed with broad sheets of tinfoil or plates of aluminum or brass, placed as near as possible to other similar sheets or plates. Actual contact is prevented by thin layers of dielectric. Condensers of large capacitance are made by building up alternate sheets of tinfoil and dielectric, every other sheet of tinfoil being connected to one terminal part and the intermediate ones to the other. Condensers are commonly classified as air. paper, mica and oil, in accordance with the dielectric used.

Static or electrostatic condensers are those of the stationary type designed for electrostatic charges; their construction is described above; they are the most common electric condensers. Synchronous condensers are synchronous motors operating with highly excited fields and little or no load; they possess marked capacitance and act like static condensers in counteracting inductance in a circuit; see Condensers, synchronous.

Static condensers whose capacitance may be changed are called variable condensers. Such condensers are constructed of semicircular metal plates for the conductors and air or oil for the dielectric; alternate plates are fastened to a central shaft by means of which they may be rotated, thus varying the overlapping portions. Condensers for standards of capacitance measurements are made with mica as the dielectric.

Condensers are used extensively in telephone work, in radio communication, in connection with induction coils and in many installations for absorbing an inductive discharge or counteracting excessive inductance in a circuit or system.

CONDENSERS, EXHAUST STEAM.—Condensers are used for the purpose of condensing exhaust steam to water, thus creating a vacuum and so permitting full expansion of the steam to be utilized. Condensers are classified as surface, barometric and jet, the choice for any type depending upon cost, power required for operation, vacuum required, condition and quality of cooling water, and whether the condensate is required for further use.

The barometric type of condenser is a jet condenser set higher than 34 ft. above the level of the discharge well. It is admirable where the water is dirty or acid; it is extremely simple and fits in where a suitable basement or pit is not available. The steam condensed is mixed with the cooling water and cannot be used for boiler feed except when the water is quite pure. The power required is considerably greater than for the surface condenser but less than for the jet type. The initial cost is low but the operating power costs rather high, the auxiliaries taking between 4.5 to 13.5% of the prime-mover capacity, according to its size.

The jet type of condenser consists of a cast iron shell into which the exhaust is led, having the circulating water sprayed through the chamber in jets. This type requires greater care in designing the tail pump or discharge, etc., than the barometric type. Two jets are usually employed for large prime movers. The water efficiency is the same as that of the barometric type, the amount of air handled is less, while the power requirements are greater than the barometric and surface types.

The surface condenser has no limitation as to size; it is the most expensive type to purchase, requires the largest quantity of water and the lowest power input for cooling water and air extraction. It consists of a sheet steel shell with two heads or water boxes into which the circulating water passes. The two boxes are connected by a large number of small brass tubes through which the water circulates. The steam is fed into the shell, passes around the tubes, thus being condensed by conduction, and trickles down to the bottom whence it is pumped out. The condensate is available for boiler feed purposes. Air infiltration is a minimum as the only air entering is that with the steam and through leaks. The area of surface condensers varies between 2.5 sq. ft. of tube surface per kilowatt continuous rating of the turbogenerator for units of 10,000 kw. down to 1.4 sq. ft. for the largest machines.

Manufacturers:

Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott-Ehrhart."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System." (Distilled water.)
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Nordberg Mfg. Co., Milwaukee, Wis.
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa. "Lehman."
Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y.
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa. "C. H. Wheeler."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

CONDENSERS, STATIC, MISCELLANEOUS.—Static condensers are employed for many purposes besides those specifically listed below, athough those constitute the most common uses. Among miscellaneous uses a fairly common one is to shunt the vibrator on induction coils so as to suppress excessive sparking and produce a sharper make and break. They are also used to reduce sparking in flashers, vibrating type rectifiers, etc. They are used in the condenser type lightning arrester. To some extent they have been applied to counteract the low power-factor caused by heavy inductive loads, such as induction motors. Such condensers are made of rugged design and carefully insulated.

Manufacturers:

Apollo Magneto Corp., Kingston, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont. Can.
Dubilier Condenser Co., Inc., 217 Centre St., New York, N. Y. (Mica dielectric.)
Eastern Parts Mfg. Co., Inc., 135 Spring St., New York, N. Y. "Pemko."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

Electric Specialty Co., The, 233 N. Elm St., Cresco, Iowa. "Standard," "Mansbridge."
GENERAL ELECTRIC CO., Schenectady, N. Y. Developed and perfected by this company for improvement of power-factor. Standardized for circuits ranging in frequency from 40 to 125 cycles, in voltage from 220 to 2,300 volts ,and in capacities from 30 to 300 kv-a., although they can be supplied for other voltages and capacities whenever necessary. Advantages of static condenser equipment over synchronous apparatus are most pronounced for capacities of 500 kv-a. and less. They are comparatively low in cost in the smaller sizes, have extremely low losses, require practically no attendance, and give long service due to absence of moving parts. One installation effected an increase in power-factor of 0.65 to 0.85, enabling generating equipment to carry 24 per cent greater load, reducing excitation requirements 20 per cent, and improving voltage regulation, and eliminated necessity for new generator, boiler and auxiliary capacity. (Bulletin 49714B.) See adv. pages 1203-1223.—Adv.



Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa. (Standard, mica.)
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Parkin Mfg. Co., San Rafael, Cal.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass. "Faradon."

CONDENSERS, STATIC, PARALLEL AND SERIES.—The capacitance of cendensers connected in parallel is equal to the sum of the capacitances of the separate condensers. When condensers are connected in series the joint capacitance is equal to the reciprocal of the sum of the reciprocals of the capacitances of the separate condensers. Thus, if C_1, C_2 and C_3 are three capacitances joined in series, the reciprocal of the joint capacitance is

$$1/C=1/C_1+1/C_2+1/C_3.$$

CONDENSERS, STATIC, RADIO.—Condensers used for radio sets are generally of small capacitance, because of the high frequency used. Those used in transmitting stations must withstand high voltages. The latest type of high-voltage condenser contains mica as the dielectric with tinfoil conductors, the whole system being highly compressed to prevent energy losses due to vibration. Another type of transmitting condenser is made up of glass plates using tinfoil conductors. Still another uses a composition dielectric. For receiving stations where the voltages are small, the variable condenser used consists of a set of movable semicircular plates which can be rotated between a set of fixed plates. Air is usually the dielectric in variable condensers, although oil is sometimes used. Oil condensers of this type may also be used in transmitting sets.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.

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De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Dubilier Condenser Co., Inc., 217 Centre St., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Specialty Co., The, 233 N. Elm St., Cresco, Iowa. "Mansbridge," "Standard."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
General Radio Co., 11 Windsor St., Cambridge, Mass.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Johnson, George F., 625 Black Ave., Springfield, Ill. ("Illinois" variable condenser.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
Parkin Mfg. Co., San Rafael, Cal.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Simon, Emil J., 217 Broadway, New York, N. Y. "Seibt."
Tecla Co., Inc., Detroit, Mich.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Tresco, 1201 Kahl Bldg., Davenport, Iowa. "Perfection."
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass. "Faradon."

CONDENSERS, STATIC, TELEPHONE AND TELEGRAPH.—The usual form of telephone condenser is made of two long strips of tinfoil separated by strips of paper, rolled up, dried, boiled in paraffin, and then sealed in a tin box. Each terminal is a strip of brass held in contact with the tinfoil (called the "plate") by pressure alone. The capacitance is usually from 0.1 to 2 mf. For telegraph circuits about the same type condenser is used and the range is generally from 0.1 to 3 mf. Another type of a low-capacity condenser (0.005 mf. and under) is sometimes made of a pair of insulated wires wound on a spool.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Specialty Co., The, 233 N. Elm St., Cresco, Iowa. "Cresco," "Standard," "Mansbridge."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Tecla Co., Inc., Detroit, Mich.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CONDENSERS, SYNCHRONOUS. — A synchronous condenser or synchronous phase advancer is a synchronous machine running as a motor with a little or no load and having its excitation adjusted for the purpose of improving the power-factor or controlling the voltage of the system to which it is connected. In power-factor improvement, the synchronous condenser is usually connected at the load end of a transmission or distributing line which supplies an inductive load. By making the synchronous condenser take a leading current, it is possible to reduce the line current and thus reduce line and generator losses or to permit a larger load to be carried by the generators and line. In voltage control, the synchronous condenser is connected at the receiving end of a transmission line having considerable inductive reactance. By having it take a lagging current at light loads and a leading current at heavy loads, the voltage at the receiving end may be kept nearly constant while the voltage at the sending end is maintained constant. The synchronous condenser seems to offer the best means of voltage control for very long lines at extra high voltages.

These uses of the synchronous condenser are based on the unique relation of the field excitation of a synchronous motor and the phase angle of its line current. At a certain excitation the motor current and voltage are exactly in phase; if the field is excited beyond this critical value, the motor takes a leading current and acts like a condenser; if the field is excited below the critical value, the motor takes a lagging current and acts as an inductive load, just like an induction motor.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line including large sizes for power factor control as well as its correction or improvement. Designed for 480 to 13,200 volts. Machines are provided with special winding to increase starting torque and make them self-starting. This winding is a most effective anti-hunting device and will keep motor in step, if possible to operate a synchronous motor on system. Where desired installations can be provided with automatic starting and control equipment to be operated without attendance other than occasional inspection. Send for further information in Bulletin 41311, and a list of applications, Bulletin 41312. See adv. pages 1203-1223.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONDENSITE AND CONDENSITE PRODUCTS.—Condensite is a material composed chiefly of a phenolic condensation product, resulting from the chemical reaction between phenol and formaldehyde. It is made in many forms and colors and is useful as a molding material, as an impregnating material and as a chief constituent in certain insulating varnishes, enamels and cements. In its first form the product is a gum-like substance that will not harden under heat, but has to be combined with a hardening agent. It then gives a hard infusible and nearly insoluble substance, with a dielectric strength of 11,000 to 15,000 volts per mm. and a resistivity of 4×10^{10} ohm-cm. at ordinary temperatures. It is high in mechanical strength and heat resistance and will stand temperatures as high as 200° C. or several hours without any perceptible effect.

As a plastic molding material Condensite is applied to a great variety of products for electrical purposes. It is used for a number of parts for meters and other instruments, because of the possibility of using metal inserts and the ease of molding pieces that would be difficult to make in other materials. Ignition systems for automobiles afford many parts, especially in the distributor, that may be made of Condensite, such as the plates carrying the contacts, the rotating contact maker, coil caps and covers, relay bases and covers, etc. Condensite is also molded into insulators of various kinds, such as busbar insulators, where its rugged characteristics make it less liable to breakage than porcelain. Commutators for starting motors and lighting generators on automobiles are often molded of Condensite. There are also numerous charging plugs, attachment plugs, switch handles, buttons, rings and other small parts made of Condensite in addition to hundreds of other parts not used with electrical apparatus.

Manufacturers:

Alden-Napier Co., 54 Willow St., Springfield, Mass. "Na-ald."
Auburn Button Works, Inc., 40-46 Washington St., Auburn, N. Y.
Belden Mfg. Co., 2300 S. Western Ave., Chicago Ill. "Beldenmold."
Boonton Rubber Mfg. Co., Boonton, N. J. "Hi-Tensit."
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Mack Molding Co., Little Falls, N. J.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Shaw Insulator Co., 5-7 Kirk Pl., Newark, N. J.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

CONDENSITE CELORON.—Trade name for molded fiber insulation manufactured by the Diamond State Fibre Co., Bridgeport, Pa.

CONDENSITE CO. OF AMERICA.—Bloomfield, N. J. Manufacturer of Condensite and Condensite products, synthetic waxes and oils. Business established 1910. President and general manager, Kirk Brown; vice-president and treasurer, Charles E. Van Vleck; secretary, Frank H. Presby; sales manager, Sandford Brown. Factories, Bloomfield, N. J., and Wyandotte, Mich.

CONDENSITE MOLDING MACHINES.—See Molding machines, insulation.

CONDENSIVE LOAD. — A condensive load, also called an anti-inductive load, is one in which the current leads the voltage across the load.

CONDENSIVE REACTANCE.—Whenever a condenser or any capacitance is connected to an alternating e.m.f. an alternating current will flow through the circuit. This current is equal to the product of the capacitance and the rate at which the e.m.f. is changing. In symbols,

$$I_c=2\pi fCE_c, \text{ whence } E_c=I_c/(2\pi fC).$$

Condensive reactance is the factor by which the current must be multiplied to give the effective value of the condenser voltage; or $X_c=1/(2\pi fC)$, where X_c is the condensive reactance, f is the frequency and C is the capacitance.

CONDENSIVE REACTANCE VOLTAGE. —The condensive reactance voltage is the product of the condensive reactance and total current in the circuit. This e.m.f leads the current to which it is due by one-quarter of a period. The phase difference between the condensive reactance voltage and the inductive reactance voltage is one-half a period. $E_c=I_c/2\pi fC$). See Condensive reactance.

CONDIT ELECTRICAL MFG. CO.—838 Summer St., South Boston, Mass., Manufacturer of medium and high-voltage switching and protective equipment. Business established 1898. President, treasurer and general manager, S. B. Condit; vice-president, F. H. Condit; secretary, A. M. Dirwanger; sales manager, R. J. Neagle.

CONDUCELL.—Trade name for cable splicing joints manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

CONDUCTANCE.—The conducting power of any conductor, whether a solid or electrolyte, or its ability to carry electricity disregarding any decomposition effects. It is the reciprocal of the resistance, and its unit is the mho (reciprocal of ohm). Its symbol is g. Mathematically, $g=1/R$; the direct-current form of Ohm's law may also be written $I=gE$. From the latter, conductance may also be defined as the factor

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by which the d-c. e.m.f. must be multiplied to give the current in the circuit; it is also the current, in amperes, flowing per volt of e.m.f expended in merely overcoming the resistance. The conductance of a unit mass is called its conductivity or specific conductance.

CONDUCTANCE OF AN A-C. CIRCUIT.—This is the factor by which the impressed e.m.f. must be multiplied to give the component of current in phase with the e.m.f.

$$g=R/(R^2+X^2).$$

CONDUCTIVITY.—In general the ability of a substance to conduct electricity. Specifically, it is measured quantitatively as the current in amperes flowing through a centimeter-cube of the material (one centimeter long and of one square centimeter uniform cross-section), when an e.m.f. of one volt is applied to the two ends. It is sometimes called specific conductance. For metals it is usually of the order of 600,000 down to 10,000; for melted salts 10 to 0 1; for solutions 0.5 to zero, according to the concentration.

CONDUCTOR, CONTACT.—In electric railways that part of the distribution system, other than the traffic rails, which is in immediate electrical contact with the circuits of the cars or locomotives. A trolley wire is a flexible contact conductor and a contact rail is a rigid contact conductor. See Rails, conductor or third, and Wire, trolley.

CONDUCTOR, ELECTRICAL.—In the generally accepted sense a conduotor is any medium that permits the ready passage of electric charges or currents. There is no definite dividing line between conductors and nonconduotors, since these terms are only relative; even insulators or dielectrics possess feeble conducting powers under certain conditions (high tension). Usually, however, the term conductor is confined to materials having relatively high conductivity or conductance. Conductors may be solids, liquids or gases. Solutions or other liquids that are good conductors are called electrolytes. Metals are the best conductors. To keep down the resistance losses, the conducting parts of electric circuits and apparatus are made of high-conductance metal, such as copper. The most common form of conductor is wire, which is made in many types having distinctive names. In the wire and cable industry the word conductor is generally restricted to mean a wire or combination of wires not insulated from each other, suitable for carrying a single electric current; in this sense it differs from wire in that the latter may include the insulation around the conductor.

CONDUCTOR, STRANDED.—A conductor composed of a group of wires or of any combination of groups of wires suitable for carrying a single electric current. The wires in a stranded conductor are usually twisted or braided together.

CONDUCTORS, ARMORED.—See Cable, armored; also Cord, flexible, armored.

CONDUCTORS, LIGHTNING.—See Lightning rods; also Cable, lightning conducting.

CONDUIT.—In electrical work a conduit is a closed protection pipe or duct into which electric wires or cables may be drawn. It is used very extensively, both for the protection of wiring in buildings and for protecting transmission, distribution and communication or signaling cables that are run underground. This gives the two main classes of conduits, the former being called interior conduit, and the latter underground conduit.

Development and Uses.—The first electric wiring in buildings was for bells, annunciators, telephones and similar low-voltage circuits, for which what has come to be known as office or annunciator wire was used. As electric lighting and later power was introduced into buildings the circuits were made heavier, but their insulation was not greatly improved. The art had not progressed enough to know what insulation and precautions were necessary for 110 volts or higher. The results were that numerous fires broke out in buildings that were electrically lighted and most of them were ascribed to "crossed wires." From this grew regulation of electric wiring and the development of improved methods of installation. Recognizing that the wires had to be better protected, one of these improvements was a thin brass tube draw-in or interior conduit system. Later heavier metal was used and iron and steel substituted for brass, the conduit being eventually developed into the rigid steel conduit now so widely used. A very extensive line of conduit boxes and other accessory fittings was gradually developed using both cast iron and sheet steel so that now the metallic conduit system is the highest type of interior wiring installation in use and the system is being most rapidly extended.

For wiring a finished building the installation of rigid conduit requires too much ripping up of walls, floors and ceilings and is therefore quite costly. To overcome this, flexible nonmetallic conduit, also called flexible fabric tubing or "loom," was developed. Later flexible steel conduit was brought out. Both these are widely used in wiring or rewiring of old buildings, as well as a development from the latter, viz., flexible steel-armored cable.

As electric utility service gradually became more general in the cities the number of overhead circuits for telephone, telegraph, lighting, power and railway service rapidly increased. In many cities there were not only separate companies rendering these different classes of service, but often competing companies in the same class of service. The result was a dense mass of overhead wires and poles that were not attractive in appearance and in many cases constituted life hazards to firemen and also pedestrians. In almost every large city during the eighties there arose an agitation for placing wires underground. Many technical problems were involved in this, as well as heavy financial outlay. Edison central-station companies first used iron-pipe-protected or armored solid conductors. Wood conduit or pump log was later introduced, also clay or tile pipe, fiber conduit, and concrete or stone. Now underground conduit is used in every large and medium-sized city and in many small ones, and even in suburban towns. It has only one competitor, which is specially armored lighting circuit cable that is buried directly in the ground in outlying districts and parks where it is not likely to be disturbed by excavation.

Conduit has many advantages, both for interior and underground wiring. It fully protects the conductors from contact with other circuits, from interference by workmen in subsequent work on the building or in street excavation, from the action of moisture, acids, or other corrosive agencies, and from other influences that might damage the insulation. It permits the ducts to be installed at one time and the wires or cables to be drawn in later when they are needed; they may also be withdrawn, if defective or of insufficient load capacity, and new or larger wires or cables drawn in their place with little trouble or expense.

On account of these and minor advantages the use of conduit has very rapidly increased. Interior conduit is used not only for protecting the concealed wiring of buildings, but also for enclosing exposed wire runs both on the inside and outside of buildings; it is also used on depot platforms, docks, on shipboard, on machinery, locomotives, cars, automobiles, etc.

Rigid steel conduit is the most widely used. It, or its equivalent is required for all lighting and power circuits, both concealed and surface, in several large cities because in these cities buildings are so frequently altered with accompanying disturbance of unprotected wiring. In all communities the tendency is to install circuits of all kinds more and more in conduit.

With the increasing congestion of cities and their increased density of loads the placing of overhead circuits underground is steadily increasing. The amount of conduit used for underground installation is therefore steadily increasing. The same types of conduit that are used underground may also be used in the floor of basements, for service connection, etc.; for this purpose either iron pipe or fiber conduit is most used.

Production. The rapid increase in the use of both interior and underground conduit is shown from production figures. The Bureau of the Census has reported in the census of electrical manufactures that the value of both underground and interior conduit in 1899 was $1,066,163; in 1904, $2,416,245; in 1909, $5,098,264; in 1914, $4,874,709. Estimates for the year 1920 place the production of rigid interior conduit at about $20,300,000, of flexible fabric tubing at about $5,000,000, and of flexible steel conduit at $150,000. No reliable figures are available as to the 1920 production of underground conduit, except that of the fiber type about 13,000,000 ft. was produced. Aside from the above figures for interior conduit there was produced in 1920 about $1,800,000 worth of conduit fittings, including outlets and switch boxes and other accessories.

CONDUIT, AERIAL RING.—This is a method for distributing aerial telephone lines from the terminal box on the cable to the subscribers' stations. It consists of metal rings attached to a messenger wire, through which rubber-covered pairs of wires are drawn. It is not a "conduit" in the generally accepted sense of the word, but is called aerial ring conduit because the rings confine the wire pairs as do the conduits in the interior wiring of a building.

CONDUIT, AUTOMOBILE, AND FITTINGS THEREFOR.—The wiring of gasoline automobiles and electric vehicles is subjected to severe operating conditions and often outright abuse. Oil, moisture, acid, alkali, dust and mud play havoc with the insulation of automobile wires and cables, leading to leakage, grounds and sometimes short-circuits, unless the wiring is adequately protected. In the wiring of buildings conduit has been found of the greatest all-around value for giving suitable protection to the wires, so it was natural to utilize conduit for protecting automobile wiring also. Rigid conduit is not so well suited for automobiles, because the wires are relatively short and in most cases many bends have to be made. For these reasons the conduits are nearly always flexible, either flexible metallic conduit, or flexible fabric tubing. For the former both flexible steel and flexible brass are used; the nonmetallic or fabric conduit is a very dense, seamless and tough, but flexible tubing capable of withstanding hard usage. Junction boxes, box connectors, bushings and other necessary accessory fittings are provided to make the conduit system as complete, even though on a small scale, as in a building. The protective value of such automobile conduit systems is becoming recognized, as is shown by their increasing use. The flexible steel duct is also used for carburetor and exhaust tubing.

Manufacturers:

Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. "Fle-X-Met."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Auto-Steelflex," "Auto-Brassflex," and "Auto-Flextube," are "National" conduits for automobile wiring. Auto-Steelflex is also made into carburetor and exhaust tubing. A complete line of fittings, junction boxes, etc., is provided—everything for the wiring system of the car. All of the skill and experience that goes into the making of other National conduits—installed in the country's finest buildings—is applied to the manufacture of National Automotive products. See display adv. pages 1302-4.—Adv.

Pennsylvania Flexible Metallic Tubing Co., Broad & Race Sts., Philadelphia, Pa.

CONDUIT BENDERS.—See Benders, conduit and pipe, portable.

CONDUIT BODIES.—These are conduit fittings used with interior conduit that form a body for several kinds of outlet and junction boxes, etc. By using three simple body boxes, one for junctions, another for switches, and a third for outlets, they may be adjusted and changed by using special couplings to give almost any combination desired. The conduit is screwed into these couplings and no bushings or locknuts are then required. Only one size of knockout is provided but the two special couplings will allow the use of either ½ in. or ¾ in. conduit. While these boxes are designed to be supported by the conduit, they may be attached to the wall if desired, small knockouts for nails or screws being provided in the bottoms.

Manufacturers:

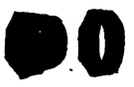
Adapti Co., Cleveland, Ohio.

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

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CROUSE-HINDS CO., Syracuse, N. Y. "Condulets."
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Endoulets."
Penn Electrical & Mfg. Co., Irwin, Pa.
Pratt Chuck Co., Frankfort, N. Y. "Pratt."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. "Spragueletts." (See display advertisement on pages 1306-1307.)
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Wirelets."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. In the first illustration is shown the "Deep" Type "T & B" Body. This is of drawn steel with knockouts removed and two special couplings for ½ in. conduit and one for ¾ in. conduit assembled therein, making a "T" conduit body. The special couplings used for this purpose are shown in the second illustration. This deep body is especially designed for the reception of all those







wiring devices known to the trade as the flush type. The cover plates are secured direct to the device in the same manner as a flush wall plate. There are two other adaptations of this idea known as the "T & B" Shallow Body (see adjacent cut) and the "T & B" Branch Body (see cut below). The former is designed to receive all types of wiring devices except flush type. The latter, longer in form, is designed especially for branches,





"T. & B." Branch Body

junctions, pull work or extensions.—Adv.

CONDUIT BOXES.—Boxes of drawn or cast steel, for use in electric wiring of buildings, to serve as junction boxes or for the mounting of electrical devices and fixtures, which may be supported from fixture studs, or attached directly to the box, or mounted on the box cover. Knockouts are provided in the boxes which may be removed as desired to permit the attachment of conduit. The principal sizes are: 4½ in. square; 4 in. square; 4 in. round and 3½ in. round. Also see Boxes, conduit for concrete construction; Boxes, conduit, junction and pull; Boxes, conduit, outlet; Boxes, conduit, snap switch; also see Conduit bodies.

CONDUIT BUSHINGS.—See Bushings, conduit, box and cabinet; Bushings, conduit, end outlet.

CONDUIT CLEANERS.—See Cleaners, conduit.

CONDUIT COUPLINGS, NIPPLES AND UNIONS.—Conduit couplings for rigid conduit are short pieces of pipe threaded at each end on the inside so that the ends of two pieces of conduit may be joined. Nipples are similar fittings but threaded on the outside. A conduit union consists of three parts: one to thread onto the end of one piece of conduit, a second oppositely threaded to screw on another piece of conduit and a third intermediate part or nut to draw these pieces together. Couplings are also made for fastening two pieces of flexible steel conduit together. They consist of two pieces forming a split sleeve, which bolt together over the conduit and securely hold the ends in place. Conduit fittings are also made to permit rigid and flexible conduit to be joined together.

These fittings are generally made with two finishes to correspond to the conduit finish. For use on rigid conduit black enameled fittings are most common, while on flexible conduit galvanized or sherardized fittings are used.

Manufacturers:

AMERICAN CIRCULAR LOOM CO., 90 West St., New York, N. Y.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The straight and angle couplings illustrated here are representative of a line of water tight conduit couplings, elbows, unions, etc., made of cast brass and very durable and convenient. The elbows for corner heads have capped openings to facilitate fishing wires into conduits.—Adv.





Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can
CENTRAL TUBE CO., First National Bank Bldg., Pittsburgh, Pa. (couplings). "Central Black." "Central Special." "Central White."
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal Que., Can.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Conduletz."
Curtis & Curtis Co., The, 188 Garden St., Bridgeport, Conn.
Dart Mfg. Co., E. M., Providence, R. I. "Dart."
Dole Valve Co., The, 1923-1933 Carroll Ave., Chicago, Ill.
ENAMELED METALS CO., 61 Bridge St., (Etna), Pittsburgh, Pa. "Pittsburgh."
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "Bendhick."
Fralick & Co., S. R., 15 S. Clinton, St., Chicago.
Garland Mfg. Co., West Pittsburgh, Pa. "Galvaduct," "Loricated."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Jefferson Union Co., Lexington, Mass. "Jefferson."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
Luzerne Rubber Co., The, Trenton, N. J.
MARK MFG. CO., 111 W. Washington St., Chicago, Ill. (See display adv. page 1305.)
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Conduit Co., Ltd., Dufferin & Queen Sts., Toronto, Ont., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display adv. pages 1302-4.)
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell"
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. "Rattan." (See display adv. page 1308,)
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Couplings for double strip flexible conduit and double strip flexible and rigid conduit. Likewise for single strip flexible conduit and single strip flexible and rigid conduit. Furnished in standard sizes. Couplings for conduit bodies are also described under "Boxes, Conduit, Junction and Pull." Sprague products, see display adv. pages 1306-7.—Adv.
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) A line of fittings for "Ovalduct" conduit. —Adv.
Steelduct Co., The, 213-17 Dollar Bank Bldg., Youngstown, Ohio. "Steelduct."
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. The Erickson coupling or conduit union, as shown in the first illustration, does away with running threads and permits opening of the conduit at any point desired. A circuit may also be started from the two outlets and a good strong connection made at any point in the run. Made of malleable iron, galvanized, in eight sizes, designed for conduit of the same sizes; namely, ½, ¾, 1, 1¼, 1½, 2, 2½, and 3 ins. Another type, the Chase coupling also Chase nipples, permit removal of the box without disturbing the conduit. Nipples are galvanized. Eleven standard sizes from ¼ in. to 3½ ins. A





"T. & B." Special Coupling

third type, shown in the illustration above is known as the "T & B" Special Coupling and is described under "Conduit Bodies". A fourth type, "T & B" Split Couplings, is made in sizes for ½, ¾ and 1-in. conduit.—Adv.
Threadless Pipe Fittings Corp., Newark, N. J. (Exclusive distributors, Rubino & Liebstein, Newark, N. J.)
Universal Chain Co., The, Stroudsburg, Pa.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V.V."

CONDUIT FASTENERS.—Various methods are used for fastening interior conduit in place. The simplest consists of pipe straps that straddle the conduit or pipe. Conduit clamps hold the conduit from one side. Beam clamps are used to clamp conduit to I-beams or similar steelwork. Conduit hangers consist of ring, clamp or strap supports for hanging conduit from ceilings or along walls. Flexible nonmetallic conduit or flexible tubing (commonly called "loom") is held in place at outlets by what are called loom clamps, and in cabinets, etc., by flexible tubing fasteners. For these various types see Straps, conduit or pipe; Clamps, conduit; Clamps, beam; Hangers, conduit and pipe; Fasteners, flexible tubing.

CONDUIT, FIBER.—See Conduit, underground, fiber.

CONDUIT FITTINGS.—This term covers broadly all fittings used with a conduit system. It generally is applied only to metal fittings used with either rigid or flexible metallic or nonmetallic conduit. Where electrical devices of various kinds are required the runs of conduit must be interrupted or terminated and the proper box, plate or other fitting inserted to mount the device. For mounting fixtures, drop cords or special switches on the ceiling, conduit boxes, deep or shallow, or flat plates are used. For such switches or receptacles in walls, conduit boxes or switch boxes are employed. For floor outlets a specially constructed conduit box with watertight cover is required. In concrete buildings special boxes known as concrete boxes or rings are installed.

The above are practically all meant to be attached to and supported by the building, and the conduit must be firmly attached to the box or plate by means of other fittings known as locknuts, bushings, clamps, etc., the particular fitting depending on the style of conduit used and the requirements of the particular locality. There are also several large lines of cast or drawn steel fittings adapted to be supported from the conduit only (if rigid) and suited to some of the above uses, though principally employed as outlets where it is required to permanently space the wires entering or leaving the conduit. This is required at service entrances, at motors, generators, or similar equipment and where the wiring changes from closed to open work. The spacing is done by a porcelain cover with an opening for each wire.

There have recently been put on the market several lines of boxes, known as conduit bodies, claimed to be suitable for most of the purposes mentioned above. These use a special bushing and may be supported either from the rigid conduit or from the wall.

The principal types of conduit fittings are separately listed under their individual

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names, as boxes, bushings, connectors, covers for boxes, conduit couplings, nipples and unions; caps, conduit or pipe end; service entrance fittings, etc.

CONDUIT, INTERIOR, FLEXIBLE FABRIC.—This conduit is often called nonmetallic flexible conduit or more commonly flexible tubing. For details and manufacturers see Tubing, flexible fabric, or nonmetallic conduit.

CONDUIT, INTERIOR, FLEXIBLE STEEL.—A flexible conduit having a spirally wound steel armor. It usually consists of two layers of steel tape wound in opposite directions. This conduit is very flexible and may be bent readily to conform to almost any curve or contour. Flexible conduit is much used for wiring old buildings because it is easily "fished" and the wires are easily pulled through after it is in place, as it always tends to straighten out and thus sharp bends are avoided. It is also used as an auxiliary to rigid conduit systems in taking care of tortuous bends, also in wiring machine tools and other heavy-duty appliances for which flexible steel conduit is preferred to armored cable or armored cord. Such conduit generally has a galvanized finish.

Manufacturers:

Arrow Flexible Conduit Co., 210-12 Canal St., New York, N. Y.

Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. "Fle-X-Met."

Circle Flexible Conduit Co., Inc., 188 21st St., Brooklyn, N. Y. "Circle."

Columbia Metal Hose Works, 540-550 W. 58th St., New York, N. Y. "Columbia."

DEWES CO., THE A., 199 Lafayette St., New York, N. Y. Manufactured to Underwriters' specifications. Made in in-



Flexible Steel Conduit

side diameters of ⅛, ¾, 1½, 2 and 2½ ins. Price lists showing current prices and discounts will be mailed to regularly recognized electrical supply jobbers upon request.—Adv.

EASTERN TUBE & TOOL CO., INC., 594 Johnson Ave., Brooklyn, N. Y. "Brooksteel."

Federal Armored Cable Co., 609 W. 48th St., New York, N. Y. "Federal."

Garland Mfg. Co., West Pittsburgh, Pa. "Sterling."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display adv. pages 1302-4.)

Short Electrical Mfg. Corp., Penn Yan, N. Y. "Plia Steel."

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague flexible conduit is flexible, strong and easy to pull wires through. It is invaluable for following contours or connecting vibrating machinery. It is made in sizes from ⅜ to 2½ ins. Sprague products, see display adv. pages 1306-7. —Adv.



THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."

Triangle Conduit Co., 50-52 Columbia Height, Brooklyn, N. Y. "Triangle."

CONDUIT, INTERIOR, RIGID METALLIC.—Rigid conduit for interior work is a drawn mild steel tubing used to enclose the wires for an electric lighting, power or other system. It is soft enough to permit bends to be made without injury and is enameled or otherwise finished inside and out so that it is not readily affected by acids, alkalies, rusting or moisture. It is generally furnished in 10-ft. lengths and in the following nominal sizes, ⅛, ¾, 1, 1¼, 1½, 2, 2½, 3, 3½, and 4 ins. in diameter. It is threaded at both ends and usually furnished with one coupling per length. The threads are protected by a cap in some cases to prevent injury during shipment. Two finishes are generally provided, either enameled or galvanized. In either case the pipe is thoroughly cleaned both inside and out to remove dirt, grease, rust, scale, burns, etc. It is then coated with either the zinc or special enamel compound.

Conduit is installed either concealed or exposed. For the former it must be installed while the roughing-in work on a building is done, if disturbance of the plastering is to be avoided. For exposed work it is used chiefly in industrial plants, basements, tunnels and on large machines, cars, locomotives, etc.; it may be installed at any time for such work as a rule.

Manufacturers:

AMERICAN CIRCULAR LOOM CO., 90 West St., New York, N. Y. "Xduct" is a galvanized conduit made of a high-grade, spellerized, mild steel tube selected on account of its uniformity and



Xduct Galvanized Conduit

freedom from defects. It is thoroughly cleansed of all dirt and rust in preparation for the zinc coating process. The heavy coating of pure zinc, electrolytically deposited uniformly and continuously, serves as the best possible protection against corrosion. The interior of the tube receives a coating of alkali- and acid-resisting enamel, which also reinforces the insulation of the wires. "Xduct" has an electro-galvanized exterior, a smooth enameled interior and sharp, clean-cut, zinc-coated threads. It is easily cut and has the very best bending qualities. Another type of conduit is known as "Electroduct." It



Electroduct Enameled Conduit

is manufactured of the same high-grade steel tubing as "Xduct" and passes through the same cleansing process. It then receives a special and alkali-resisting coating of enamel, internally and externally. It fishes, bends and cuts easily and has clean and perfect threads. The conduits come in 10-ft. lengths, threaded at both ends, with one coupling. "Xduct" and "Electroduct" conduit pipe is known and spoken of by nominal inside diameter, and is made in standard sizes from ¼ to 6 ins.—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

CENTRAL TUBE CO., First National Bank Bldg., Pittsburgh, Pa. The rigid metallic conduit, made by this company, and shown below, is characterized by its great ductility and softness, which is due entirely to the special heat treatment which it receives during the process of its manufacture. Cut at the left shows a piece of ½-in. "Central





"Central Black" Conduit **"Central White" Conduit**

Black" conduit that has been wound around a piece of 3-in. pipe. There is no flattening or buckling of the pipe, and the enamel has not cracked or flaked off under this severe test. Cut at the right shows ½-in. "Central White" bent and kinked like a piece of wire. This is an extremely severe test and one which could not be expected in normal service. "Central White" stood this test perfectly; the weld remained intact, and the galvanizing retained its continuous coating without cracking or flaking. "Central Black" and "Central White" are prepared with great care for enameling or galvanizing. Both interior and exterior surfaces are acid pickled, washed in clear water, alkali pickled and again washed. Both surfaces are protected by the applied coating. Each length is threaded on each end, and one coupling is furnished, already screwed on. The enamel used on "Central Black" conduit is both acid and alkali proof, and can only be chipped off with great difficulty. Threads are full and true.—Adv.

CLIFTON MFG. CO., 65 Brookside Ave., Boston, Mass.

ENAMELED METALS CO., Pittsburgh, Pa. "Pittsburgh Standard" thread protected enameled conduit. Reaches the job ready to install. The patented



"Pittsburgh Standard" Enameled Conduit

thread protector assures clean threads, with a thin film of enamel to prevent rust. Eliminates reversing couplings and running dies over pipe ends. Made from heavy-wall, soft iron pipe, coated with a special enamel, baked on. "Pittsburgh Standard" costs no more than ordinary enameled conduit. Enameled Metals Co. is sole manufacturer.—Adv.

Garland Mfg. Co., West Pittsburgh, Pa. "Galvaduct," "Loricated."

MARK MFG. CO., 111 W. Washington St., Chicago, Ill. Manufacturer of "Navalite" enameled steel and "Zinkote" electrogalvanized pipe for electric wire conduit. Made from the ore to finished product in our plants. For further information see our display advertisement on page 1305.—Adv.

National Conduit Co., Ltd., Dufferin & Queen Sts., Toronto, Ont., Can. "Xceladuct," "Orpenite."

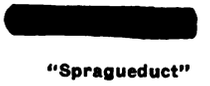
National Enameling & Mfg. Co., Renshaw Blvd., Pittsburgh, Pa. "Alumaduct," "Armyduct," "Enamelduct."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Sherarduct" rigid steel conduit is made from the highest grade of mild steel spellerized tubing. Both the exterior and interior surfaces are sherardized—the alloying of zinc with the steel surface of the conduit. This makes Sherarduct absolutely rustproof. In addition, both surfaces are coated with a clear, transparent acid and alkali-proof enamel, baked on. This double protection is found in Sherarduct exclusively. It is the only conduit that is rustproof and acidproof both inside and outside. Economy black enameled rigid conduit is made from the same high-grade tubing as Sherarduct—it differs only in the protective treatment applied. See display adv. pages 1302-4. —Adv.

North American Electrical Products Corp., Equitable Bldg., New York, N. Y.

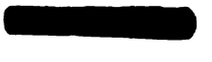
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. "Spragueduct,"



"Spragueduct"

shown in the first illustration, is a rigid conduit, black enameled inside and out. Sizes are ½ to 6 ins., in 10 ft. lengths. Sharp threads, uniform bending are its characteristics. Coupling one end. Another strictly Sprague product is



"Greenfielduct"

"Greenfielduct," second illustration. This is a high grade conduit, hot galvanized from end to end, inside and out. Sizes ½ to 4 ins., 10 ft. lengths with coupling. Sprague products see display adv. pages 1306-7.—Adv.

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Steelduct Co., The, 213-17 Dollar Bank Bldg., Youngstown, Ohio. "Steelduct."
Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio. "Buckeye."

CONDUIT LOCKNUTS.—See Locknuts, conduit.

CONDUIT SEALING PLUGS.—See Caps, conduit or pipe end.

CONDUIT SYSTEMS, UNDERGROUND.—Conduits for underground power cables are preferably constructed of fireproof material, since cable burnouts at times produce very high temperatures at points where they occur. Vitrified tile, terra cotta, stone pipe and fiber are used as conduit material. The conduits are surrounded by a jacket of 3 ins. of concrete to preserve alinement and give protection from later excavations. In the case of stone pipe and fiber duct the concrete is poured in to fill the space between the ducts, making a solid structure throughout. Tile conduit is made square and there are no voids to fill. The conduit line is carefully graded to drain into manholes and to avoid water pockets as far as possible. Cables are so crushed when water in a duct freezes as to be permanently injured.

The individual runways for cables in a conduit system are called ducts. The number of ducts laid is fixed by the number of cables which it is expected will be routed that way. In general work, not less than four are laid, except for short branches where two are provided. The heat liberated by loaded cables limits the maximum desirable number to about 20 ducts. Where a larger number is needed, as in the vicinity of a station, it is necessary to build additional conduit lines with a separation of 8 ft. or more between the lines. On account of the heavy expense and annoyance of tearing up pavements, it is general practice to make provision in conduit lines for ample ducts to take care of the needs of many years to come. The reserve ducts are installed at much less expense than re-excavation.

Manholes must be placed at intersections, and at intervals of 400 to 500 ft. in straight runs. Handholes are placed where lateral connections are to be made for consumers. (For further details see Manholes.) Where connections under car tracks or up poles require a rather sharp turn, the duct is preferably iron pipe laid without the concrete jacket. Creosoted pump log, which is suitable for communication circuits using low voltages, is too inflammable to be a satisfactory material for power circuits.

CONDUIT SYSTEMS, UNDERGROUND, FOR STEAM AND HOT-WATER PIPING.—Electric central stations very often sell steam or hot water as a by-product for house heating purposes to customers located in districts within a radius of up to one to two miles from the generating station. To distribute the steam or hot water, special conduit systems are used. There is quite a little variation in the methods used, depending upon the number of customers served, pressure of the system, superheat, etc. Systems having from 3 to 5 lbs. pressures have been built as well as systems with pressure up to 250 lb. and at several degrees of superheat. The steam is metered as it is delivered to the customer while hot water can only be sold at a flat rate.

The construction of the distributing system sometimes includes a tunnel in which the individual pipes are grouped. For smaller systems or streets with only a few customers, one or two pipes are installed in a wooden conduit. A split conduit held together with wires and having a protecting outer coating is used and an air space is provided between the pipe and conduit to minimize radiation losses. When more than one pipe is run in a conduit a special large size conduit is used. For this reason the pipes are often run separately, a protecting conduit being used for each one. The pipe used depends on the pressure, high-pressure systems using a steel pipe or special corrosion-resisting alloy. Low-pressure systems have water of condensation and steel pipe is, therefore, replaced by wrought iron pipe as the lower carbon content of this decreases the corrosive action.

Manufacturers:

American District Steam Co., N. Tonawanda, N. Y. "Adsco."
Ric-Wil Co., The, Cleveland, Ohio.
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."

CONDUIT THREADING DEVICES AND MACHINES.—Special tools or machines used for cutting threads on the ends of pipe or conduit to enable screwed joints to be made. On large construction jobs where a great deal of conduit has to be cut and threaded, these special devices effect much saving of time and labor as compared with hand threading by die and stock. In pipe and conduit mills threading is always done by special threading machines.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
BORDEN CO., THE, Warren Ohio. "Beaver." "Square-End."
Curtis & Curtis Co., The, 188 Garden St., Bridgeport, Conn. "Forbes."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Mueller Mfg. Co., Ltd., W. H. Sarnia, Ont., Can.

CONDUIT, UNDERGROUND, CONCRETE OR STONE.—Conduit made entirely of fine concrete, known as stone pipe, is now used in some cases for power distribution systems instead of clay tile. It is made in standard lengths of 5 ft. and jointed together by means of metal ferrules, one of which is attached to each section. The alinement is, therefore, maintained by the ferrules. This conduit is made only in single-duct form, because the weight of a multiple-duct conduit would be excessive for shipping. Several ducts are laid together in concrete, giving a solid and durable conduit system. The stone pipe is somewhat fragile and must be handled carefully. Short lengths used to provide flexibility or adjustment in bringing the ducts just to the manhole walls are also furnished with this conduit or may be cut from any broken pieces available. The standard inside diameter is 3½ ins., corresponding to the clay tile. The weight is about 7½ lbs. per foot of length.

Manufacturers:

Chicago Stone Conduit Co., Addison St. & Chicago River, Chicago, Ill. "Stone-Duct."

CONDUIT, UNDERGROUND, FIBER.—Fiber conduit is used extensively for carrying underground cables of all classes of service. It was originated and first manufactured in 1893. In the process of manufacture, wet wood pulp or fiber is wrapped in a minutely thin film upon a forming mandrel, under pressure, until the desired thickness of wall is obtained. The fibers become felted and form a solid, homogeneous wall. Taken off the mandrel, the wet pulp structure is subjected to a drying process, after which it is placed in a vat of liquid compound. This compound is a preservative, and is also insulating and waterproofing. The compound thoroughly permeates the entire structure so that after treatment the wall presents a close resemblance to hard rubber. The finished ducts are smooth tubes with bore diameters ranging, in the most used standard sizes, from 2 to 4½ ins., inclusive, and are in standard 5-ft. lengths. The conduit is provided with either of two lathe-cut types of joint—the socket type (mortise and tenon); or that called the Harrington type (ends of conduit are tapered and fit into a coupling that has a corresponding interior taper). The Harrington joint permits conformity to moderate ditch irregularities in laying.

Fiber conduit is light in weight, not easily broken and easily handled and laid. In constructing an underground conduit run, the ducts are laid on a bottom layer of concrete and concrete is either poured over each succeeding layer of ducts, or the ducts are built up to the desired multiple by means of concrete separators and the duct structure is enveloped in concrete in the concreting operation. These forms of conduit construction make a conduit line that is strong and highly resistant to mechanical stresses, such as settlement of the surrounding earth, and to electrolytic and other corrosion. For fiber conduit fittings see Bends, elbows and other fittings, fiber conduit.

Manufacturers:

American Fiber Conduit Corp., 103 Park Ave., New York, N. Y. "American."

FIBRE CONDUIT CO., THE, Orangeburg, N. Y. Originator, patentee and manufacturer for 28 years (1893-1921), of Orangeburg fibre conduit, Orangeburg fibre bends and Orangeburg fibre fittings for carrying underground transmission and distribution cables, and central station and substation cable runs. Orangeburg fibre conduit, bends and fittings are the development from careful study, experimentation and experience. The requirements of efficient underground cable protection and economical installation costs are met with Orangeburg fibre conduit. Efficient cable proteotion is assured by the various physical properties of Orangeburg fibre conduit which consist of high insulation, minimum moisture absorption and tight joints which tend to eliminate the possibility of electrolytic action on the cable. Abrasion of the cable sheath is impossible due to the smooth bore and no offsets at the joints. Economical installation costs are assured by the light weight of the conduit and the accuracy and uniformity of manufacture which all make for ease and speed in handling and laying with the resultant saving of time and money. During the 28 years that cover the production of Orangeburg fibre conduit, the majority of light and power companies that require underground conduit have experimentally installed and tested Orangeburg conduit; have found it best suited for their needs and have installed it in steadily increasing quantities. Many of these companies have standardized their subway construction with Orangeburg fibre conduit as the duct material. Many millions of feet of 3 in., 3½ in., 4 in. and 4½ in. Orangeburg fibre conduit are now in service, carrying high-tension and low-tension transmission and distribution cables. Orangeburg fibre conduit, bends and fittings are manufactured with two types of joint, which are socket joint (mortise and tenon); and Harrington joint (ends of pipe are tapered and fit tightly in a bevelled coupling, without butting). Orangeburg fiber conduit is manufactured with a wide range of sizes, as is shown by the following table of dimensions:

Note—Sizes listed within the rectangles are standard and are carried in stock.

Orangeburg Conduit		Thickness of Wall	
Inside Diameter	Standard Length	Sooket Joint	Harrington Joint
*1"	30"	*¼"	*¼"
*1½"	60"	*¼"	*¼"
2"	60"	¼"	¼"
2½"	60"	¼"	⅛"
3"	60"	⅛"	¼"
3½"	60"	¼"	⅛"
4"	60"	¼"	¼"
4½"	60"	⅛"	⅛"
* 5"	60"	*⅜"	*⅜"
* 6"	60"	*⅜"	*¼"
* 8"	60"	*⅜"	*⅜"
*10"	60"	*⅜"	Not made
*12"	60"	*⅜"	Not made

Note—Sizes indicated by an asterisk, (*), are special and are manufactured on special order, only.

Orangeburg Bends		45° and 90°	"S" Bends	
Inside Diam.	Legth Overall	Standard Radius	Stand. Offset	Stand. Radius
*1"	30"	18"	10"	8"
*1½"	60"	18"-24"-36"	20"	36"
2"	60"	18"-24"-36"	20"	36"
2½"	60"	24"-36"	20"	36"
3"	60"	36"	20"	36"
3½"	60"	36"	20"	36"
4"	60"	36"	20"	36"
4½"	60"	36"	20"	36"
*5"	60"	36"	20"	36"

Note—Bends of special degree or radius are manufactured on order.

Orangeburg Fittings consist of Crosses; Tees; Caps; Short Elbows; Reducers; Couplings; and Junction Boxes with one, two, three or four outlets. These fittings are produced to connect with all sizes and types of Orangeburg Conduit and Orangeburg Bends. Also see adv. on inside back cover.—Adv.

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Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
North American Electrical Products Corp., Equitable Bldg., New York, N. Y.

CONDUIT, UNDERGROUND, TILE OR TERRA COTTA.—For high-tension power and lighting cables, medium-tension cables and important telephone and telegraph cables, conduits made of various clay products are extensively used because of their fireproof nature and the possibility of making multiple-duct sections which facilitate laying the conduit. Vitrified or salt-glazed tile and terra cotta are the materials of this class most used. The conduits are made single or multiple-duct, chiefly the latter, sections with 2, 3, 4, 6, 9 and 12 ducts being employed most. The ducts have either square or round bores, the standard size being 3½ ins. in diameter; the former are lighter in weight and used more than the round bore. The outside of the section is usually rectangular with slightly beveled longitudinal edges to prevent chipping. Sections usually have butt joints with end sockets between the ducts to permit inserting pegs or plugs for alining. The standard section lengths range from 18 to 36 ins., depending on the number of ducts per section; short sections from 6 to 15 ins. long are made to permit adjustments near manholes or to unite runs that have been made from each end. Since the outer surfaces of the sections are planes, there are no large voids to be filled between them. Where several sections are superposed in a conduit run having over nine ducts, their joints are commonly staggered to give additional strength.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y. "Clermont."
CLAY PRODUCTS CO., THE, Brazil, Ind. Manufacturers of electrical clay salt glazed multiple conduit.

Single Duct (Round)	18 in. long
Single Duct (Square)	18 in. long
Two Duct	24 in. long
Three Duct	24 in. long
Four Duct	36 in. long
Six Duct	36 in. long
Nine Duct	36 in. long

—Adv.
Grand Ledge Clay Product Co., Grand Ledge, Mich.
International Clay Products Co., 31 Union Sq., New York, N. Y. "Clermont."
National Fire Proofing Co., Pittsburgh, Pa. "Camp," "McRoy," "Natco."

CONDUIT, UNDERGROUND, WOOD, OR PUMP LOG.—On account of its low cost and light weight creosoted wooden pump log has been widely used in conduit construction and for some classes of work has been found quite satisfactory. It was one of the earliest forms of conduit used, but when power cables of high voltage and high power capacity were used the pump log proved too inflammable and short-lived. Consequently its use is now confined principally to telephone and signaling circuits, where the voltage is low and where very little heating effect is experienced. The wooden log is generally sawed to size in the form of a block and bored out to the proper diameter for the cable. It is then thoroughly treated with a creosote compound under pressure.

Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky.
AMERICAN LINE MATERIALS CO., 1461 McCormick Bldg., Chicago, Ill. We make this of yellow pine at Norfolk, Va., and of Douglas fir at Tacoma, Wash.; it is creosoted full vacuum treatment, and is the most economical and satisfactory conduit for the carrying of all forms of lead cable; it is 4½x4½ ins. outside measurement, in random lengths; has a 3-in. hole in the center, a mortise at one end and a tenon at the other; its cost of laying is very low compared with other conduits and when repairs to wires are necessary, it is easily accessible; it is in general use by the large telegraph companies and telephone companies all over the country.—Adv.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky.
Indiana Creosoting Co., 401 W. Main St., Louisville, Ky.
Michigan Pipe Co., Bay City, Mich.
North American Electrical Products Corp., Equitable Bldg., New York, N. Y. "Bitu-Duct."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
SOUTHERN WOOD PRESERVING CO., Atlanta, Ga.
Tidewater Crossarm & Conduit Co., Tacoma, Wash.

CONDULET.—Trade name for a very extensive line of conduit fittings manufactured by the Crouse-Hinds Co., Wolf & N. 7th Sts., Syracuse, N. Y.

CONDULETTO.—Trade name for receptacles and rosettes manufactured by the Crouse-Hinds Co., Wolf & N. 7th Sts., Syracuse, N. Y.

CONDULINE.—Trade name for filling compound manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

CONDULOCKNUT.—Trade name for conduit locknuts manufactured by the Central Nut Lock Co., 332 S. Michigan Ave., Chicago, Ill.

CONES, GROUND.—Various special fittings for making ground connections have been devised. A cone-shaped receptacle filled with moisture-holding materials known as grounding cone is one of these. These cones are often made of copper and filled with charcoal. They have a cable securely soldered to the bottom, to which the ground wire is attached. Cones 1 to 2 ft. long are commonly used.

Manufacturers:

Arrow Conductor & Mfg. Co., 1536 W. Adams St., Chicago, Ill.
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
PARAGON ELECTRIC CO., Old Colony Bldg., Chicago, Ill. "Paragon."

CONFERENCE CLUB, THE.—An organization to promote co-operation in the electrical industry. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

CONGRESS.—Trade name for rubber belting manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

CONICAL REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-3086 W. 106th St., Cleveland, Ohio.

CONITE.—Trade name for molded insulation manufactured by the Continental Fibre Co., Newark, Del.

CONLAN.—Trade name for watertight receptacles and plugs manufactured by the Conneaut Metal Works Co., Conneaut, Ohio.

CONLEY FROG & SWITCH CO.—Memphis, Tenn. Manufacturer of track frogs, manually operated track switches and track work for electric railways. Business established 1907. President and general manager, J. E. Conley; vice-president, B. L. Mallory; secretary and treasurer, E. H. Baumgarten; sales manager, E. H. Baumgarten. Main office and factory, Bodley Ave., Memphis, Tenn. Branch offices, Peoples Gas Bldg., Chicago, Ill.; 88 State St., Boston, Mass.

CONNEAUT.—Trade name for marine wiring devices and lighting fixtures manufactured by the Conneaut Metal Works Co., Conneaut, Ohio.

CONNEAUT METAL WORKS CO., THE.—Conneaut, Ohio. Manufacturer of lighting fixtures and electrical wiring devices. President, W. Lumley; secretary, A. B. Wilson.

CONNECTED LOAD.—The combined continuous rating of all the receiving apparatus connected to the system or part of the system under consideration. The term connected load is used chiefly to refer to the total rated load on a power or lighting consumer's premises.

CONNECTICUT.—Trade name for electric automobile clocks manufactured by the Connecticut Electric Clock Co., 89 Woodbine St., Hartford, Conn.

CONNECTICUT.—Trade name for radio and telephone equipment manufactured by the Connecticut Telephone & Electric Co., Meriden, Conn.

CONNECTICUT ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Chairman, E. S. Francis, 272 Asylum St., Hartford, Conn.; secretary, George M. Chapman, Waterbury, Conn.

CONNECTICUT DYNAMO & MOTOR CO., THE.—Lyons Ave. & Coit St., Irvington, N. J. Manufacturer of generators, motor-generators and other electroplating equipment. Business established 1888.

CONNECTICUT ELECTRIC CLOCK CO.—89 Woodbine St., Hartford, Conn. Manufacturer of electric automobile clocks. Business established 1920. President, A. H. Stevens; vice-president and general manager, R. H. Stevens; secretary and factory manager, W. H. Greenleaf; treasurer, A. W. Fox.

CONNECTICUT ELECTRIC MFG. CO.—Bridgeport, Conn. Manufacturer of wiring devices. Business established 1906. President, A. H. Trumbull; secretary, H. M. Doyle. Main office, Connecticut & Florence Ave., Bridgeport, Conn. Factories Bridgeport, Conn.; Bantam, Conn.; Trenton, N. J. Branch Office and warehouse, San Francisco, Cal. District offices, New York, N. Y.; 431 S. Dearborn St., Chicago, Ill.

CONNECTICUT TELEPHONE & ELECTRIC CO.—Meriden, Conn. Manufacturer of radio and telephone equipment. Business established 1894. President, F. C. Wilcox; secretary, B. C. Rogers; treasurer, B. L. Lawton.

CONNECTION.—In electrical circuits and apparatus a completed electrical contact is called a connection. It may be a contact between wires, contactors, ground, or in general any conducting materials.

CONNECTION, TELEPHONE.—This refers to the electrical joining of two telephone instruments for the purpose of talking. The connection begins when the answering operator plugs into the answering jack of the calling line. It is a completed connection when the electrical circuits from telephone to telephone are finally closed. A cross connection is a semipermanent wire, soldered or held by screws. See Frames, distributing. Parallel telephone connections are generally referred to as "bridge connections." This term refers particularly to a connection of apparatus across a pair of wires forming a transmission line.

CONNECTOR, TELEPHONE.—See Switches, telephone, automatic connector.

CONNECTORS, ANGLE.—Angle connectors are used with flexible steel conduit and armored cable to make a connection to a junction or switch box, cabinet, etc. They are made with either a 45° or 90° angle and permit the conduit or cable to be fastened to a box in a narrow wall or space, where there is not sufficient room to bend the conduit and use a straight box connector. They have a clamping device at one end that slips over the conduit and cable and is then drawn together or held in place by means of a screw. The other end is threaded and has a shoulder which fits up against the box and is held in place by a locknut on the inside of the box.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

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CONNECTORS, BATTERY.—Short pieces of copper strip or flexible wire with an eyelet or spring clip fastened to each end for conveniently making a firm connection to battery binding posts. These are largely used with dry batteries. Another form is made of a short brass or copper rod drilled to hold the wires to be connected; the wires are held in place by winged set screws or thumb screws. For storage batteries the connectors are usually lead-encased, consisting of a stud and a pair of lead-covered nuts. Also see Nuts, lead-encased.

Manufacturers:

Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C."
American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barcy & Nicholson, Detroit, Mich.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Breasnell, J. H., 26 Court St., Brooklyn, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Champion Storage Battery Corp, 193 Church St., Poughkeepsie, N. Y. "Champion."
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C.
Ferry Mfg. Co., 2113 S. 4th St., St. Louis, Mo.
FITZGERALD MFG. CO., THE, Torrington, Conn.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
Ideal Clamp Mfg. Co., Brooklyn, N. Y.
Lemke Electric Co., 509–513 Cedar St., Milwaukee, Wis.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco," "Sta-There," "All-Redi."
Mendell Mfg. Co., Mattapoisett, Mass.
Munning & Co., A. P., Church St., Matawan, N. J.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.
Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass. "Universal."
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Salem Electrical Supply Co., 9 Front St., Salem, Mass.
Shain, Charles D., Times Plaza, Brooklyn, N. Y.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Universal Battery Co., 3410 S. LaSalle St., Chicago, Ill.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Victor Storage Battery Co., Rock Island Ill. "S. O. S."

CONNECTORS, BOX AND CABINET.—Malleable iron connectors having a clamp at one end and the other end threaded to receive a locknut or to screw into a threaded receptacle in cast iron boxes. When used with flexible conduit, armored cable or metal raceway a locknut is placed on the inside of the box or cabinet to clamp the connector in place by pulling the shoulder on the clamping collar against the box. The clamping device is either a split collar or a solid collar for armored cable or flexible steel conduit and a screw is used to make the collar grip tightly. For use with metal raceway the clamp end of the connector is arranged to hold the raceway by means of a screw through the base.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
E. & B. Mfg. Co., The, 965 Woodward Ave., Detroit, Mich. "Snap."
Economy Electric Specialty Co., 6937 S. Halsted St., Chicago, Ill. "Economy."
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
GILLETTE-VIBBER CO., New London, Conn. "GeeVee."
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. A complete line of box connectors, panel box connectors and angle box connectors is furnished, for Greenfield flexible steel conduit and (BX) armored conductors. These are electrogalvanized. Sprague products, see display adv. pages 1306-7.—Adv.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."

CONNECTORS, BRASS CYLINDER AND SLEEVE.—Brass cylinders with the ends bored out to form wire sockets or continuous sleeves, in either case fitted with one or two set screws at each end for holding wires inserted in the sockets or sleeve ends. These connectors are widely used in testing work and for miscellaneous wire connections of temporary character where the voltages are low and the connectors can be guarded from ground or short-circuit contacts. They are made in various sizes for wires up to about No. 0 A.W.G.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.
Mendell Mfg. Co., Mattapoisett, Mass.
Mondell Mfg. Co., New Bedford, Mass.
Morse, Frank W., 289 Congress St., Boston, Mass.
Munning & Co., A. P., Church St., Matawan, N. J.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONNECTORS, COPPER, ELBOW, STRAIGHT, TEE, ETC.—High-tension switchboards frequently have copper tubing buses instead of the flat bar. This is because the current carried is relatively small and the tubing gives much greater strength for the same cross section. The connectors used with this are of two general forms, those in which the tubing is shrunk onto the connector and those in which the connector is split and bolts onto the tubing. Both types are generally made of cast copper and are produced in a number of different styles, combinations and sizes. In addition to the elbow, straight and tee connectors, angle connectors for different angles, separable connectors, and round to flat connectors are made.

Manufacturers:

Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.

CONNECTORS, CORD.—Cord connectors are made in the form of a separable plug of either porcelain or composition material. They vary in size from the pin plug type to the heavy type with prong terminals, according as they are designed for use on battery or ordinary lighting circuits. These connectors serve for conveniently connecting sections of extension cord and in some cases are also used as cord switches for small portable appliances, although cord switches specially designed for this service are to be preferred.

Manufacturers:

B. & W. Specialty Mfg. Co., 100 Boylston St., Boston, Mass. "B. & W."
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The two-pole water tight connector shown here has cast brass body and is provided with effective gaskets where the cord enters and at the point of separation. It is rated at 15 amps., 125 volts and is suitable for hard usage and underwater service. The line also comprises a connector of 6-amp. capacity, non-water-tight.—Adv.



Cord Connector

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
CONVENOLITE CO., THE, 231 N. Wells St., Chicago, Ill. General distributors, Schweitzer & Herz, 231 N. Wells St., Chicago, Ill. "Conveno."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
International Register Co., The, 15 S. Throop St., Chicago, Ill.
Lemke Electric Co., 509-513 Cedar St., Milwaukee, Wis.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Wirt Co., 5221 Greene St., Philadelphia, Pa.

CONNECTORS, EDISWAN AND OTHER AUTOMOBILE TYPE.—Autombile lamps, spotlights and other attachments do not use an Edison screw base because the jarring and vibration would soon cause them to become loosened. Ediswan or bayonet connections are resorted to in overcoming this difficulty. Very often special lamps, that are used when making repairs on the road or in changing a tire, are provided with a long cord and may be connected in the circuit by means of one of these connectors. They have two brass prongs or pins that enter corresponding holes in the receptacle or socket and are then given a partial turn, whereby they are locked in place. The connecting cord is attached to the opposite end of the connector.

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Manufacturers:

Breeze Metal Hose & Mfg. Co., 22 Calumet St., Newark, N. J.
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Crescent Mfg. Co., The, 129 Reade St., New York, N. Y. "Crescent."
Metal Specialities Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass.
Smith Mfg. Co., Inc., F. A., 183-187 N. Water St., Rochester, N. Y. "Smith."

CONNECTORS, EMERGENCY.—Wiring fittings for making temporary joints, taps and splices to wires and cables. They consist of a clamp device for attaching to the main conductors and gripping them securely, and means for making temporary connection to these fittings for tap splices In nearly all cases the splice is purely mechanical and no solder is used in the connection.

Manufacturers:

Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Dossert & Co., 242 W. 41st St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

CONNECTORS, FLEXIBLE STEEL CONDUIT AND ARMORED CABLE.—Fittings used in connecting flexible steel conduit and armored cable end to end, to steel cabinets, to rigid conduit, to metal raceways for surface wiring, etc. They are usually malleable iron fittings of the squeeze type, having a split band or collar which is drawn tight by means of a screw Other types do not have a split collar, but have a set screw arranged to hold the armor securely against the sides of the collar. Connectors of this general type are also used for connecting to outlet boxes, etc.; for these see Connectors, box and cabinet.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Atlantic Tubing Co., 1756 Cranston St., Providence, R. I.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
ESSEX MFG. CO., 17 Mulberry St., Newark, N. J.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill.
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display adv. pages 1302-1304.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Overbagh Co., Cameron, 221 W. Randolph St., Chicago, Ill.
Pratt-Chuck Co., The, Frankfort, N. Y.
Pyle National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (squeeze type). (See display adv. page 1308.)
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. Malleable iron, galvanized. 13 sizes, from ¼ to 2 in. These are known as "Squeeze" Connectors, and are also supplied for 45 and 90 degree angle work. A third type is known as the Inclined Set Screw Type.—Adv.

CONNECTORS, LOW-TENSION SEPARABLE.—These connectors may be used on any low-tension circuit where little current is carried, as in the case of telephone systems, annunciator or alarm systems. They consist of a number of separate contacts set in an insulating block, that fit over corresponding prongs or contacts on another block. When the two are placed together the connections for several circuits are completed. They are used on such systems where the circuits are opened occasionally, having the advantage that a skilled man is not required for the work.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Murdock Co., William J., 40 Carter St., Chelsea, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y.

CONNECTORS, METAL MOLDING OR RACEWAY.—Fittings used in metal raceway work in connecting the raceway to armored cable, wooden raceway or molding, open wiring or rigid conduit. They are usually malleable or cast iron connectors, arranged to clamp the raceway by means of a screw. There are several forms of connectors, elbow, tee and straight, and they are made in standard sizes and with both male and female threads.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Jordan Bros., 74 Beekman St., New York, N. Y. "Tapon."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

CONNECTORS OR TAPS, SERVICE WIRE.—Where it is desirable to be able to disconnect overhead service wires at times, a screw type connector which requires no soldering is found useful. These do not open the main, but clamp around it. There are several forms of these available, some of which are flat split clamps with a screw connection for the service wire and others are like split sleeves with a lug into which the service wire may be sweated.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Cameron Appliance Co., 48 Waters Ave., Everett, Mass.
Dossert & Co., 242 W. 41st St., New York, N. Y.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONNECTORS, SOLDERLESS.—Solderless connectors are used for splicing either stranded or solid conductors, without the use of solder. Strong mechanical and good electrical connection between wires and cables is secured by threaded connections which give a clamping action. There are several different methods used to clamp the wire. One type has a center fitting or sleeve with jaws which grip the wire or cable securely, as a nut is run on the fitting from each end. Another type consists of a tapered sleeve put on each wire and forced tightly against it as pressure is applied by running a nut from each end onto a center fitting. In some of the other types set screws or clamping screws are used to give the clamping action. These connectors are made in a number of forms, for end-to-end splices, three-way or tee connectors, tap connectors, elbows, reducers, stud connectors, etc. They are used very widely for stranded conductor cable work, as the time taken to make a splice with these connectors is much less than other methods. Several types of these solderless, connectors are approved for use where the National Electrical Code otherwise requires a soldered connection.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
COLUMBIA METAL BOX CO., 226 E. 144 St., New York. N. Y. The Columbia "NOTORCH" connector is approved by the National Board of Fire Underwriters. Simply scrape the in-



Solderless Notorch Connector

sulation from the wires, insert the ends in the brass jaw and then tighten up the screws. Its simplicity commends it for lighting fixture work, motor leads up to 4 h. p., conduit fittings, junction boxes, etc. Has capacity to hold 2 No. 12 or 3 No. 14 wires in each end.—Adv.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Cruban Machine & Steel Corp., 63 Duane St., New York, N. Y.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Dossert & Co., 242 W. 41st St., New York, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Fulton Co., E. E., 3208 Carroll Ave., Chicago, Ill. "Fulco."
Great Lakes Radio Supplies Co., 1st National Bank Bldg., Elmhurst, Ill.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass. "H-C."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Mathias-Hart, 516 Atlantic Ave., Boston, Mass.
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)
Morse, Frank W., 289 Congress St., Boston, Mass.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
Simpson, Alexander B., 152 E. 53rd St., New York, N. Y. "Coldsplice," "Midget."
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Meliorate."
Stover & Co., S. H., Chamber of Commerce Bldg., Pittsburgh, Pa. "Wa'ger."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U. S. E. M."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Westinghouse-Krantz." (See display adv. pages 1395-1402.)

CONNECTORS, SOLDERLESS, INSULATED.—These connectors are similar to the solderless connectors described above, but are furnished with insulating covers which are placed over the connector after it is in place. The insulating cover eliminates the need for taping the connection and makes it readily accessible for inspection, etc. The covers are furnished in different forms, some in sections to screw together, and others in the form of a split sleeve which is bolted together. They are made for the principal types of connectors, such as two-way or end-to-end, three-way or tee, elbow, cable taps, etc.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Dossert & Co., 242 W. 41st St., New York, N. Y.

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Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."
Morse, Frank W., 289 Congress St., Boston, Mass.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Meliorate."
Stover & Co., S. H., Chamber of Commerce Bldg., Pittsburgh, Pa. "Walger."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."

CONNECTORS, SPRING CLIP.—Metal connectors usually of copper or phosphor bronze in which the tension of a spring clip is used to maintain a contact. These are made for several purposes, some for connecting two wires together where the clip snaps over the wire, others for mounting on a base or terminal box so that the connections may be made and changed easily. Another form is sometimes placed on dry batteries in place of screw binding terminals or posts to facilitate connections. They are widely used for testing work, where only temporary connections are needed.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Breaznell, J. H., 26 Court St., Brooklyn, N. Y.
E. & B. Mfg. Co., The, 965 Woodward Ave., Detroit, Mich.
Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

CONNECTORS, STAGE.—Plug type connectors having spring metal contacts mounted in fiber bases and used to make electrical connection by plugging into special fiber block receptacles mounted in stage or wall pockets. They are used to give connections for stage lights, borders, fans and miscellaneous electrical theatrical appliances, and also to connect lengths of stage cord or cable together.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Chicago Stage Lighting Co., 112 N. La Salle St., Chicago, Ill.
Dossert & Co., 242 W. 41st St., New York, N. Y.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Morse, Frank W., 289 Congress St., Boston, Mass.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

CONNECTORS, STUD.—Brass or bronze studs, one end arranged to receive a wire or cable and the other end threaded to screw into block terminals or to clamp onto a strap or other terminal by means of a nut on the end of the stud. They are used for connecting wires or cables to terminal blocks or busbars. They are made to have the cable sweated into the connector and also in the form of solderless connectors.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Godfrey."
Dossert & Co., 242 W. 41st St., New York, N. Y.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S".
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."

CONNECTORS, TEST.—See Clamps, telephone line test. Also under Switches telephone, automatic connector.

CONNECTORS, TRAILER.—Brass fittings of male and female design, used in connection with suitable cables, for carrying electric connections for signals, and sometimes heat and light, from motor car to trailer. Heat and light connections between cars are usually made by what are called jumpers; see Jumpers.

CONNECTORS, WATER-TIGHT, FOR CABLES.—These connectors are for use with low or medium-tension underground cable or cable installed in locations where moisture is apt to be present. Very often where taps or splices are made in a manhole that is likely to be filled up with water, the moisture gets into the joint and creeps back by capillary action. Watertight connectors generally consist of a clamping device to give a good electrical contact and a rubber sleeve that fits over the joint and over the lead sheath of the cable.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See Connectors, cord.—Adv.
Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. This watertight connector prevents moisture from following lead armor into the outlet box. Made in six sizes to take the usual sizes of armored lead conductors.—Adv.

CONNERSVILLE.—Trade name for electric floor scrubbers and vacuum cleaners manufactured by Landers, Frary & Clark, United Vacuum Appliance Division, Connersville, Ind.

CONNOR & SON, LTD., J. H.—Ottawa, Ont., Can. Manufacturers of electric washing machines.

CONOIDAL.—Trade name for electric pumps, blowers, exhaust fans, air washers etc., manufactured by the Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Can.

CONOVER MFG. CO.—565 W. Van Buren St., Chicago, Ill. Manufacturer of motor-driven dishwashing machine for domestic use. Business established 1920. President, G. W. Conover; vice-president, Oscar Karpen; secretary, F. L. Benham; treasurer, Edward Anderson; general manager, W. F. Little; sales manager, H. S. Conover.

CONSOLIDATED CAR HEATING CO.—Albany, N. Y. Manufacturer of electric car heaters, bells, buzzers, door opening devices, switches, etc. President and treasurer, Cornell S. Hawley; vice-president, W. S. Hammond; secretary, J. H. McElroy. Main office, Albany, N. Y. Branch offices, New York, N. Y.; 343 S. Dearborn St., Chicago, Ill.

CONSOLIDATED ELECTRIC CO., LTD.—230-232 King St., E., Toronto, Ont., Can. Manufacturer of motors and generators. Business established 1899. President and general manager, J. G. Howorth; vice-president, A. H. Howorth; secretary, treasurer and sales manager, B. S. Hyde.

CONSOLIDATED ELECTRIC LAMP CO. Danvers, Mass. Manufacturer of incandescent lamps. President, Frank W. Marsh; treasurer, Jasper Marsh; secretary, L. W. Fox.

CONSOLIDATED ELECTRIC MFG. CO., INC.—223-25 N. 13th St., Philadelphia, Pa. Manufacturer of switch boxes, switchboards and panelboards. Sales representatives, King-Cramer Co., New York, N. Y.; Sperry & Bittner, Pittsburgh, Pa.; F. H. Young, St. Louis, Mo.; G. W. Russell, Jr., Detroit, Mich.

CONSOLIDATED LAMP & GLASS CO.—Coraopolis, Pa. Manufacturer of lighting units, portable lamp bases and illuminating glassware. President, James L. Lewis; vice-president, J. F. Kirk; secretary and treasurer, W. P. Barker; general manager, W. A. Sargeant. Main office, Coraopolis, Pa. Branch offices, 66 W. Broadway, New York, N. Y.; 17 N. Wabash Ave., Chicago, Ill.; 1103 Empire Bldg., Pittsburgh, Pa.; 233 Sherlock Bldg., Portland, Ore.; 634 Arch St., Philadelphia, Pa.; 351 Pacific Electric Bldg., Los Angeles, Cal.; 113 Wortley Rd., London, Ont., Can.

CONSOLIDATED MINING & SMELTING CO. OF CANADA, LTD.—Trail, B. C. Can. Producer of electrolytic copper and zinc. Business established 1906. President, J. J. Warren; secretary, J. Litto; general manager, S. G. Blaylock; sales manager, D. S. Pugh. Main office, Trail, B. C. Branch office, Drummond Bldg., Montreal, Que., Can.

CONSOLIDATED SAFETY VALVE CO.—119 W. 40th St., New York, N. Y. Manufacturer of safety valves.

CONSONANCE.—In electrical circuits this refers to a condition in a transformer which produces resonance in the primary circuit due to the proper combination of inductance and capacitance in the secondary circuit. Consonance, except in radio circuits, is a condition to be avoided.

CONSTANT-CURRENT CIRCUITS.—See Circuits, lighting and power.

CONSTANT-POTENTIAL CIRCUITS.—See Circuits, lighting and power.

CONSTRUCTION MACHINERY CO.—Waterloo, Iowa. Manufacturer of gasoline engines. G. B. Arthur, general sales manager.

CONSULTING ENGINEER.—A technically trained engineer of long experience and high professional standing in some one or more branches of engineering who confines his practice chiefly to advisory or consulting service in the solution of engineering and related technical problems for corporations, firms, individuals or public authorities. This often includes the design and supervision of engineering works, development of processes and inventions, and sometimes responsibility for the entire conduct of the engineering phases of a business. He may be a specialist in electrical, mechanical, civil, mining, chemical, sanitary, structural or other branches of engineering. Also see Electrical Engineering.

CONSUMERS RUBBER CO., THE.—1302 Ontario St., Cleveland, Ohio. Manufacturer of hard rubber rods, sheets, tubing, battery jars, belting, packing, mica and mica products, soldering paste, tapes and other insulating materials. President and manager, J. N. Kirby; secretary and treasurer, Thomas J. Jones.

CONTACT CONDUCTOR.—See Conductor, contact.

CONTACT MAKERS, TESTING.—Wave forms of alternating currents and e.m.f.'s are sometimes determined by connecting the measuring instrument periodically and momentarily to the circuit. The device by which this is accomplished is essentially a rotating key, one part of which is rigidly connected to the generator shaft and rotates with it. The rotating member consists of a wheel of insulating material, within which are imbedded one or more metal strips or small rods. The other contact of the key is usually in the form of a brush mounted on a graduated arc. One terminal of the generator is connected to the brush and the other to the metal strip in the rotating member. As the wheel rotates the circuit is momentarily closed through the brush and imbedded rod. An electrostatic voltmeter, electrometer or ballistic galvanometer may be used for indicating the value of the e.m.f. at the instant of contact. By changing the angular position of the brush, the e.m.f. at other positions of the armature is indicated by the deflection. By plotting the angular positions of the brush as abscissas and the deflections of the measuring instrument as

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ordinates, the shape of the e.m.f. wave is obtained.

Manufacturers:

American Platinum Works, 225-231 New Jersey Railroad Ave., Newark, N. J.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Hickey & Schneider, Inc., 434-42 E. Jersey St., Elizabeth, N. J. "H & S."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.

CONTACT METALS.—Metals specially suited for electrical contact points. See Metals, contact.

CONTACTOR.—A device for repeatedly establishing and interrupting an electric circuit under normal conditions. It differs from a circuit breaker in that the latter is primarily a protective device for breaking the circuit under abnormal conditions.

CON-TAC-TOR.—Trade name for switches, contactors, sign flashers, thermostats, relays and interrupters manufactured by the Absolute Con-Tac-Tor Co., 127 N. Dearborn St., Chicago, Ill.

CONTACTORS, MAGNETIC.—A magnetic contactor is an electromagnetically actuated device for repeatedly establishing or interrupting an electric power circuit. There are two principal types of contactors: solenoid-operated and clapper-operated. The movable contact of the solenoid type is mechanically connected to a plunger placed inside the operating coil. The movable contact of the clapper type is attached to an armature which is attracted to a core placed inside the operating coil. The clapper type contactor is simpler and has been adopted by practically all controller manufacturers. It is sometimes called a clapper switch.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th & Wesley Aves., Columbus, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y. "Whittingham."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Magnetic Contactors are designed and manufactured



C-H Shunt Contactor



C-H Magnetic Lockout-Contactor

almost entirely for use in connection with C-H electric controllers. Contactors used on controllers for steel mills are built of steel in order to secure less weight, greater strength and better magnetic characteristics. On the other hand, contactors used on elevator controllers have other characteristics which are equally important for this service. Among these are carbon - to - copper contacts which are long-lived, interchangeable on either d-c. or a-c. controllers, easily renewable and absolutely nonwelding. C-H contactors used on elevator controllers are usually quiet. The wearing parts of shunt, lockout, and spring-closed contactors of similar sizes are interchangeable, thus reducing the number of spare parts which must be carried in stock. C-H Contactors for a-c. high-tension work are oil-immersed and are operated either by clapper-type magnets or high-torque motors. See display adv. pages 1225-1230.—Adv.



C-H Spring Closed Contactor

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hartman Electrical Mfg. Co., Mansfield, Ohio.
Jeffrey Mfg. Co., 1st Ave & 4th St., Columbus, Ohio. "Arcmaster."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTACTORS, MISCELLANEOUS.—Contactors are used for a number of purposes aside from controller service, and their wide application has necessitated the use of several distinct types. Most of the important and more common types are described elsewhere, this classification being intended for special forms of contactors. One type that has been used for rather low current circuits is a liquid contactor. Two electrodes are placed in a glass tube which is partly filled with mercury and then with an inert gas. When the tube is tilted in one direction the electrodes are surrounded by mercury which completes the circuit. If tilted in the opposite direction the mercury flows to the other end and the circuit is opened. Other forms of contactors are used for miscellaneous purposes, such as with special carbon contacts or with silver, tungsten or platinum contacts where very many interruptions of small currents are obtained, and it is desired to have contacts free from pitting.

CONTACTORS, MOTOR-ACCELERATING.—Motor-accelerating contactors may have either shunt or series coils. Shunt contactors have coils wound to be connected across the line and are used in connection with automatic controllers of the counter e.m.f., series relay, and dashpot pilot-relay types. With series or lockout contactors, the motor current passes through the coils, and the magnetic circuits of the contactor are designed so that it is held open on high currents and closes when the current falls to a predetermined value.

CONTACT POINTS.—See Points, contact and sparking.

CONTACT SPRINGS, BURGLAR-ALARM.—See Springs, burglar-alarm contact.

CONTACTS, CARBON, CIRCUIT BREAKER, ETC.—Carbon contacts of the butt type are very often used on circuit breakers and controllers of various kinds. They may be used with fairly heavy current and on interrupting it will not pit very much and will not freeze together. Butt contacts are very often used as auxiliary contacts on air-break circuit breakers using copper contacts for the main current. These auxiliary contacts are generally replaceable, so that when an exceptionally severe short-circuit causes serious arcing or excessive pitting new ones may be inserted at a small cost. Blocks of carbon are generally used for such contacts. Also see Contacts, controller and circuit breaker.

Manufacturers:

MORGANITE BRUSH CO., INC., 519 W. 38th St., New York, N. Y. "Battersea."
PURE CARBON CO., Wellsville, N. Y.

CONTACTS, CONTROLLER AND CIRCUIT BREAKER.—Controller contacts are usually of copper, although brass and carbon are frequently used. Tungsten and silver contacts are sometimes used, principally for pilot circuits. Contacts are either of the sliding, wiping, or butt type. Sliding contacts are those where a brush or shoe slides over a number of stationary buttons or segments, as in the ordinary hand starter or rheostat. For this service brass, carbon or copper shoes are generally used and the buttons are usually brass in the small and copper in the larger sizes. Wiping contacts are those where two contacts come together in such a way that a little wiping motion is obtained which keeps the surface clean. Butt contacts are similar to wiping contacts, except that when copper-to-copper contacts are used a rolling action is obtained instead of wiping. If carbon-to-copper contacts are used it is not necessary to have either a wiping or rolling action. On magnetic contactors copper-to-copper contacts of the butt type are used where long life of contacts is desired. Carbon-to-copper contacts are used on elevator and similar control service where it is essential that the contactor shall not "freeze" in the closed position. Circuit breakers use butt contacts mostly for the main contacts and replaceable carbon plate contacts for the auxiliary or arcing contacts. For carbon contacts, see Contacts, carbon, circuit breaker, etc.

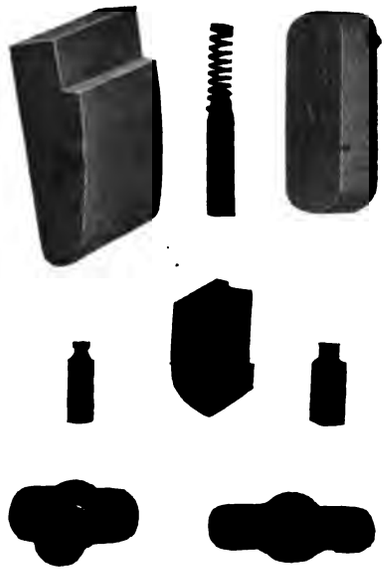
Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Calebaugh Self-Lubricating Carbon Co., Inc., 1503 Columbia Ave., Philadelphia, Pa. (carbon)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cosby Electric & Machine Co., R. R. 1705 E. Broad St., Richmond, Va.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Contacts are manufactured exclusively for use in connection with equipment of C-H manufacture. See display adv. pages 1225-1230.—Adv.
Dominion Carbon Brush Co., 38 Duke St., Toronto, Ont., Can.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis., "I-C."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
MORGANITE BRUSH CO., INC., 519-523 W. 38th St., New York, N. Y. Carbon contacts in many grades for switches, cutouts, controllers, also for magnetos and ignition apparatus. For switches, cutouts, controllers, etc., we supply hard, dense carbons having very small proportion of graphite, very homogeneous and uniform in grade. Where

When writing to manufacturers please mention the
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destructive sparking takes place an electro-graphitic variety gives longest life and suffers least. (See this company's entry under Brushes, carbon and



Morganite Carbon Contacts

graphite.) Hard carbons give best results on ignition apparatus, made up in all sizes and shapes, as illustrated.—Adv.

Mendell Mfg. Co., Mattapoisett, Mass.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Parkin Mfg. Co., San Rafael, Cal.
PURE CARBON CO., Wellsville, N. Y. (carbon)
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTINENTAL.—Trade name for incandescent and projecting lamps manufactured by the Continental Lamp Works, Inc., 532-40 W. 22nd St., New York, N. Y.

CONTINENTAL.—Trade name for wood flumes manufactured by the Continental Pipe Mfg. Co., Seattle, Wash.

CONTINENTAL.—Trade name for water filters manufactured by the New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.

CONTINENTAL-BAKELITE.—Trade name for molded insulation manufactured by the Continental Fibre Co., Newark, Del.

CONTINENTAL ELECTRIC LAMP CO.—1438 Bryan Pl., Chicago, Ill. Manufacturer of automobile lamps. Business established 1919. President, Leo Alter; secretary and treasurer, R. W. Armstrong.

CONTINENTAL FELT CO.—64-66 E. 11th St., New York, N. Y. Manufacturer of felt cushions, gaskets, etc. Business established 1905. President and general manager, John Newbold; secretary, Sarah Newbold; treasurer, M. M. Newbold.

CONTINENTAL FIBRE CO.—Newark, Del. Manufacturer of molded insulation. President, S. J. Wright; vice-president, N. N. Wright; secretary, H. L. Bonham; treasurer, J. T. Wright. Main office, Newark, Del. Branch offices, 233 Broadway, New York, N. Y.; 332 S. Michigan Ave., Chicago, Ill.; 301 5th Ave., Pittsburgh, Pa.; 525 Market St., San Francisco, Cal.; 411 S. Main St., Los Angeles, Cal.; 1710 Royal Bank Bldg., Toronto, Ont., Can.

CONTINENTAL LAMP WORKS, INC.—New York, N. Y. Manufacturer of incandescent and projecting lamps. Business established 1920. President, Thomas Spina; vice-president, Nicholas Fabian; secretary, treasurer and general manager, T. P. Vilaghy. Main office, 532-40 W. 22nd St., New York, N. Y. Branch office, 1432 Syndicate Trust Bldg., St. Louis, Mo. Sales representatives, C. H. Wallis & Co., 1432 Syndicate Trust Bldg., St. Louis, Mo.; the Electric Lamp & Appliance Co., 143 2nd St., San Francisco, Cal.; Domestic Electrical Supply Co., Inc., 38 Park Pl., New York, N. Y.

CONTINENTAL MOTORS CORP.—2951 Jefferson Ave., E., Detroit, Mich. Manufacturer of gasoline engines. Business established 1902. President, R. W. Judson; secretary, W. R. Angell; treasurer, G. W. Yeoman; general manager, J. F. Bourquin; sales manager, C. D. McKim. Factories, Detroit, Mich., and Muskegon, Mich.

CONTINENTAL PIPE MFG. CO.—Seattle, Wash. Manufacturer of wood tanks and flumes. President, T. B. Garrison; vice-president and general manager, Joe L. Long; vice-president, H. K. Munroe; secretary and treasurer, W. E. Russell. Main office, Seattle, Wash. Factories, Seattle, Tacoma, Wash.; Portland, Ore. Branch offices, Woolworth Bldg., New York, N. Y.; Tower Bldg., Chicago, Ill.; Jacobson Bldg., Denver, Colo.; Lewis Bldg., Portland, Ore.; Hyde Bldg., Spokane, Wash.; Public Market Bldg., Yakima, Wash.; Tacoma, Wash.; Seattle, Wash.

CONTINENTAL SALES DISPLAY CORP.—2 W. 45th St., New York, N. Y. Manufacturer of electrical advertising machine.

CONTINEOLIS.—Trade name for coiling machines manufactured by the Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York, N. Y.

CONTINUOUS CURRENT.—A direct current which is practically nonpulsating. This term is not used nearly as much in the United States as the term "direct current". In Europe, on the contrary, the term "continuous current" is used very freely whereas direct current is seldom spoken of.

CONTINUOUS RATING.—The output at which a machine can operate continuously without exceeding the temperature limitations. Also see Rating.

CONTINUOUS WAVES, RADIO.—See Radio telegraph transmitting apparatus.

CONTRA-POLE ELECTRIC CO., INC.—1227-1241 Prospect Pl., Brooklyn, N. Y. Manufacturer of violet-ray high-frequency generators and attachments. President, B. F. Jancke; vice-president and treasurer, T. Mueller; secretary, A. Wilner.

CONTRACTING, ELECTRICAL.—Electrical contracting is almost invariably understood to be the business of installing electric wiring and equipment on a contract basis. It is now one of the well established branches of electrical industry, performing an important function that can be taken care of most satisfactorily and economically by specialists in installation work.

Development. The first work of electrical installation was done by the manufacturers who had developed the generators, lamps, motors, switchboards and other related equipment. They were the only ones then informed on the characteristics of the apparatus and the requirements for its installation so as to give the service that was guaranteed by the manufacturer. Such installation work was at first chiefly in electric light and power plants, also consisting at times of complete street lighting systems. This necessitated that the manufacturer organize quite a large construction department with responsible engineers supervising the erection work. The cost of maintaining such departments became very heavy and the work gradually was turned over more and more to the central stations as the latter became more proficient in their mastery of their own plant apparatus and the lamps, motors and other utilization equipment that they served energy to. At present, manufacturers maintain a construction organization large enough only for supervising the erection of new types or of very intricate apparatus.

For smaller equipment, aside from plant and street lighting apparatus, it became impossible for manufacturers to maintain the necessary elaborate installation organization. This led to the establishment of the electrical contracting business. The first contractors were usually electric bell hangers, taking care of wiring of bells, buzzers and simple low-votage circuits as well as installing of speaking tubes in residences, small stores and shops. As they acquired more experience and electrical knowledge they began to install electric lighting circuits and fixtures and later also motors and other appliances.

In many communities, however, the contractors were slow to take up the heavier electrical work and in others there were no electrical contractors at all. Therefore, it was up to the central stations to do the wiring for their customers. In most cases this was done only because there was no alternative, if the extension of the use of electricity was not to be retarded, and it was later discontinued as contractors capable of executing it satisfactorily undertook this business. It is now recognized that the central station and contractor each has a distinct field and the former competition between them has almost entirely disappeared.

The electrical contracting business has had many vicissitudes. Most of the men who entered it did so as wiremen. Many of these were determined to learn the business from the ground up and by patiently taking up every phase of the work gained a mastery that eventually developed them into skilled contractors. Others, urged on by enthusiasm, blossomed out into contractors soon after having had some experience in the practical work but in many cases lacked the knowledge of business methods, which resulted in many failures. Keen competition resulted in a great many cases, the contractors frequently underbidding each other so that the work was undertaken at a loss. Guesswork instead of careful estimating was very largely responsible for this. Consequently for many years this branch of the industry was not held in very high repute.

In 1901 there was organized the National Association of Electrical Contractors which has steadily gained in membership and prestige and has accomplished much to eliminate the loose business methods and the cutthroat competition formerly prevailing. Other electrical interests have also aided in helping the contractors to develop their business along modern business lines. To eliminate the irresponsible individuals, the licensing of electrical contractors has been put into effect in quite a few states and in many cities in which state licenses are not required. Educational work conducted largely by the national and local associations has aimed to teach the contractors the outlines of business accounting. Much attention has been given to an investigation of "overhead" expenses and of scientific estimating instead of guesswork. These various measures have stabilized electrical contracting very materially.

Present Status. Electrical contractors may be divided into two main classes. One consists of large firms that specialize on the heavier installation work, such as for large buildings, power plants, railroads, theaters, industrial plants, schools, public buildings, etc., and maintain an organization of technically trained engineers and estimators who make a careful survey of every proposed contract and in many cases lay out the details for executing the work most economically and satisfactorily. Architects' plans being often incomplete as to electrical features, many details have to be designed to make the electrical installation effective. The other general class of electrical contractors confines itself mostly to the smaller construction jobs in residences, apartment buildings, stores, small factories, etc. This class is by far more numerous than the former and handles many more contracts, which, of course, are for much smaller amounts.

Within the last few years this latter class of contractors has broadened considerably by undertaking not only regular contract work but also engaging in the merchandising of electrical supplies. By some of them the merchandising end of this business had been undertaken many years ago, but only in a spasmodic manner. It is now come to be recognized as being an important function of the electrical contractor who is, therefore, now more commonly called contractor-dealer. The more enterprising contractor-dealers have established electric shops in which a complete line of the more commonly used electric appliances, lamps, lighting fixtures and ordinary wiring supplies are maintained. These shops are attractively furnished and maintained as a separate department of the business on a strict business basis. Other contractors have also established service stations for charging and taking care of automobile batteries and other automotive electrical equipment.

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In a few cases some of the large contractors, have also established merchandising departments.

Aside from these two main classes of electrical contractors there is also a smaller group that specializes very largely, such as for the installation of underground electric conduit systems, street lighting systems, electric railway lines, power transmission lines, etc. Others specialize in motor repair and maintenance service for industrial plants and other motor users.

The investment in the contracting and mercantile branch of the industry at the beginning of 1921 was approximately $175,000,000. During the past few years there has been a very marked tendency, on the part of electrical contractors, to combine the functions of construction with merchandising, hence it is impossible to segregate the investment in contracting-construction alone.

Of the $2,000,000,000 credited to merchandise sales for the year 1920, $200,000,000 represents the value of contracting sales and the labor charges therefor, and $45,000,000 represents revenue received for repair and maintenance work.

There are about 6750 electrical contractor-dealers in the United States and Canada and approximately 1900 central stations in these countries do electrical contracting.

CONTRACTORS, ELECTRICAL.—Companies, firms or individuals engaged in the installation of electrical circuits and equipment. For further details see Contracting, electrical.

CONTROL SYSTEMS.—When the combined requirements of an electrically driven machine, of the motor driving it, and of the circuit supplying the energy become so exacting that standard or special but simple types of motor starters and controllers cannot handle them, even with contactors, relays and other much used controller appurtenances, it is often necessary to resort to auxiliary machines, such as motor-generators, synchronous converters, accessory motors, etc. In such cases the control equipment embodies many special control features and principles, and is often spoken of as a control system. This is also true where a group of machines, individually driven, is to be controlled by one master controller, as in multiple-unit train control.

Control systems are of many types, of which those most used are briefly described below:

Kraemer System. The Kraemer control system requires three machines: a main driving slip-ring induction motor, a d-c. shunt motor connected to the main motor mechanically, and a separate synchronous converter. The controller consists of a reversing switch and secondary-resistance controller for the main motor, by means of which the equipment is started and brought up to speed. The secondary resistance is then disconnected and the slip rings of the main motor connected to those of the converter. The d-c. brushes of the converter are permanently connected to those of the d-c. motor. The speed of the equipment is regulated by a rheostat in the d-c. motor field circuit. As the speed of the main driving motor is decreased, the slip energy passes through the converter to the d-c. motor, which assists in driving the main shaft. The power-factor is adjusted by a rheostat in the converter field. This system is used for rolling-mill drive. Its advantages are speed control without rheostatic loss, and possibility of power-factor correction.

Multiple-Unit Systems. A system of control of the motors of the train of the remote-control type so designed that small master controllers, located on car platforms or in cabs, carrying only small control circuit currents, serve to operate through electric train circuits the main controller and reverser located under each motor car, or in suitable compartments as on locomotives. Thus all heavy power currents are handled by apparatus located near to the main motors controlled. The distinguishing feature of this system of control, however, is that it provides for the operation from any car, on which master controllers are placed, of as many motor cars in the train as is desired. Several locomotives in tandem may also be similarly controlled. The control circuits are carried through from car to car (or locomotive to locomotive) by means of jumper cables fitted with suitable plug and receptacle connections. Two general types of multiple-unit systems of control have been developed: electromagnetic and electropneumatic. This system of control is also installed on single locomotives, especially those driven by several motors of large total horsepower rating.

Multivoltage System. Multivoltage distribution is obtained either by operating several generators of the same or different voltages in series, or by means of balancer sets. Multivoltage control is used in those cases where a stable low speed is required. Multivoltage systems are also sometimes used for electrical testing where wide variations in voltage are required.

Owing to the complication and additional cost of distribution, multivoltage systems are seldom used commercially. For rubber calender service, three voltages have been used, but two voltages are more common. On a 115-230-volt system rubber calender controllers are usually arranged for a speed range of 8 to 1; 50% speed reduction by armature resistance is obtained on 115 volts, and the speed at 115 volts with all resistance out is, therefore, twice the minimum speed. The speed at 230 volts is twice that at 115 or four times the minimum. Speed increase of 2 to 1 by resistance in the shunt field makes the maximum speed 8 times the minimum. Rubber calender controllers are usually magnetic with drum-type pilot master or push-button control. On other multivoltage applications manual multivoltage controllers of the drum type have been used.

On a-c. circuits, two-voltage distribution is sometimes used. Squirrel-cage motors are connected to the low-voltage lines for starting and to the high-voltage lines after the motor is up to speed. This system does away with the necessity of a separate autotransformer for each motor.

Scherbius System. The Scherbius control system performs practically the same functions as the Kraemer system. Speed adjustment without rheostatic loss and power-factor control are obtained with this system. The slip rings of the main drive motor are connected to an a-c. commutating machine, which is connected to an a-c. generator mechanically. The slip energy is, therefore, taken from the slip rings of the motor through the commutating machine and generator back to the line.

Ward Leonard System. The Ward Leonard system requires a separate generator for each motor. The motor is started with a low generator voltage and speeds up as the generator field is strengthened. When full generator voltage is reached the speed can be increased further by weakening the motor field. The motor is usually reversed by changing the generator field connections. This system is used principally for large reversing rolling mills and mine hoists. The controller usually consists of a master switch which controls the various magnetic contactors for reversing and varying the speed. Controllers of this type are generally cheaper than those where resistance in the armature circuit is used, because the contactors handle only the field current. In mine hoists and rolling-mill service, high peak currents are obtained and for this reason the generator is usually driven by a slip-ring motor to which a flywheel is connected. When the primary current exceeds a predetermined value resistance is inserted in the secondary of the slip-ring motor, which tends to slow down and allow the flywheel to deliver some of its stored energy.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville, Terrace, Boston, Mass. "Ceaco."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. The Scherbius system of speed control for steel mill main rolls has been developed by this company to a point where it is possible to regulate the induction motor above as well as below its synchronous speed, so that the normal speed of the motor lies in a much used part of the speed range, permitting the regulating set to be shut down and its wear and losses to be avoided during a great number of operations. Advantages of this system are, briefly: Higher efficiency; low first cost, except in special cases; power factor correction obtained with no added complication and with little or no increase in first cost; overload capacity of main roll motor the same at or near synchronous speed as at the other speeds, and synchronous speed of the main roll motor is between the maximum and minimum speeds. See page 1214 for survey of G-E service to steel mills.—Adv.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLER FINGERS AND SEGMENTS.—Controller fingers for pilot circuits are usually punched from brass, copper or bronze. In some cases steel fingers with tips of copper, silver or platinum are used. Controller fingers for main circuits are made of brass, copper or bronze. The commonest form of finger is made of brass with a drop-forged copper arcing tip. The segments of face-plate controllers are flat copper punchings. The segments of drum controllers are flat strips rolled so that they will fit the drum cylinder to which they are fastened by screws.

Manufacturers:

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Controller Fingers and Segments are manufactured exclusively for use with Cutler-Hammer equipment. See display adv. pages 1225-1230.—Adv.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Electric Materials Co., The, North East, Pa.
Eureka Co., The, North East, Pa.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Russell Mfg. Co., 814-818 Bath Ave., Niagara Falls, N. Y. "Trigger-Lock."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLER HANDLES.—Wooden or molded insulations are used for controller handles. On face-plate controllers, the handle is usually attached to the contact arm. Drum-controller handles are attached to the cylinder shaft, which extends through the head of the drum. In some cases the shaft extension is milled to fit a broached hole in the handle. Metal han-

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dles are common on enclosed controllers where it is possible to provide an insulating coupling between the handle and live parts. Metal handwheels are sometimes used on drums and for controllers mounted on the rear of switchboards. Handles of both the drum and enclosed face-plate type usually have an index which indicates speed points.

Manufacturers:

American Enamel Co., Neville St., Providence, R. I.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Novelty Turning Co., 34 Main St., Norway, Me.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stephenson Mfg. Co., South Bend, Ind.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WATERBURY BUTTON CO., 835 S Main St., Waterbury, Conn. (See display adv. page 1328.)
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLER, MOTOR.—A motor controller is a device or group of devices for controlling the electric power delivered to the motor. Motor controllers are most commonly used for starting, but are also used for reversing, speed regulation, quick stopping (see Braking, dynamic), overload protection, etc.; frequently they serve for various combinations of these functions. There are three general types of controllers: manual, semimagnetic and full magnetic (see definitions below); the control features listed above can be obtained with any of these types.

Manual Controllers. Manual controllers are those having all of their basic functions performed by hand. An example of this type is the ordinary motor-starting rheostat or "starting box."

Semimagnetic Controllers. Those having part of their basic functions performed by electromagnets and part by other means. An example of this type is a controller having a manually operated switch for reversing the motor and an automatic starter for accelerating the motor.

Full Magnetic Controllers. Those having all basic functions performed by electromagnets. An example of this type is a push-button-controlled automatic starter. The operator simply presses the button and the controller closes the line circuit and accelerates the motor.

The selection of a controller for any given job depends on the machine to be driven, the type of motor used and the work to be done, as indicated by the following examples.

For line shaft and similar drives where the motor is not started often and where speed regulation is not required, a simple manual starter can be used. For fan service a manual controller is usually satisfactory; in addition to starting and accelerating the motor, however, speed regulation is often necessary to vary the quantity of air delivered. Reversible variable-speed controllers are used for crane service and may be of either the manual or magnetic type. For air-compressor service, where it is desired to maintain the pressure within certain limits, an automatic starter controlled by a pressure governor is commonly used.

The controller design also depends upon the type of motor used. Controllers for the different types of d-c. motors (series, shunt, compound) are usually very much alike, but the various types of a-c. motors require quite different controllers.

Single-phase commutator motors are usually connected directly to the supply lines for starting, although resistance is sometimes placed in series for starting and also for regulating the speed.

Squirrel-cage induction motors are started either by (1) connecting them directly to the supply lines, (2) placing resistance or reactance in series with the line to cut down the current, (3) reducing the voltage across the motor terminals by means of autotransformers, and (4) by connecting the windings in star for starting and delta for running, thus reducing the voltage at starting to 57% of normal. The starting torque of the average squirrel-cage motor is about 1.4 times normal when the motor is connected directly to the line. Since the torque varies as the square of the voltage, controllers of either the resistance, autotransformer, or star-delta type should not be used if the motor must start with a load. It is not practical to regulate the speed of a squirrel-cage motor.

Slip-ring induction motors are started and their speed regulated by means of resistance placed in two or three phases of the secondary circuit. The characteristics of a slip-ring motor with resistance in the secondary are similar to those of a d-c. shunt motor with resistance in the armature circuit.

Synchronous motors are usually provided on the field member with an auxiliary winding, known as the amortisseur or damping winding, which in polyphase motors also serves as the secondary of an induction motor and permits starting by the autotransformer method.

CONTROLLER, MULTIPLE-UNIT.—See under Control systems.

CONTROLLER REGULATORS.—These are devices, mechanical in their operation, which regulate the operation of controller handles. Their object is to make it impossible for an operator to start up a large motor improperly as by moving the controller handle so rapidly as to cut out the resistance or throw the motor across the line before it has had a chance to pick up speed. The devices sometimes consist of an oil dashpot arrangement, which may be adjusted so that the handle may be moved to the full-speed position in a definite time. Automatic controllers are often equipped with a regulator which will permit resistance to be cut out in one step only when the preceding step has been operated a definite time, or in other cases when the current has been reduced to a certain value. For the latter see Starters, motor, automatic.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLER RELEASE DEVICES.—Motor-starting rheostats and manual speed regulators are usually equipped with a low-voltage release device which allows the starting or regulating lever to return to the "off" position if the voltage fails. The low-voltage release of a motor-starting rheostat consists of a small electromagnet which attracts an armature on the starting lever in the "full on" position. A spring returns the lever to the starting position if the voltage fails. The arrangement for speed regulators is the same, except that the release magnet has an armature to which a spring pawl is fastened. This pawl fits into notches cut in the regulating lever.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

CONTROLLERS, COMPRESSOR AND PUMP, AUTOMATIC.—Automatic control of motor-driven air or gas compressors is obtained by using a pressure governor which controls the operation of an automatic starter. The pressure governor is usually arranged to make contact when the pressure reaches the lower limit, causing the controller to operate and start the motor. When the upper limit is reached the governor breaks the circuit and the equipment stops. The governor is usually of the diaphragm type or the gage type.

Automatic control of pressure pumps is obtained in the same way, except that on open-tank systems the automatic starter is controlled by a float switch. A float rises and falls with the liquid and causes a contact to be made at one limit and broken at the other.

In some cases, instead of starting and stopping the motor, the speed of the motor is regulated in order to keep the pressure constant. In this case the speed regulator is operated by a pressure-controlled position.

Air compressors and pumps of the displacement type require a high torque when starting against pressure. For this reason they are frequently supplied with an unloading device, which usually consists of a solonoid-operated valve so arranged that the load is not applied until the motor is up to speed.

The torque required by a centrifugal fan, or a centrifugal pump discharging against a constant head, is approximately proportional to the square of the speed. The torque at starting is therefore small and controllers of the autotransformer type, etc., can be used.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Automatic Switch Co., 154 Grand St., New York, N. Y.
Brunner Mfg. Co., Broad & Gilbert Sts., Utica, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass. "Ceaco."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See discussion under "Starters, motor, automatic." See display adv. pages 1225-1230.—Adv.
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

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Flint & Walling Mfg. Co., Kendallville, Ind. "Hoosier."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Globe Mfg. Co., Battle Creek, Mich. "Globe."
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Leader Iron Works, Decatur, Ill. "Leader."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Rowan Controller Co., The, 308 N. Holliday St., Baltimore, Md.
S-C Regulator Mfg. Co., The, Fostoria, Ohio. "S-C."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Traction Brake Co., Pittsburgh, Pa.

CONTROLLERS, DRUM TYPE.—The movable contacts of a drum controller consist of segments (usually copper) mounted on a cylinder. As the cylinder is rotated these segments make contact with stationary fingers. Drum controllers are extensively used for street car and other railway motors, vehicles and trucks, hoists and cranes, furnace charging machines and numerous other steel-mill auxiliaries, etc. For traction-service controllers see Controllers, street car, locomotive, vehicle and truck.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The distinctive features of Cutler-Hammer Drums are the straight line, non-stubbing fingers, the universal head construction, the accessibility of all parts and the sturdy, dependable construction throughout. The contact fingers are patented, and their design is such that they make a straight-line contact with the segments. This feature absolutely prevents stubbing. The universal head is so designed that any one of four methods of operating the drum can be used. These are the usual rotary operating handle, the bevel-gear straight-line drive with backward and forward movement, sheave for Standard C-H Drums are now constructed entirely of metal. The segments are carried on a square steel shaft, which is enveloped in an insulating tube. The finger supports are likewise clamped to another square steel shaft, similarly insulated. The removal of two cap screws permits taking out the finger board and fingers as a unit. The segment shaft and segments can also be taken out easily by the removal of the universal head plate. See display adv. pages 1225-1230.—Adv.



C-H Drum Controller

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, ELEVATOR.—Electric elevators are controlled in three different ways: (1) by shipper rope, (2) by a master switch in the car, and (3) by push buttons. Shipper-rope control is in general cheaper than the other types and is used principally for slow-speed freight service. The shipper rope is sometimes used to shift belts where the combination of a straight and crossed belt is used for obtaining reversal. In other cases the shipper rope controls an electric switch which reverses the motor. An automatic starter is generally supplied with the reverse switch so that protection against overtravel may be obtained by the use of limit switches. Car-switch control is used on nearly all passenger elevators and on some freight machines. The car switch makes and breaks the circuits for the coils of the contactors on the control panel and in this way it is possible to select the direction of rotation and control the speed. Push-button control is used on dumbwaiters and on passenger elevators where the service is not sufficient to justify the expense of an operator. A single push button is placed at each landing for calling the car and a push button for each floor is placed in the car. A control relay is usually provided for each floor and when any button is pressed the corresponding relay closes and causes the controller contactors to operate and start the motor. When the car arrives at the preselected landing, a limit switch opens the circuit to the relay and the equipment stops. The limit switch is usually geared to the winding engine, although in some cases hatchway limit switches are used at the landings.

There are two broad types of elevator machines: the drum and traction types. The hoisting rope of the drum type machine is fastened to the drum and is wound up on it as the car rises. A geared limit switch can be used with this type of machine so as to cause the motor to slow down and stop at the upper and lower limits of travel.

The ropes of the traction machine are fastened to the top of the car, are then passed over a set of sheaves, and attached to the counterweight. There is a possibility of the cables slipping on the sheaves and for this reason hatchway limit switches are used with this machine instead of a geared limit switch.

When magnetic controllers are used it is possible to use various safety devices which open the circuits to the contactor coils. An overspeed governor is sometimes supplied which stops the motor in cases of overspeeding. Door safety switches can be used on both landing and car doors, to prevent operation until all doors are closed. Slack-cable switches are usually furnished which cause the motor to stop in case the hoisting cables become slack due to the car sticking in the guides, etc.

High-torque squirrel-cage induction motors are frequently used for elevator service, and for this motor the controller should consist of a main magnetic contactor and a reversing switch. When a slip-ring induction motor is used, a controller for cutting the resistance out of the secondary circuit is necessary in addition to the main contactor and the reverse switch. When a slip-ring motor is used a slow speed for making landings can be obtained by reinserting the starting resistance, but this is not usually desirable due to the fact that the motor will overspeed if the load is overhauling. If a slow speed for making landings is required on a-c. circuits, a two-speed motor should be used which has a separate primary winding for obtaining the slow speed.

On d-c. circuits both shunt and compound wound motors are common. If the motor is compound, the controller must be arranged to short-circuit the series field when the motor is up to speed to prevent overspeeding in case of an overhauling load. For slow-speed elevators the controller consists of a reversing switch and an automatic starter for cutting out the starting resistance. When slow speed is necessary it is obtained by inserting the starting resistance and shunting the armature with a resistance. For high-speed machines, controllers are provided with contactors which insert resistance in the motor shunt field.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Elevator Control Systems embody an experience covering a quarter of a century. Each C-H Elevator Controller provides for the proper co-ordination of the elevator motor with its corresponding elevator machinery. It provides for comfort and safety for passenger service, and permits the accomplishment of the largest amount of work with the least depreciation in equipment for freight service. Carbon-to-copper power contacts, which are long-lived, interchangeable on either d-c. or a-c. systems and easily renewable, are used. The constant-time-element type of acceleration has been standardized because of its simplicity and the smooth acceleration which its use insures. The magnetic contactors used on C-H Elevator Control Systems are quiet in operation and have a high sealing pull which keeps down the contact temperature and prolongs the life of the contacts. C-H Elevator Controllers have few auxiliary interlocking contacts, and their design is purposely made as simple as possible to eliminate breakdowns, and to facilitate the location of trouble, should that ever be necessary. See display adv. pages 1225-1230.—Adv.



C-H Full Magnetic Elevator Controller

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Kaestner & Hecht Co., 500 S. Throop St., Chicago, Ill.
PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.
Reliance Elevator Co., 2122 W. Austin Ave., Chicago, Ill.
Rosenberg Elevator Co., F., 170-174 Reed St., Milwaukee, Wis.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, FLAT RATE.—See Indicators, excess demand.

CONTROLLERS, MINE AND OTHER HEAVY-DUTY HOIST. — Controllers for large mine shaft hoists are usually of the magnetic type with a master switch. On a-c. circuits, slip-ring induction motors are used with primary voltages of 220, 440, 550 and 2200. Air-break primary contactors are used on practically all low-tension jobs and both air-break and oil-immersed contactors on 2200 volts. The secondary resistor is either of the cast grid or water rheostat type. When cast grid resistors are used, a number of magnetic contactors, controlled by series relays, are used for accelerating the motor and regulating the speed. With a water rheostat the motor acceleration and speed are controlled by varying the height of water in the rheostat. On d-c. circuits with a compound wound motor an equipment similar to that used on a car-switch-controlled elevator is used. On account of the high rope speed, however, additional armature shunt switches are usually supplied for obtaining slow speed at the limits of travel.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

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CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Control Systems for mine hoists vary according to size and type of hoist. For small hoists C-H Drum Controllers are used extensively. For larger hoists, automatic control is necessary, both for the protection afforded the motor and the hoisting machinery, and the better opportunities for safeguarding the lives of employees and passengers. Grid type resistors are used with the drum controllers, and in many cases with the magnetic contactors as well. For very large hoists, operated by a-c. motors, however, liquid rheostats are used. See display adv. pages 1225-1230.—Adv.

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of control equipment for electric mine hoists embracing the following three types: rheostatic hand control with drum controller, rheostatic magnetic control with master controller and contactor panel, and liquid rheostat secondary control. G-E motors of various types for mine hoisting are also available. This Company's service to coal mines is portrayed on page 1212.—Adv.

Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.

SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)

Standard-Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, MISCELLANEOUS HOIST.—Small hoists are frequently supplied with manual controllers. They are nonreversible in only those cases where the load is hoisted by power and lowered by brake. Both drum type and face-plate controllers are used for this service. Magnetic controllers with push-button or master-switch control are preferred if the service is heavy. For skip-hoist service, where automatic operation is usually required, magnetic controllers are common. Skip hoists are generally arranged to start by push button or by a contact-making weighing device, run to the top and dump. After a time interval the motor is automatically reversed, the skip returns to the bottom and stops. Skip-hoist controllers are practically the same as those for elevator service. Bucket hoists and the hoists on some cranes are supplied with dynamic lowering controllers which may be either drum type, or magnetic with a master switch.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

CONTROLLERS, PLUGGING TYPE.—A motor is said to be "plugged" when the armature connections are reversed while it is running. The counter voltage of the armature is added to the line voltage and it is therefore necessary to provide additional resistance to limit the current. Magnetic controllers for plugging service are usually supplied with an extra contactor and an additional step of resistance.

CONTROLLERS, PRINTING-PRESS.—Printing-press controllers are nearly all of the speed-regulating type. On d-c. circuits speed regulation by both armature and field resistance is used, while on a-c. circuits the speed is regulated by resistance in the secondary circuits of slip-ring induction motors. Resistors of comparatively high ohmic value are necessary because of the wide variation in load for different classes of work. Both manual and magnetic controllers are used on flat-bed presses, and ordinary nonreversing speed-regulating controllers are satisfactory.

For continuous web presses, such as are used for large newspapers, a more complicated controller is necessary due to the possibility of breaking the paper sheet or "web," which is fed from a large paper roll. Magnetic controllers of the time-limit type, operated by push buttons located at different points around the press, are preferred for this service. The operator is able to start, stop, inch and increase or decrease the speed from the push-button stations. Paper-break switches are usually installed which stop the press if the web breaks. On high-speed web presses two motors are frequently used. A small back-geared motor starts the press and runs it at low speed while the paper is being fed in or patched. After the press is under way the large motor is started and the small motor disconnected.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Cline Electric Mfg. Co., Fisher Bldg., Chicago, Ill.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See display adv. pages 1225-1230.—Adv.

Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague motor starting and control systems for alternating and direct current are designed to fulfill the necessities of all motor applications. As this company was a pioneer in the application of motor drive to printing machinery and as this class of motor drive embodies the principal forms of control equipment, the principal forms of Sprague controllers will be mentioned under the above head. Full automatic control provides for complete control of all operations, jogging, starting, running at low speed,



Push Button Station

increase of speed to desired point, decrease of speed and stopping, from any one of a number of push button stations. Each push button station contains five buttons—"Jog," "Fast,"



Full Automatic Controller

"Slow," "Safe-stop," and "Run." First illustration shows such a station. In the second illustration is shown the full automatic controller for direct current, single motor drive. The single motor controller is for the smaller sized rotary presses, is extremely simple and requires very little space. They are also supplied in modified form for two motor drive. A distinctive feature is the use of separate contactors or magnetic switches for handling the armature steps on the larger sized controllers, face plate contacts carrying no heavy currents. Manually operated, starting and control equipment for direct current motors, used on printing machinery and other classes of work embody in various types the usual features such as speed regulation, starting, reversing, dynamic breaking, no-voltage release, etc. The fundamental principle of the Sprague full-automatic control, the motor-operated dial switch, makes possible the manufacture of an a-c. controller very similar in construction and operation to the d-c. controller, and without auxiliary devices. These also are operated from push button stations. The semi-automatic system provides for direct connection or gearing of the driving motors, and utilizes the same driving equipment for the same types and sizes of presses as the full-automatic system. The third illustration shows a type of a-c. single phase motor,



Semi-Automatic Controller

semi-automatic control. Sprague alternating current motor controllers embody all the usual types, such as drum controllers for two and three phase motors of the larger sizes, open dial type controllers for the smaller two and three phase variable speed motors, nonreversible dial type controllers and controllers used in connection with variable speed single phase motors, for three to fifteen H. P. motors. Sprague products, see display adv. pages 1306-7.—Adv.

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, PUMP, AUTOMATIC.—See Controllers, compressor and pump, automatic.

CONTROLLERS, ROLLING MILL.—There are three principal types of rolling mills, and for each of these types electric drive is finding wide usage and superiority as compared with the former engine drive; these types are: (1) constant speed, (2) adjustable speed, (3) reversing. Although the constant-speed and adjustable-speed rolls run in one direction continuously, the controllers are usually reversible for backing out in case material sticks, and for quick stopping. Rolling-mill controllers are, in nearly all cases, of the magnetic contactor type with master switch control. Large constant-speed rolls are usually driven by a-c. slip-ring induction motors with a flywheel for limiting the line currents. In some cases a permanent step of resistance is placed in the secondary of the motor, which causes it to slow down as the load increases, and so allows the flywheel to give up some of its energy. In other cases a combination of relays and contactors is used, which insert resistance in the secondary circuit when the load increases beyond a predetermined point. Slip regulators of the water-rheostat type are also used for this purpose.

On small adjustable-speed rolls d-c. compound wound motors are used and the speed control is obtained by a rheostat in the shunt-field circuit. A-c. motors with secondary-resistance speed control by means of master switch and magnetic contactors are also used. For large equip-

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ments the Kraemer or Scherbius systems of control are common (see Control systems). Some manual control equipments of this type have been installed, but the majority are magnetic.

Small reversing rolling mills are driven either by d-c. series motors or a-c. slipring motors, and in either case a reversible magnetic controller arranged for plugging is necessary. For large reversing mills the Ward Leonard system of control is used. (see Control systems).

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Control Systems are used extensively in steel mills. The ruggedness and simple design of C-H Magnetic Contactors of the butt contact type have been particularly valuable features in rolling mill control systems. C-H Magnetic Contactors for this service are made of steel, instead of cast iron, because of the better magnetic characteristics, less weight and greater strength which the steel imparts. These all-steel contactors act very quickly—an important advantage in rapid reversing service. From the standpoint of upkeep, the snappy action results in quick rupture of the arc and minimum burning of the contacts. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. Complete equipment for the Scherbius system of speed control described briefly under Control Systems. Also other complete control equipments for main roll motors. See page 1214 for information on G-E service to steel mills.—Adv.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, SERIES-PARALLEL—Series-parallel controllers are used for railway work and for the trolley motion on large cranes, ore bridges, etc. Drum controllers are common for railway service, while magnetic controllers with drum master are used on the larger equipments The motors are started in series and with the starting resistors in circuit and, after full speed in the series position is obtained, the motors are connected in parallel with the starting resistors again in circuit and the equipment accelerated to full speed This method has the advantage of a slow operating speed without series resistance loss, and a low resistance loss on acceleration.

CONTROLLERS, SPECIAL AND MISCELLANEOUS.—Aside from the various types of motor controllers and starters listed, there are made controllers of other types and for other services. There are also frequent occasions where a controller has to be designed for some special service for which standard equipment does not fully meet all requirements. The art of controller design and manufacture has progressed to such a point that there are practically no problems in motor control that cannot be taken care of. Even where the sequence of operations is very intricate and the service severe, special controllers can usually be designed after a study of all the conditions involved. Where formerly intricate control called for very elaborate mechanical equipment, it is now effected by electrical control apparatus with a precision and economy that explains to a large extent the widespread use of electric motor drive in places where nothing but mechanical drive was believed to be feasible. Large reversing rolling mills in steel works are an illustration of the combination of motor and controller design in successfully meeting the most exacting requirements.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. In addition to the many styles of standard controllers built for general uses, The Cutler-Hammer Mfg. Co. builds controllers for all sorts of special work. Wherever an electric motor is used, C-H engineers are prepared to design a control system which will insure the maximum possible service under the operating conditions required. Because of the extent and variety of these special control systems it is possible to mention only a few representative systems: Hulett machines, ore and coal unloaders, car dumpers, ore bridges, gas cock reversing mechanisms, skip hoists, rotating furnace tops, calender controllers, etc. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, SPEED-REGULATING—Speed-regulating controllers may be either manual or magnetic, but the speed regulation is usually manually controlled, even though an automatic starter is used for starting and stopping. On direct current a rheostat in the armature circuit provides speeds below normal and speeds above normal are obtained by a shunt-field rheostat. In some cases both armature and field control are obtained by one combination rheostat.

Remote control of speed is obtained on printing-press controllers and on large field rheostats. These rheostats are driven either by motor, a solenoid-operated ratchet device or a solenoid retarded by a dashpot. In either case, the driving mechanism is controlled by push buttons, which cause the speed to increase or decrease as long as the proper push button is depressed.

Speed control is also obtained by means of a master switch controlling magnetic contactors, which are used to insert or cut out resistance as desired.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave. Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati. Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See discussion under Controllers, starting, speed regulating and reversing. See display adv. pages 1225-1230.—Adv.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Rowan Controller Co., The, 308 N. Holliday St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Union."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. (For small motors.) "S. S. White."
Wirt Co., 5221 Greene St., Philadelphia, Pa.

CONTROLLERS, STARTING AND SPEED-REGULATING.—Starting and speed-regulating controllers may be manual or magnetic. Manual controllers of the face-plate, drum or multiple-lever type are used. The armature resistor (on d-c. circuits) is designed for starting duty only, and speed regulation is obtained by resistance in the field circuit. Face-plate controllers are sometimes supplied with two levers, one of which cuts out the armature resistance and the other inserts resistance in the field circuit. The operating handle is fastened to the field lever and, in starting, this lever carries the armature lever with it until all armature resistance is out. The armature lever is held in place by a no-voltage release mechanism, but the field lever is free and is used to adjust the speed. On failure of voltage both levers are returned to the "off" position. Also see Controllers, speed-regulating.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Controllers for this service include both manually operated controllers and those operated automatically through some form of master switch. C-H Bulletin 2230 is an



Starter and Regulator

example of the manually operated type and is intended for use with adjustable-speed d-c. motors. It combines in a single piece of apparatus a starting rheostat to bring the motor up to normal or full field speed, and a field rheostat to regulate the speed above normal. C-H Bulletin 6330 is an automatic controller for adjustable-speed motors driving machine tools. Speed regulation is by field control. Any desired range up to six times normal can be provided, depending, of course, upon the motor used. A multiple speed drum type master switch gives the workman ready control of starting, stopping and regulating the motor speed from a single operating handle. Low-voltage protection imparts a feeling of security to the workman by insuring that the motor cannot start again after power failure until the master switch is operated. Graduated dynamic braking brings the motor to rest smoothly and quickly when the master switch is brought to the stopping position. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio.

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SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard-Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, STARTING, AUTOMATIC.—See Starters, motor, automatic.

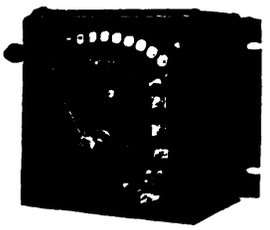
CONTROLLERS, STARTING, PLAIN RESISTANCE TYPE.—See Rheostats, motor starting.

CONTROLLERS, STARTING, SPEED-REGULATING AND REVERSING.—Controllers for obtaining this combination of functions may be either manual or magnetic. Manual controllers of both the face-plate and drum type are common. The addition of the reversing feature to face-plate controllers requires not only a complete additional set of segments for cutting out resistance, but also the necessary contacts for obtaining reversal. It is also necessary to have an insulated starting lever. On drum controllers additional fingers and segments are required for reversing and an extra set of segments for cutting out resistance in the reverse direction.

In some cases the motor is reversed by a manual switch, an automatic starter accelerates the motor, and the speed is regulated by a manual rheostat. In other cases reversal is obtained by means of magnetic contactors controlled by a master switch or push buttons. In fact it is possible to obtain almost any combination of manual and automatic control of the various functions, depending on the nature of the work to be done. Also see Controllers, starting and speed-regulating.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cline Electric Mfg. Co., Fisher Bldg., Chicago, Ill.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Bulletin 3110 is used for decreasing the motor speed below normal by the use of an armature resistor. It is built for fan duty and for constant-torque machines. Fan-duty regulators are used with ventilating fans, centrifugal pumps and other loads on which the torque decreases with the speed. Constant-torque regulators are intended for use with motors driving loads on which the torque does not decrease with the speed; for example, printing presses, positive pressure blowers, machine



C-H Motor Speed Regulator

tools, etc. C-H Bulletin 3130, a multiple-switch speed regulator, is designed for use with large motors and motors of medium size in which the operating conditions are severe. Speed regulation is by armature resistor only. C-H Bulletin 3230 is a compound speed regulator with both an armature resistor and a shunt field resistor, the latter being suitable for increasing the motor speed up to a maximum of 25% above normal. C-H Bulletin 3235 is of the same type, but is built with multiple switches in the armature circuit to care for the severe operating conditions. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill. "Goodman."
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Rowan Controller Co., The, 308 N. Holliday St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, STARTING, SPEED-REGULATING, REVERSING AND DYNAMIC-BRAKING. — Dynamic braking is obtained on drum controllers by means of a contact in the "off" position, which connects a resistor across the armature. Dynamic braking is obtained on magnetic controllers by means of a spring-closed magnetic contactor which, when de-energized, connects a resistor across the armature. In some cases an ordinary shunt contactor is used, the coil of which is connected across the armature. When the equipment is stopped, the counter voltage of the armature causes the switch to close and connect a resistor across the armature. If series motors are used, the series field must be included in the braking circuit and the connections arranged so that braking current flows through the field in the same direction as the power current. In other respects these combination controllers are similar to the foregoing (see Controllers, starting, speed-regulating and reversing).

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cline Electric Mfg. Co., Fisher Bldg., Chicago, Ill.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. Manually operated controllers for this work are of the drum controller type (see controllers, drum type.) Automatic controllers, which can be classified under this heading are used largely in connection with motors driving machine-tools and printing presses. C-H Bulletin 6335 is an automatic machine-tool controller. Speed regulation is obtained by field control. Any desired range up to six times normal can be provided, depending upon the motor used. A drum-type master switch provides for starting, stopping, and regulating the speed of the motor from a single operating lever. Low-voltage protection and graduated dynamic braking are provided. C-H Bulletin 6425 is a self-starting speed regulator, designed especially for the control of printing presses. In this controller provision is made for increasing the speed 100% above normal by means of shunt field control and decreasing the speed 40% below normal by means of an armature resistor. The field rheostat is short-circuited during acceleration, so that the motor always starts under full field. Push-button master switches are used for operating the controller. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLLERS, STREET CAR, LOCOMOTIVE, VEHICLE AND TRUCK.—Street-car controllers and those for switching locomotives are almost always of the manually operated drum type and employ the series-parallel principle. Except in the case of cars running in one direction only over loop terminal lines a controller is placed on each end of the car or locomotive, but each controller is arranged for reversing so that complete control is obtainable at either end. Similar controllers are used for mine locomotives and storage-battery trucks equipped with two motors. On electric vehicles, trucks and tractors with only one motor the control is obtained by parallel and later series connection of the battery sections, by straight rheostatic control (the battery remaining always in series), or by rheostatic control combined with field weakening for higher speeds (obtained by shunting the field circuit or connecting the field coils in parallel). Such field weakening is also resorted to in some types of railway controllers. Where several locomotives or motor cars are operated in a train, multiple-unit control is used (see Control systems, multiple-unit). For characteristics of series-parallel control, see Controllers, series-parallel.

Manufacturers:

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. (Locomotive, vehicle and truck). See discussion under Controllers, drum. See display adv. pages 1225-1230.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Furnished with all G-E locomotives, railway and industrial types, and are built also for use in all kinds of railway service, including units for safety car operation, master types for multiple unit control, motor driven controllers for automatic substations, and special controllers for use with automotive motors applied to electric vehicles. The K controller in various forms is a popular type for city and interurban service. Its principal characteristics have remained unchanged for many years although improvements have been made from time to time. Features of special construction include separate power and reverse cylinders, individual magnetic blowout shields, cutout switches for disconnecting a damaged motor, parts made easily replaced and provision for emergency stopping. (Bulletins 44678 and 44501.) See adv. pages 1203-1223. —Adv.
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill. "Goodman."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. (Locomotive, vehicle and truck.) "Uemco."

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Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONTROLS AUTOMATICALLY GOVERNING OPENING AND CLOSING OF MOTOR-OPERATED DOORS OR SHUTTERS.—These are control mechanisms which when operated either by a push button or automatic device, such as a thermostat or time switch, will control the operation of a motor attached to a door opening or closing mechanism. They are applied to either rolling, sliding, swinging or lifting doors or bulkheads in mines, on docks, on ships, or in railroad shops, warehouses, theaters, factories, garages, etc. The different types of doors are operated by the motor through gears and pinions in the case of rolling doors, chains and sprockets for sliding or lifting doors, and racks and pinions for swinging doors. The motor may be so controlled as to open or close the door or to leave it in any desired position. The control may be operated by hand as well as automatically. Such control sets may be provided as a protective measure in case of fire or other emergency, or for convenience in remote-control operation under normal conditions.

Manufacturers:

Carter-Crane Controls, 122 S. Michigan Ave., Chicago, Ill.

CONTROLS, AUTOMOBILE HEADLIGHT.—These are devices for controlling the direction of the headlight beam. Their purpose is to furnish a means to illuminate the road when the automobile is taking a turn in the road or going over the top of a hill. The headlights may be connected to the steering mechanism through gearing, giving automatic control of lateral direction, or manual control may be provided for turning or tilting the headlights. Such controls are not yet widely used.

Manufacturers:

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)

CONUS.—Trade name for oil cups manufactured by American Galco, Inc., Grand Central Palace, New York, N. Y.

CONVECTION.—Circulation of a fluid (either gas or liquid) caused by differences in temperature or specific gravity in different places. Often caused in electrolytes by the concentration of electric current at a small electrode causing local heating and thus self-generated circulation or convection; also by the current either taking an ion out or putting an ion into the electrolyte, thereby making it specifically lighter or heavier at the immediate surface of the electrode, and causing it to rise or fall. Evolution of gas at an electrode also makes the electrolyte there specifically lighter and causes a convection current upward; the gas bubbles also mechanically carry electrolyte upward by friction as they rise.

CONVENO.—Trade name for cord connectors and lamp adapters manufactured by the Convenolite Co., 231 N. Wells St., Chicago, Ill.

CONVENO-LITE.—Trade name for equipment for adapting old lighting fixtures to modern needs manufactured by the Convenolite Co., 221 N. Wells St., Chicago, Ill.

CONVENOLITE CO., THE.—231 N Wells St., Chicago, Ill. Manufacturer of lighting fixtures, cord connectors and adapters. General distributors, Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.

CONVERSION PRODUCTS CORP.—149 Broadway, New York, N. Y. Manufacturer of rust-preventing, cutting and extruding compounds. Business established 1920. President, Darwin R. James, Jr.; vice-president and treasurer, William H. Buell; vice-president and general manager, H. C. Wilson; secretary, Lester C. Burdette. Factories, Newark, N. J.; Lowell, Mass.

CONVERT-A-CAP.—Trade name for convertible attachment plug manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

CONVERTER.—The A. I. E. E. Standardization Rules define a converter as "a machine employing mechanical rotation in changing electrical energy from one form into another." Under this broad definition a converter may be any one of several types, of which the principal ones are: D-c. converter, which converts a direct current of one voltage to a direct current of another voltage (this is often called a dynamotor); synchronous converter and the cascade or motor converter, which convert alternating current into direct current; inverted synchronous converter, which converts direct current into alternating current; frequency converter (often called frequency changer) which converts an alternating current of one frequency into an alternating current of another frequency; phase converter, which converts a single-phase alternating current into a polyphase alternating current, or the reverse, but usually the former. Cascade converters, frequency converters and phase converters are generally double or even triple machines, the frequency and phase converters being usually motor-generator sets.

CONVERTER, BOOSTER.—A combination of a synchronous converter with a generator, usually an alternator, on the same shaft. The generator armature is connected in series with the main circuit and thus the voltage is increased or decreased by changing and reversing direction of the excitation of the booster.

CONVERTER, CASCADE.—A machine that converts a-c. power into d-c. power and consists of an induction machine built on the same shaft with a double-current machine, the secondary of the induction machine being electrically connected to the armature of the double-current machine. The induction machine acts (1) as a motor in mechanically driving the double-current machine and (2) as a transformer and frequency changer, in giving power electrically to the double-current machine. The double-current machine, therefore, functions as a generator and as a synchronous converter at the same time. The cascade converter is used almost exclusively in Europe, due in the main to 25-cycle current not being used there. The successful development of the 60-cycle synchronous converter in the United States has worked against the use of the cascade converter in this country. The cascade outfit, which is also known as the motor converter, is not as simple nor as compact and efficient as the synchronous converter.

CONVERTER, COMMUTATING-POLE.—A synchronous converter equipped with narrow auxiliary poles, midway between the main poles. These are excited with a few turns carrying the main direct current. In this way a field for commutation is produced which is proportional to the current to be commutated. Improved commutation is obtained, which also makes possible higher speeds and smaller machines.

CONVERTER, COMPOUND.—A synchronous converter with a series as well as a shunt field winding. With this is used a reactance coil connected in series on the a-c. side. The e. m. f. is thus kept constant under increasing load. The operation differs from that in a d-c. generator. In the converter the effect of the increased excitation is to produce a leading current, which, in connection with the series reactance, raises the a-c. voltage at the converter terminals. The d-c. voltage, maintaining a constant relation to the alternating, is correspondingly raised. This method is only available for maintaining constant d-c. voltage or for slight increases. See also Converter, synchronous.

CONVERTER, INVERTED.—A synchronous converter reversed in its function so that it changes d-c. power into a-c. power. If it is not in parallel on the a-c. side with other synchronous machines, it loses its synchronous speed characteristic and acquires the speed characteristic of a d-c. shunt of compound motor. Since the speed depends largely upon the field strength, which in turn depends on the magnitude and phase of the alternating current, the speed and therefore the frequency will decrease and increase with leading and lagging current, respectively. It is desirable to provide the inverted converter with a speed-limiting device or a speed-control combination if it is likely to supply large lagging currents. Inverted converters have a much more limited use than the "direct" or "normal" converter, but are occasionally used for changing d-c. power to a-c. power when the former is the only kind available and a small amount of the latter is desired. Synchronous converters sometimes become inverted accidentally, for example, in case of a short-circuit on the a-c. side, in which case speed-limiting devices, overload and reverse-power relays are expected to disconnect them from the lines.

CONVERTER, MOTOR.—Another name for cascade converter. See Converter, cascade.

CONVERTER, ROTARY.—A name very commonly used for synchronous converter. See Converter, synchronous.

CONVERTER SALES CO., INC.—116 Market St., Newark, N. J. Manufacturer of cable and wire lugs. President, Morris Lefkowitz; secretary and treasurer, Max Tischler.

CONVERTER, SINGLE-PHASE.—While for most purposes the single-phase synchronous converter is inferior to the polyphase converter, in small sizes for motion-picture projection lamps or battery-charging service its simplicity, as compared with a motor-generator, commends it and, on account of the relatively small current, commutation difficulties can be eliminated by proper design.

CONVERTER, SPLIT-POLE.—A synchronous converter designed to adjust the d-c. e. m. f. by changing the distribution of the flux in the poles. This is done by having one or sometimes two narrow auxiliary poles at the sides of the main poles. These regulating poles have a separate winding and by changing their excitation the flux distribution curve in the pole faces is changed. In the case of a three-phase or six-phase converter the increased flux will be effective in raising the d-c. e. m. f. while not reacting on the alternating current. A variation of as much as 25% can be obtained in this way. These are sometimes called regulating-pole converters.

CONVERTER, SYNCHRONOUS.—A machine which takes a-c. power and delivers d-c. power. It consists of a rotating armature and commutator and fixed fields with windings like those of a shunt or a compound d-c. generator. In addition, slip rings are built on the other end of the shaft and connected to the armature windings so that alternating currents may pass through them. It thus combines the operation of a synchronous motor and a d-c. generator in one machine.

Synchronous converters may be either single-phase or polyphase, but the polyphase type of three or six phases is most common. The larger the number of phases the greater the output per unit weight of the machine, though there is little gain in operating with more than six phases and this is the number generally used in large converters. These converters can be designed for any voltage at which d-c. generators can be operated.

Since the same armature winding is used for both d-c. and a-c. systems, there is a fixed ratio between the direct and alternating voltages; the value of this ratio depends upon the number of phases, as given in the following table, in which are also shown the corresponding line current ratios:

Number of phases	Ratio effective a-c. to d-c. terminal voltages	Ratio effective alternating to direct currents
Single phase	0.71	1.50
Three phase	0.61	1.00
Two phase diametrical	0.71	0.75
Two phase adjacent brushes (four phase)	0.50	0.75
Six phase adjacent brushes	0.35	0.50

These ratios are derived as follows: The maximum a-c. single or two-phase voltage is equal to the d-c. voltage. The ratio of the three or six-phase voltage to the single-phase is that of the side of an inscribed equilateral triangle or hexagon to the diameter of the circle. The effective values are equal to 0.707 times the maximum values. These voltage ratios are based on assumption of unity power-factor and no losses. The actual ratios found in practice are, however, only slightly higher than these. The current ratios are based on the relation of input and output for each case. The efficiency is always high and is here assumed at 94%. The power-factor is taken as unity.

Voltage control on the d-c. side of synchronous converters is accomplished (1) by controlling the alternating voltage supplied to the slip rings or (2) by changing the magnitude and distribution of the flux under the pole faces. The first method is carried out (a) by the use of an a-c. voltage regulator, commonly of the induction type, connected in on the a-c. side; (b) by

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a synchronous booster which is built on the same shaft as the armature of the converter and connected in series with it so that the voltage of the booster may add to or subtract from the a-c. line voltage; (c) by series reactors in the a-c. leads, and changes in the power-factor produced by changes in the excitation so that the voltage drop at the slip rings is correspondingly varied. The second method is carried out by having the pole cores divided, or split, into two or three parts, each part being provided with a field winding. Since the counter a-c. voltage of the converter depends upon the total number of lines of force per pole and upon their distribution, while the d-c. voltage depends upon the total number of lines of force but not upon their distribution, this split-pole arrangement provides a means of changing either the direct or the alternating voltage independent of the other.

The power-factor of a synchronous converter can be controlled by its excitation in the same way as that of the synchronous motor. It is not advisable to operate a synchronous converter near full load at a power-factor much below unity on account of the increase in heating, which is greater in the converter than in the motor for low power-factor.

The starting and the bringing up to normal speed of synchronous converters may done by driving them with an auxiliary motor, usually of the a-c. induction type; by supplying the d-c. side with direct current and running the machine up to normal speed as a shunt motor; or by supplying the a-c. side with alternating current at reduced voltage on starting, and running the machine up nearly to synchronous speed as an induction motor. In the latter case, the machines usually reach synchronous speed and then become synchronous motors. In starting with alternating current, the shunt field windings are commonly sectionalized to prevent the stepup transformer action between the armature and field coils, and it is not unusual to lift the brushes off the commutator to prevent the sparking which occurs at the brushes at starting.

Hunting, or pulsation in the angular velocity, sometimes occurs with converters as with other synchronous machines. This is caused by sudden changes in load or in the applied voltage, or by pulsations in the speed of the alternators supplying the converters. This hunting is practically eliminated by placing damping grids in the pole faces. These grids are also useful in giving a starting torque as an induction motor.

Parallel operation of synchronous converters is common for the d-c. side, but they are usually connected to the secondaries of separate transformers on the a-c. side, the primaries of these transformers being in parallel. The division of the load is controlled by the excitation, as it is with d-c. generators.

Transformer connections for three-phase converters may be either delta or star (Y). With the latter connection, the neutral of the Y may be connected to the neutral of a three-wire d-c. distribution system supplied by the converter. If this arrangement is used, it is frequently desirable to provide a zigzag-Y in which each leg of the Y is made up of two equal secondaries from separate transformers adding their voltages at 60°. By this means the magnetic unbalance in the transformer cores which exists in the simple Y when an unbalanced load is on the three-wire system is practically eliminated. Transformer connections for six-phase converters are very commonly diametral; i. e., three transformer secondaries are connected respectively across what would be diameters of a two-pole converter armature, these diameters being 120° apart. In this manner a three-phase supply operates a six-phase converter. Double-delta and double-star are other transformer connections also used to operate six-phase converters from three-phase sources. Double T's may be used to supply six-phase converters from two-phase sources.

Since the armature winding experiences both motor and generator action, the actual current at any instant is the difference between the a-c. and d-c. components. The effective current is thus, in the case of polyphase converters, smaller than that of a generator of equal output, and decreases as the number of phases increases. For a machine of given dimensions, the relative average armature current losses based on unity power-factor for different cases are as follows:

D-c. generator or motor	1.00
Single-phase converter	1.45
Three-phase converter	0.59
Two-phase (4-phase) converter	0.39
Six-phase converter	0.27

With decreasing power-factor these ratios are rapidly increased.

Since the commutator has to carry the whole of the direct current, it is relatively larger in a polyphase converter than in a generator or motor. With increase of frequency, design becomes more difficult, so that while successful converters are built for 60 cycles, 25-cycle current has generally been provided where many converters were to be used, as in the case of electric railway transmission systems.

It is possible to run converters to change from direct to alternating current, under which condition the converter is said to be "inverted." A weakening of the field, due to armature reactions, is then liable to develop under certain conditions, which results in dangerously excessive speed. Thus whenever there is likelihood of d-c. driving, as when charging batteries or operating in parallel on the d-c. side, a speed-limiting device is advisable.

Since there is no mechanical connection to any other machine to bring about end play of the shaft, commutator scoring is particularly liable to occur in these converters. For this reason magnetic or mechanical shaft oscillators to produce periodical end motion are often used.

The principal applications and list of manufacturers of synchronous converters are given under Converters, synchronous, applications of.

CONVERTERS, FREQUENCY.—Machines, commonly known as frequency changers, which consist usually of a motor-generator set and are used to change a-c. power from one frequency in one circuit to another frequency in another circuit. The most common arrangement consists of a synchronous motor driving a synchronous alternator. Such sets are reversible so that power may flow in either direction as desired. They are used to tie systems of different frequencies together, as well as supply power in one direction only to certain circuits. Another type of frequency converter consists of a wound-rotor induction machine driven by any suitable motor. The frequency of the current in the secondary of the induction machine depends upon the slip of the rotor and may be fixed at any desired value by the speed of the driving motor. Induction-type frequency changers are used to a very limited extent on account of difficulty in adapting the speed of the driving motor to the required frequency, poor voltage regulation and their not being easily reversible. Frequency converters are made in sizes up to 15,000 kv-a.; the largest in the world, which is rated at that figure, is installed in the Battle Creek, Mich., station of the Consumers Power Co. For telephone frequency converters, see Converters, harmonic.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E frequency-converter sets can be made up of two synchronous machines or one induction and one synchronous. Synchronous motors made by this company are equipped with special windings which prevent hunting and aid in starting. If the two sets are of different characteristics the division of load, which varies with a given stator setting, cannot easily be changed. With the G-E phase shifter, successfully developed for this purpose, the load can be shifted from one machine to another during actual operation. Other points on loading, excitation, selection of speeds and applications are fully explained in Bulletin 42552A. See adv. pages 1203-1223.—Adv.

Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.

Leich Electric Co., Genoa, Ill.

Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONVERTERS, HARMONIC.—These are an assembly of pole-changers, coils, transformers, etc., for generating alternating current of several frequencies for ringing party-line bells in a telephone system.

CONVERTERS, MISCELLANEOUS.—There are many applications of converters other than those listed above, and the machines are generally developed by the manufacturers to meet special conditions. Some of the forms these may take are described above, such as inverted, cascade, compound, commutating-pole, split-pole or booster converters. In addition to these types there are other converters for special purposes, such as to provide telephone ringing current. One form of converter for this purpose is similar to a vibrating-type rectifier, and converts 60-cycle current to pulsating current for ringing polarized and biased telephone bells. (Also see Rectifiers.)

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J. (Frequency.)

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J.

Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)

Leich Electric Co., Genoa, Ill.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONVERTERS, SYNCHRONOUS, APPLICATIONS OF.—Synchronous converters are generally used to convert alternating to direct current. They are very extensively used for furnishing d-c. power to electric railways and to three-wire distribution systems in industrial and congested districts where the load is large. They are also used for storage-battery charging in large garages, where numerous batteries are charged or a fleet of electric vehicles kept. Some large motion-picture theaters use synchronous converters to supply the arc, as a d-c. arc gives better results than an a-c. arc, and a synchronous converter is a more efficient means of obtaining direct current than a motor-generator or rectifier. Synchronous converters are also used for electrolytic work and for miscellaneous laboratory purposes.

In sizes above 200 kw. the synchronous converter is the most economical means for obtaining direct current from an a-c. system and is very generally employed by the large Edison central-station systems for this purpose. For this service the converter set consists of a transformer which reduces the a-c. pressure to the converter voltage, a potential regulator in the a-c. leads and the converter itself. The converter receives current through collector rings on the a-c. side and delivers it from a commutator and brushes on the d-c. side. The converter as designed for lighting and power service has a simple shunt field (with interpoles of 60 cycle). For electric railway service, the fluctuating load necessitates a compound wound field and the induction regulator is not used.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.

Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."

Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J.

Electromotor Co., 32-40 S. Clinton St., Chicago, Ill.

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GENERAL ELECTRIC CO., Schenectady, N. Y. G-E synchronous converters are well known through their extensive use by railroads, electric light and power plants, coal mines and large industrial projects and electro-chemical operations in all sections of the country. The commutating pole synchronous converter, introduced by the General Electric Company, has been so successful in operation that it is



G-E Synchronous Converter

now practically a standard design for all the larger sizes. These machines in the smaller sizes are especially suitable for railway substation equipment subjected to infrequent peak loads. A momentary capacity of three times normal load allows the selection of substation units with less regard to limitations imposed by occasional peaks. For low-voltage industrial and electrolytic work, the regulating pole or booster type of synchronous converter is recommended. (Bulletin 42500.) See adv. pages 1203-1223.—Adv.

Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
NORTHWESTERN ELECTRIC CO., 408 S. Hoyne St., Chicago, Ill. "Martin."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CONVEYORS, BELT TYPE.—The belt type conveyor is the simplest type of power conveyor. A large number of different forms are used, depending upon the product to be carried. In some cases a light cotton belt is supported on and driven over a smooth wooden board. This is used for handling very light products. Larger belts nearly always run over steel rollers. The belt is driven by the end roller, which may be turned by a motor or operated by a belt from a line shaft. Heavy rubber and canvas belts are used for the heavier products. Steel belt guides forming sides to keep the articles carried in position are used on many belts. The wide variation in use of these belts gives many special features, as in the case of a belt carrying coal or other bulk material, which has the outer pulleys or idlers over which the belt runs tilted up to form a slight but continuous trough in the belt.

A modification of this type is known as the slat type. It has a sort of endless chain composed of wooden slats across the direction of travel of the conveyor. This type is used for heavy work. Chain conveyors are also used, being provided with catches to haul trays, boxes, etc., in which the products are placed.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio.
Alvey Mfg. Co., 3200 S. Broadway, St. Louis, Mo. "Amco."
Bartlett & Son Co., The C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairmont Mining Machinery Co., Fairmont, W. Va.
Haslett Spiral Chute Co., The, 510 N. 61st St., Philadelphia, Pa.
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
Kennedy Van Saun Mfg. & Engineering Corp., 120 Broadway, New York, N. Y.
Lamson Co., The, 100 Boylston St., Boston. Mass. "Lamson."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Portable Machinery Co., Inc., Passaic, N. J.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Robins Conveying Belt Co., 13 Park Row, New York, N. Y. "Hunt."
Ruboil Belting Co., 41 N. 10th St., Philadelphia, Pa. "Ruboil."
Webster Mfg. Co., Tiffin, Ohio.
Weller Mfg. Co., 1820 N. Kostner Ave., Chicago, Ill. "Weller Made."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

CONVEYORS, BUCKET TYPE.—Bucket type conveyors are used in handling coal, stone and other loose material that is handled in large quantities. They consist essentially of a long chain having buckets suspended between the two outer links. The buckets generally overlap a small amount so that material will not fall between them. The chain which carries the buckets is usually driven by a motor through suitable reduction gearing. Each side of the chain has two heavy malleable iron links, which have a roller between them. This roller or wheel generally runs on a tee rail.

The chain may run either in a horizontal, vertical or inclined plane. At the turns special idler wheels, or driving wheels are provided. The turn is made without disturbing the position of the bucket, so that no coal or other material is spilled and so that, in a power plant, for instance, the coal may be carried up to the top of the bunkers then turned back into the horizontal plane again and delivered to the bunkers where the discharger automatically dumps the bucket. Bucket conveyors are very widely used in many industries and nearly all of them operate in the same general manner.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio.
Caldwell & Son Co., H. W., 17th St. & Western Ave., Chicago, Ill.
Haslett Spiral Chute Co., The, 510 N. 61st St., Philadelphia, Pa.
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
Kennedy Van Saun Mfg. & Engineering Corp., 120 Broadway, New York, N. Y.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Peck."
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass. "McCaslin."
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Ruboil Belting Co., 41 N. 10th St., Philadelphia, Pa. "Ruboil."
Webster Mfg. Co., Tiffin, Ohio.
Weller Mfg. Co., 1820 N. Kostner Ave., Chicago, Ill. "Weller Made."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

CONVEYORS, PNEUMATIC TYPE.—Pneumatic conveyors are used to handle ashes, grain, coke, lime, cement, food products, etc. They usually operate by creating a suction in a pipe and drawing the material along. The suction is generally provided by a motor-driven high-speed centrifugal suction blower attached to the outlet of the pipe. For long distances compressed air is used instead of suction. The size and construction of the pipe is varied. For handling ashes a cast iron pipe of from 10 to 12 ins. in diameter is used. Other lighter materials are carried in a large flexible hose. This feature is important in that it permits unloading of freight cars, wagons, etc., by merely placing the conveyor intake at any convenient point. The material may then be conveyed to the proper place without forming any objectionable dust. Pneumatic conveyors are also used as cash, small parcel, message or mail carriers in department stores, large business offices, telegraph and post offices, etc.

Manufacturers:

Green Engineering Co., East Chicago, Ind.
Guarantee Construction Co., 140 Cedar St. New York, N. Y. "Airveyor."
Lamson Co., The, 100 Boylston St., Boston, Mass. "Lamson."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

CONVEYORS, PORTABLE.—Portable conveyors are usually rather small motor-driven conveyors having the motor connected to the driving roll by belt or chain. They are made in the belt, bucket and slat types. Portable conveyors are usually mounted on a small iron truck that may be wheeled from place to place, wherever it may be needed. Some are made merely as horizontal conveyors, running along close to the floor. Other types have the driven end of the conveyor fastened to the frame while the other end may be raised to any convenient level for loading onto shelves or for piling material. Belt conveyors used for this purpose have cross slats fastened to the belt at intervals which prevent packages from slipping back on the belt. The slat type, having wooden bars across the conveyor with occasional projections for gripping the box, barrel or other article, is also used.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio.
Alvey Mfg. Co., 3200 S. Broadway, St. Louis, Mo. "Amco."
Barber-Greene Co., Aurora, Ill. "B-G."
Bartlett & Son Co., The C. O., Cleveland, Ohio.
Brown Portable Conveying Machinery Co., 10 S. LaSalle St., Chicago, Ill. "Brown-Portable."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Portable Machinery Co., Inc., Passaic, N. J.

CONVEYORS, SCREW OR SPIRAL.—These conveyors are used to convey pulverized or finely divided material, or sometimes also heavy bulk material such as concrete, in a steel chute, trough, box or pipe. They consist of a long steel shaft on which steel flights or spirals are placed. The form of the flight depends upon the material carried. It is usually solid, while for some special purposes, such as for carrying sugar, a ribbon conveyor is used having a steel ribbon supported a short distance away from the shaft by steel arms, thus leaving an opening near the middle along the shaft.

The screw or spiral is often run in a wooden box or trough. The shaft is driven from the end and suitable cast or wrought iron hangers with bearings in them are suspended from the box at intervals. Alinement is preserved in this manner. The box or trough is built very close to the path of the screw so that there is but little clearance on the edges. Steel boxes or special semicircular casings are also used.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio.
Bartlett & Son Co., The C. O., Cleveland, Ohio.
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.
Haslett Spiral Chute Co., The, 510 N. 61st St., Philadelphia, Pa.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Robbins Conveying Belt Co., 13 Park Row, New York, N. Y. "Hunt."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

CONVEYORS CORP. OF AMERICA.—Chicago, Ill. Manufacturer of Coal and ash handling machinery. President, A. L. Currey; secretary, L. A. Griffin; treasurer, J. A. Daviess. Main office, 326 W. Madison St., Chicago, Ill. Branch office, 110 W. 40th St., New York, N. Y.

CONWAY CLUTCH CO, THE.—1956 W 6th St., Cincinnati, Ohio. Manufacturer of friction clutches. Business established 1895. President and treasurer, A. J. Conway; vice-president, M. J. Conway; secretary and general manager, Alfred A. Conway. Sales representatives, Medart Pat. Pulley Co., St. Louis, Mo.; E. A. Kinsey Co., Cincinnati, Ohio, and Indianapolis, Ind.; Spears Wells Machinery Co., Oakland, Cal.

COOK.—Trade name for telephone protectors, terminals and supplies manufactured by the Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill.

COOK & SWAN CO., INC.—New York, N. Y. Manufacturer of lubricating oils and greases. Business established 1865. President, Gilbert P. Smith; vice-president, Dennis E. Bergen; secretary, J. Howard Smith; treasurer, Alpin I. Dunn. Main office, 148 Front St., New York, N. Y. Factories, Elizabeth, N. J., and Jersey City, N. J. Branch office, 141 Milk St., Boston, Mass.

COOK BELTING CO., H. N.—Howard & Fremont Sts., San Francisco, Cal. Manufacturer of power transmission belting.

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COOK ELECTRIC CO.—900-10 W. Van Buren St., Chicago, Ill. Manufacturer of telephone protectors, terminals and supplies. Business established 1900. President and general manager, George R. Folds; vice-president, A. D. Edwards; secretary and treasurer, E. King. Factories, Chicago, Ill., and Zion City, Ill.

COOK, FULTON.—St. Maries, Idaho. Producer of cedar poles.

COOK POTTERY CO.—Prospect St. & P. & R. Ry., Trenton, N. J. Manufacturer of electrical porcelain specialties. Business established 1897. President and treasurer, Charles Howard Cook; secretary and general manager, Paul G. Duryea. Sales representative, A. J. Cox Co., 564 W. Monroe St., Chicago, Ill.

COOK TIE & POLE CO.—919 Commercial Trust Bldg., Philadelphia, Pa. Manufacturer of poles and ties. Business established 1918. Sole owner, Elmer A. Cook.

COOKERETTE.—Trade name for electric domestic ranges manufactured by the H. G. Weeks Mfg. Co., Hamilton, Ohio.

COOK'S SONS, ADAM.—708-710 Washington St., New York, N. Y. Manufacturers of lubricating oils and greases. Business established 1868. General manager, George Baum; superintendent, Joseph Daly.

COOKERS, ELECTRIC, FIRELESS.—Fireless cookers are devices constructed in such manner that when a cooking utensil having boiling material in it is placed in the cooker, the heat will largely be retained and the material will continue to boil for several hours or at least a long time. The heat-insulating material may take several forms; hay or straw was used in some of the early forms, and felt or asbestos together with a metal lining and air space are used in the modern forms. Electric fireless cookers are designed to heat the material to the boiling point in the cooker itself by having a heating unit placed under the cooking utensil. When the boiling point is reached or has been maintained for a few minutes, the current is turned off and the heat will be retained in the cooker for several hours. Some of these devices have a thermostat or time switch to automatically turn off the current at a predetermined condition or time. They serve as economical means for preparing broths, stews and other foods that require long cooking, and on account of the thorough cooking produce very savory dishes.

Manufacturers:

ALLMUR MFG. CO., Marion, Ind.
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Electrical Development Co., 534 Bienville St., New Orleans, La.
Kercher Electric Cooker Co., 2927 Newbury St., Berkeley, Cal. "Kercher." (Exclusive distributors, C. C. Payne Electric Co., Oakland, Cal.)
Sterolectric Co., 117 W. Howard St., Muncie, Ind. "Stero."
Utensils Co., 303 E. Columbia St., Ft. Wayne, Ind. "Utenco."
Weeks Mfg. Co., H. G., Hamilton, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COOKING (COOKERY), ELECTRIC.—The use of electric heat for domestic and commercial cooking purposes has grown to tremendous proportions and the opportunities for further development are practically without limit. In its broadest sense, electric cookery includes that accomplished by means of the many portable cooking appliances as well as by means of the electric range. Domestic appliances, such as hot plates, grills, percolators, fireless cookers, etc., are generally designated as socket devices, since they are usually intended for use on ordinary lighting circuits. Electric ranges for both domestic and commercial service require special wiring. Electric cookery in the sense in which it will be used here, applies to that done on electric ranges both domestic and commercial, the latter including baking. For information on socket appliances see entry under each separate appliance.

The first practical attempt at electric cookery was made in England in 1890. And the first effort to introduce electric cookery to the public was at the Crystal Palace Electrical Exhibition in London in 1891. In 1895 in the Cannon Street Hotel, London, the first electrically cooked banquet was given in honor of the Lord Mayor and was a success both in cookery and in creating general interest.

The first activities in the United States took place about 1900 when a fireless cooker manufacturer in Toledo, Ohio, placed an electric heating unit in his device. No further progress worthy of mention occurred until 1905 when three electrical manufacturers began to experiment with a frail and undependable hot plate. It was not until 1909, however, that a range which was considered practicable and cooked for any length of time, was put on the market.

During the twelve years since 1909, electric range manufacturers have developed a cooking device that is entirely practicable from every standpoint. And a large number of central stations have successfully solved the numerous technical and commercial problems in connection with its merchandising, installation and service.

Today, practically 5000 communities in this country have an electric cooking rate which brings the cost of operation well within the means of the average family. Before recent increases in electricity rates were allowed, the cooking rate in 3500 communities was 5 cents per kilowatt-hour or less, and in more than 30% of the 5000 communities mentioned above the rate was 3 cents or lower.

Electric ranges were first installed by small central stations which did not carry appreciable power loads, but in recent years it has been found, because of the diversity-factor as well as other indications, that electric cooking load does not come at the peak, and many of the larger central stations have actively developed this phase of their business. The Southern California Edison Co., of Los Angeles, has over 3000 ranges on its lines today. The Edison Electric Illuminating Co., of Boston, 2000; the Idaho Railway Light & Power Co., Boise, Idaho, 2000; the Texas Power & Light Co., Dallas, 1500; the Montana Power Co., Butte, 1600; the Union Electric Light & Power Co., St. Louis 1200; the Washington Water Power Co., Spokane, 2500.

The superiority of electric cookery lies in the ideal quality of electric heat which is even, dependable, easily regulated and not subject to fluctuation through pressure, atmospheric conditions or drafts, nor can it be extinguished by liquids boiling over. Range construction provides for thickly insulated ovens on the fireless cooker or refrigerator principle. Hence, the heat is not only conserved, but the ovens are free from gaseous fumes and air currents.

The average consumption of an electric range is one kilowatt-hour per person per day. This figure applies in estimating the cost for a family of four. The energy consumption is considerably less per person with increased numbers in the family. Reports from a large number of central-station companies indicate an average revenue of from $42 to $50 per annum per range. This figure is based on experiences with 10,802 ranges. The average maintenance cost of a number of companies serving range customers is $4.50 per range per annum.

The relative density of electric ranges used in the United States is indicated by the following figures which show the number of ranges in use in each state as of June, 1920:

Alabama	40	Montana	2457
Arizona	100	Nebraska	81?
Arkansas	400	New Hampshire	125
California	5359	New Jersey	17?
Colorado	1527	New Mexico	250
Connecticut	492	New York	1025
Delaware	267	N. Carolina	1394
Dist. of Col.	530	N. Dakota	200
Florida	427	Ohio	1200
Georgia	77	Oklahoma	500
Idaho	2751	Oregon	253?
Illinois	3050	Pennsylvania	26?
Indiana	2000	Rhode Island	32
Iowa	233?	S. Carolina	468
Kansas	1070	S. Dakota	300
Kentucky	70?	Texas	4000
Louisiana	3?	Utah	3000
Maine	337	Vermont	30
Maryland	2?	Virginia	19?
Massachusetts	2720	Washington	515?
Michigan	1900	West Virginia	175
Minnesota	541?	Wisconsin	541?
Mississippi	82	Wyoming	96?
Missouri	4250		

The total number of ranges in use in the United States today is in excess of 75,000.

From statistics compiled by the National Electric Light Association and The Society for Electrical Development, it is found that the average additional investment required on the part of central stations to serve range customers is between $35 and $60. The usual practice regarding installation provides for three No. 6 wires and 15-amp, 3-wire meters for the average range of 5 to 6 kw. connected load. The average cost of wiring from meter to range is $27. For details regarding construction features of various types of ranges see Ranges, electric.

In the commercial field, electric bake ovens, heavy-duty hotel-type ranges, broilers, frying griddles, plate and food warmers, hot plates, urn heaters and many other forms of equipment are extensively used in bakeries and hotels. The electric bake oven appears to be used in greatest numbers and to offer more general advantages to central-station companies. Most bakeries in smaller cities are located in the business section where large lighting transformers are installed and, when a bakery does its baking between midnight and morning, it is often possible to connect the bake oven to a large lighting transformer which is fully loaded during the evening lighting peak. Commercial electric bread baking ovens are made in many sizes—from a small portable oven with a capacity of 30 one-pound loaves of bread to a large bake oven having a capacity of 600 such loaves at one baking.

Electric restaurant apparatus has been developed to such an extent that commercial cookery is today on a sound business basis. There are hundreds of installations throughout the United States in prominent hotels, restaurants, clubs, domestic science schools, hospitals, etc.

COOKING POTS, ELECTRIC.—Kettles, pots and like cooking appliances in which heat is applied by electric current passing through heating elements within the base of the pot. They are used principally in hotels, restaurants, clubs, etc., or on ships on which electric cooking is used. Their chief use is in cooking large quantities of soups, broths, stews, vegetables, fruits, meats, etc.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO. Warren, Pa. "Sepco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

COOKSON.—Trade name for steam traps, steam and oil separators manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

COOLEY ELECTRIC CO., GEORGE R.—Seattle, Wash. Manufacturer of marine lighting fixtures and fittings. President, George R. Cooley; secretary, E. T. S Cooley; sales manager, E. Jackobson. Main office, 912 Western Ave., Seattle, Wash. Branch office, 808 Lewis Bldg., Portland, Ore.

COOLEY MFG. CO.—98 Park Pl., New York, N. Y. Manufacturer of refillable fuses.

COOLIDGE & SCHUSSLER.—826 Metropolitan Life Bldg., Minneapolis, Minn. Manufacturers of cedar poles.

COOLING PONDS, TOWERS AND PLANTS.—Where water is scarce or extremely impure and so must be conserved, whether for condenser cooling or boiler feed, the spray pond and cooling tower are resorted to. As about 90% of the cooling is done by evaporation, breaking up of the water and a generous supply of air is important. This is accomplished by means of a large cooling tower surface, by spraying the water, and, in the case of the simple cooling pond, by large water surface. In the ponds several sprays are often used to break up the water which falls into a large open tank.

Cooling towers may be of wood or steel,

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may utilize natural air circulation or mechanical draft, the aim being to present maximum cooling surface in trays, maximum breaking up of water and the most intimate contact between water and air, but at the same time to minimize loss of water by spraying, windage and evaporation. Cooling towers are classed as natural-draft open type, natural-draft closed type and forced-draft type. Natural-draft towers are from 50 to 80 ft. high. They require power only for pumping the water to the tower. The forced-draft type may be shorter and requires a mechanical blower, sometimes used only during the summer. The forced type occupies the least ground space, consumes the most power, but is the only one independent of atmospheric and temperature conditions.

Sprays are similar in effect to the cooling tower, but may often be located where a tower would not be feasible. The initial cost is much less, also the cost of maintenance. The addition of sprays to cooling ponds can double and treble the equivalent cooling surface of the pond, permitting increased condensation or higher vacuum.

Manufacturers:

Badger & Sons Co., E. B., 75 Pitts St., Boston, Mass. "Badger."

Binks Spray Equipment Co., 3120 Carroll Ave., Chicago, Ill.

Cooling Tower Co., Inc., 15 John St., New York, N. Y.

Downington Iron Works, Inc., Downington, Pa.

Wheeler-Condenser & Engineering Co. Carteret, N. J. "Wheeler-Balcke" wood, "Wheeler-Barnard" steel.

Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa. "C. H. Wheeler."

COOLING SURFACE.—That surface, in electrical equipment, that is exposed on any material that is to be cooled. In an armature it is the surface from which the heat generated may pass off into the air. In a steam condenser of the surface type it is the area exposed to the steam by the tubes through which the cooling water is circulated. In water-cooled transformers it is the area of the cooling coil immersed in the oil, or for self-cooled transformers with radiator or tubular cases, the area exposed to the cooling action of the air.

COOLING TOWER CO., INC.—15 John St., New York, N. Y. Manufacturer of cooling towers. Business established 1910. President, A. B. Tappen; secretary and treasurer, L. A. Phillips. Factories, Newark, N. J., Montour Falls, N. Y. Sales representatives, Schumaker-Santry Co., 141 Milk St., Boston, Mass.; Rossiter & Saner, Union National Bank Bldg., Houston, Tex.; Sullivan Co., Shreveport, La.; D. B. Wright, 521 Hurt Bldg., Atlanta, Ga.; Feaster's Sales Co., Inc., 1311 4th Ave., Birmingham, Ala.; York Ohio Ice Machine Co., 1106 Woodland Ave., Cleveland, Ohio; C. M. Robinson Co., 16 W. 12th St., Cincinnati, Ohio; Central Construction & Supply Co., 2224 Arch St., Philadelphia, Pa.; Coon De Visser Co., Ford Bldg., Detroit, Mich. Great Western Contracting Co., 1208 Grand Ave., Kansas City, Mo.; Texas Mfg. Co., Fort Worth, Tex.; H. K. Painter, 14 President St., Savannah, Ga.

COOMBS & CO., R. D.—30 Church St. New York, N. Y. Manufacturers of transmission line structures and structural steel and ornamental iron work. Business established 1911. President, R. D. Coombs; secretary, A. W. Coombs; treasurer, W. L. Cadwallader.

COOPER.—Trade name for storage batteries manufactured by the Cooper Storage Battery Co., Dunbar St. & B. O. R. R., Cincinnati, Ohio.

COOPER & CO., CHARLES.—194 Worth St., New York, N. Y. Manufacturers of copper sulphate, sulphuric, nitric, hydrochloric acids, etc. Business established 1857.

COOPER CO., THE C. & G.—Mt. Vernon Ohio. Manufacturer of gas and steam engines. Business established 1833.

COOPER HEWITT ELECTRIC CO.—Hoboken, N. J. Manufacturer of rectifiers and lamps for industrial illumination. Business established 1902. President and treasurer, William A. D. Evans; vice-president, N. R. Birge; secretary, E. E. Davies; sales manager, A. D. Childs. Main office and factory, 95 River St., Hoboken, N. J. Branch offices, 161 Summer St., Boston Mass.; 215 Fisher Bldg., Chicago, Ill.; 1st National Bank Bldg., Cincinnati, Ohio Engineers' Bldg., Cleveland, Ohio; Ford Bldg., Detroit, Mich.; Security Bldg., Milwaukee, Wis.; Drexel Bldg., Philadelphia, Pa.; Westinghouse Bldg., Pittsburgh, Pa.; Title Guaranty Trust Bldg., St. Louis, Mo. University Bldg., Syracuse, N. Y. Sales representative, Keese Engineering Co., Los Angeles, Cal.

COOPER OVEN THERMOMETER CO. THE.—Pequabuck, Conn. Manufacturer of electrical indicating thermometers. Business established 1884. President, treasurer and general manager, Albert E Whittier; vice-president, Horace R. Whittier; secretary, George W. Priest.

COOPER STORAGE BATTERY CO.—Dunbar St. & B. & O. R. R., Cincinnati, Ohio. Manufacturer of storage batteries. President, I. J. Cooper; vice-president, H. H. Brenner; general sales manager. C. W. Noll. Branch offices, Cooper Co., Atlanta, Ga.; I. J. Cooper Rubber Co., Cincinnati, Ohio; Birmingham, Ala.; Cleveland, Ohio; Columbus, Ohio; Dayton, Ohio; Indianapolis, Ind.; Knoxville, Tenn.; Memphis, Tenn.; Nashville, Tenn.; Louisville, Ky.

COPE & SON, LTD.—150 Hastings St., W., Vancouver, B. C., Can. Manufacturer of electric heating appliances. Managing director, F. T. Cope.

COPE, T. J.—1620 Chancellor St., Philadelphia, Pa. Manufacturer of underground construction tools and specialties. Business established 1881. E. J. Irish, general manager.

COPES.—Trade name for feed water regulators manufactured by the Northern Equipment Co., 110 W. 11th St., Erie, Pa.

COPPER.—A salmon-colored metal whose properties of very high electrical conductivity, coupled with ductility and comparatively low cost, cause it to be used for most electrical conductors. Its chemical symbol is Cu; at. wt. 63.6; sp. gr. 8.9; m.p. 1085°C.; b.p. 2100°C. Next to its electrical uses the most important uses are for alloys; alloyed with zinc it produces brass, with tin it makes bronze, while alloys of lesser importance are made by combining it with nickel, aluminum, manganese, phosphorus, boron, etc., frequently with a third constituent. It is used also in certain construction work on account of its toughness and resistance to ordinary corrosion, and for retorts, kettles, coins, wire gauze, etc.

The world's production just before the war had reached 1,000,000 tons annually; in 1918 it was 1,395,000 metric tons. The United States produces over 60% of the total; this country's production in 1918 amounted to 1,860,000,000 lbs. (refinery output), compared with 2,476,000,000 lbs. in 1918, and 1,652,000,000 lbs. in 1913. Next to the United States the leading producing countries are Japan with about 100,000 tons annually, and Chile and Mexico each with 75,000 tons. Other important producers are Canada, Peru, Spain, Germany Australia and South Africa.

The principal ores include native copper (chiefly from Michigan), chalcopyrite ($CuFeS_2$), bornite ($CuFeS_2CuS$), cuprite (Cu_2O), and the carbonates azurite and chrysocolla. The metal is recovered from its ores usually by smelting, sometimes by leaching. Smelting is carried on in blast or reverberatory furnaces, the product being copper matte, which is a mixture of the sulphides of copper and iron. This is poured molten into Bessemer converters and blown with air, which oxidizes the iron and the sulphur. The former is slagged off with silica, while the latter passes off as sulphur dioxide gas. The resulting crude copper, called blister copper, is cast into anodes after a partial furnace refining and is then refined electrolytically.

The electrolyte is a solution of copper sulphate and free sulphuric acid containing about 40 to 60 grams of copper and 135 gr. of free H_2SO_4 per liter. In the multiple system, which is generaly used, cathode starting sheets are made by depositing thin sheets on greased plates from which they can be stripped off. In the series system the copper deposits on the back of the anode next to it, the plates thus acting as bipolar electrodes. The cathodes are melted down and cast into suitable shapes, at the same time absorbing about 0.03% of oxygen, which increases the electrical conductivity. Electrolytic copper as marketed carries 99.93 to 99.95% copper.

Gold and silver contained in the blister copper drop to the bottom of the electrolytic tanks in the form of impure slimes containing many other metals. From treatment of these enough gold and silver is recovered to more than pay for the cost of the electrolytic refining of the copper. Other metals go into solution in the electrolyte, which has a small portion continuously abstracted for purification. Nickel is a valuable by-product of this part of the process, while in some plants copper sulphate is also made for the market during purification of the electrolyte. In leaching processes the leaching is done with water, dilute sulphuric acid, or ammonia, depending on the ore. Usually a copper sulphate solution is obtained, from which the copper is either cemented out on scrap iron, or in the better processes deposited by electrolysis, using insoluble anodes.

COPPER AS AN ELECTRICAL CONDUCTOR.—The electrical and mechanical properties of copper make it a very satisfactory material for electrical conductors. Its resistance is lower than that of any other metal except silver; its mechanical strength, when hard drawn, is ample for safe use on overhead lines; its ability to withstand exposure to the elements induces a long life, and its ductility when annealed, facilitates jointing and other mechanical operations. It is readily soldered, thus insuring permanently good electrical connections. Its principal electrical and mechanical properties are as follows:

Resistance at 20°C. or 68°F. is 10.36 ohms per mil-foot.

Resistance at 20°C. (68°F.) in ohms per mile is 54,700 divided by the area in circular mils.

Conductivity (annealed) 98.5%; (hard drawn) 97.5%.

Weight in pounds per mile is 0.016×circular mils.

Tensile strength, annealed, 30,000 to 35,000 lbs. per sq. in.

Tensile strength, hard drawn, 55,000 to 65,000 lbs. per sq. in.

Specific gravity, 8.89.

COPPER BARS, BILLETS, INGOTS, SLABS, ETC.—Copper in this form is furnished to large manufacturers and copper dealers for rolling and forming into rods, sheets, foil, tubing, wire, etc. The bars, billets and ingots are cast in rough form and rolled approximately to a uniform size to be further rolled and drawn to the finished sizes. Large slabs of varying thickness are furnished for rolling into sheet and foil, in which form it is very widely used.

Manufacturers:

AMERICAN BRASS CO., THE, Waterbury, Conn. Copper sheet for electrical work of every description. Rectangular bars and strips, special drawn shapes, manufactured in a wide variety of shapes and sizes, which are especially suitable for busbar work and all kinds of electrical construction. Hot rolled copper rods and bars for bolts, forgings, etc. (For location of mills and factories, see alphabetical listing under firm name.)—Adv.

Anaconda Copper Mining Co., 42 Broadway, New York, N. Y. "N.E.C.", "B. & M." electrolytic, "A.B.S.", "M.A." casting.

Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn.

Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, B. C., Can. "Trail."

Electric Materials Co., The, North East, Pa.

ROME BRASS & COPPER CO., Rome, N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry. See display adv. page 1312.—Adv.

Taunton-New Bedford Copper Co., Taunton, Mass. (bars)

COPPER CLAD STEEL CO.—Rankin, Pa. Manufacturer of electrical wires. Business established 1915. President, J. M. Roth; vice-president, James H. Hammond; vice-president and general manager, S. E. Bramer; secretary, Frank R. S. Kaplan; treasurer, S. F. Loeb. Main office and factory, Rankin, Pa. (P. O., Braddock, Pa.) Branch office, 30 Church St., New York, N. Y. Sales representative, Steel Sales Corp., Jefferson & Adams St., Chicago, Ill.

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COPPER DROP.—The drop in potential in a copper conductor due to overcoming its resistance. It is given in volts and equals the product of the current in amperes and the resistance of the conductor in ohms. Also see Voltage drop. The term "copper drop" is also occasionally applied to the voltage drop in other conductors and came into general usage chiefly because copper is the most used of all conductors.

COPPER FOIL.—Copper foil is very thin sheet copper, that has been carefully rolled many times to give a thin, flexible and rather soft sheet. It may be used in electroscopes and other special electrical apparatus requiring a very fine conducting sheet.

Manufacturers:

Popper & Sons, Leo, 143 Franklin St., New York, N. Y.

COPPER LOSS.—The energy loss in an electrical conductor, apparatus or machine due to current passing through the resistance of the conductor or windings. This loss is converted into heat. It varies as the square of the current and as the resistance, or $W=I^2R$ where W is the copper loss in watts, I the current in amperes, R the resistance in ohms. It is often referred to as the I^2R loss.

COPPER RODS, SHEETS AND TUBING.—Copper is furnished to manufacturers in the form of rods, sheets and tubing, carefully rolled or drawn so as to be of uniform cross-section and size. The rods are generally cylindrical in form and are used largely in wire manufacture where the rods are sent through a series of drawing dies and annealing processes to produce wire of various sizes. The sheets and tubing are used largely in manufacturing parts of electrical equipment, being well adapted to punch press or automatic screw-machine operations. Copper sheet is also furnished in many sizes and used for copper ribbon and other similar forms Sheets are much used to make many parts for which the corrosion-resisting or highly conductive properties of copper are utilized. Bars are sometimes rolled or furnished in rectangular form, such as for busbars. Copper tubing is also used for this purpose. See busbars, copper, solid; also Busbars, copper, tubular.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Alloy Steel Products Corp., 123 Liberty St., New York, N. Y. (sheets, tubing)
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn. (tubing)
American Copper Products Corp., 200 Broadway, New York, N. Y. (rods)
American Electrical Works, Phillipsdale, R. I. (rods) "Emelectric."
ANACONDA COPPER MINING CO., Rolling Mills Dept., 111 W. Washington St., Chicago, Ill. (rods) (See display adv. page 1246.)
Barkelew Electric Mfg. Co., Middletown, Ohio.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian Seamless Wire Co., Ltd., 198 Clinton St., Toronto, Ont., Can. (tubing)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chase Metal Works, 236 Grand St., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Follansbee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa. (sheets)
Harris & Co., Arthur, 212 Curtis St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
New Haven Copper Co., The, Seymour, Conn.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
PHILLIPS WIRE CO., Pawtucket, R. I. (rods)
Randolph-Clowes Co., The, Box 1012, Waterbury, Conn. (tubing)
ROME BRASS & COPPER CO., Rome, N. Y. We specialize in furnishing "Rome Quality" brass and copper bars, sheets, rods, tubes, copper commutator bars, segments, busbars and special shapes exactly suited for all phases of the electrical industry. See display adv. page 1312.—Adv.
Rome Hollow Wire & Tube Co., Railroad St., Rome, N. Y.
ROME WIRE CO., Rome, N. Y. is equipped to furnish round copper rods in small or large tonnage, guaranteed to be round, true to size, free from fins. Prompt shipment of large tonnages can be made of either black rods as they come from the rolls, or cleaned. The illustration shows a coil of copper rod, cleaned, ready for shipment. Rome Wire standard specifications cover hot and cold rolled copper rods which shall be free from scale, brittleness, hard spots or cracks. The rods to be uniformly cylindrical in form. Conductivity of the copper used shall not be less than 98 per cent, 100 per cent conductivity being based on copper having a resistance of 0.1530 ohms per meter gram at 20 deg. C. For the purpose of calculating weights, cross sections, etc., the specific gravity of copper shall be taken as 8.89 at 20 deg. C. The average variation in diameter shall not exceed .010 ins. above or below the nominal gage on all sizes between .250 ins. and .500 ins., both inclusive. For all sizes above .500 ins. to 1.00 ins., the average variation in diameter shall not exceed .015 ins. above or below the nominal gage. Rods are furnished in coils approximately 36 ins. in diameter, and the rod in each coil is furnished in one piece, without joints. The illustration above shows finished rods ready for shipment. For other Rome Wire Company products see display advertisement on page 1247. —Adv.



Rome Copper Rod



Rome Finished Rods Ready for Shipment

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Taunton-New Bedford Copper Co., Taunton, Mass. (rods and sheets)
Wheeler Condenser & Engineering Co., Carteret, N. J. (tubing) "Crescent."
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich. (tubing)

COPPER SULPHATE.—$CuSO_4$. A salt whose solution is used as the principal electrolyte in primary cells of the gravity or Daniell type, which formerly were used extensively in closed-circuit telegraphy and railroad and other signaling. It is usually obtained in large blue crystals, and is commercially called blue vitriol or bluestone.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal. "Selby."
Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.
COOPER & CO., CHARLES, 194 Worth St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Mallinkrodt Chemical Works, St. Louis, Mo.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."

COPPER WIRE, BARE.—See Wire, copper, bare; also Wire, trolley.

COPPERS, BATTERY.—Electrodes used in some forms of wet primary cells. They are made of two or three strips of sheet copper bent and fastened together with rivets in the form of a star. A rod or insulated wire attached to the strips leads up through the battery cover to form one terminal. This type is used in the Daniell and gravity cells.

Manufacturers:

Beattie Zinc Works, Reading, Mass.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Edes Mfg. Co., The, Water St., Plymouth, Mass.
Grasselli Chemical Co., The, Cleveland, Ohio.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

COPPERCLAD STEEL WIRE.—See Wire, copperclad steel.

COPPERS, SOLDERING.—Soldering coppers are square castings with pointed tips made of pure copper designed to be heated in a gas furnace, fire pot or blow torch and to retain sufficient heat to melt solder for a few moments. They are made in a number of sizes weighing from a few ounces to 4 lbs. or more. The size depends upon the nature of the work to be soldered; very large or heavy work conducting the heat away from the copper very rapidly requires a heavy copper, while light terminals or other similar work requires only a small copper.

These devices are commonly spoken of as soldering irons but as the tip is always made of copper the term "soldering coppers" is more accurate and is preferred by most dealers and manufacturers. Special tips are sometimes made for light work where the space available is not large enough for an ordinary copper. When an electric soldering iron is used the copper is usually hollow and has the heating element within it, and in other cases is solid with the element around it. Soldering coppers are generally sold without handles, merely having an iron rod fastened to the copper head and pointed at the other end to be driven into a wooden handle. Also see Irons, electric, soldering and tipping; also Irons, soldering, miscellaneous.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Bernz Co., Otto, 17-37 Ashland St., Newark, N. J. "Always Reliable."
Commutator Co., 125 1st St., N., Minneapolis, Minn.
Electric Materials Co., The, North East, Pa.
Follansbee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa.
HERBST, PAUL W., Chicago, Ill. We specialize in coppers designed for switchboard assemblers and adjusters. See display adv. page 1258.—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Motor Products Corp., Detroit, Mich. "Diamond Detroit."

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Pacific Metal Works, 153-159 1st St. San Francisco, Cal.
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Taunton-New Bedford Copper Co., Taunton, Mass.

COPPERSERT.—Trade name for electric boiler insert type heaters manufactured by the Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash.

COPPERWELD.—Trade name for copperclad steel wire manufactured by the Copper Clad Steel Co., Rankin, Pa.

COPYING MACHINES, ELECTRICALLY OPERATED.—These machines are used to copy letters, orders, statements, telegrams, drawings, etc. They are generally machines operating by pressing the original copy against a sheet of moistened copy paper. Small motors are used to operate the machines, and the pressure of the paper on the copy paper is obtained by a series of rollers, usually provided with automatic adjustment features. A small amount of clean water and a supply of copy paper are kept in the machine and when the copy has been made the sheet is automatically cut off to a uniform size.

Manufacturers:

Regina Co., The, 47 W. 34th St., New York, N. Y. "Victoria."

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CORBIN.—Trade name for electric door openers and electric door locks manufactured by the P. & F. Corbin Division of American Hardware Corp., New Britain Conn.

CORBIN CABINET LOCK CO.—New Britain, Conn. Manufacturer of cabinet locks, padlocks and hardware specialties. Business established 1882. General Manager, C. H. Baldwin. Branch offices and warehouses, 21 Warren St., New York N. Y.; 52 N. 6th St., Philadelphia, Pa.; 66 E. Lake St., Chicago, Ill.

CORBIN DIVISION, P. & F., OF AMERICAN HARDWARE CORP.—New Britain, Conn. Manufacturer of electric door openers and door locks. Vice-president and general manager, Charles B. Parsons Main office and factory, New Britain, Conn. Branch offices, 101 Park Ave., New York, N. Y.; 8th & Arch Sts., Philadelphia, Pa.; 60 W. Lake St., Chicago, Ill.

CORA.—Trade name for commercial lighting units manufactured by the Consolidated Lamp & Glass Co., Coraopolis, Pa.

CORD.—A small cable, very flexible and substantially insulated to withstand wear. There is no well defined dividing line between a cord and cable in respect to size and likewise none in respect to the character of insulation between a cord and a stranded wire. Many types of cords have an insulating covering consisting principally of rubber.

CORD ADJUSTERS, CONNECTORS CLAMPS, HOLDERS, SWITCHES WEIGHTS.—See Adjusters, cord; Connectors, cord; Clamps, cord; Holders, cord Switches, pendent and cord; Weights, cord, telephone switchboard.

CORD, BORDER LIGHT.—See Cable border light.

CORD, FLEXIBLE, ARMORED.—Stranded cord having rubber and cotton braid insulation twisted together with a cotton or jute filler or having a protecting braid, and covered with an outer wrapping of flexible interlocked steel armor, or a woven braid of fine steel or copper wire. Cords of this type are made to stand exceptionally hard wear. They are much used for inspection, trouble and other extension hand lamps, small tools and appliances in machine shops, assembling and erecting shops, garages, engine and boiler rooms, etc. They are required in show windows and show cases to prevent the former custom of window dressers attaching cards, etc., by pinning to lamp cord. For heavy currents requiring large conductors or multiconductor connections this type of conductor is called armored cable (see Cable, armored).

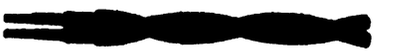
Manufacturers:

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Garland Mfg. Co., West Pittsburgh, Pa. "Sterling."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO. Fulton Bldg., Pittsburgh, Pa. "Flexsteel." (See display adv. pages 1302-1304.)
Okonite Co., The, Canal St., Passaic N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Pratt-Chuck Co., The, Frankfort, N. Y. "Quickstrip."
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triangle."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio. "Realflex."

CORD, FLEXIBLE, BREWERY.—Cord used for pendants, drop cords or extension lamps in damp places, such as breweries. It differs from ordinary lamp cord only in that the outer braid is saturated with weatherproofing compound, while lamp cord has a dry glaze cotton covering. It consists of two stranded conductors, cotton wound, insulated with vulcanized rubber and covered with cotton braid and then twisted into pairs.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture the well known "Americore" brewery cord.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B.I.W."
Bourn Rubber Co., 58 Warren St., Providence, R. I.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" new code flexible brewery cord is made up of two flexible conductors, seamless rubber insulated, braided, twisted and saturated with weatherproof compound. Made in sizes 10, 12, 14, 16 and 18 B. & S. For other "Paranite" products, see pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Morse, Frank W., 289 Congress St., Boston, Mass.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire brewery cord is furnished with two stranded tinned copper conductors, each insulated with seamless rubber insulation and covered with one weatherproof braid after which the two are twisted together. The 16 gage brewery cord illustrated shows the stranded



Rome Flexible Brewery Cord

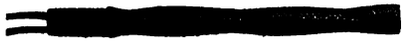
conductor first wrapped with fine Sea Island cotton, then the seamless rubber insulation and finally the black weatherproof braid. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U.S."

CORD, FLEXIBLE, CANVASITE.—A type of lamp cord adapted for use as drop cords, portable extensions and other cords receiving hard usage in damp places, such as cellars, garages and manufacturing plants. It consists merely of brewery cord with an additional coating of weatherproofed braid. Two stranded rubber-insulated conductors having weatherproofed braids are twisted into a pair and then covered with an additional cotton braid which is saturated with weatherproof compound. When no compound is applied to the braid, it is called "abrasion-proof cord" and is suitable for use in dry places.

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bourn Rubber Co., 58 Warren St., Providence, R. I.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)

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Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. See display advertisement on pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Morse, Frank W., 289 Congress St., Boston, Mass.
Okonite Co., The, Canal St., Passaic N J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire canvasite cord is furnished with two stranded tinned copper conductors, each insulated with seamless rubber insulation and covered with one weatherproof braid, after which the two are twisted together and covered with an additional weatherproof braid as further protection against dampness. Can-



Rome Flexible Canvasite Cord

vasite cord is the same as Brewery cord except for the final covering of weatherproof braid. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. The 16 gage canvasite cord is illustrated. For other Rome Wire Company products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CORD, FLEXIBLE, DECK OR MARINE—A portable cord designed to withstand rough usage in very damp places, as on a ship or dock. It generally consists of two stranded conductors each insulated with a coating of vulcanized rubber and covered with a cotton braid, which are twisted into pairs. Jute fillers are used to make the cord round and a coating of vulcanized rubber and cotton braid added. The cotton braid is then saturated with a weatherproof compound. Sometimes also called deck cable.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B.I.W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1239.)
Marine Electric Co., 195 Fremont St. San Francisco, Cal. "Meco."
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Okonite Co., The, Canal St., Passaic N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire deck cables are made with two stranded copper conductors insulated with seamless rubber insulation covered with braid. The two wires are twisted together with a jute filler which is then insulated with a wall of seamless rubber to which two additional weatherproof cotton braids are added. The 14 gage Deck Cable illustrat-



Rome Flexible Deck Cable

ed shows the various coverings described. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I. "Duracord."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U.S."

CORD, FLEXIBLE, LAMP.—Lamp cord is the most widely used type of flexible cord. It is used for pendants, drop cords, for wiring shower or other chain fixtures, for table and other portable lamps, and for other extensions in dry places where the usage is not hard. It is also occasionally used for bell and annunciator wiring and for other purposes where a flexible conductor having a neat covering is desirable. It is composed of two stranded conductors, generally No. 16 or 18 A. W. G., each covered with a serving of cotton, a coating of vulcanized rubber and an outer braid of cotton or silk. The conductors are usually twisted together into pairs, although in some cases they are laid parallel and covered with another cotton or silk braid. Green and yellow cotton braids are the coatings commonly used, but the silk braids are also made in various other colors.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of lamp cord, National Electrical Code standard.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B.I.W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence R. I. (See descriptive advertisement under Wire, asbestos-covered.—Adv.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" lamp cord (type "C"), glazed cotton twisted, is made in sizes 22 to 10 B. & S. Type "C" silk covered braided and twisted lamp cord, in same sizes as above. "Paranite" parallel new code lamp cord (Type "P. O.") is made in two finished, glazed cotton covered, and silk covered. Sizes run from No. 22 to No. 10 B. & S., in both coverings. For other Indiana Rubber & Insulated Wire Co.'s products, see display advertising on pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire lamp cords are manufactured to meet all requirements, using annealed copper wires of No. 30 Brown & Sharpe gage, having a diameter of .01 in. twisted into a cable of the required carrying capacity. The conductor is



Rome Twisted Pair Lamp Cord

then covered with fine Sea Island cotton, after which it is insulated with seamless rubber and finished with an outer braid of silk or cotton of desired color. The conductors may be furnished single, or twisted together or laid parallel and braided over all with either silk or cotton. Above is illustrated the No. 18 Brown & Sharpe gage twisted pair lamp cord with green and yellow cotton braid. Below is shown the No. 18 parallel lamp cord with dry cotton braid. All copper wire used in



Rome Parallel Lamp Cord

Rome lamp cords conforms to the strict general specifications for Rome bare copper wire (see that classification). For other Rome Wire Company products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U.S."

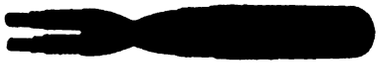
CORD, FLEXIBLE, PACKINGHOUSE.—Consists of two stranded rubber-insulated conductors, each provided with a cotton braid, twisted together with a filler of jute or similar material to form a round cord and protected by two outer weatherproofed braids. It is suitable for pendent or portable use in damp places and will withstand very hard wear; largely used in meat packing establishments and the like.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B.I.W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

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Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Rose St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1239.)
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Okonite Co., The, Canal St., Passaic N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire packing house cord is made with two stranded tinned copper conductors each covered with seamless rubber insulation not less than 1/32 in. in thickness. Each conductor is covered with a cotton braid and twisted together with jute filler and finished with two weatherproof braids. The 14 gage



Rome Packing House Cord

Packing house cord illustrated shows the first wrapping of fine Sea Island cotton, the individual seamless rubber insulation and first weatherproof braid, the jute filler and the final two coverings of black weatherproof braid. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U.S."

CORD, FLEXIBLE, PORTABLE HEATER.—Cord used for connecting electric pressing irons, air heaters, soldering irons, disk stoves and other household and industrial heating appliances taking not over 660 watts and whose cords are likely to be exposed to a high temperature. A stranded conductor is covered with a separator, usually a tight, close wind of fine cotton, then a layer of rubber at least 1/64 in. thick, or an impregnated felted asbestos covering is applied. A braid of asbestos enclosed by an outer braid is applied over the insulation. Each conductor may be covered by the outer braid or it may bind the two twisted conductors together, forming a round cord. The felted asbestos insulation is protected in the same way by an outer braid. In some cases the outer braid is made of heavy twine instead of glazed cotton. Where the conductors are covered separately, they are twisted into a pair.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
CORD, flexible, portable heater.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of heater cord.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Wire, asbestos-covered.)—Adv.
Driver-Harris Co., Harrison, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-5.)
INDEPENDENT LAMP & WIRE CO., 1787 Broadway, New York, N. Y. (See display adv. page 1251.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" heater cord is made in three styles: twisted, covered as a pair; twisted, covered individually and parallel, covered. Sizes run from No. 18 to No. 10 B. & S. For other "Paranite" products see display advertisement on pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Morse, Frank W., 289 Congress St., Boston, Mass.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire heater cord, for use with percolators, toasters, flatirons, water heaters, etc., is ordinarily furnished in Nos. 14, 16 and 18 gage. The conductor is extra flexible, covered with a cotton wind, insulated with rubber compound, braided asbestos fibre, and finished with a gray or black glazed cotton outer braid. The outer braid can be fur-



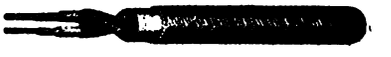
Rome Flexible Heater Cord

nished in other colors if desired. This type of cord can be furnished in twisted pair, twisted pair with braid over all, or parallel with braid over all. The gauge 16 heater cord, twisted pair, shows the various coverings described. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX ELECTRIC HEATING CO., 85 Sidney St., Cambridge, Mass.
Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass. "Tirex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CORD, FLEXIBLE, REINFORCED.—Reinforced cord is used for heavy pendants, portable lamps, fans and other appliances where good wearing qualities are essential. It consists of twisted-pair lamp cord with an additional jacket of vulcanized rubber, which makes it round, and protected by an outer cotton or silk braid which is saturated with weatherproof compound in some cases.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of "Americore" flexible reinforced cord.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Bourn Rubber Co., 58 Warren St., Providence, R. I.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" reinforced portable cord, Type "P." is covered with a glazed cotton braid; also furnished with silk braid if desired. Sizes run from 18 to 10 B. & S. Type "P. W. P." of same general specifications as above, is covered with a weatherproof braid. "Paranite" special reinforced portable cord, Type "P. S." is made in sizes 18 and 16 only. Can be supplied with silk outside braid, or (in type "P. S. W. P.") with weatherproof outside braid. For other "Paranite" products, see pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROME WIRE CO., Rome, N. Y. Rome Wire reinforced portable cord is furnished with two stranded copper conductors insulated with seamless rubber insulation and cotton braid, twisted together and reinforced with another seamless rubber insulation around the two, after which it is covered with



Rome Reinforced Flexible Cord

a black weatherproof braid, a green and yellow cotton braid, or plain dry cotton braid as desired. The 18 gage reinforced portable cord illustrated above shows the various coverings described with green and yellow braid as the final covering. All Rome Wire is manufactured from copper having 98 per cent conductivity conforming to the strict general specifications of the Rome Wire Company, and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triangle."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I. "Duracord."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Wolf & Davis, 71-73 Spring St., New York, N. Y.

CORD, FLEXIBLE, SPECIAL AND MISCELLANEOUS NOT OTHERWISE LISTED.—The many uses to which flexible cords are put and their special requirements for such service do not permit using any standard type or types of construction for all purposes. Besides those listed above, special cords are made to meet the requirements of extremely hard wear, such as "hard usage" cord, or high temperatures, where asbestos-protected cords are used, or to withstand oil and constant vibration, as on automobiles, etc., and for other exceptional and miscellaneous purposes.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Flexible Woven Cable Co., 170 Purchase St., Boston, Mass. "Wovenite."

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Gottschalk Mfg. Co., John W., Philadelphia, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1239.)
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flexcord" portable electric cord has the strength and flexibility to stand the hardest kind of service. The wires have a double protective treatment. They are rubber-insulated and covered with a loom braid. The braid is treated with a compound that protects the wires from being damaged by water, corrosion, etc. See display adv. on pages 1302-4.—Adv.

CORD, FLEXIBLE, STAGE OR THEATER.—Cord very similar to packing-house cord. It consists of two stranded conductors with a rubber coating and cotton braid on each conductor impregnated with a weatherproof compound. The conductors are then twisted with a filling of jute to make a round cord, and two cotton braids each impregnated with a weather-proofing compound are then applied. It is used for portable lights on lecture platforms, theater stages and the like. Sometimes called "stage cable," but should not be confused with border-light cable (see Cable, border-light).

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of "Americore" heater or stage cable.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" theater or stage cable (type "T"). is made in sizes 14 to 2 B. & S. For other "Paranite" products see pages 1235-1239.—Adv.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

CORD, LEATHER, FOR CAR BELLS AND REGISTERS.—Some street and other electric railway companies prefer to use leather cord instead of braided cordage for the bell signals and for operating the fare registers. The cord used is merely a round strip of leather similar in quality to round leather belting. It is flexible, but will retain its position and shape. Leather cord is quite strong and will wear well. It is provided with splicers and terminal clips: for these see Splicers, cord. Also see Cord or cordage, braided.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelhpia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.

CORD OR CORDAGE, BRAIDED.—For lamp suspensions, street-car registers and bells, trolleys, etc., various forms of weatherproof cords are used. These are of braided cotton weatherproofed, braided cotton with wire center, and of hemp. They should be strong, especially those for arc lamps and trolley ropes, and have good wearing qualities in addition to being waterproof.

Manufacturers:

Gottschalk Mfg. Co., John W. Philadelphia, Pa. "Linotape."
Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Roebling's Sons Co., John A., Trenton, N. J.
SAMSON CORDAGE WORKS, Boston, Mass. Manufacturers of braided cotton cordage, in all sizes and colors for all purposes. Samson Spot Cord (trade



Samson Spot Cord

mark registered in U. S. Patent Office) is made of extra quality cotton yarn, carefully inspected and guaranteed, free from all imperfections of braid and finish. The colored spots in any color are a trade mark used only with Samson Spot Cord. Samples and information gladly furnished on request.—Adv.
Silver Lake Co., Newtonville, Mass.
Wolf & Davis, 71-73 Spring St., New York, N. Y.

CORDS, FLEXIBLE, DETACHED APPLIANCE.—Manufacturers of portable lamps, heating, motor-driven or other electrical appliances almost invariably supply with each appliance a flexible cord for connecting it to the supply circuit. This has an attachment plug at one end to connect to the circuit receptacle or socket, and has the other end either permanently connected to the appliance or has it provided with a special plug for connecting to the terminals of the appliance. In the latter case the cord with its end plugs becomes a separate auxiliary to the appliance. Appliance terminals have been standardized to only a limited extent; as a rule, a manufacturer of heating appliances, for instance, has all his appliance terminals of one type so that any of his cords may be used with any of his appliances. They are seldom, however, interchangeable with other makes of appliances. For the convenience of persons using several makes of appliances there have been placed on the market detached cords equipped at one end with attachment plugs, usually of standard separable type, and at the other end with a special plug designed to fit over any of the round or flat prong types of appliance terminals. These cords are made in various lengths and either of ordinary lamp cord, or reinforced, or portable heater cord as conditions of use require.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
New England Electrical Works, Lisbon, N. H.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Tricord."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

CORDS, FLEXIBLE, TELEPHONE SWITCHBOARD AND RECEIVER.—A telephone switchboard cord is a flexible cord conductor with a plug at one end Two cords (forming a pair) are electrically connected together at their other ends. The cord circuit from plug to plug is the means of connecting subscriber lines. The answer-end is used to answer the calling subscriber. The calling end is used to connect to the called line through the jack. These cords generally have a very rugged construction and a very closely braided covering over fine copper tinsel conductors. Occasionally switchboard cords whose conductors are steel wire are used, each steel wire being covered with a wrapping of fine copper wire to add conductivity. It lasts longer than tinsel cord, but has more transmission loss.

Receiver cords are flexible conductors which connect the receiver to the rest of the telephone set. They have two conductors each made of fine copper tinsel for flexibility and insulated by silk and cotton coverings and braids. One form of receiver cord is a straining cord in which one end is braided without conductors, intended to be tied to a stationary lug to take the strain off the tinsel or other conductors.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture "Americore" rubber covered switchboard cables, National Electrical Code standard. Flexible tinned copper conductor; also "Americore" twin wires and cables.—Adv.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Gottschalk Mfg. Co., John W., Philadelphia, Pa.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Runzel-Lens Electric Mfg. Co., 1751 N. Western Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "De Veau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y. "Duratex."
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

CORE, ARMATURE.—The iron structure which forms a part of the magnetic circuit of dynamoelectric machines and upon which the armature windings are placed. It is practically always laminated perpendicular to the axis of rotation to reduce eddy currents to a minimum, and slotted to make convenient places for the armature conductors.

The magnetic quality of the iron is such as to give as high a permeability and as low a hysteresis loss as practical. The electrical quality is such as to give as high a resistance to eddy currents as is convenient with the desired magnetic qualities and cost.

Armature cores are provided with ventilating ducts in medium and large sized machines by putting spacers between the laminations at desired intervals.

CORE LOSSES.—The energy losses appearing as heat in armature and trans-

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former cores, due to hysteresis and eddy currents in the iron of these cores. They are often called the iron losses. See Hysteresis loss, also Eddy current loss.

CORE, POLE.—Field cores are sometimes called pole cores. See Cores, field.

CORE PUNCHINGS, ARMATURE.—See Armature punchings.

CORES, ELECTROMAGNET.—The function of the core of an electromagnet is to furnish a path of low reluctance for the magnetic flux. Iron is the only suitable material; the softer and more pure grades are the best. After the magnetic field has been removed the soft iron retains very little magnetism. Steel, however, will retain a greater or less part of its magnetism, depending on its composition, and is used where that feature is desirable, as in the case of certain a-c. magnets. If an alternating or pulsating current flows through the coils there will be induced in the core eddy currents which cause an energy loss. By building up cores of thin sheets or bundled wires, insulated from each other, this loss is reduced. In the process of manufacture these pieces acquire a thin film of iron oxide which is sufficient insulation against the eddy currents for ordinary cores. Whether the core should consist of sheets or wires depends on the shape of the core and the direction of the magnetic flux or lines of force through it.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland; Ohio.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Calif.
Liberty Electric Corp., Port Chester, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.

CORES, FIELD.—The field core is that part of the magnetic circuit of a dynamo-electric machine upon which is placed the winding that carries the exciting or magnetizing current. Field cores are sometimes made of iron having a higher permeability than that of other portions of the magnetic circuit outside of the armature core so that these cores may be of reduced cross-section and hence permit of a reduction in the size of the field coil. In some cases the cores are made of laminated iron or steel.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.
Liberty Electric Corp., Port Chester, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

CORES, PAPER.—This form of core is commonly used in radio instruments. It is generally built up of layers of paper in the form of a cylinder, and sometimes impregnated with wax or other insulating compound. Coils wound over these cores are merely inductances that are used in tuning and are often arranged in sections with several coils in a row so that they may be used singly or in series.

Manufacturers:

Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (For radio.) (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.

CORES, RESISTANCE COIL.—Many types of small resistance coils are wound on cylindrical cores. As they are generally subject to considerable heating, the cores are of materials that will withstand heat, such as porcelain, metal with a mica or asbestos sheath, or Bakelite or fiber.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Liberty Electric Corp., Port Chester, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

CORES, TRANSFORMER.—The iron magnetic circuit around which the primary and secondary coils of a transformer are placed. The varying flux due to the alternating current passes through the core and by cutting the coils produces the induced e. m. f.'s therein. The core is always composed of laminations (which see) and may take several forms depending upon the class of transformer. Also see Transformer, core type and shell type.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Calif.
Liberty Electric Corp., Port Chester, N. Y.
Packard Electric Co., Warren, Ohio. "Packard."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
United Electric Apparatus Co., 1259-33 Columbus Ave., Boston, Mass.

CORK INSERT CO.—164 Federal St., Boston, Mass. Manufacturer of cork insert pulleys, etc. P. H. Custis, manager.

CORLISS CARBON CO.—Bradford, Pa. Manufacturer of carbon, graphite and metal composition brushes. Business established 1910. President, J. F. Kerlin; vice-president and treasurer, Otto Koch; secretary, George B. Morris; general manager, W. C. Kalb; sales manager, N. G. Johnson. Main office and factory, Bradford, Pa. Branch offices, 90 West St., New York, N. Y.; 612 Union Bank Bldg., Pittsburgh, Pa.; 146 Summer St., Boston, Mass.; 454 Peoples Gas Bldg., Chicago, Ill. Sales representatives, Electrical Specialty Co., 525 Market St., San Francisco, Calif.; Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

CORNING GLASS WORKS.—Corning, N. Y. Manufacturers of illuminating glassware.

CORN POPPERS, ELECTRIC.—Electric corn poppers are appliances arranged to pop corn by the heat given off from an electric heating element. The element is usually in disk form and is protected from the corn falling onto the wires by a fine screen or grid which covers it, or by a steel plate.

Manufacturers:

Cretors & Co., C., 620 W. 27th St., Chicago, Ill. "Earnmore."
Dunbar & Co., 2652 W. Lake St., Chicago, Ill.
Holcomb & Hoke Mfg. Co., Indianapolis, Ind. "Butter-Kist."
Kingery Mfg. Co., 420-424 E. Pearl St., Cincinnati, Ohio.

CORONA.—In a total eclipse the sun is seen to be surrounded by a luminous envelop which is called the corona, from the Latin word meaning crown. A luminous discharge between conductors which resembles the luminous envelop of the sun is likewise known as corona. If the voltage between two smooth conductors of a transmission line is gradually increased, a voltage is finally reached at which the conductors become surrounded by a pale violet light and a slight hissing sound is heard. The light and sound are caused by a slow discharge of electricity into the air. This discharge is the corona. If the voltage is raised above this critical value a voltage is finally reached at which the air breaks down completely and a disruptive discharge or spark jumps from one conductor to the other.

The formation of corona is accompanied by energy loss in a number of forms, as heat, as chemical action forming ozone and nitrous oxide which on combining with water form nitric acid, as light and noise. The nitric acid may cause corrosion of wires and connectors, while heat may cause deterioration of insulation other than air. The voltage at which corona will form depends upon the radius of the wires, distance apart, condition of surface, barometric pressure, humidity, etc. Formulas have been developed for the calculation of the corona voltage and the power loss due to corona, given in kilowatts per mile of single conductor. The subject of corona is of great importance in high-tension engineering. See Corona discharge, applications of.

CORONA DISCHARGE, APPLICATIONS OF.—A useful application of an electrical discharge is the removal by electrical precipitation of suspended dust, smoke, and fumes from gases, as in cement mills and smelters. The essential apparatus for this purpose consist of a low-voltage 25 to 60-cycle single-phase alternator, a static transformer, a synchronously driven mechanical rectifier and suitably arranged pipes in which are placed the high-voltage conductors and through which the dust or smoke-laden gases pass. The low voltage is raised to 30,000 or even to 250,000 volts, which, by means of the rectifier in the secondary circuit, produces undirectional corona discharge. Negative corona has been found to be most effective for this purpose. See Cottrell process of electrical precipitation; also Precipitation equipment, electrical.

Another use of corona discharge is its application to a so-called smoke indicator by means of which an excess of smoke or fumes above a certain density is indicated. The apparatus consists of a small high-voltage transformer in the secondary circuit of which is connected a set of spark gaps. An excess of smoke or dust passing between the spark gaps produces a discharge which operates an indicating circuit. By adjusting the width of the spark gaps, the indicator circuit can be operated whenever the smoke density exceeds a predetermined value.

The corona discharge also forms ozone, which is a strong oxidizing agent. An apparatus called the ozonator makes use of this principle for the purification of noxious odors; see Ozonators.

CORONA LIGHTOLIER.—Trade name for lighting unit manufactured by the Lightolier Co., 569 Broadway, New York, N. Y.

CORRESPONDENCE SCHOOLS.—A list of schools that have courses for teaching electrical engineering or special branches of electrical work by the correspondence plan is given under Education, electrical.

CORTLAND SPECIALTY CO., THE.—176 Railroad St., Cortland, N. Y. Manufacturer of welding compounds. President, Frank Zuber; treasurer, H. R. Sargent.

CORTLAND WELDING COMPOUND CO.—Cortland, N. Y. Manufacturer of welding compounds and fluxes.

CORY & SON, INC., CHARLES.—New York, N. Y. Manufacturer of ship signaling and communicating systems. Business established 1845. President, W. S. Doran; vice-president, Frank W. Wood; secretary and treasurer, R. L. Casson. Main office and factory, 183-187 Varick St., New York, N. Y. Branch offices, 11 Mission St., San Francisco, Calif.; 207 Market St., Philadelphia, Pa.; 83 Columbia St., Seattle, Wash.

COS.—Contraction of cosine when referring to this function of a specific angle, as cos A, cos 30°, cos θ.

COSBY ELECTRIC & MACHINE CO., R. R.—1705 E. Broad St., Richmond Va. Manufacturer of lighting fixtures, elevators, motors, motor starters and storage batteries. Business established 1910. General manager, R. R. Cosby.

COSINE.—One of three most used trigonometric functions. In any right-angled triangle the cosine of one of the acute angles is the ratio of the side between this angle and the right angle to the hypotenuse of the triangle. In mathematical expressions the contraction cos is nearly always used, as cos 60° = ½.

COSMO.—Trade name for electric body-heating apparatus and electrotherapeutic lamp manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

COSMOGRAPH.—Trade name for motor-driven motion-picture machines and accessories manufactured by the Cosmograph Motion Picture Machine Co., Inc., Film Bldg., Cincinnati, Ohio.

COSMOGRAPH MOTION PICTURE MACHINE CO., INC.—Film Bldg., Cincinnati, Ohio. Manufacturer of motor-driven motion-picture machines and accessories. President, S. M. Bradley; vice-president and general manager, A. Gorretta; secretary, Hiram Bradley; treasurer, J. B. Pears; acting secretary and sales manager, Leo E. Dwyer.

COTELCO.—Trade name for electrical reset annunciators manufactured by the S. H. Downs Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

COTENAMEL.—Trade name for cotton-covered magnet wire manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

COTO-COIL CO.—Providence, R. I. Manufacturer of electrical coils and radio transformers. John S. Elliott, manager. Main office and factory, 87 Willard Ave., Providence, R. I. Branch office, 95 South St., Boston, Mass.

COTTAGE IRONER.—Trade name for electric ironing machine manufactured by the William G. Yates Co., Cleveland, Ohio.

COTTAGE PLANING MILL CO.—Everett, Pa. Manufacturer of insulators, pins and brackets. Business established 1889. G. H. Gibboney, owner.

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COTTONITE.—Trade name for cotton-covered magnet wire manufactured by the Acme Wire Co., New Haven, Conn.

COTTRELL PROCESS OF ELECTRICAL PRECIPITATION.—This is a process for the separation of suspended solid or liquid particles from a gas or vapor by passing it through an intense electrical field. It was developed into commercial success and patented by Dr. F. G. Cottrell and associates within the last 16 years, the work being conducted since 1912 by the Research Corporation. The gas, fume or smoke to be treated is passed through a treater or precipitator, which usually consists of metallic tubes or pipes from 6 in. to 4 or 5 ft. in diameter, in the axis of which is stretched a wire or other conductor; the pipes are connected to ground and the axial wires to the negative side of a high-tension direct-current or pulsating-current circuit, whose positive is grounded. Potentials of 30,000 to 250,000 are used, depending on the materials being treated and related conditions; the potential is raised to the highest possible point that gives copious negative corona discharge and just short of the disruptive voltage that would cause breakdown and arcing. Under the influence of this powerful corona action ionization takes place and the suspended particles are driven transversely to the pipes to which they adhere momentarily and then drop to a settling or collecting chamber. The negative corona discharge is found much more effective than the positive or alternating corona. The high-tension direct current is obtained by stepping up the potential of a single-phase current by means of a transformer and then rectifying this high-tension current through a mechanical or other suitable rectifier. See Precipitation equipment, electrical.

This process is applied effectively chiefly for two general classes of precipitation: Removal of suspended dust, smoke, acid or other destructive or objectionable particles from the smoke or fume discharged from smelter, cement, chemical or other plant chimneys that prove injurious to the neighborhood; recovery of similar particles from the smoke or fume as an economic means of preventing or minimizing waste. These two objects are often combined. Installations in which the process has been found of special value are in recovering dust from cement kilns; dust, rich in metallic content, from lead, copper, silver, arsenic and other smelters; acid mist or minute drops from the fumes of sulphuric and other acid plants; tar globules from illuminating or producer gas plants; powdered milk, sugar and other food products from evaporator plants. The process has also been applied in many other plants, including iron blast furnaces and coal-burning power plants to remove smoke and fine flue ash particles, electrochemical plants to remove calcium carbide dust, chlorine product particles, powdered alundum, etc. In some cases the cost of the equipment has been heavier than was warranted in removing only a mild nuisance, but where the materials recovered are valuable or where the nuisance of failing to remove them is serious the process is economically applied. In a California cement plant 100 tons of cement dust have been recovered daily by the Cottrell process. A modification of the process has also been applied to removal of emulsified water from oil.

COUCH CO., INC., S. H.—Norfolk Downs, Quincy, Mass. Manufacturer of telephone apparatus for private installations. Business established 1901. President and treasurer, Samuel H. Couch; vice-president and sales manager, William Couch; general manager, A. T. Morrison. Main office and factory, Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass. Branch offices, 337 W. Madison St., Chicago, Ill.; 170 Purchase St., Boston, Mass. Sales representatives, William A. Leiser & Co., Philadelphia, Pa.; Sierra Electric Co., San Francisco, Calif.

COULOMB.—The coulomb is the practical unit of quantity of electricity; it is the quantity flowing through a circuit in one second when the current is one ampere. The total quantity of electricity conveyed by a current I in t seconds is It coulombs. Another unit of quantity much used in electroplating and storage-battery work is the ampere-hour, which equals 3600 coulombs.

COULOMB, CHARLES AUGUSTIN de.—A French physicist (born Angouleme, 1736, died Paris, 1806) celebrated for his researches in electricity and magnetism. In 1777 he gained an Academy prize for his work on magnetic needles and again in 1779 for his "Theory of Simple Machines." He is famous for his experiments on static electricity and the invention of the torsion balance for measuring the forces of magnetic and electrical attraction. He took part in the investigation attending the introduction of a metric system of weights and measures by the French Government, being a member of the commission of 12 appointed under provision of the law of April, 1795. His name has been given to the unit of electrical quantity.

COULOMB'S LAWS.—See Electrostatic laws and Magnetic laws.

COULOMETER.—An electrolytic cell containing a metallic salt, an anode of the same metal, and a cathode for receiving deposited metal. The quantity of coulombs passing is determined by weighing the amount of silver, gold, or lead, etc., deposited, and calculating therefrom. A gas coulometer measures the same quantity, but by means of the volume of gas generated in a suitable cell, such as of hydrogen at a cathode, oxygen at an anode. Very commonly but inappropriately called a voltameter; since it measures coulombs it is much more properly called a coulometer. (Also see Voltameters.)

COUNTER-CLOCKWISE ROTATION.—When vectors are employed in generating sinusoidal quantities, such as e. m. f and current, the vectors are assumed to rotate counter-clockwise. This is an international convention. The leading vector, when there are two, is drawn counter-clockwise of the lagging vector. Also see Lead and lag.

COUNTER E. M. F.—This is any e. m. f. in a circuit which opposes the current in the circuit. The current is due to the difference between the impressed and counter electromotive forces.

As applied to electrical machinery in particular, counter e. m. f. is an electromotive force produced by a changing flux through a winding as the result of rotation of the winding or of alternations of the flux, which is in more or less opposition to the applied voltage; for example, the counter e. m. f. of a shunt motor or of a transformer. A counter e. m. f. is necessary to the efficient operation of motors and transformers.

COUNTER E. M. F. OF ELECTROLYTIC CELLS.—The electromotive force which shows itself on interrupting the current running through an electrolytic cell. The instant that the impressed voltage is cut off there is often found to exist a voltage self-generated by the cell, in a direction opposite to the previously applied voltage. Current generated in the cell by this back or counter e. m. f. flows in a direction opposite to the previously used electrolyzing current. If a voltmeter is connected across in shunt between anode and cathode while electrolyzing current is being applied, the instant this current is shut off the voltmeter, without changing its terminals, will indicate the back e. m. f., being operated by the reversed current flowing through the cell.

COUNTERPOISE, RADIO.—A system of electrical conductors forming one portion of a radiating oscillator, the other portion of which is the antenna. In land stations a counterpoise forms a capacitive connection to ground.

COUNTERS AND SHELVING, STORE.—Modern electrical dealers' and jobbers' salesrooms are very nicely furnished. Attractive rooms cannot be arranged unless the counters and shelves are of a style and quality to correspond with the other woodwork and furnishings. While rather rough boards can be used by any local carpenter or handy man to construct counters and shelves that will hold the material, this is not practiced in modern stores. Some manufacturers and millwork companies specialize in the construction of attractive and well made counters and shelves to be used for this purpose. The shelving is often adjustable as to the distance between shelves. Small holes in the uprights or framework permit clamps or pins to be inserted and the shelves to be placed wherever desired; special adjusting clamps or devices are also used.

Manufacturers:

Chesapeake Iron Works, P. O. Box 1123, Baltimore, Md. (Shelving.)
Darby Sons Co., Edward, 416 N. 18th St., Philadelphia, Pa. "Pen-Dar."
Heller & Co., W. C., Montpelier, Ohio.
Irving Iron Works Co., Long Island City. New York, N. Y.
Lyon Metallic Mfg. Co., Aurora, Ill.
Sani Products Co., 209 W. Randolph St., Chicago. Ill.

COUNTERS, ELECTRICALLY OPERATED.—Electrical counters are used for counting small parts in manufacturing processes or for counting the number of operations or speed of a machine. When used in counting parts, it is often done by the weighing method using an electrically operated weighing machine. and determining the number from the weight obtained. For counting operations or speed, small contacts are closed by the machine operation and actuate a relay recording mechanism. Speed of machinery is obtained by counting the revolutions recorded in any definite interval.

Manufacturers:

Electric Weighing Co., 180 13th Ave., New York, N. Y.

COUNTERS, POLE AND TALLY.—A small recording instrument, registering on a dial each pressure of the hand or finger. Mounted in a case about the size of a watch, it is carried in the palm of the hand while making tallies of materials, counting poles, etc.; in this form they are commonly called pole counters. Another form for mounting in sockets is used on the keyshelf of telephone switchboards for registering calls; these are often called peg counters.

MANUFACTURERS:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
International Register Co., The, 15 S. Throop St., Chicago, Ill.
Root Co., The C. J., Bristol, Conn.
Veeder Mfg. Co., Sargeant & Garden Sts., Hartford, Conn.

COUNTERS, REVOLUTION OR SPEED.—An instrument, usually consisting of a worm and gear arrangement connected to a dial, which records the total number of revolutions of a shaft for the time it is connected thereto. In order to obtain the speed, the intervening time must be observed. Revolution counters are sometimes made to be permanently attached to the shaft for use on pumps, slow-speed motors, coil-winding machines, etc. When only occasional measurements are required, they are made portable and have a small rubber point which is pressed against a countersunk hole in the shaft end. These counters should not be confused with tachometers; the latter indicate the speed in r.p.m. directly.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
Cummings Ship Instrument Works, 10 High St., Boston, Mass. "Smith-Cummings."
Durant Mfg. Co., 655-665 Buffum St., Milwaukee, Wis. "Productimeter."
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Foxboro Co., Inc., The, Foxboro, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Hart Mfg. Co., R. A., Battle Creek, Mich. "Standard."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McDonnell Odometer Co., 3501-03 S. Kedzie Ave., Chicago, Ill.
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Root Co., The C. J., Bristol, Conn. "Bristol," "Elm City," "Roco."
Veeder Mfg. Co., Sargeant & Garden Sts., Hartford, Conn.
Zernickow, O., 15 Park Row, New York, N. Y. "O-Z Tachoscopes."

COUPLE.—A pair of different materials usually metals, capable of acting as a source of electromotive force when subjected to heat or immersed in an electrolyte. The former is called a thermocouple, which see, and the latter a cell or battery.

COUPLE GEAR.—Trade name for electric and gas-electric commercial trucks and tractors, tram tractors for lumber, fire engines and apparatus, made by the Couple-Gear Freight-Wheel Co., 1450 Buchanan Ave., S. W., Grand Rapids, Mich.

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COUPLE-GEAR FREIGHT-WHEEL CO.—1450 Buchanan Ave., S. W., Grand Rapids, Mich. Manufacturer of electric and gas-electric trucks and tractors for fire and commercial uses. Business established 1905. President, W. C. Hopson; vice-presidents, G. P. Hummer and A. J. Brown; secretary and treasurer, M. H. Hopkins; general manager, J. W. Brown. Manufacturers' representatives, C. L. Smith Co., 30th St. & 11th Ave., New York, N. Y.; Eastern Electric Vehicle Co., 179 West 1st St., South Boston, Mass.; Couple Gear Power Truck Co., 72 E. South Water St., Chicago, Ill.; P. C. Dykes & Co., 258 1st St., San Francisco, Calif.

COUPLER LOOSE, RADIO.—A loose coupler is a high-frequency transformer used in radio receiving circuits to connect the detector circuit to the antenna circuit. Its most common form is that of two solenoid coils mounted on the same axis. The coupling between the two coils is varied by sliding one coil in or out of the other. The self-inductance of each coil is made individually variable by a system of taps.

COUPLER, RADIO.—An apparatus which is used to transfer radio-frequency energy from one circuit to another by associating portions of these circuits. Circuits may be coupled together in a number of ways, but three methods or kinds of couplers are most common. These are known as direct couplers, inductive couplers and capacitive couplers.

A direct coupler is one which magnetically joins two circuits, having a common conductive portion or an inductance coil common to the two circuits.

An inductive coupler is one which joins portions of the circuits through the action of magnetic forces. They are connected only by mutual inductance. See Coupler, loose, radio.

A capacitive coupler joins portions of the circuits by electric fields, and the energy is transferred through the action of electric forces. This type has an electrostatic condenser common to both circuits.

COUPLERS, CAR, ELECTRIC RAILWAY.—Devices to mechanically connect electric cars together so that they may be operated in train or singly as desired. Due to the comparatively sharp curvature of electric railway tracks existing at many points on nearly every system, all couplers for this class of service are of the radial type. They range in design from those of the simplest radial bar type with simple pin connections to modern tight-lock type, coupling (simultaneously with the mechanical connection) the air lines and electrical cables for multiple-unit control. Couplers of design modified from steam-railway practice are in common use. To prevent surges when cars are operated in train, tight-lock couplers have been developed and are frequently used for installation on modern equipment. Suitable buffing and pulling springs are essential features of couplers.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.

OHIO BRASS CO., THE, Mansfield, Ohio. Tomlinson automatic couplers, for electric railway, mine and industrial cars, and Tomlinson M. C. B. couplers for electric railways. The former couples cars and air lines automatically and simultaneously, and, if desired, electric circuits between cars. Tomlinson M. C. B. intercouples with standard M. C. B. All Tomlinson couplers are supported with spring draw bar carrier which absorbs grade changes without straining the car.—Adv.

Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

COUPLING COEFFICIENT, INDUCTIVE.—The ratio of the effective mutual inductance of two circuits to the square root of the product of the effective self-inductances of each of these circuits.

COUPLINGS, CONDUIT AND PIPE.—See Conduit couplings, nipples and unions.

COUPLINGS, CONDUIT ROD.—The detachable couplings with which the rods used in introducing the pulling cable into an underground conduit are equipped are made in several forms. They usually consist of an iron socket into which the rod is fitted, with a hook or screw arrangement to fasten onto the next coupling. In general, they are arranged so that they will disjoint only when bent at an angle with the axis of the rod, and this may be done only in a manhole and not while the rod is in the duct.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

COUPLINGS, FRICTION CLUTCH.—Friction clutch couplings are used to couple two sections of a shaft together. They are very much like a friction clutch, having a small pulley fastened to one shaft. The other shaft has the friction mechanism on it. the mechanism being operated by a sliding collar on the shaft. One type of coupling consists of four or more shoes that grip the pulley securely when the mechanism is operated. Another type has the friction material in the form of a band, similar to a brake band, and the pulley is gripped securely all around the circumference. There are other types of friction clutch couplings made and applied to motor-driven shafting that is sectionalized.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Brown Clutch Co., The, Sandusky, Ohio.
Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Chain Belt Co., Milwaukee. Wis.
Conway Clutch Co., The, 1956 W. 6th St., Cincinnati, Ohio.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gump Co., B. F., 431-437 S. Clinton St., Chicago, Ill.
Hilliard Clutch & Machinery Co., The, 102 W. 4th St., Elmira, N. Y. "Hilliard."
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
Webster Mfg. Co., Tiffin, Ohio.

COUPLINGS, INSULATED, FOR LEVERS, RODS, ETC.—Insulated couplings are often inserted in operating levers and brace or stay rods on machinery where it is desirable to insulate one part of the rod from the rest. They are generally made of molded insulating compounds or special cement with a metal covering or armor on the outside. Metal inserts are placed at each end to receive the lever or stay rod, usually being tapped so the rod may be screwed into the coupling. They are generally cylindrical or hexagonal in shape and slightly rounded at the ends. Couplings are tested at voltages of from 4000 to 8000, so may be used on machinery within such voltage limits.

Manufacturers:

Bond Co., Charles, 617 Arch St., Philadelphia, Pa.

MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

COUPLINGS, SHAFT, FLEXIBLE.—Mechanical devices for connecting two shafts together which permit a certain amount of flexibility in the connection and allow inaccuracies in the shaft alinement. Various forms of couplings are made, many consisting of two flanges with a leather or similar flexible coupling member. This type is generally used for direct connection of motors to generators or for connecting any two machines where it would difficult to secure perfect alinement. Other forms are made for line-shaft connecting, allowing not only imperfect alinement but slight angular drive. The clutch type of coupling is also very popular. (For the latter see Clutches, friction; also Clutches, magnetic.)

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa. "Mather."
Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa. "Grundy."
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Bruce-Macbeth Engine Co., The, 2111 Center St., N. W., Cleveland, Ohio.
Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Fawcus Machine Co., 2820 Smallman St., Pittsburgh, Pa.
Francke Co., The, New Brunswick, N. J. General sales agents, Smith & Serrell, Central Ave. at Halsey St., Newark, N. J. "Francke."
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Hickey & Schneider, Inc., 434-48 E. Jersey St., Elizabeth, N. J. "H & S."
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
Karge-Baker Corp., Phoenix, N. Y.
Kentucky Electrical Co., 817 Lewis St., Owensboro, Ky. "Lawrence."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
TERRY STEAM TURBINE CO., THE, Terry Sq., Hartford, Conn.
Thomas Flexible Coupling Co., Warren, Pa.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

COUPLINGS, SHAFT, RIGID.—A mechanical device for rigidly connecting two shafts together. Rigid couplings can only be used where the shafts are perfectly alined, so they are found mostly in cases where a motor or pump, motor-generator or any other two machines, are mounted on the same base, or for connecting sections of line shafting that is carefully alined. The three principal types are flanged face, compression and jaw couplings. Flanged face couplings are the most common.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa. "Bond."
Brown Co., The A. & F., 79 Barclay St., New York, N. Y.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
National Foundry Mfg. & Supply So., Hepburn & Canal Sts., Williamsport, Pa. "National."
Penntroy Corp., The, Troy, Pa. (General sales agents, Smith & Serrell, Central Ave. at Halsey St., Newark, N. J.) "Pintite."
Vulcan Iron Works, 730 S. Main St., Wilkes-Barre, Pa.

COUPLINGS, SHAFT, INSULATED.—A form of coupling, usually flexible, in which, the two shafts are thoroughly insulated from each other, usually by making the central driving disk or other connecting member of nonconducting material. They are used mostly on high-voltage motors or generators for connecting them to their load or driver and then only where the frames are not grounded. The National Electrical Code requires that all machines operating at over 150 volts shall have their frames thoroughly grounded when accessible to other than qualified attendants. When this is not the case and the frames are not grounded, they must be permanently and effectively insulated from ground; this means that the couplings must also be insulated.

Manufacturers:

Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa. "Grundy."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

COVERING, ELECTRIC RANGE BOILER.—Many kitchen range boilers are now heated by means of electric heating elements placed either inside and immersed in the water, or outside of the boiler at the

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side or bottom of the tank or in a heating chamber alongside it. A bare boiler radiates considerable heat and a large percentage of the heat delivered to the water therein is thereby lost. Economy usually requires that this waste be eliminated and that water that is heated may be stored for use at some later time.

Coverings are, therefore, provided to keep the heat in the boiler. They are usually made with an asbestos lining backed up with a dead air space and hair-felt insulation. This is then covered with paper and a canvas cover used on the outside. The coverings generally completely enclose the boiler, fitting over the top and entirely around the sides. The edges are laced together, this process serving to draw the covering tight and leave a smooth finish.

Manufacturers:

Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."

COVERING, PIPE AND STEAM BOILER.—Steam and hot-water pipes and boilers are generally covered with an insulating material to prevent radiation of heat. Magnesia is one of the most common heat-insulating materials used. It consists of hydrated basic carbonate of magnesia and asbestos fiber. The carbonate is a light, pure white crystalline material containing a large number of microscopic air spaces separated by the crystals. It has not the strength to withstand shipping or handling and the asbestos fiber is added to reinforce it. The general proportions are 85% magnesia and 15% asbestos fiber. When used as pipe covering the magnesia is molded into shape to fit a pipe of certain diameter and in sections about 3 ft. long, the sections being split longitudinally. Very large pipes generally have the sections made as segments about 6 ins. wide. Magnesia cement is sometimes made of the same materials and used to cover irregular surfaces, as on a boiler, feed-water heater, large valve, etc.

Asbestos is also used as a heat insulator. It is often made up as a paper and successive layers applied. It is also mixed with cement and used as such or made into blocks. Long fibers are sometimes woven into a thick felt which is furnished in large sheets. Wool felt is also used on some pipes where a moderately warm temperature prevails, as with hot-water lines.

Manufacturers:

Atlas Mineral Products Co., Mertztown, Pa. "Atlas."
Celite Products Co., 1134 Van Nuys Bldg., Los Angeles, Cal. "Sil-O-Cel."
Excello Mfg. Co., The, Cleveland, Ohio. "Evertite."
Franklin Mfg. Co., The, Franklin, Pa.
Hamilton Engine Packing Co., 54-56 Alanson St., Hamilton, Ont., Can.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Magnesia Association of America, 702 Bulletin Bldg., Philadelphia, Pa.
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."

COVERS, BATTERY JAR.—Battery covers for wet primary cells are generally made of porcelain. They serve to hold the electrodes in position and to prevent dust or dirt from falling into the electrolyte. Covers for small storage cells are of the same material as the container, hard rubber or glass. Lead-lined wood tanks for storage batteries are sometimes covered with plate glass. Hard-rubber covers are sealed to prevent splashing of the acid when the battery is moved about. They are provided with a small vent to allow the gas to escape while charging. Glass covers are never tight-fitting and therefore require no vent. All the covers serve to keep the electrolyte free from dust, reduce evaporation, and prevent spraying of electrolyte during charge.

Manufacturers:

Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y. "Champion."
Cook Pottery Co., Prospect St. & P & R Ry., Trenton, N. J. (Porcelain.)
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
Goodrich Rubber Co., B. F., Akron, Ohio.
Hopewell Insulation & Mfg. Co., Inc. Hopewell, Va.
Stokes Rubber Co., Joseph, Trenton, N. J.

COVERS, CONDUIT OUTLET BOX.—Covers usually made of metal finished similarly to the box and shaped to permit their use on round, octagonal or square boxes. The covers usually have two screw holes or slots through which they are fastened to the outlet box by machine screws. A considerable number of different types of covers are made, depending upon the purpose for which the outlet is to be used. They are sometimes made as a flat closed cover or with a raised closed center to permit later use. For mounting surface snap switches a flat cover with several slots radiating from the center is used and the arrangement of the slots is such that a number of sizes and types of switches may be mounted by a machine screw and nut. For drop cords and rosettes either flat or raised-center covers are used and these are provided with one, two, or three bushed outlets. Porcelain covers are sometimes used for drop cords also. Various receptacles are also made to mount on covers and these usually have a larger opening in the cover; the receptacles are mounted by means of screws or a special clamping member.

Manufacturers:

All-Steel-Equip Co., Aurora, Ill.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Electric Box & Cover Co., Inc., 29 Ave. C., Newark, N. J.
Faries Mfg. Co., Decatur, Ill.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display adv. page 1301.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
Michigan Stamping Co., Detroit, Mich.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Paiste Co., H. T. Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PARKER & SON, INC., J. H., Parkersburg, W. Va. Porcelain outlet box covers, for use on 3¼ in. and 4 in. receptacle boxes.—Adv.
Pratt-Chuck Co., The, Frankfort, N. Y.
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City," "Wirelets."
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."
UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

COVERS, FAN AND SWITCH OUTLET.—Covers for fan-circuit or switch outlets are metal plates that fit over the opening or outlet and attach to the outlet box, receptacle or switch. They are sometimes used when an outlet that has been installed is not to be used for some time, as in the case of a fan that is removed during the winter months, or a switch outlet that has been installed for future use. When used in a wall or ceiling they are sometimes mounted flush with the surface and painted or calcimined like the wall. In other cases raised covers or covers with brush brass or other finishes are used.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

COVERS, MANHOLE.—The covers of manholes in streets must be strong enough to carry the heaviest traffic. They are usually of rugged cast iron construction, ribbed on the under side and roughened on the upper side to prevent slipping. Where manholes are not ventilated a double cover is used, the lower cover being made tight. This is also done where it is desired to keep manholes locked, the lock being applied to the lower cover.

Manufacturers:

Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Donley Bros. Co., The, E. 74th St. & Aetna Rd., Cleveland, Ohio.
Fremont Foundry & Machine Co., Fremont, Nebr.
Keystone Iron & Steel Works, 2931 Santa Fe Ave., Los Angeles, Cal.
Leitelt Iron Works, 315 Mill Ave., Grand Rapids, Mich.
Pechstein Iron Works, Box 344, Keokuk, Iowa.
S. E. T. Valve & Hydrant Co., 50 Church St., New York, N. Y. "S. E. T."
Smyser-Royer Co., York, Pa.
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."

COVERS, METAL RACEWAY OUTLET BOX.—Covers which with a corresponding raceway box body can be fitted together to form an enclosed box in which a fixture, switch, receptacle or rosette may be connected and mounted. Porcelain covers are sometimes used for rosettes or drop-cord work, and they are made with one or more smooth outlet holes. Metal covers for the same purpose have an insulating bushing in the hole. Raised covers are made with a series of mounting holes to permit receptacles and switches of various types or sizes to be mounted. Fixture box covers have a fixture stud mounted on the cover.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
CROUSE-HINDS CO., Wolf & North 7th Sts., Syracuse, N. Y. "Condulet."
Machen Electric Mfg. Co., 4639-43 E Thompson St., Bridesburg, Philadelphia, Pa.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

COVERS, OR HUSKS, SOCKET.—In electric lighting fixtures it is often desirable to provide a cover (sometimes taking the form of a husk) which will take the weight of a globe or shade independently of the shell of the socket. For purposes of design and ornamentation, it is also frequently necessary in fixture designs to cover up the plain lines of the socket with an ornamental cover in keeping with the design of the rest of the fixture.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Best Electric Corp., 476 Broadway, New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Diamond Rubber Co., The, Akron, Ohio.

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Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Farics Mfg. Co., Decatur, Ill.
McGill Mfg. Co., Valparaiso, Ind.
NATIONAL X-RAY REFLECTOR CO. 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio. "V. M. C. Brass."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

COVERS, SWITCH.—A metal cover or cap, usually circular, used to cover the mechanism of a surface type rotary snap switch. The cover has an insulating lining, a hole for the operating key, and often a segmental slot through which the "on" and "off" indicator can be seen. The covers of flush wall switches are usually called flush switch plates; see Plates, flush switch. Enclosures for knife switches of either the plain enclosed or safety type are called boxes; see Boxes, switch and cutout.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Magnus Electric Co., Inc., 109 Broad St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National." (See display adv. pages 1302-1304.)
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

COVINGTON MACHINE CO.—Covington Va. Manufacturer of coke drawing and loading machines, motor-driven punches, etc. President and general manager, F. U. Humbert; vice-president, F. W. King; treasurer, G. W. Lipscomb; manager, E. H. Archer.

COWAN TRUCK CO.—Dorchester, Mass. Manufacturer of electric trucks and tractors. President, J. L. Wyckoss; secretary, J. A. Eaton; treasurer, D. N. White. Main office, Dorchester, Mass. Branch offices, Detroit, Mich.; Cincinnati, Ohio; New York, N. Y.; Boston, Mass.; Philadelphia, Pa.; San Francisco, Cal.; Seattle, Wash.; St. Louis, Mo.; St. Paul, Minn; 659 W. Lake St., Chicago, Ill.

COWIE ELECTRIC CO., THE E. S.—Kansas City, Mo. Manufacturer of storage batteries and battery repair shop equipment. Business established 1900. President, treasurer and general manager, Ernest S. Cowie; vice-president, G. H. Jewett; secretary, E. J. Cowie. Main office and factory, 1818 McGee St., Kansas City, Mo. Branch office, 317 S. Market St., Wichita, Kans.

COWLES & CO., C.—Water & Chestnut Sts., New Haven, Conn. Manufacturers of electric cigar lighters, automobile lighting switches and lamps. President and general manager, L. C. Cowles; treasurer, C. M. Costello; secretary and sales manager, M. S. Bottume.

COX, J. FILLMORE.—Bayonne, N. J. Manufacturer of pipe and tube bending and coiling machines.

COX ARRESTER CO., C. E.—Eaton Ohio. Manufacturer of lightning arresters.

COX AUTOMATIC PIPE BENDING CO.—Bayonne, N. J. Manufacturer of conduit and pipe benders.

COXE.—Trade name for chain grate stoker manufactured by the Combustion Engineering Corp., 11 Broadway, New York, N. Y.

COZY GLOW.—Trade name for electric heaters manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CP.—The form cp. is the abbreviation for candlepower, while c. p. is the abbreviation for chemically pure.

CP.—Trade name for motor-driven refrigerating machinery manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

C. P. C.—Trade name for batteries, carbons, etc., manufactured by the Carbon Products Co., 220 Broadway, New York, N. Y.

CQ.—Trade name for safety switches manufactured by the Columbia Metal Box Co., 224-228 E. 144th St., New York, N. Y.

C. Q. A.—Trade name for special telegraph relays manufactured by J. H. Bunnell & Co., 32 Park Place, New York, N. Y.

CR.—The form Cr is the chemical symbol for the metallic element chromium.

CRAMER & SWAIN.—2916 N. 16th St. Omaha, Neb. Manufacturers of radio equipment. Business established 1919, as the C & S Radio-electric Co.

CRAMP & SONS SHIP & ENGINE BUILDING CO., WILLIAM, I. P. MORRIS DEPT.—Richmond & Norris Sts., Philadelphia, Pa. Manufacturer of hydraulic turbines, turbine governors and electric pumps. Business established 1830. President and general manager, J. H. Mull; vice-president, H. Birchard Taylor; secretary and treasurer, Charles T. Taylor.

CRANDALL PACKING CO.—Palmyra, N. Y. Manufacturer of packing. Main office and factory, Palmyra, N. Y. Branch offices, New York, N. Y.; Cleveland, Ohio; Pittsburgh, Pa.; St. Louis, Mo.; Chicago, Ill.; Detroit, Mich.; Birmingham, Ala.; New Orleans, La.; Philadelphia, Pa.; Boston, Mass.; Denver, Colo.; Kansas City, Mo.

CRANE.—Trade name for motor-driven saws, carbon rheostats and oscillographs manufactured by Harold G. Crane, 322 Front St., Adrian, Mich.

CRANE CO.—Chicago, Ill. Manufacturer of valves, pipe fittings, packing, steam and oil separators, steam regulators and other steam specialties. Business established 1855. President, R. T. Crane, Jr.; vice-president, J. B. Berryman; secretary, H. P. Bishop; treasurer, P. T. Kelly; general manager, J. H. Wrath; sales manager, C. D. Little. Main office, 836 S. Michigan Ave., Chicago, Ill. Factories, Chicago, Ill., and Bridgeport, Conn. Branch offices in all principal cities.

CRANE, HAROLD G.—322 Front St. Adrian, Mich. Manufacturer of oscillographs, motor-driven saws and carbon rheostats.

CRANE, LTD.—Montreal, Que., Can Manufacturer of valves, pipe fittings, packing, steam and oil separators, steam regulators and other steam specialties. Main office and factory, 1280 St. Patrick St. Montreal, Que., Can. Branch offices and warehouses, 11th Ave. & 5th St., W., Calgary, Alta.; New Roy Bldg., Halifax, N. S.; 358 Frank St., Ottawa, Ont.; 88 Terauley St., Toronto, Ont.; 540 Beatty St., Vancouver, B. C.; 93 Lombard St., Winnipeg, Man.; 1408 Broad St., Regina, Sask. District offices, 11 McNab St., S., Hamilton, Ont.; Canadian Bank of Commerce Bldg., Quebec, Que.; 20 Olivier Bldg., Sherbrooke, Que.; 210 Central Bldg., Victoria, B. C.

CRANES, ELECTRIC, MISCELLANEOUS.—Several types of electric cranes are commonly used for special purposes in railroad yards, machine shops, foundries, warehouses, wharves, buildings under construction and many other places. One of the most important types is the gantry crane, of both traveling and fixed designs. These cranes are very similar to traveling cranes as far as operation is concerned, but instead of having an overhead runway, the bridge member is supported on structural legs which are either fixed at the ground or provided with wheels and suitable gearing so that the whole structure may be propelled along tracks on the ground. This type is often used in railroad and storage yards.

Jib cranes are often used in factories, machine shops and foundries. They comprise suitable jibs or booms forming a horizontal, projecting arm secured to a post or column. They are provided with motor-driven hoisting tackle and sometimes with a motor which through suitable gearing will swing the jib around into different positions. Pillar cranes and pillar jib cranes are used in storage and freight yards for transferring and storing material. Pillar cranes have an upright pillar with a swinging arm or boom secured to it at the bottom and extending up at an angle, the top being guyed to the top of the pillar; this type resembles a derrick. Pillar jib cranes have the jib horizontal but placed at the top of a pillar which is free to turn. Stacking cranes are also used in warehouses and storerooms to stack any material in piles. They consist of a hoisting motor on a truck with a swinging vertical curved arm having the hoisting cable running over pulleys at its end. It may be moved right up to a pile of boxes and will pick up others and place them on top of the pile.

Manufacturers:

Bedford Foundry & Machine Co., Bedford, Ind.
Brown Hoisting Machinery Co., The, Cleveland, Ohio.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Industrial Works, Bay City, Mich. (Transfer.) "Industrial."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Terminal Engineering Co., Inc., 17 W. 44th St., New York, N. Y.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

CRANES, ELECTRIC, TRAVELING.—Traveling cranes are the most widely used type of crane. They are characterized by the fact that they have a bridge with wheels on each end that travel upon an overhead structure or set of rails. This structure may be built separately out in the open, or it may form part of the roof-supporting structure of a building and in many cases is supported on brackets from the walls. The bridge usually has two I-beams or girders on which a hoisting truck, called the trolley, can move back and forth. The operator's cab is usually hung below one end of the bridge. Traveling cranes are usually supplied with three motors, although there may be more. One is used for operating the hoist, another for propelling the bridge along the runway or structure and the third for propelling the trolley carrying the hoisting mechanism back and forth across the span of the crane. For very large cranes or in special cases the trolley may be equipped with two or more separate mechanisms for hoisting. Two entirely separate trolleys are also used, each having its own hoisting motor.

Traveling cranes have been built in very large sizes. Spans as wide as 125 ft. have been used with lattice girder bridge construction. For very long erecting shops, etc., two or three separate cranes are used on different sections of the same runway. The hoisting motors on some large cranes are rated at 75 tons. For the types of equipment used, see Motors, crane and hoist; Controllers, starting, speed regulating, reversing and dynamic braking; Brakes, electric crane.

Manufacturers:

Bedford Foundry & Machine Co., Bedford, Ind.
Box & Co., Inc., Alfred, Philadelphia, Pa.
Box Iron Works Co., William A., Blake & 33rd Sts., Denver, Colo.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Chesapeake Iron Works, P. O. Box 1123, Baltimore, Md.
Cleveland Crane & Engineering Co., The, Wickliffe, Ohio.
Columbia Hoist & Crane Co., Borden & Van Pelt Aves., Long Island City, N. Y.
Cyclops Iron Works, 837-847 Folsom St., San Francisco, Cal.
Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich.

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Erie Steel Construction Co., 615 Haybarger Lane, Erie, Pa. "Erie."
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
LINK-BELT CO., Philadelphia, Chicago, Indianapolis. "Link-Belt."
Locomotive Crane Co., Bucyrus, Ohio. "Ohio."
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York, N. Y.
Maris Bros., 56th St. & Grays Ave., Philadelphia, Pa.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Moore Co., The Franklin, Winsted, Conn.
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
New Jersey Foundry & Machine Co., 90 West St., New York, N. Y. "Delta."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Reading Chain & Block Corp., 2140 Adams St., Reading, Pa. "Reading."
Roeper Crane & Hoist Works, 1730 N. 10th St., Reading, Pa.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. The Sprague Adjustable Loop System is adapted primarily for handling miscellaneous and bulk freight and materials in marine and railroad terminal sheds. It is known as the adjustable loop system because the overload track on which the hoisting and conveying machines are operated is in the form of a continuous unbroken loop which is adjustable in length. Sprague Products, see display adv. pages 1306-7.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Whiting Corporation, Harvey, Ill.

CRANES, LOCOMOTIVE AND DOCK.—Locomotive and dock cranes usually consist of a cab and a jib or boom carried on a turntable which is mounted on trucks. The trucks of electric cranes are provided with motors to propel the crane along on tracks. The boom or jib is usually arranged so that it may be raised or lowered to suit conditions. A separate motor is generally provided for this purpose. For rotating the boom on the turntable and raising or lowering the load separate motors may or may not be used. In some cases only one motor is used for the entire crane, the various functions being operated from it in turn by means of mechanical clutches. Steam locomotive cranes have a boiler, water barrel or tank and engine mounted on the cab. Both electric and steam locomotive cranes are much used by large power plants for piling coal in storage and retrieving it.

Dock cranes are often of special construction. One example is a one-leg gantry crane. This crane has one end supported on an overhead structure along the side of the pier building or warehouse, the track and conducting rail being similar to those used on traveling cranes. The bridge extends past the other support which is of the gantry type, having rails on the dock on which the whole bridge support travels. The extension past the edge of the dock permits the hoisting trolley to run out over the ship being unloaded and then convey the material to the warehouse or building or the reverse. This type is sometimes called a portal crane.

Manufacturers:

Automatic Electrical Devices Co., 120-122 W. 3rd St., Cincinnati, Ohio.
Baker R & L Co., The, Cleveland, Ohio. (Industrial portable.) "BRL."
Bradney Machine Co., Inc., Middletown, N. Y.
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Industrial Works, Bay City, Mich. "Industrial."
LINK-BELT CO., Philadelphia, Chicago, Indianapolis. Link-belt locomotive cranes are designed and built for the most severe conditions of continuous and dependable service, and are adapted to almost any work where heavy and bulky materials are handled. They are usually operated by steam generated by their own boilers, but can also be furnished for electrical operation when desired. The crane consists of two principal parts, the lower frame which is carried on four or eight wheels, and the upper rotating frame. Special attention is given to the design of individual parts, and to the co-ordination of all parts to fit into the general design of the crane, to secure the most compact, yet readily accessible, combination, possible.—Adv.
Locomotive Crane Co., Bucyrus, Ohio. "Ohio."
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
McMyler-Interstate Co., The, Bedford, Ohio.
Moore Co., Franklin, Winsted, Conn. "Franklin Moore."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill.
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P & H."
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

CRANES, WRECKING, ELECTRIC RAILWAY.—Equipment consisting of crane apparatus mounted on a suitable car and usually having propulsion motors for lifting and moving heavy parts of cars or their equipment in cases of wrecks or serious derailments, so as to clear the track for regular operation. Frequently the wrecking crane is so constructed and arranged as to be available for regular construction or other purposes.

Manufacturers:

Industrial Works, Bay City, Mich. "Industrial."
Locomotive Crane Co., Bucyrus, Ohio. "Ohio."
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill. "O. S. Dependable."
Whiting Corporation, Harvey, Ill.

CRANITE.—Trade name for packing manufactured by the Crane Co., 836 S. Michigan Ave., Chicago, Ill., and Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

CRANTILT.—Trade name for steam traps manufactured by the Crane Co., 836 S. Michigan Ave., Chicago, Ill., and Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

CRAWFISH.—Trade name for leather belting manufactured by the Southern Belting Co. 602-608 S. Peters St., New Orleans, La.

CRAWFORD.—Trade name for industrial electric ovens manufactured by the Oven Equipment & Mfg. Co., New Haven, Conn.

CRAWFORD.—Trade name for electric ranges manufactured by the Walker & Pratt Mfg. Co., 31-35 Union St., Boston, Mass.

CRAWFORD MFG. CO.—13-21 Park Row, New York, N. Y. Manufacturer of induction motors. President, L. E. Wooten; vice-president, John J. Crawford; secretary and treasurer, P. L. Gill.

CREAGHEAD ENGINEERING CO.—Cincinnati, Ohio. Manufacturer of mast arms, etc.

CREAM SEPARATORS, MOTOR-DRIVEN.—Appliances for separating the cream from the milk, in which centrifugal motion is imparted to the fluid container by an electric motor, and the cream and milk, having different specific gravities, are thus separated. The motor is sometimes mounted on the same base as the separator, or it is mounted on a shelf supported by the separator body. Heavier motors used on large separators are separately mounted and belt-connected. On some models vertical shaft motors are used, forming an integral part of the separator. These machines are extensively used in dairies and creameries, where their cleanliness in comparison with engine-driven outfits is much appreciated.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill. "Butterfly."
Burrell & Co., Inc., D. H., Little Falls, N. Y. "Simplex."
De Laval Separator Co., 164 Broadway, New York, N. Y.
Rock Island Plow Co., Rock Island, Ill. "Great Western."
Sharples Separator Co., West Chester, Pa.
Vermont Farm Machine Corp., 53 W. Jackson Blvd., Chicago, Ill. "United States."

CREAM WHIPPERS, MOTOR-DRIVEN.—Appliances for whipping cream, in which an electric motor is arranged to drive the whipping blades or straps. On the smaller sizes, for use in the home, the motor forms an integral part of the appliance. Large sizes, for use in hotels and restaurants, are sometimes used for other purposes also, and have large motors separately mounted and driving the whipper by means of a belt and gearing. These are arranged to permit different speeds, depending on the material being whipped, which may be whipping cream, white of egg, cake or pastry batter, etc.

Manufacturers:

Hall Kitchen King Co., 909 Mutual Life Bldg., Philadelphia, Pa. "Kitchen King."
Kollins Kitchen Kraft, 501 Monadnock Block, Chicago, Ill. "Kollins."
White-Stokes Co., Inc., 150 W. Lake St., Chicago, Ill. "Mallo."

CREAMERY PACKAGE MFG. CO., THE.—Chicago, Ill. Manufacturer of motor-driven dairy machinery. Business established 1870. President and general manager, E. W. Chandler; secretary and treasurer, G. W. Walker; sales manager, E. F. Wellinghoff. Main office, 61-7 W. Kinzie St., Chicago, Ill. Factories, Fort Atkinson, Wis.; Lake Mills, Wis.; Elgin, Ill.; DeKalb, Ill.; Rutland, Vt.; Bay City, Mich.; Portland, Ind.; Mankato, Minn.; Coffeyville, Kans.; Blytheville, Ark.; Minneapolis, Minn. Branch offices and warehouses, 133 E. Swan St., Buffalo, N. Y.; 318 Third St., N., Minneapolis, Minn.; 113 S. 10th St., Omaha, Neb.; 1907 Market St., Philadelphia, Pa.; 6 N. Front St., Portland, Ore.; 699 Battery St., San Francisco, Cal.; 119 St. Clair St., Toledo, Ohio; 406 Sycamore St., Waterloo, Iowa.

CREASEY.—Trade name for motor-driven ice breakers manufactured by the H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.

CREGIER ELECTRICAL MFG. CO.—220 W. Ontario St., Chicago, Ill. Manufacturers of switchboards, panelboards, borderlights, etc. Partnership, George A. Cregier and L. Viterna.

CREMCO.—Trade name for electric house pumps manufactured by the Crestline Mfg. Co., Crestline, Ohio.

CREO-PRESERVALINE.—Trade name for creosote oil manufactured by the Compressed Wood Preserving Co., Winton Bank Bldg., Cincinnati, Ohio.

CREOSOTE OIL FOR WOOD PRESERVATION.—Creosote oils and compounds are of value as a preservative of pole butts, crossarms, railway ties and other wooden parts which are exposed to moisture and weather conditions. In most cases the life is materially lengthened by the treatment, which should be applied before decay has set in among any of the wood cells. Also see Wood preservation.

Manufacturers:

Barrett Co., The, 17 Battery Pl., New York, N. Y. "Carbosota."
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
C-A Wood Preserver Co., Arcade Bldg., St. Louis, Mo. "Perfecto-Sote."
Compressed Wood Preserving Co., Winton Bank Bldg., Cincinnati, Ohio. "Creo-Preservaline."
Dielectric Mfg. Co., St. Louis, Mo. "Phenoleum."
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
International Creosoting & Construction Co., Galveston, Texas.

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Northeastern Co., The, 80 Beverly St., Boston, Mass. "Noreacol."
Republic Creosoting Co., Merchants Bank Bldg., Indianapolis, Ind.

CREOSOTING PLANTS FOR CROSS-ARMS, POLES AND TIES.—Creosoting plants used to impregnate wood crossarms, pole butts and ties with creosote oil generally employ one of two fundamental processes. The simplest form is a dipping process in which the poles or other material are merely placed in a huge tank filled with the creosote oil and allowed to remain in it for some time, heat being applied to the tank to warm the oil. The second method introduces the creosote under pressure. In this process the material is placed in a sealed tank, after having been thoroughly dried, and the air is exhausted from the inside of the tank. Heated creosote oil is then admitted to the tank under heavy pressure and it is forced into the fibers and cells of the material, penetrating a half inch or more. Various other processes, which are modifications of and additions to these principles, are also employed in some creosoting plants. Mechanical means of opening and separating the fibers to insure penetration are also resorted to.

A third process sometimes used is known as brush treatment. It consists in applying the hot creosote by means of a brush just like paint. Only superficial penetration is secured and the simple equipment necessary is hardly worthy of being called a creosoting plant. Also see Wood preservation.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Welding Co., Carbondale, Pa. (Cylinders only.)
Carney & Co., B. J., Grinnell, Iowa.
Graver Corp., East Chicago, Ind.
Lord & Co., Lee H., Box 693, Peoria, Ill.
Republic Creosoting Co., Merchants' Bank Bldg., Indianapolis, Ind.
Walsh Tie Co., 914 Security Bldg., Minneapolis, Minn.

CREO-WOOD.—Trade name for wood flumes manufactured by the Continental Pipe Mfg. Co., Seattle, Wash.

CREPACO.—Trade name for electric centrifugal pumps manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

CREPACO-BABCOCK.—Trade name for motor-driven cream testers manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

CRESCENDO.—Trade name for vibrating bells and buzzers manufactured by the Manhattan Electrical Supply Co., 17 Park Pl., New York, N. Y.

CRESCENT.—Trade name for welding compound manufactured by the Anti-Borax Compound Co., Fort Wayne, Ind.

CRESCENT.—Trade name for electric meat choppers manufactured by the Brecht Co., St. Louis, Mo.

CRESCENT.—Trade name for floodlight projectors, spotlights, searchlights and accessories manufactured by the Brenkert Light Projection Co., 49 Cortland Ave., Detroit, Mich.

CRESCENT.—Trade name for belt fasteners manufactured by the Crescent Belt Fastener Co., 381 4th Ave., New York, N. Y.

CRESCENT.—Trade name for lighting fixtures manufactured by the Crescent Brass Products Co., 8410 Lake Ave., Cleveland, Ohio.

CRESCENT.—Trade name for electrical automobile accessories, manufactured by the Crescent Mfg. Co., 129 Reade St., New York, N. Y.

CRESCENT.—Trade name for lubricating oil manufactured by the Crescent Oil Co., 602 W. Pratt St., Baltimore, Md.

CRESCENT.—Trade name for wrenches and pliers made by the Crescent Tool Co., Jamestown, N. Y.

CRESCENT.—Trade name for electric dishwashers and clothes washing machines manufactured by the Crescent Washing Machine Co., New Rochelle, N. Y.

CRESCENT.—Trade name for expansion bolts manufactured by F. H. Evans, 31 Hewes St., Brooklyn, N. Y.

CRESCENT.—Trade name for bushings and insulators made by M. Kirchberger & Co., Inc., 1425 37th St., Brooklyn, N. Y.

CRESCENT.—Trade name for vibrating bells manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

CRESCENT.—Trade name for portable lamp guards, soldering sticks, paste and salts, coloring and frosting compounds, insulating compounds, socket handles and toggle bolts manufactured by the McGill Mfg. Co., Valparaiso, Ind.

CRESCENT.—Trade name for motor-driven planers and jointers manufactured by the P. Pryibil Machine Co., 512-524 W. 41st St., New York, N. Y.

CRESCENT.—Trade name for brass and copper pipes and tubes manufactured by the Wheeler Condenser & Engineering Co., Carteret, N. J.

CRESCENT ART METAL CO., THE.—Bridgeton, N. J. Manufacturer of lighting fixtures. Business established 1897. President and treasurer, William C. Mulford; secretary, Henry K. Reeves.

CRESCENT BELT FASTENER CO.—New York, N. Y. Manufacturer of belt fasteners. Frank S. Voss, sales manager. Main office, 381 4th Ave., New York, N. Y. Branch office, 32 Front St., Toronto, Ont., Can.

CRESCENT BRASS PRODUCTS CO., THE.—8410 Park Ave., Cleveland, Ohio. Manufacturer of lighting fixtures and brass castings. Business established 1910. President and general manager, C. H. Hofrichter; vice-president, Emil Zeller; secretary and sales manager, W. R. Mardis; treasurer, Albert C. Hofrichter.

CRESCENT ELECTRIC CO.—Mountain Grove, Mo. Manufacturer of wiring devices. President, William M. Nelson; vice-president, James A. Douglas; secretary, W. S. Candler; treasurer, J. A. Chase.

CRESCENT INSULATED WIRE & CABLE CO.—Olden & Taylor Sts., Trenton, N. J. Manufacturer of insulated wire. President, C. Edward Murray; secretary and sales manager, A. H. Battye; treasurer, J. C. Murray.

CRESCENT MFG. CO., THE.—129 Reade St., New York, N. Y. Manufacturer of electrical automobile accessories.

CRESCENT OIL CO.—602 W. Pratt St., Baltimore, Md. Manufacturer of lubricating oils.

CRESCENT TOOL CO.—Jamestown, N. Y. Manufacturer of drop-forged tools. Business established 1907. President and general manager, Karl Peterson; vice-president, C. Emil Nelson; secretary, Chas. F. Falldine; sales manager, C. R. Swisshelm.

CRESCENT TRUCK CO., THE.—30 Church St., New York, N. Y. Manufacturer of storage battery trucks and tractors. President, F. Conlin; secretary, P. W. Saitta; treasurer and sales manager, F. W. Conlin. Factory, Elizabeth, N. J.

CRESCENT WASHING MACHINE CO.—New Rochelle, N. Y. Manufacturer of electric clothes washing machines and dishwashers. President and general manager, H. E. Merseles; vice-president and treasurer, T. F. Merseles; secretary, F. L. Holt; sales manager, J. F. Donovan. Main office and factory, New Rochelle, N. Y. Branch offices, 800 N. Clark St., Chicago, Ill.; 313 Atlanta National Bank Bldg., Atlanta, Ga.

CRESCO.—Trade name for condensers for rural telephone lines manufactured by the Electric Specialty Co., 233 N. Elm St., Cresco, Iowa.

CREST-FACTOR.—Also called peak-factor. The ratio of the crest of the wave or maximum value of an alternating e.m.f. to the effective or r.m.s value. For a sine wave the crest-factor is $\sqrt{2}$ or 1.4142.

CRESTLINE MFG. CO.—Crestline, Ohio. Manufacturer of electric pumps.

CREST VOLTMETER.—Crest voltmeter measure the crest (wave-peak) or maximum value of an alternating voltage. They usually operate in connection with a condenser type bushing of a testing transformer. The principle of operation is that the average value of the half wave of the charging current in the condenser bushing, which flows into and out of the bushing when it is subjected to a voltage strain, is proportional to the crest of the voltage wave. The charging current is rectified by means of small mercury-arc rectifier bulbs and is then measured by a sensitive d-c. milliammeter that is calibrated to read directly in terms of the maximum value of the high a-c. voltage wave. All of the divisions on the scale are approximately equal and it is possible therefore to read low voltages with the same accuracy as the higher voltages. This makes them very useful in insulation testing. For manufacturers, see Voltmeters, special and miscellaneous.

CRETORS & CO., C.—620 W. 27th St., Chicago, Ill. Manufacturers of electric corn poppers and peanut roasters.

CREW LEVICK CO.—Philadelphia, Pa. Manufacturer of lubricating oils and greases. Business established 1862. President, F. W. Frueauff; vice-president and general manager, R. R. Choate; secretary, C. E. Foster; treasurer, E. J. Hasse; sales manager, R. M. Shanklin. Main office, 111 N. Broad St., Philadelphia, Pa. Refineries, Titusville and Warren, Pa. Branch offices, Chicago, Ill.; New York, N. Y.; Syracuse, N. Y.; Pittsburgh, Pa.; Boston, Mass.

C. R. I.—Abbreviation for crystal rough inside, as applied to illuminating glassware.

CRIBBING GUARDS.—Narrow metal strips nailed vertically on a wooden line pole to prevent damage to the wood by the gnawing of horses. They are quite commonly called pole strips. See Strips, pole.

CRITERION.—Trade name for belting manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

C. R. O.—Abbreviation for crystal rough outside, as applied to illuminating glassware.

CROCKER-WHEELER CO.—Ampere, N. J. Manufacturer of motors, generators and transformers. Business established 1888. President, S. S. Wheeler; secretary and sales manager, E. Lang; treasurer, T. S. Fuller. Main office and factory, Ampere, N. J. Branch offices and warehouses, 37 W. Van Buren St., Chicago, Ill.; Cleveland, Ohio; San Francisco, Cal. District offices, Baltimore, Md.; Birmingham, Ala.; Boston, Mass.; Newark, N. J.; New Haven, Conn.; 30 Church St., New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa., Syracuse, N. Y.

CROFOOT.—Trade name for gears manufactured by the Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass.

CROFOOT GEAR WORKS, INC.—1601 Hyde Park Ave., Boston, Mass. Manufacturer of gears. Business established 1911. President, treasurer and general manager, Charles E. Crofoot.

CROFTON STORAGE BATTERY CO.—423-5 W. Queen St., Toronto, Ont., Can. Manufacturer of storage batteries.

CRONK & CARRIER MFG. CO., THE.—109 W. Water St., Elmira, N. Y. Manufacturer of pliers, tree trimmers, screw drivers and other hardware specialties. Business established 1883. President, C. F. Carrier; vice-president, E. L. Cronk; secretary, W. J. Wetmore; treasurer and sales manager, G. H. Carrier. Sales representatives, Sand, Hulfish & Laselle, Charles & Redwood Sts., Baltimore, Md.; Sprake Sales Co., 822 Higgins Bldg., Los Angeles, Cal.; 525 Market St., San Francisco, Cal.; 633 Railway Exchange Bldg., Portland, Ore.; 223 Kerns Bldg., Salt Lake City, Utah.

CROOKES' DARK SPACE.—A dark space which surrounds the negative electrode of a highly rarefied tube, such as a mercury-arc rectifier tube, through which an electric discharge is passing. The space appears dark in contrast to the luminous effect of the rest of the discharge. The volume of the space increases as the vapor pressure in the tube decreases. Its volume in the case of a rectifier partly determines the rectifying power and increases this power as the volume of dark space increases.

CROOKES, SIR WILLIAM.—An English physicist and chemist, born in London in 1832. He studied at the Royal College of Chemistry. In 1854 he became superintendent at the meteorological department of the Radcliffe Observatory, Oxford, and in 1855 professor of chemistry at the Chester Training College. In 1863 the Royal Society elected him a fellow, and since then many scientific bodies have conferred distinctions on him. His method of producing extreme vacua rendered incandescent lighting a practical possibility and led to the development of gaseous tube lighting. His original researches in chemistry and physics led to the discovery of the metal thallium in 1861. He discovered the sodium amalgamation process for separating gold

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and silver from their ores in 1865, and a new method for spectroscopic investigation of substances, one of the numerous results of his prolonged studies of radiant matter. He devised the radiometer and later the otheoscope. He has published works on such widely separated subjects as sanitation, spiritualism, beet-root sugar manufacture, dyeing and calico printing, besides translations on chemistry. The name "Crookes tube" has been given to special types of vacuum tubes.

CROSBY.—Trade name for guy clamps manufactured by the American Hoist & Derrick Co., St. Paul, Minn.

CROSBY.—Trade name for wire rope clips manufactured by the Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.

CROSBY CO., THE.—Buffalo, N. Y. Manufacturer of magneto parts and sheet metal stampings. President, William H. Crosby; vice-president, William H. Hill; treasurer, Edward S. Gram; secretary, L. R. Cooper. Main office and factory, Buffalo, N. Y. Branch offices, 30 Church St., New York, N. Y.; 914 Ford Bldg., Detroit, Mich.; 415 Schofield Bldg., Cleveland, Ohio.

CROSBY STEAM GAGE & VALVE CO.—Boston, Mass. Manufacturer of gages, valves, feed water regulators, etc. Business established 1875. President, C. H. Millett; vice-president and treasurer, F. F. Raymond; vice-president and sales manager, A. B. Carhart. Main office, Boston, Mass. Branch offices, 100 Walker St., New York, N. Y.; 121 2nd St., San Francisco, Cal.; 180 N. Market St., Chicago, Ill.

CROSS.—This generally refers to a trouble condition, as any accidental contact between electrical conductors. It is a term used largely for telephone or telegraph overhead circuits or cables when interference is caused due to contact between neighboring conductors or circuits.

CROSS.—Trade name for oil filters manufactured by the Burt Mfg. Co., Akron, Ohio.

CROSS MAGNETIZATION.—A magnetic field set up by the windings of a dynamo-electric armature, which crosses at a right angle the field produced by the field poles, thus tending to distort the field. See Armature reaction.

CROSS TALK.—Conversation on one telephone circuit, which is unintentionally heard on another circuit. It is due to crossed wires, electrostatic induction, or electromagnetic induction.

CROSSARMS, IRON OR STEEL.—For heavy trolley feeders and for steel poles, crossarms are sometimes made of iron or steel. Such arms are usually designed for the particular service in which they are to be used. In the simpler forms they usually consist of a piece of angle iron attached by a cast iron collar around the pole. Where the length is such that this does not give sufficient stability, a fabricated structure is employed.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Eastern Malleable Iron Co., The, Naugatuck, Conn. (Malleable iron break-arms.) "Beardsley."
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Bo-Arrow."
Hull & Co., S. W., 3729 Prospect Ave., Cleveland, Ohio.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Threadless Pipe Fittings Corp., Newark, N. J. (Exclusive distributors, Rubino & Liebstein, Newark, N. J.)
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CROSSARMS AND SIDE ARMS, WOOD.—The use of wood crossarms for overhead electric lines is almost universal. For the usual sizes of power circuit wire from No. 8 to No. 00, the arm is 3¼x4¼ or 3½x4½ ins. in section. The larger section is standard with companies in the eastern states principally. Where special strains are imposed, the arms are used in pairs or "doubled." Where transformers are mounted on crossarms a section 4x5 ins. is often used. This is also a common size for transmission-line arms. The length is fixed by the number of pin holes and the separations between them. Arms are made for 2, 4, 6 or 8 pins for distribution purposes, the 2 and 4-pin sizes being used only in smaller towns or rural service. The separation between pins is about 12 ins. and between the pole pins about 30 ins. for distributing lines. Spacings for transmission arms are from 24 to 40 ins. For communication circuits the dimensions and spacings are different, the arms often being longer. Arms are made of fir and yellow pine chiefly; the fir arm lasts better and is generally less knotty than pine. Side arms or alley arms have nearly the full length of the arm extending to one side of the pole; they are used mostly in alleys where buildings or barns prevent symmetrical mounting of the arm.

Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky.
AMERICAN LINE MATERIALS CO., 1461 McCormick Bldg., Chicago, Ill. Wood crossarms are made almost entirely in three woods, Douglas fir, from Washington; heart long leaf yellow pine, from Mississippi and Georgia; and creosoted yellow pine from Virginia, Georgia and Mississippi; the Douglas fir arm is more widely distributed than any other because of its beauty, its strength in comparison to weight and its wonderful durability. The best known and most used arm is the fir



"Rainier" Douglas Fir Cross-Arm

crossarm made by the American Line Materials Co. in southwestern Washington and named by them the "Rainier" and so nationally advertised. These crossarms are not painted and almost never creosoted, neither being necessary. The long leaf yellow pine crossarm should have a heart content of at least 75% or otherwise should be treated with a pure distillate creosote oil by a thoroughly reliable creosoter; poor oil or poor work is worse than none.—Adv.
Atlantic Creosoting & Wood Preserving Works, Norfolk, Va.
Barnes-Lindsley Mfg. Co., 503 Couch Bldg., Portland, Ore. "B-L."
Byrne-Turner Co., 212 1st National Bank Bldg., Bellingham, Wash.
Carolina Cross Arm Co., Inc., P. O. Box 122, Elkin, N. C.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky.
Cook Tie & Pole Co., Commercial Trust Bldg., Philadelphia, Pa.
Eggers Pole & Supply Co., 610 Paulsen Bldg., Spokane, Wash.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Frye & Co., J. Marshall, Hattiesburg, Miss.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky.
Gulf Cross Arm Co., Dothan, Ala.
Gulfport Creosoting Co., 401 W. Main
Indiana Creosoting Co., 401 W. Main St. Louisville, Ky.
International Creosoting & Construction Co., Galveston, Tex.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
Lord & Co., Lee H., Box 693, Peoria, Ill.
McCormick Lumber Co., McCormick, Wash.
Manson Lumber Co., 101 Border St., East Boston, Mass.
National Tank & Pipe Co., 275 Oak St., Portland, Ore.
Norfolk Creosoting Co., Norfolk, Va.
Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.
Republic Creosoting Co., Merchants' Bank Bldg., Indianapolis, Ind.
Southern Pine Mfg. Co., The, City National Bank Bldg., Paducah, Ky.
SOUTHERN WOOD PRESERVING CO., Atlanta, Ga.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Tidewater Crossarm & Conduit Co., Tacoma, Wash.
Vreeland, B. F., 411 Commonwealth Bldg., Denver, Colo. "Buffalo Brand."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Williams Cypress Co., Ltd., F. B., Patterson, La.

CROSSES, METAL RACEWAY OR MOLDING.—Metal cross-shaped fittings used at the point where one raceway or molding circuit crosses another. The cross usually consists of two parts, one a base which is fastened securely to the wall or ceiling and has an attachment device for the ends of the raceway base; the cover or cap of the cross fits over the ends of the molding cap and closes the joint.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

CROSSINGS, TRACK (90 DEGREE).—Track crossings where the angle between the tracks is exactly 90° are made as a standard product and stocked by companies dealing in railway track equipment. They are used on electric railways of all kinds, and are very common in street railway work. A unit crossing comprises merely a single track cross with short extensions of the track in each of the four directions. Thus a double-track crossing will require four unit crossings. They are made in several designs and weights for the varied conditions met. Wrought iron is used in nearly all types but where the traffic is very heavy manganese steel inserts are used to increase the life.

Standard crossings are very accurately made and are well reinforced by special straps and guard rails and in the heavier crossings by a third reinforcing rail on the outside. For crossings made at any angle other than 90°, see Track work, special.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Kilby Frog & Switch Co., Birmingham, Ala.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Station H, Cincinnati, Ohio.

CROSSINGS, TROLLEY.—A device used where two trolley wires cross each other to permit the trolley wheels to operate over either wire. It commonly consists of a bronze or malleable iron pan, in the latter case arranged with bronze renewable approaches which are held to the body by bolts or cam-shaped interlocking hooks.

Where it is necessary to keep the two crossing wires insulated from each other, an insulated trolley crossing is used, in which case one wire is carried over the other. The lower wire passes through a metallic pan and offers a "live" or metallic underrun for the trolley wheel. The upper wire is insulated from the live pan by suitable wood, fiber or composition insulation, giving a short "dead" or nonconducting section on each side of the live wire over which the trolley wheel coasts without taking energy.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
OHIO BRASS CO., THE, Mansfield, Ohio. O-B Live Rigid, Live Adjustable and Insulated Adjustable crossings have renewable cam tips which simplify installation and improve operation.—Adv.
Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CROSSOVERS, PORCELAIN.—Specially shaped porcelain insulators designed to do away with the use of porcelain tubes or flexible loom where wires in open work cross each other. One fitting is required at a single-wire crossing, while at a crossing of two two-wire circuits four are necessary. They may be put in place after the wiring is completed and serve to separate the wires and to so secure them so to prevent any rubbing of their insulation.

Manufacturers:

Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.
Jordan Bros., 74 Beekman St., New York, N. Y. "Tapon."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CROUSE-HINDS CO.—Syracuse, N. Y. Manufacturer of conduit fittings, guy anchors, locomotive headlights, floodlight projectors and reflectors. Business established 1897. President and treasurer, Huntington B. Crouse; vice-president, Jesse L. Hinds; secretary and general manager, William L. Hinds; sales manager, Albert F. Hills. Main office and factory, Wolf & 7th North Sts., Syracuse, N. Y. Branch offices, Boston, Mass.; 417 S. Dearborn St., Chicago, Ill.; 30 Church St., New York, N. Y.

CROWE.—Trade name for electric shoe nailing machine manufactured by the Specialty Shoe Machinery Co., 201 W. Colorado Ave., St. Joseph, Mo.

CROWE NAME PLATE & ENGRAVING CO.—1749 Grace St., Chicago, Ill. Manufacturer of dials and name plates for electrical devices. Business established 1901. President, John O. Barrett; secretary, treasurer and sales manager, E. C. Coolidge. Sales representative, Winslow Goodwin, 19 Pearl St., Boston, Mass.

CROWFEET, FIXTURE.—The crowfoot is a small fixture fitting made of malleable iron, which fastens by means of bolts or screws to an outlet box or outlet plate. It is drilled and tapped to hold a fixture hickey or stem. Its name comes from its shape, being a central stud with four projecting claws or feet which are drilled for the bolts or screws.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Katie Foundry, The, Galt, Ont., Can.
Liberty Machine Co., Wauwatosa, Wis.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass. (Insulated.)
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., Cedar Rapids, Iowa. "Stelco."
Wapak Hollow Ware Co., The, Wapakoneta, Ohio.

CROLEY CO., JOHN A.—120 Liberty St., New York, N. Y. Manufacturer of electric furnaces and electric furnace steel. Factory, Detroit, Mich.

CROWN.—Trade name for rail bonds manufactured by the American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.

CROWN.—Trade name for friction tape manufactured by the Commercial Electrical Supply Co., Broadway & Spruce Sts., St. Louis, Mo.

CROWN—Trade name for telephones, receivers, transmitters and push buttons manufacured by the Liddell Electric Mfg. Co., 481 N. Washington Ave., Bridgeport, Conn.

CROWN.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CROWN.—Trade name for motor-driven sewing machines manufactured by the A. G. Mason Mfg. Co., 7817 St. Clair Ave., N. E., Cleveland, Ohio.

CROWN.—Trade name for power transmission belting manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

CROWN AND CROWN PLANER.—Trade name for belting manufactured by the Page Belting Co., E. Penacock St., Concord, N. H.

CROWN CHANDELIER CO., INC.—610-614 Broadway, New York, N. Y. Manufacturer of lighting fixtures, domes and portable lamps.

CROWN ELECTRICAL MFG. CO.—St. Charles, Ill. Manufacturer of electric lighting fixtures.

CROWN ELECTRICAL MFG. CO., LTD.—Brantford, Ont., Can. Manufacturer of electric lighting fixtures.

CROWN-LITE.—Trade name for electric lighting fixtures manufactured by the Crown Electrical Mfg. Co., Ltd., Brantford, Ont., Can.

CRUBAN MACHINE & STEEL CORP.—63 Duane St., New York, N. Y. Manufacturer of solderless connectors.

CRUCET MFG. CO.—292 5th Ave., New York, N. Y. Manufacturer of electric lighting fixtures and portable lamps.

CRUCIBLE STEEL CASTING CO.—Lansdowne, Pa. Manufacturer of steel castings. President, C. R. H. Cunningham; vice-president and treasurer, H. Bloodsworth; secretary, H. C. Cunningham.

CRUISER.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

CRYOLITE.—A fluoride of sodium and aluminum ($AlF_3 \cdot 3NaF$) found in quantity only in Greenland; easily fusible, and used in making a fused bath which dissolves aluminum oxide at 1000°C. from which combination aluminum is electrolytically deposited.

CRYSTAL.—Trade name for electric washing machines manufactured by the Crystal Division, Mallory Industries, Detroit, Mich.

CRYSTAL DETECTOR.—See Detectors, radio.

CRYSTAL DIVISION, MALLORY INDUSTRIES.—Detroit, Mich. Manufacturer of electric washing machines.

CRYSTAL ELECTRIC SIGN CO.—922 S. Vendeventer Ave., St. Louis, Mo. Manufacturer of electric signs. Owner and manager, R. L. Marten.

CRYSTALITE.—Trade name for soldering salts manufactured by the Reade Mfg. Co., 135 Hoboken St., Jersey City, N. J.

CRYSTALOI.—Trade name for radio detectors manufactured by the Connecticut Telephone & Electric Co., Meriden, Conn.

CRYSTALS AND PRISMS, CHANDELIER.—The better grades of crystals are of cut flint glass and are used on lighting fixtures of period design, such as the Louis XVI. They are cut into prismatic or bead forms. The cheaper grades are molded prisms and beads or simply short pieces of glass tubing and are used on decorative shades, commonly for portable lamps or occasionally for dining-room domes.

Manufacturers:

American 3 Way-Luxfer Prism Co., 1309 S. 55th Court, Cicero, Ill.
Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y.
Wyle & Bros., Inc., J. J., 18-20 E 27th St., New York, N. Y.

CRYSTOLON.—Trade name for electrically produced abrasives and grinding wheels manufactured by the Norton Co., Worcester, Mass.

C. S.—Trade name for distribution and service boxes manufactured by the Canton Specialty Co., Gas & Electric Bldg., Canton, Ill.

C-T.—Trade name for electric trucks manufactured by the Commercial Truck Co., 27th & Brown Sts., Philadelphia, Pa.

CU.—The form Cu is the chemical symbol for the metallic element copper.

CULVER.—Trade name for shaking and dumping grate manufactured by the Automatic Furnace Co., 1st & Harshman Sts., Dayton, Ohio.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

CULVER SUPERIOR GLASS CO.—72-74 N. State St., Westerville, Ohio. Manufacturer of radio lenses. President, T. C. Tussey.

CUMMINGS.—Trade name for marine telltales manufactured by the Cummings Ship Instrument Works, 10 High St., Boston, Mass.

CUMMINGS, A. B.—53-59 Falmouth St., Attleboro, Mass. Manufacturer of miniature motion-picture machines. Business established 1907. A. B. Cummings, sole owner.

CUMMINGS SHIP INSTRUMENT WORKS.—10 High St., Boston, Mass. Manufacturer of electrical marine instruments. H. R. Gary, manager.

CUMMINS.—Trade name for motor-driven perforating machines manufactured by the B. F. Cummins Co., 4740 Ravenswood Ave., Chicago, Ill.

CUMMINS CO., THE B. F.—4740 Ravenswood Ave., Chicago, Ill. Manufacturer of motor-driven perforating machines. President, B. C. Murray; vice-president, E. M. Cummins; secretary, F. G. Murray; treasurer, J. F. Ryan.

CUNNINGHAM.—Trade name for amateur radio equipment manufactured by the Audi-Tron Mfg. Co., 35 Montgomery St., San Francisco, Cal.

CUNO ENGINEERING CORP., THE.—Meriden, Conn. Manufacturer of automobile inspection lamps and cigar lighters, automobile starting switches and ignition timers. Business established 1913. President, Charles Cuno; secretary and treasurer, Charles H. Cuno. Sales representatives, A. J. Fisk, 965 Woodward Ave., Detroit, Mich.; George L. Holmes, 1776 Broadway, New York, N. Y.; Cotten & Co., 1215 Widener Bldg., Philadelphia, Pa.; Tuthill Sales Co., St. Louis, Mo.; A. H. Mohrig, 1521 Van Ness Ave., San Francisco, Cal.

CUPID.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

CUPRIC ION.—The cathodic constituent which tends to be liberated from a cupric salt subjected to electrolysis. It is a divalent copper atom, with equivalent weight equal to one-half the atomic weight of copper.

CUPRON CELL.—A primary cell of the Lalande type consisting of two plates of zinc, between which is a plate of copper surrounded by copper oxide as a depolarizer. The electrolyte is a 15 to 18% solution of caustic soda. See Batteries, wet, open-circuit.

CUPRONIC.—Trade name for resistance wire manufactured by the Branford Electric Co., Inc., 9 Church St., New York, N. Y.

CUPROUS ION.—The cathodic constituent which tends to be liberated from a cuprous salt subjected to an electrolyzing current. It is really a monovalent copper atom, with equivalent weight equal to the atomic weight of copper.

CUPS, OIL AND GREASE.—See Oil and grease cups.

CURFMAN MFG. CO., F. L.—114 E. 2nd St., Maryville, Mo. Manufacturer of flashlights.

CURLING-IRON HEATERS.—See Heaters, electric, curling iron.

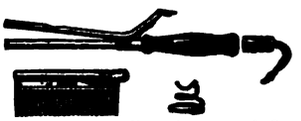
CURLING IRONS, ELECTRIC.—These appliances are often called hair curlers. They consist of a hollow round nickeled rod containing an insulated heating element; a hinged side rod of semicircular section fitting against the main rod; a hollow handle; and a detachable cord with small plug (usually swiveling) for attaching to the curler handle and an ordinary attachment plug at the other end for connecting to a lamp socket or wall receptacle. The household type is much used on dressing tables. Hair-dressing establishments sometimes use a heavier type. Also see Wavers, electric.

Manufacturers:

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can., "Hotpoint," "Edison."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)

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LANDERS, FRARY & CLARK, New Britain, Conn. Supplies necessary heat for one-fifth cent per hour. Nickel



"Universal" Curling Iron and Comb

plated finish—25 watts. Has 6-ft. cord and plug. Furnished with or without aluminum hair drier.—Adv.

NORTHERN ELECTRIC CO., 542 St. Clair St., Chicago, Ill. "Service" combination electric curling iron and waver rod. An iron of quality at a reasonable price. Has non-conducting, comfortable



"Service" Curling Iron

handle. Heating element guaranteed for one year. Clamp may be detached and rod used as waver. Equipped with flexible cord and separable attachment plug. Length over all 11½ ins.; rod, ⅜ in. diameter. Highly nickel plated; very attractive and as good as it looks. Costs little, operates economically, and gives long service.—Adv.

Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

RUSSELL ELECTRIC CO., 140 W. Austin Ave., Chicago, Ill. Manufacture more curling irons than all other



Russell Curling Iron

United States manufacturers combined. Moderate in price, reliable, fully guaranteed for two years. Trade name Hold-Heet.—Adv.

Slaughter Co., William E., 1716 S. Michigan Ave., Chicago, Ill. "Parisian."

Thome, Mathias, 22 W. Monroe St., Chicago, Ill.

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CURLING IRONS WITH COMBS, ELECTRIC.—These appliances are identical with the foregoing, but also have a detachable comb with hollow back that can be slipped over the round heating rod after the side rod is detached. The comb is thus heated and can be used to aid drying the hair after a shampoo. For directly heated electric combs see Combs, electrically heated.

Manufacturers:

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. The distinctive advantage of the curling iron shown is that the shield opens



"Hotpoint" Curling Iron and Comb

parallel to the rod, permitting the iron to be easily withdrawn from the hair. Point is tapered similar to professional models. Another feature is the swivel, separable contact plug. This plug is designed to permit the turning of the iron without twisting the cord. The plug is held by the small finger of the hand when the iron is turned. Constructed of hard fibre. An aluminum comb for drying the hair can also be furnished. The iron attains and holds a correct heat, and does not burn the hair. Furnished in two sizes, large —11¾ ins. long, and small—11¼ ins. long. See display adv. pages 1292-3.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal." (See descriptive advertisement under Curling irons, electric, also Wavers.)—Adv.

NORTHERN ELECTRIC CO., 542 St. Clair St., Chicago, Ill. "Service."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Slaughter Co., William E., 1716 S. Michigan Ave., Chicago, Ill. "Parisian."

CURRENT, ALTERNATING.—A current which alternates in direction at regular intervals. Unless distinctly specified otherwise, the term refers to a periodic current with successive half waves of the same shape and area. The abbreviation for alternating current is a-c., when used adjectively as in a-c. motor; the form A. C. is also used, especially by older writers.

CURRENT-CARRYING CAPACITY OF WIRES AND CABLES.—The capacity of a conductor to carry current is fixed by its ability to radiate the heat generated within it by the passage of current through it. The radiation of heat is, of course, more rapid on wires run openly than from those in conduit, and the wire tables, therefore, allow greater current for open wiring than for wiring in conduit. The character of the insulation is also a factor, since some kinds of insulation can be operated regularly at higher temperatures than others. The rise in temperature requires some time to reach its maximum value under a given load (in large cables two hours or more). The current rating of wires therefore depends upon the conditions under which they are installed, the character of the insulation and the time during which the current is to be carried.

The carrying capacities fixed by Rule 18 of the National Electrical Code for rubber and other insulated copper wires are very conservatively based upon a rise of temperature which will not be sufficient to injure the insulation if continued indefinitely. For aluminum wires and cables the current-carrying capacity is rated by this rule at 84% of that of copper of equal size and with equal insulation.

CURRENT, CONDUCTION.—A conduction current is one traversing conducting material, as compared to a current which may be present in a dielectric or nonconductor; the latter is often called leakage current.

CURRENT DENSITY, ELECTROCHEMICAL.—The measure of concentration of current at the electrodes or through the electrolyte. Specifically, the number of amperes per square centimeter of electrode or of cross-section of electrolyte; in English units the density is given in amperes per square foot; in books on electroplating sometimes given as amperes per square decimeter. It conditions or determines the products obtained at the electrodes; the applied electromotive force only determines this indirectly to the extent that it affects the current density.

CURRENT, DIRECT.—A unidirectional current. Ordinarily the term designates a practically nonpulsating current, as that of a battery. Also see Direct current.

CURRENT, DIRECTION OF.—When the source of e. m. f. is a primary cell, the direction of current outside of the cell is from the carbon or copper electrode to the zinc electrode. Before the development of the electron theory, this was universally accepted as the positive direction of current. It is now known that the electrons move in the opposite direction. When a current is the result of electromagnetic induction, its flow is always in such a direction as to oppose the motion of the conductor, or the change in the magnetic field producing it. In other words, the current flows in such a direction that its magnetic field opposes any changes in the inducing field.

CURRENT EFFICIENCY, ELECTROCHEMICAL.—The ratio of the amount of useful electrochemical action performed to the calculated theoretical amount, assuming that the output corresponded to the amperes passing., Hence it is often called the ampere efficiency. Thus, if 90 grams of copper is obtained, and the amperes passing should, by calculation, deposit 100 grams, the ampere or current efficiency is 90%.

CURRENT, ELECTRIC.—Current is the time rate of flow of electricity. In the modern electron theory an electric current is a stream of electrons moving under the influence of an electromotive force through the relatively large spaces between the atoms of a conductor or through the atoms themselves. According to this theory the speed of the electrons may be slow, but the high speed of the electric current is due to the fact that the impulse is passed on very rapidly from electron to electron.

The battery or generator does not produce electricity. The e. m. f. developed drives the electricity in a manner analogous to the driving of water by a water pump. The electric transmission of power is thus closely analogous to the transmission of power by water through pipes. To make the analogy more exact, the water after leaving the motor should be returned by another pipe to the pump. The water would, under such conditions, be merely a vehicle of energy. Likewise an electric current is a continuous flow of electrical energy. The practical unit of electric current is the ampere, which see.

CURRENT IN TELEPHONY.—Numerous terms are applied to the current flowing in telephone lines or apparatus, depending principally upon the character of the current, its effect on the apparatus or its origin. A few of these terms are given below.

Earth Current. Electrical current which flows in the earth. It is due to nature or to leakage from trolley lines, etc. It makes grounded telephone lines noisy.

Operating Current. The least value of current which will operate a relay. The value of this least current depends on the magnetic condition of the relay. If it has just been saturated in the same direction by a very strong current, it will operate on a very little current. If the iron core of the relay is neutral (has no residual magnetism) or has just been magnetized in the opposite direction, the operating current will be high.

Nonoperating Current. The greatest current which will not operate a relay. The exact value of this current depends on the magnetic condition of the relay. If it has just been saturated in the same direction, the nonoperating current will be low. If the iron is neutral or has been saturated in the opposite direction, the nonoperating current will be large. It is necessary to specify the testing conditions.

Pulsating Current. To ring a biased polarized telephone bell, the current must flow in a series of pulsations, with resting periods between. This is usually secured by wiping out alternate half cycles of an alternating current, leaving only those which flow in the same direction. This is the pulsating current as known to telephony.

Release Current. The highest current which may remain flowing in a relay and still permit the relay to release. It is somewhat dependent on the strength of the current flowing before the reduction takes place. If the initial current is high, it must be reduced quite low before release takes place.

Ringing Current. Any current which rings a telephone bell. It is usually alternating current or pulsating current, but it may be direct current.

Saturating Current. A value of current which produces sufficient magnetizing force to saturate the core of a relay or magnet with magnetism. It carries the magnetism to a high value. It is not a sharply defined value even for a given relay.

Sneak Current. Current leaking from external sources onto a telephone line; it may be small in volume, but it sometimes damages telephone apparatus by the accumulated heat.

Superimposed Current. Alternating current and direct current mixed for the purpose of ringing biased polarized bells. It imitates pulsating current.

Talking Current. Any current which is used to convey speech. It may be applied to direct current fed to a transmitter, but is often restricted to the alternating current whose wave corresponds to the voice and may be said to carry it.

Tone Current. Alternating current of such a frequency as to make a sound or tone in a telephone receiver. Any fre-

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quency from 500 to 1500 cycles per second is used, though most of the tone currents used commercially are very impure (have manly frequencies in them).

Undulating Current. Direct current which undulates or changes value. It may be analyzed into direct current and alternating current. The current in a telephone transmitter is undulating while the user is speaking.

CURRENT LIMITER.—See Indicators, excess demand.

CURRENT MARGIN.—In a nonpolar telegraph system the difference between the current flowing through a receiving instrument when operated to that flowing when not operated.

CURRENT METER.—An instrument designed to revolve freely with the current in a stream or flume and indicate the water velocity by the number of revolutions. It is used in hydraulic power plants to determine the velocity, which is then referred to a rating curve that indicates the corresponding discharge. The term current meter is rarely applied to an instrument for measuring electric current, because such instruments are properly called ammeters.

CURRENT, OSCILLATING.—A periodic current whose frequency is determined by the constants of the circuit or circuits in which it flows.

CURRENT, PULSATING. — A current which pulsates regularly in magnitude. As ordinarily employed, this term refers to unidirectional current only.

CURRENT RATIO, TRANSFORMER.—The current ratio of a current transformer is the ratio of the r. m. s. primary current to the r. m. s. secondary current under specified conditions of load.

CURRENT, SHORT-CIRCUIT. — See Short-circuit current.

CURRENT TAPS, MULTIPLE TYPE.—Current taps are special plug sockets in which an auxiliary set of contacts is arranged on the side to receive an attachment plug. These side contacts are in multiple with the connections for the socket which forms the lower end of the current tap. This permits a tap or auxiliary circuit to be used from one original outlet by merely inserting the plug in the side outlet. The plug may be either an Edison screw type plug or a special prong type plug or the prong cap of a separable plug, depending on the type of outlet provided at the side. Current taps are very useful where the number of outlets in a room is small and where attaching of an appliance would require removal of the lamp from possibly the only socket in the room, thus leaving it dark. The plug end of the current tap is inserted into the fixture socket and the lamp which has been removed is screwed into the socket end of the current tap, pointing in the same direction as originally; this is an important advantage in many cases. The shade or reflector can usually be moved to the socket of the current tap, which in most cases has a bead for the shade holder. Some current taps have a pull switch or key for controlling the socket end, which is an advantage by day or when a portable lamp is attached to the side outlet.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin current taps have lever key switch for control of lamp in socket. Furnished with swivel shell plug for connecting to Edison screw base outlet, or tapped ⅛, ¼ or ⅜ inch for attaching to fixture.—Adv.



Benjamin Current Tap

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.

Electric Co., The, 94 Allyn St., Hartford, Conn. (Exclusive distributor, Watts & Barry, Inc., 50 Church St., New York, N. Y.)

Esler Electric Mfg. Co., Delphi & Western Aves., Marion, Ind. "Jiffy."

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

Hubbell, Inc., Harvey, Bridgeport, Conn. "Te-Tap."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

PARKER & SON, INC., J. H., Parkersburg, W. Va. The "Tusum" double socket plug is constructed of highly finished, strong composition, of a dark brown color, having shade holder rings for "Uno" type shade holder. They are wired in multiple or in series, and will withstand 450 degrees of heat without injury.—Adv.



"Tusum" Double Socket Plug

TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

UNION ELECTRIC CORP.—103 Mott St., New York, N. Y.

CURRENT TAPS, SERIES TYPE.—Series current taps are constructed in a similar manner to the multiple current tap, having an auxiliary set of contacts on the side to receive an attachment plug. In this type the connections are such that when the auxiliary circuit is plugged in, the socket and tap circuits are in series. This is an advantage for testing purposes or for limiting the current to a low value, as when it is desired to use a very low speed on an electric fan. Series current taps are used to a very limited extent compared with multiple taps.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

CURTAIN SUPPLY CO.—350 W. Ontario St., Chicago, Ill. Manufacturer of car curtains, etc.

CURTAINS AND FIXTURES, ELECTRIC CAR.—Curtains used in electric cars generally are provided with a spring roller at the top and a combination stop and pair of guide blocks at the bottom. These blocks are on the ends of a spring-actuated rod which is placed in the lower edge of the curtain. By operating a pair of pinch handles in the center of this curtain rod small friction blocks pressing against the side guides in the window frame are withdrawn and the curtain may be rolled up or down. When the handles are released the blocks hold the curtain in place. These holding blocks are also guide blocks and slide in grooves in the frame, thus keeping the curtain in place and automatically maintaining the bottom level. The spring rollers, friction blocks, pinch handles, etc., constitute the curtain fixtures. The curtains are made of several materials, imitation leather, fiberoid, pantasote, wool terry, some tapestries, printed duck, etc.

Manufacturers:

Curtain Supply Co., 350 W. Ontario St., Chicago, Ill.

Du Pont de Nemours & Co., Inc., E. I., Fabrikoid Division, Wilmington, Del. "Fabrikoid."

Pantasote Co., 11 Broadway, New York, N. Y.

Railway Supply & Curtain Co., 614-618 S. Canal St., Chicago, Ill. "Sta-Rite," "Notear."

Zapon Leather Cloth Co., 200 5th Ave., New York, N. Y. "Zapon."

CURTAINLESS SHOWER CO., INC.—New York, N. Y. Manufacturer of electric toasters and grills. President, treasurer and general manager, S. J. Cutting; vice-president, H. B. Pitcher; secretary, H. C. Boos. Main office, 507 5th Ave., New York, N. Y. Branch offices, 1105 Mallers Bldg., Chicago, Ill.; 1404 Arrott Bldg., Pittsburgh, Pa.; 18 S. 7th St., Philadelphia, Pa.

CURTIS.—Trade name for steam turbines manufactured by the General Electric Co., Schenectady, N. Y.

CURTIS & CURTIS CO., THE.—188 Garden St., Bridgeport, Conn. Manufacturer of pipe cutting and threading machines. Business established 1882. President and treasurer, Lewis B. Curtis; vice-president and secretary, A. M. Curtis; sales manager, E. L. Wells Curtis.

CURTIS, ESTATE OF ALBERT B.—Worcester, Mass. Manufacturer of motor-driven oil extractors.

CUSACK CO., THOMAS.—Harrison & Loomis Sts., Chicago, Ill. Manufacturer of electric signs and sign lighting equipment. President, Thomas Cusack; vice-president and treasurer, G. B. Read; secretary, J. M. Laughlin; general manager, W. B. Metzdorf.

CUSHING.—Trade name for stage receptacles and plugs manufactured by the Chase-Shawmut Co., Newburyport, Mass.

CUSHIONS, EAR, TELEPHONE.—These cushions are placed on telephone receivers and serve the double purpose of relieving the pressure of the receiver on the ear and eliminating to a large extent outside noises. Very often a fine rubber sponge is used for this purpose. It is cylindrical in shape, having a hole in the center to permit the sound waves to reach the ear. By using cushions a receiver or pair of receivers may be held close to the ear by means of a headband without causing discomfort. In some cases, as in radio telephone or telegraph communication, it is essential that the receiver be held close to the ear and that outside noise be eliminated.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Colytt Laboratories, 565 W. Washington St., Chicago, Ill. "Clariphone."

Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Therapphone."

CUSHMAN CO., THE.—14 Elm St., Barre, Vt. Manufacturer of magnetic heaters. Business established 1912. Conducted by G. H. Cushman and C. S. Cushman.

CUSHMAN ELECTRIC CO.—43 S. Main St., Concord, N. H. Manufacturer of linotype motors. President and general manager, A. L. Cushman.

CUSHMAN MOTOR WORKS.—Lincoln, Neb. Manufacturer of lighting and power plants. Business established 1903. President, E. B. Sawyer; vice-president, B. A. George; secretary and general manager, L. M. Ward; treasurer, W. T. Irons; sales director, L. M. Decker. Main office, 932 N. 21st St., Lincoln, Neb. Factories, Lincoln, Neb., and Winnipeg, Can. Branch offices and warehouses, Kansas City, Mo.; Portland, Ore.; Stockton, Cal.; Winnipeg, Can. Sales representatives, Applegarth-Brittingham Electric Co., Washington, D. C.; Badger-Packard Machinery Co., Milwaukee, Wis.; John M. Brant Co., Bushnell, Ill.; W. J. Dabney Implement Co., Atlanta, Ga.; John Deere Plow Co., Baltimore, Md.; John Deere Plow Co., Syracuse, N. Y.; F. B. Du Bois Co., Toledo, Ohio; Moline-Hooper Co., Memphis, Tenn.; R. B. George Machinery Co., Dallas, Tex.; Miller Brothers Electric Co., Norfolk, Va.; Prosser-Sivright Co., Minneapolis, Minn.

CUSTER CAR.—Trade name for children's electrically propelled automobiles manufactured by the Custer Specialty Co., 119-121 Franklin St., Dayton, Ohio.

CUSTER SPECIALTY CO. — 119-121 Frankin St., Dayton, Ohio. Manufacturer of children's electrically propelled automobiles. Business established 1916. L. Luzern Custer, sole owner.

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CUSTOM MADE.—Trade name for transformers made by the American Transformer Co., 178-182 Emmett St., Newark, N. J.

CUTLER-HAMMER MFG. CO.—Milwaukee, Wis. Manufacturer of electric control systems, motor controllers, rheostats, dimmers, lifting magnets, magnetic clutches and separators, wiring and other specialties, and heating devices. Business established 1893. President, Frank R. Bacon; vice-president and general manager, A. W. Berresford; vice-president and treasurer, F. L. Pierce; secretary, T. E. Barnum; sales manager, W. C. Stevens. Main office, 12th St. & St. Paul Ave., Milwaukee, Wis. Factories, Milwaukee, Wis., and New York, N. Y. Branch offices, 50 Church St., New York, N. Y.; 323 N. Michigan Ave., Chicago, Ill.; Farmers' Bank Bldg., Pittsburgh, Pa.; 77 Franklin St., Boston, Mass.; Commonwealth Bldg., Philadelphia, Pa.; Guardian Bldg., Cleveland, Ohio; Gwyne Bldg., Cincinnati, Ohio; Kresge Bldg., Detroit, Mich. Sales representatives, H. B. Squires Co., 583 Howard St., San Francisco, Cal.; 206 S. San Pedro St., Los Angeles, Cal.; 552 First Ave., S., Seattle, Wash.; General Machinery Co., Birmingham, Ala.; H. L. Baughan, 1710 Glenarm St., Denver, Colo.; L. Brandenburger, Salt Lake City, Utah. Exclusive distributor (Magnetic Gear Shift), Fred E. Castle Co., Kresge Bldg., Detroit, Mich.

CUTOUT.—The term cutout was used in the early electrical days to refer to any device used for cutting out an entire circuit or portion of a circuit. It was applied not only to special forms of these devices that still go under the name of cutout, such as film cutouts and arc lamp cutouts, but also to fuses and circuit breakers. In modern practice the word cutout is seldom applied to fuses and circuit breakers except for transformer primary fuses, although it is still retained in the term cutout base, which is properly a fuse base or fuse receptacle.

CUTOUT BASES.—See Bases, cutout.

CUTOUT, SERIES.—In constant-current series lighting circuits, the lamps are cut in and out by opening or closing the lamp loop. This operation is performed by series cutouts without disturbing the continuity of the main circuit. They are not always placed at each lamp, but may be used for a group of lamps, if placed where both ends of the circuit are accessible. Cutouts are controlled by a spring to insure the completion of the operation. This spring may be in the handle or in the contacts. With underground circuits they are placed in the base of an iron lamp post or in a manhole. The underground type is often arranged to act as a pothead for cables as well as a series cutout. Also see Cutouts, arc lamp; Cutouts, film.

CUTOUTS, ARC LAMP.—A general term applied to a number of devices designed to disconnect or cut out an arc lamp from a series circuit without interrupting the continuity of the circuit. The cutout sometimes takes the form of a switch enclosed in a box, sometimes is located in the arc-lamp hanger mechanism so that the arc lamp is cut out when the lamp is lowered, and sometimes is made a part of the plug or pothead, in which the pulling apart of the device to disconnect the lamp also short-circuits the terminals of the circuit on the line side. This term is also sometimes applied to the automatic series cutout in the arc-lamp mechanism whereby the arc is cut out and the lamp short-circuited when the electrodes are used up. Arc lamp cutouts made for use external to the lamp itself are usually so constructed as to completely disconnect the lamp from the circuit; this is to render the lamp safe to touch and work upon.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
G & W Electric Special Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
GENERAL ELECTRIC CO., Schenectady, N. Y. A new pole type absolute plug cutout, designed to be mounted in the base of ornamental post or in the housing provided on ornamental brackets. Described in Booklet B-3356. Also cutouts for use with arc and incandescent street lighting units of all types. See adv. pages 1203-1223.—Adv.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CUTOUTS, FILM, INCANDESCENT STREET LAMP.—A device applied upon series street-lighting circuits at each terminal of an incandescent lamp for the purpose of closing the circuit and preventing the interruption of service when the filament of the lamp burns out or breaks. In a series street-lighting circuit the entire current flows through all of the lamps which are placed in series one after another in the circuit. Interruption of the circuit at any point will therefore put out all of the lamps on that circuit. As incandescent lamps are always likely to burn out and interrupt service, the film cutout device is provided to automatically close the circuit across the terminals of a burned out lamp the instant it burns out. This is done by providing between the terminals of the lamp, in the lamp socket or receptacle, a thin film of cloth or paper through which the current will jump when there is a sudden rise of voltage from the lamp terminals, as when the lamp burns out. The film having been once punctured by the current in this way, contact between the terminals is established by a kind of welding action through the broken down spot in the film. The film is renewed when the lamp is renewed. Ordinary films are made to puncture at about 300 volts. Several different designs of film cutout mechanisms are in use. They all depend on putting the thin film between metal terminals. Were films not provided at each lamp, the burning out of the lamp would either open the circuit and interrupt the service, or would result in the establishment of a dangerous destructive arc in the lamp which, if maintained, would destroy the socket. For the films used, see Films, cutout.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
GENERAL ELECTRIC CO., Schenectaly, N. Y. A repeating type magazine film cutout, available with standard G-E series sockets, which gives 15 new dielectric surfaces from each roll. The film roll is enclosed in a highly insulated capsule, making it moisture-proof and heat-proof, and permits it to be placed in the linemen's pockets without causing any damage to the dielectric surface of the film. See adv. pages 1203-1223.—Adv.
LINE MATERIAL CO., S. Milwaukee, Wis. (See display adv. page 1278.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

CUTOUTS, FUSE TYPE.—See Fuses.

CUTOUTS, FUSIBLE PRIMARY.—These are used for the protection of small and medium size transformer substations. For 2300-volt distributing transformers the fuse link is carried on a removable plug which is inserted in an enclosed porcelain base attached to the crossarm near the transformer. This type is in general use for transformers up to 25 kv-a. For larger transformer substations the expulsion, oil-filled, and chemical-filled types are found more reliable. Insulator plug type cutouts are usually supplied with the transformer by the manufacturer and the other kinds are usually purchased separately.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chemelectric Co., The, 4327 Kenmore Ave., Chicago, Ill. "S & H." (Exclusive distributor, G & W Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.)
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
Essex Mfg. Co., 117 Mulberry St., Newark, N. J.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. D & W Oil Fuse Cutouts are designed to give the utmost protection on all classes of circuits, particularly for junction or primary protection near the source of current. These are made in four types, namely, standard and heavy service, pole and subway types. Heavy service cutouts have increased interrupting capacity. The pole types



D & W Oil Fuse Cutouts.

are designed for overhead circuits and are made in sizes of from 50 to 300 amps. at 2,200 volts, and in smaller sizes up to 13,200 volts. The subway types, made in the same ratings, are specially protected against the entrance of moisture or water, are vented, and fuses can be renewed quickly and with ease. This cutout has performed satisfactorily even when completely submerged under water for days. These subway cutouts overcome the difficulties which have existed in most cutouts for such service, and have proven eminently satisfactory in this field. D & W Oil Fuse Cutouts combine accurate overload protection with high interrupting capacity.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Fusible Primary Cutouts are manufactured for all classes of service. For circuits 3,500 volts and below the Insulator Plug type is suitable for small-capacity distributing transformers. For larger capacities and higher voltages, G-E expulsion types and D & W Oil Fuse Cutouts are recommended. The D & W Oil Fuse Cutout is also made for underground or subway service. See adv. pages 1203-1223.—Adv.
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
MOLONEY ELECTRIC CO., 7th & Hickory Sts., St. Louis, Mo.
MOLONEY ELECTRIC CO. OF CANADA, LTD., Windsor, Ont., Can.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S & C."
Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

CUTOUTS, PANEL.—Panel cutouts are used in building up a panelboard. They consist of porcelain bases which contain receptacles for plug or cartridge fuses and are often provided with either a knife switch or rotary snap switch. They are made either for one circuit or two circuits, the latter having fuse receptacles and switches on both sides of central grooves in which the small busbars or mains are placed. They are made for either two-wire or three-wire mains and for either two or three-wire branch circuits also, the former being much more common. Also see Bases, cutout; Switches, panel and panelboard or combination cutout.

Manufacturers:

King-Craymer Electric Mfg. Co., 32 Haviland St., South Norwalk, Conn. "K-C."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

CUT-OVER.—An expression used in telephone work meaning to change from one apparatus or line to another. Usually re-

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stricted to the act of actually disconnecting the old and connecting the new, or of changing from one exchange to a new one.

CUT-WELD.—Trade name for oxy-acetylene welding and cutting apparatus manufactured by the Alexander Milburn Co., 1420-28 W. Baltimore St., Baltimore, Md.

CUTTER.—Trade name for street lighting equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CUTTER ELECTRICAL & MFG. CO.—Philadelphia, Pa. Manufacturer of circuit breakers. Business established 1888. President, A. Edward Newton; secretary, E. M. Dobelbower; treasurer, William M. Scott; general manager, H. C. Campion, Jr.; sales manager, H. F. Darby, Jr. Main office and factory, 19th & Hamilton Sts., Philadelphia, Pa. Branch offices, 1007 Johnston Bldg., New York, N. Y.; 307 1st National Bank Bldg., Cincinnati, Ohio; 707 Franklin Trust Bldg., Philadelphia, Pa.; 901 Park Bldg., Pittsburgh, Pa.; 1501 Monadnock Block, Chicago, Ill.; 845 Book Bldg., Detroit, Mich.; 1626 Chemical Bldg., St. Louis, Mo.; 751 Ellicott Sq., Buffalo, N. Y.; 1124 Metropolitan Life Bldg., Minneapolis, Minn.; 923 Trader's Bank Bldg., Toronto, Ont., Can.

CUTTER, SCOTT C.—Oswego, Ill. Manufacturer of tree insulators and test clamps and clips. Business established 1910. Factory, Muncie, Ind.

CUTTERS, ARC-LAMP CARBON.—A form of pliers for cutting arc-lamp carbons and porcelain tubing. The cutting blades have V-shaped edges, and are placed so they form a square opening. The carbon is placed in this opening and is cracked by the blades which move so as to reduce the size of the opening.

Manufacturers:

Hagstrom Mfg. Co., Lindsborg, Kans.

CUTTERS, ARMORED CONDUIT, CABLE AND CORD.—Hacksaw cutters which operate in a frame that is part of a vise for holding the conduit. These are sometimes equipped with safety-back saw frame which prevents cutting into the insulation on the wires of an armored cable. These facilitate the cutting operation by securely holding the conduit or cable. For use in places where the cable or armored cord cannot be held in a vise a special hand cutter, sometimes on the order of a pair of pliers, is available.

Manufacturers:

Garland Mfg. Co., West Pittsburgh, Pa. "Sterling."

CUTTERS, BATTERY PLATE AND TERMINAL.—These cutters are long-handled shears with jaws having long cutting edges, either side or diagonal. They are used in cutting off the necks of lead storage-battery plates in order to remove them from the connecting straps or "bus-bars." They are also used in cutting off terminal posts, lead strip connectors, etc. The cutting jaws are specially tempered for cutting lead or similar relatively soft material; they should therefore not be used for cutting iron or steel or other very hard materials which require a different temper.

Manufacturers:

Orum, S. R. M., North Philadelphia, Pa.
Porter, H. K., 6 Ashland St., Everett, Mass.

CUTTERS, BOLT, NUT AND RIVET.—Bolt cutters are used for cutting bolts, nuts, rivets, rods and wire rope. They are a form of powerful hand shears with long handles to give large leverage and are supplied with various types of cutting jaws, such as side, end or combination cutting, particularly adapted to several duties. They are much used in removing rusted bolts and nuts, such as in railway track maintenance work, dismantling or repairing machinery, etc. Their use saves much time as compared with using a chisel and hammer. Cutters specially adapted for removing nuts are sometimes called nut splitters; they usually have combination side and end-cutting jaws to permit access to the nut under various conditions.

Manufacturers:

Carolus Mfg. Co., Sterling, Ill.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Helwig Mfg. Co., St. Paul, Minn. "Helwig."
Porter, H. K., 6 Ashland St., Everett, Mass. "O.K."
Roberts Mfg. Co., Somerville Station, Boston, Mass. "Victor."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil," "Bonded."

CUTTERS, CABINET AND BOX.—Hand tools used chiefly to cut relatively large holes in a steel cabinet or box, to permit fastening of large conduit or in some cases to permit special apparatus to be mounted. They consist of an adjustable cutting knife that is revolved around a small central pilot hole by means of a special handle or wrench. The cutting knife does not remove all the metal but merely scribes a circle and gradually feeds entirely through the cabinet or other steel wall. In some cases these cutters are self-feeding. They are a great advantage especially for large holes, up to about 6 ins. diameter, as they give an accurate and round hole and one that is cut much more quickly than by punching or drilling small holes around the circumference. Even for smaller holes they may save time and labor because the cutting is done only along the circumference and not over the entire surface of the circle as is usual with a drill.

Manufacturers:

Universal Tool & Appliance Co., 373 Broadway, Milwaukee, Wis. (Exclusive distributor, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.)

CUTTERS, CLOTH.—See Cloth-cutting machines, motor-driven.

CUTTERS, ELECTRIC, MISCELLANEOUS.—Electrically operated cutters are used for a number of purposes in connection with food products and on stock farms, etc. They consist of motor-driven knives, which rotate in a cylinder and cut whatever is placed therein into shreds or splices depending upon the nature of the knife. They are used to cut roots which are sometimes fed to stock, or for cutting vegetables of various kinds, grains, etc. The cutters generally have a large hopper above the knives, into which the roots or vegetables are dumped.

Manufacturers:

Heebner & Sons., Lansdale, Pa. ("Union" feed and ensilage cutters.)
Superior Churn & Mfg. Co., Northville, Mich. "Superior" root cutters.)

CUTTERS, GLASS.—Glass cutters are of two distinct types. In one a small diamond point is inserted in the end of a handle and when drawn across the glass scratches the surface sufficiently so that it may be broken on the line made. Glass cutters having a hardened steel wheel are also widely used because of their low cost. They operate in about the same manner. Glass cutters are used in cutting sheet glass for car windows, static condensers, instrument dial windows, large glass tubes, some types of lamp shades, etc.

Manufacturers:

Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Monce, Inc., S. G., Unionville, Conn "Monce."
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Eclipse," "Indian."

CUTTERS, HAIR, MOTOR-DRIVEN.—Hair clippers operated by a small motor through a flexible enclosed shaft, the motor being usually mounted on a portable stand, or suspended from a wire above the chair. They operate much more quickly and smoothly than a hand clipper and have met with favor among many barbers.

Manufacturers:

Andis O. M. Mfg. Co., 1024 12th St., Racine, Wis.
Barbers' Electric Specialty Co., The, 4204 Troost Ave., Kansas City, Mo "Coffman, The Original."
Blomfeldt & Rapp Co., 108 N. Jefferson St., Chicago, Ill. "Van Osdel."
Earl Mfg. Co., Inc., 4332 N. Gratz St., Philadelphia, Pa. "E. Z."
Electric Clipper Co., The, 537 Grand Ave., Kansas City, Mo. "Two-in-One Clean-Cut-Clipper."
Moore Electric Corp., 202 S. State St., Chicago, Ill. (Exclusive distributor, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.)
Racine Electric Co., Bridge & Ontario St., Racine, Wis.
Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill. "Universal."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."
Supreme Electric Hair Cutter Corp., 56 Taylor St., Springfield, Mass. "Supreme."
Vivis Mfg. Co., Inc., 1306 1st Ave., Seattle, Wash. "Vivis."

CUTTERS, PIPE AND CONDUIT.—Pipe and conduit cutters are made in several different types. One of the simple forms has a single cutting wheel mounted in a movable jaw, and a jaw opposite this equipped with two rollers or in some cases with two additional cutting wheels. The movable cutting wheel is controlled by a screw in a long handle so that it may be forced gradually into the pipe as the cutter is revolved around the pipe. Other forms are made up like a pipe-threading stock, having adjustable and removable knives that are gradually pushed into the pipe. These cutters are very useful in conduit work since most of them are so constructed as to cut the pipe or conduit square without leaving a large burr to file off and ream out.

Manufacturers:

THE BORDEN CO., Warren, Ohio. "Beaver" square-end pipe cutters, made in ⅛ to 1-in., ½ to 2-in., and 2½ to 4-in. sizes, are built with unbreakable knives that cut straight through



"Beaver" Pipe Cutter

the conduit easily, quickly, cleanly, leaving no burr to chafe the insulation on the wire. The company issues a carefully compiled catalog describing each model in detail.—Adv.

Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Nye Tool & Machine Works, The, 108-28 N. Jefferson St., Chicago, Ill.
Toledo Pipe Threading Machine Co., The, Toledo, Ohio.
Trimont Mfg. Co., 55-71 Amory St., Roxbury, Mass. "Trimo."
Walworth Mfg. Co., Boston, Mass.

CUTTERS, PORCELAIN TUBE.—Cutters of the plier type, adjustable or non-adjustable, for cutting porcelain tubes in two. The nonadjustable type cuts but one size of tube.

Manufacturers:

Hagstrom Mfg. Co., Lindsborg, Kans.

CUTTERS, SLEET.—See Sleet cutters, trolley wire.

CUTTERS, WIRE.—Wire cutters are sometimes provided for use in clearing away wreckage or for cutting live wires, entanglements, etc. Cutting pliers (see Pliers, cutting) are also used for cutting wire in construction work and wiring of all kinds. These usually have the cutters on the side or end and do not interfere with the ordinary use of the pliers. Wire cutters, on the other hand, are intended for that purpose only. They may be small with the cutting blades on the side, called "side cutters" or they may be very long handled, well insulated cutters for use on live wires, having the cutting edges on the inside of the jaws. Large quantities of such wire cutters were used in clearing away barbed-wire entanglements during the recent war.

Manufacturers:

Carolus Mfg. Co., Sterling, Ill.
Helwig Mfg. Co., St. Paul, Minn. "Helwig."
Porter, H. K., 6 Ashland St., Everett, Mass. "Boston."

CUTTING & WASHINGTON RADIO CORP.—New York, N. Y. Manufacturer of radio apparatus. Business established in 1916. President, Fulton Cutting; vice-president, Bowden Washington; secretary and treasurer, W. C. Schmidt; general manager, J. P. Johnston. Main office, 6 W. 48th St., New York, N. Y. Branch office, 609 Whitney Central Bldg., New Orleans, La.

CUYAHOGA SPRING CO., THE.—10252 Berea Rd., Cleveland, Ohio. Manufacturer of wire coil springs and special wire shapes.

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President and general manager, John H. Van Uum; secretary and treasurer, Harry F. Plagens.

CYANAMIDE.—See Calcium cyanamide.

CYANIDE.—This term as used commercially refers to either sodium cyanide (NaCN) or potassium cyanide (KCN). The former is supplanting the latter in use, since it is cheaper. Both are white solids, extremely poisonous. The principal uses are in solutions for leaching gold and silver from their ores, in case-hardening of steel, in commercial poisons for fumigation, and in electroplating. A new cyanide is being made at lower cost by the American Cyanamide Co. by fusing a mixture of sodium chloride and calcium cyanamide in an electric furnace. The product averages 36% equivalent sodium cyanide. Cyanide solutions of various metals are used in electroplating. The CN radical has the property in some cases of forming double salts with two metals as distinguished from simple mixtures of the single salts, which permits of the simultaneous electrodeposition of the two metals in the form of an alloy, even though the metals may be far apart in the electrochemical scale. Thus brass may be deposited electrolytically as a satisfactory plating from a solution of the double cyanide of copper and zinc. The consumption of cyanide in the United States is about 12,000 tons per year.

CYANOGEN.—A highly poisonous gas from which cyanic acid and various cyanides may be derived. See Cyanide.

C-Y-C.—Trade name for farm lighting and power plants manufactured by the Carlton, Young & Catlin, Inc., Grand Central Palace, New York, N. Y.

CYCLOIDALE.—Trade name for electric blowers and ventilating fans manufactured by the Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill.

CYCLONE.—Trade name for boiler furnace grates manufactured by the Cyclone Grate-Bar Co., 9 Grimes St., Buffalo, N. Y.

CYCLE.—A cycle of an alternating-current wave is one complete wave. It is one complete set of positive and negative values of the wave. Referring to a clock diagram, a cycle is a complete set of values of the projection of the rotating vector in one revolution. The number of cycles or complete waves per second is called the "frequency" of the wave.

CYCLONE.—Trade name for electric drink mixers, driers and fans manufactured by the Hamilton-Beach Mfg. Co., 1301-29 Rapids Drive, Racine, Wis.

CYCLONE.—Trade name for oiling device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

CYCLONE GRATE-BAR CO.—9 Grimes St., Buffalo, N. Y. Manufacturer of boiler furnace grates. President, J. H. Vought; vice-president, W. G. Vought; secretary and treasurer, E. M. Leydecker.

CYCLONE IRON WORKS.—837-847 Folsom St., San Francisco, Cal. Manufacturer of electric traveling cranes and refrigerating machines. Business established 1898. President, J. M. Etienne; vice-president and general manager, E. Etienne; secretary, V. Etienne, Jr.

CYMOMETER.—An instrument for the measurement of oscillation frequency and wave length in connection with radio communication. It may also be used for the measurement of small inductances or capacitances. It was devised by J. A. Fleming and consists primarily of a variable metallic tube condenser in series with an air-core inductance coil and includes also a sensitive indicating device.

CYPHERS INCUBATOR CO.—Buffalo, N Y. Manufacturers of electric incubators and hovers.

CYSTOSCOPY.—In medical practice the examination of the human bladder by means of specially designed incandescent lamps which are part of a cystoscope.

D

DAD'S.—Trade name for electric hand lanterns. Manufactured by Dad's Factories, 238 S. Meridian St., Indianapolis, Ind.

DAD'S FACTORIES.—238 S. Meridian St., Indianapolis, Ind. Manufacturers of electric hand lanterns.

DAGNALL ASBESTOS & INSULATION CO.—316 Lagauchetiere St., W., Montreal, Que., Can. Manufacturer of asbestos products for electrical purposes. Business established 1910. General manager, J. W. Dagnall; sales manager, G. A. Tasse.

DAHLIA.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DAINTY.—Trade name for electric sailing lights manufactured by the National Marine Lamp Co., Forestville, Conn.

DAIRY AND CREAMERY MACHINERY, MOTOR-DRIVEN, MISCELLANEOUS.—Under this classification are included the various motor-driven machines in use in dairies, creameries, cheese and ice-cream plants, that are not listed under other headings. Among such machines are emulsifiers, clarifiers, homogenizers, whey separators, ice cream batch mixers, brine freezers and various other auxiliaries. Such electrical machinery makes a very clean and sanitary installation and also makes operation economical. Also see Cream separators, motor-driven; Churns, motor-driven; Freezers, ice-cream, motor-driven; Ice breakers, motor-driven; Pasteurizers, milk, electric; Pumps, milk and cream, electric; Refrigerating and ice making machines, motor-driven; Sterilizers, milk, electric; Washing machines, bottle, electric.

Manufacturers:

Cherry Co., J. G., Cedar Rapids, Iowa. "Perfection."

Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Wizard" milk cooler, "20th Century" mixing vats, "Universal" filler and capper, "Gaulin" homogenizer.

Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill. "Davis."

Sharples Separator Co., West Chester, Pa. ("Sharples Super-Clarifier" and emulsifier.)

Vermont Farm Machine Corp., 53 W. Jackson Blvd., Chicago, Ill. (Butter workers.)

DAISON MFG. CO., INC.—916 Chestnut St., Philadelphia, Pa. Manufacturer of lamp bases and shades. Business established 1918. President and sales manager, D. D. Dailey; treasurer and general manager, C. E. Hastings.

DAISY.—Trade name for floor treads manufactured by the Ansonia Electrical Co., Ansonia, Conn.

DAISY.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DAKE ENGINE CO.—Grand Haven, Mich. Manufacturer of electric hoists and winches. Business established 1895. President, Thomas Johnston; vice-president, A. Campbell; secretary and treasurer, J. F. Johnston; sales manager, H. Z. Nyland. Sales representatives, H. L. Drullard, 30 Church St., New York, N. Y.; J. E. Chisholm & Co., Ltd., 811 Monadnock Block, Chicago, Ill.

DAKOTA.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DALE LIGHTING FIXTURE CO., INC.—107 W. 13th St., New York, N. Y. Manufacturer of lighting fixtures and portable lamps. President, M. E. Dale; vice-president and sales manager, Harry Wildnauer; secretary and treasurer, C. P. Roen.

DALITE.—Trade name for color-matching outfit manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

DALITE.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa.

DA-LITE.—Trade name for egg testers and candlers manufactured by the Grant Mfg. Co., 208 N. Wells St., Chicago, Ill.

DALLAS BRASS & COPPER CO.—Chicago, Ill. Manufacturer of lighting fixtures, fixture fittings and parts, brass and copper products, etc. President, treasurer and general manager, C. D. Dallas; vice-president and sales manager, H. S. Ullmann; secretary, F. D. Silber. Main office and factory, 820 Orleans St., Chicago, Ill. Branch offices, 81 Fulton St., New York, N. Y.; 548 Leader News Bldg., Cleveland, Ohio; 548 David Whitney Bldg., Detroit, Mich.

DALLMER MFG. CO., T. C.—9 W. Kinzie St., Chicago, Ill, Manufacturer of frames for lamp shades.

DALTON.—Trade name for motor-driven computing machines manufactured by the Dalton Adding Machine Co., 122 S. Michigan Ave., Chicago, Ill.

DALTON ADDING MACHINE CO.—122 S. Michigan Ave., Chicago, Ill. Manufacturer of motor-driven computing machines. President, James L. Dalton; vice-presidents, Grig Glover and H. C. Grubbs; secretary and treasurer, B. Dysart.

DAM.—A dam is a structure for preventing the outflow of water from a storage basin, reservoir or lake, or for obstructing the flow of a stream to elevate the surface of the water. The purpose of dams for water-power plants is to concentrate the fall at one point and to impound or store water so that it may be utilized at some other time. They are divided into two classes, impounding dams and spillway dams, which see. Also see Coffer dam; and Dam, movable.

DAM, IMPOUNDING.—Impounding dams are not designed to have any water pass over them, but merely to hold water back as in a reservoir. They are almost invariably of the gravity type, depending on their weight to resist the force of the water. Occasionally curved or arch dams are built, using the hydrostatic pressure of the impounded water to hold them in place, but the present tendency seems to be toward heavy earth dams.

DAM, MOVABLE.—A flexible portion of a water-power or other dam, consisting of a movable section, a gate or series of gates, which can be raised or lowered to permit regulating the depth of the water passing over the spillway according to flood and load conditions. In the bear-trap type, an entire section with apron, crest and spillway integral in one unit can be raised or lowered, usually by hydraulic power.

DAM, SPILLWAY.—Spillway dams permit part of the water to pass over the top. They are made in the gravity type and curved on arch dams which through their design depend on the hydrostatic pressure of the water for their stability. Arch dams require a strong solid foundation, but are economical of material. Stone, concrete, reinforced concrete, steel, timber, loose rock and earth are all used in the construction of dams and may be used independently or in combination. (Also see Spillway.)

DAMPER.—An abbreviation of damping winding or amortisseur; see Amortisseur winding. Also applied sometimes to a damping device in an electrical instrument; see Damping. Also a hinged or swiveled gate set in an air duct or smoke flue to regulate the draft or the flow of air or gas.

DAMPER RELEASE MAGNETS, STAGE VENTILATING.—These are mechanisms used to control the closing of the dampers used in stage ventilating systems. The ventilating systems are generally required to have a large damper in the stage flues that may be operated in cases of emergency, such as a fire, or for inspection and general ventilating purposes. The release magnets or control outfits are always wound for the full circuit voltage and are normally operated on closed circuit. No resistance may be used in series with the magnet. The mechanism is located in a loft

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above the scenery and is installed in an iron box with a self-closing door. The magnets are controlled by at least two switches, one at the electrician's station and the other one or more at any convenient point. In some cases they are also arranged to operate by means of a thermostatic control, closing the damper at the outbreak of fire and thus preventing the upward draft that would quickly spread the blaze.

DAMPING COIL.—A coil used with a galvanometer designed to carry occasional electric currents to produce a magnetic field for the purpose of quickly bringing the needle to rest after deflection.

DAMPING CONSTANT.—The damping constant of a circuit is a measure of the ratio of the dissipative to the reactive component of its admittance or impedance. Applied to the admittance of a condenser or other capacitive reactance, the damping constant for a harmonic e. m. f. of given frequency is the ratio of the conductance G at that frequency to twice the capacitance C at the same frequency, or equal to G/2C. Applied to a circuit having inductive reactance, the constant for a harmonic current of given frequency is the ratio of the resistance R to twice the inductance L or R/2L.

DAMPING, INSTRUMENT.—See under Instruments, electrical measuring.

DAMPING MAGNET.—A magnet used to act on the needle of an indicating instrument, rotating disk or other moving body to damp its motion. Damping magnets are widely used on watt-hour meters. See Meters, watt-hour.

DAMPING OF A CIRCUIT.—The damping at any point in a circuit from which the source of energy has been withdrawn, is the progressive diminution in the effective value of electromotive force and current at that point resulting from the withdrawal of electrical energy.

DAMPING WINDING.—An amortisseur winding; see Amortisseur winding.

DANBURY ELECTRIC MFG. CO.—Danbury, Conn. Manufacturer of plug fuse cutout bases and switches. Business established 1919. President, Frank H. Lee; vice-president, James F. Doran; secretary and treasurer, Knud Knudsen.

DANDITOY.—Trade name for toy transformers manufactured by the Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

D & W.—Trade name for fuses manufactured by the D & W Fuse Works of General Electric Co., Providence, R. I.

D & W FUSE WORKS OF GENERAL ELECTRIC CO.—Providence, R. I. Manufacturer of fuses, wire, cord, tape, lightning arresters, electrical boxes, service entrance fittings, etc.

DANA.—Trade name for motor-driven ice cream freezers manufactured by Thomas Mills & Brother, 1301 N. 6th St., Philadelphia, Pa.

DANDY.—Trade name for annunciators manufactured by the Samson Electric Co., Canton, Mass.

DANDY.—Trade name for electric toasters manufactured by the Waage Electric Co., 12 S. Jefferson St., Chicago, Ill.

DANDY.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DANIELL CELL.—A well-known type of closed-circuit primary cell with a voltage of approximately 1.1 volts. In the original form the zinc in the zinc sulphate solution was placed in a porous cup, which was surrounded by the copper in a saturated copper sulphate solution. The modern form of this cell is known as the gravity cell, which see.

DANIEL'S P. P. P. ROD.—Trade name for piston packing manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

DANVERS LAMP CO., Danvers, Mass. Manufacturer of incandescent lamps. Secretary, L. W. Fox.

DARAF.—A name proposed by Prof. V. Karapetoff for the unit of elastance. Since the latter was proposed as the reciprocal of capacitance, the daraf would be the reciprocal of the farad, its unit. Daraf is farad spelled backward.

DARBY SONS CO., EDWARD.—416 N. 18th St., Philadelphia, Pa. Manufacturer of steel cabinets, shelving, etc. President and treasurer, D. A. Longacre; vice-president and general manager, E. A. Darby; secretary, H. F. Darby.

DARCHE MFG. CO.—643 W. Washington Blvd., Chicago, Ill. Manufacturer of electric alarm clocks. Business established 1907. President and treasurer, E. J. Heilman; vice-president, A. Y. Darche; secretary, P. Heilman; general manager, O. Heilman.

DARCOID.—Trade name for sheet packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

DARE CRYPTOPHONE.—Trade name for transmitter manufactured by the Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.

DARLINGTON ELECTRIC CO.—123 N. Jefferson St., Chicago, Ill. Manufacturer of electric fountains. President, F. W. Darlington; secretary, William F. Freudenreich; treasurer, Delevan B. Cole; general manager and sales manager, E. W. Arch.

DARRIN.—Trade name for magnet switches manufactured by the Automatic Switch Co., 154 Grand St., New York, N. Y.

DART MFG. CO., E. M.—Providence, R. I. Manufacturer of pipe unions.

DASHPOTS FOR RELAYS, CIRCUIT BREAKERS, CONTROLLERS, ETC. — These dashpots are used to check the action of the relay, breaker or controller, so that the time rate of action of the device may be controlled. There are several forms, the type most commonly used consisting of an air cylinder and piston. A small hole in the piston or cylinder head allows the air to escape when the piston compresses the air in the cylinder, the rate of escape controlling the speed of the piston and consequently the action of the controlling device. The bellows type has also been used considerably.

Manufacturers:

Niagara Insul-Bake Specialty Co., Inc., 483 Delaware Ave., Albany, N. Y.

DAUGHERTY-SMITH-PHILLIPS CO.—1537 Cortland St., Chicago, Ill. Manufacturer of spring hammer and drills.

DAUM, A. F.—Pittsburgh, Pa. Manufacturer of refillable fuses.

DAVENPORT MACHINE TOOL CO.—167 Ames St., Rochester, N. Y. Manufacturer of screw machines. President, W. S. Davenport; vice-president and general manager, C. R. Burt; secretary and treasurer, A. T. Hatch.

DAVENPORT MFG. CO.—Davenport, Iowa. Manufacturer of cigar lighters and gasoline engines. Business established 1910. President, M. H. Christopherson; vice-president, J. W. Bettendorf; secretary, treasurer and general manager, W. H. Martin; sales manager, T. L. Flynn.

DAVIDSON.—Trade name for cable hangers manufactured by the Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill.

DAVIDSON CO., M. T.—New York, N. Y. Manufacturers of steam pumps. Business established 1882. President, treasurer and general manager, William C. Newell; vice-presidents, Oran S. Baldwin and John Lowe; secretary and sales manager, John Lowe. Main office, 154 Nassau St., New York, N. Y. Branch offices, 30 Oliver St., Boston, Mass.; Commercial National Bank Bldg., Washington, D. C.; 147 N. 7th St., Philadelphia, Pa.

DAVIDSON PORCELAIN CO., THE.—East Liverpool, Ohio. Manufacturer of electrical porcelain. Business established 1920. President and general manager, W. M. Davidson; vice-president, Richard B. Smith; secretary and treasurer, C. C. Danielson. Sales representatives, Roache-Paul Co., 43 Warren St., New York, N. Y.; J. W. McNair, 116 E. Woodbridge St., Detroit, Mich.; D & E Distributing Co., 9 S. Clinton St., Chicago, Ill.

DAVIS.—Trade name for electric blasting apparatus manufactured by the Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

DAVIS.—Trade name for electric sewing machine manufactured by the Davis Sewing Machine Co., Dayton, Ohio.

DAVIS.—Trade name for milk handling equipment manufactured by the Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.

DAVIS-BOURNONVILLE CO. — Jersey City, N. J. Manufacturer of oxyacetylene cutting and welding outfits. Business established 1908. President, DeWitt V. D. Reiley; vice-presidents, C. B. Wortham, H. R. Swartley, Jr.; secretary and treasurer, William G. McCune; general manager, S. W. Wortham; sales manager, H. R. Swartley, Jr. Main office, Jersey City, N. J. Branch offices, 43 Houston St., Atlanta, Ga.; 44 Federal St., Boston, Mass.; 184 Main St., Buffalo, N. Y.; Tribune Bldg., Chicago, Ill.; 2102 Union Central Bldg., Cincinnati, Ohio; 1831 E. 13th St., Cleveland, Ohio; 209 S. Houston St., Dallas, Tex.; 35-57 Washington Blvd., Detroit, Mich.; 424 E. 3rd St., Los Angeles, Cal.; 300 Builders Exchange, Minneapolis, Minn.; 1314 Market St., Philadelphia, Pa.; 316 Penn Ave., Pittsburgh, Pa.; 1321 Syndicate Trust Bldg., St. Louis, Mo.; 71 New Montgomery St., San Francisco, Cal.; 316 Occidental Ave., Seattle, Wash.; 32-34 Eastern Ave., Toronto, Ont.; St. Paul & St. Nicholas, Montreal, Que., Can.

DAVIS REGULATOR CO., G. M.—420 Milwaukee Ave., Chicago, Ill. Manufacturer of steam specialties. President, G. C. Davis; secretary, J. C. Kinsley; treasurer, W. E. Davis.

DAVIS SEWING MACHINE CO.—Dayton, Ohio. Manufacturers of electric sewing machines. Business established 1862. President, C. A. Hawkins; vice-president, J. M. Huffman; secretary, George P. Huffman; sales manager, H. M. Huffman. Main office and factory, Dayton, Ohio. Branch offices, 1401 Mallers Bldg., Chicago, Ill.; 112 W. 15th St., New York, N. Y.

DAVIS SLATE & MFG. CO.—Chicago, Ill. Miller of electrical slate and marble. President, Charles H. Davis; secretary, E. C. Costello. Main office, 610-618 E. 40th St., Chicago, Ill. Factories, Chicago, Ill., Muskegon, Mich., Fair Haven, Vt., Wind Gap, Pa., Toronto, Ont., Canada. Branch office, Davis Slate & Mfg. Co. of Canada, Ltd., 127-131 Shaftesbury Ave., Toronto, Ont., Canada.

DAVIS WATKINS DAIRYMEN'S MFG. CO.—North Chicago, Ill. Manufacturer of motor-driven dairy machinery. Main office, North Chicago, Ill. Factories, Jersey City, N. J.; Derby, Conn.; North Chicago, Ill.; Owatonna, Minn. Branch offices, Jersey City, N. J.; Denver, Colo.; San Francisco, Cal. General advertising department, 130 N. Wells St., Chicago, Ill.

DAVISON & Mc BRYDE.—1217 Independent Life Bldg., Nashville, Tenn. Producers of chestnut poles. Partnership, Charles L. Davison and F. M. McBryde.

DAVOL RUBBER CO.—69 Point St., Providence, R. I. Manufacturer of telephone pads, linemen's rubber gloves and other rubber products. President and treasurer, Charles D. Davol; secretary, Charles B. Banforth; general manager, P. Raymond Wesley; sales manager, Raymond J. Fries. Branch offices, 576 Mission St., San Francisco, Cal.; 209 S. State St., Chicago, Ill.; Old South Bldg., Boston, Mass.; 302 Broadway, New York, N. Y.

DAVY, SIR HUMPHREY.—An English chemist (born at Penzance, Cornwall, 1778, died at Geneva, Switzerland, 1829) who is famous for his researches in chemistry. He was educated at the school of Truso. In 1795 he became apprenticed to a surgeon and apothecary at Penzance. While experimenting on the curative effects of different gases, he discovered the respirability and exhilarating effect of nitrous oxide. In 1801 he was made professor of chemistry at the Royal Institution of London. His discoveries with the galvanic battery, his decomposition of the earths and alkalies and ascertaining of their metallic bases, his demonstration of the true nature of oxynrionate acid, his discovery of chlorine as an element, etc., obtained for him an international reputation. In 1809 while experimenting with a battery of 2000 primary cells he showed that an intense arc could be drawn between carbon electrodes; this phenomenon many years later was developed into the arc lamp. In 1815 Davy entered on the investigation of the nature of fire damp and the cause of explosions in coal mines, which resulted in the invention of the safety lamp. In 1812 he was knighted and in 1820 he was created a baronet.

DAWSON, JAMES J.—McKeesport, Pa. Manufacturer of motors for motion-picture machines.

DAY CO., THOMAS.—San Francisco, Cal. Manufacturer of lighting fixtures, portable lamps and lighting specialties. President, Whitman Symmes; vice-president, William Frank Garby; secretary, J. T. Gates. Main office, 725 Mission St., San Francisco, Cal.

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Branch office, 209 Brockman Bldg., Los Angeles, Cal.

DAY-GLOW.—Trade name for lighting unit manufactured by the Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind.

DAYLIGHT.—Trade name for electric washing machine manufactured by the Puffer-Hubbard Mfg. Co., Minneapolis, Minn.

DAYLIGHT.—Trade name for nitrogen lamps manufactured by the Union Lamp Co., Union Hill, N. J.

DAYLIGHT COMPETITOR.—Trade name for lighting fixtures manufactured by the Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa.

DAYLIGHT FLOOD.—Trade name for floodlight projectors manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

DAYLITE.—Trade name for lighting fixtures manufactured by the Thomas Day Co., 725 Mission St., San Francisco, Cal.

DAYLO.—Trade name for electric sign manufactured by the A. K. S. Sign Co., 936-940 W. Madison St., Chicago, Ill.

DAYLO.—Trade name for flashlights manufactured by the American Ever Ready Works of National Carbon Co., Thompson Ave. & Orton St., Long Island City, N. Y.

DAY-NIGHT.—Trade name for electric sign manufactured by the Flexlume Sign Co., 74 Kail St., Buffalo, N. Y.

DAY-N-ITE.—Trade name for electric signs manufactured by the Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.

DAYTON.—Trade name for farm lighting plants, motor-boat lighting and ignition systems, generators, batteries and switchboards manufactured by the A-C Electrical Mfg. Co., Dayton, Ohio.

DAYTON.—Trade name for mechanical stoker for small plants manufactured by the Automatic Furnace Co., 1st & Harshman Sts., Dayton, Ohio.

DAYTON.—Trade name for electric fans and motors made by the Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio.

DAYTON.—Trade name for electric house and water system pumps manufactured by the Dayton Pump & Mfg. Co., Webster St., Dayton, Ohio.

DAYTON.—Trade name for truck wheels manufactured by the Dayton Steel Foundry Co., Dayton, Ohio.

DAYTON.—Trade name for steel electric railway ties manufactured by the Dayton Mechanical Tie Co., 703-6 Commercial Bldg., Dayton, Ohio.

DAYTON.—Trade name for computing scales manufactured by the International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can.

DAYTON AUTOMOTIVE SPECIALTY CO.—310 E. 2nd St., Dayton, Ohio. Manufacturer of test apparatus for automobile electrical equipment. Business established 1918. President and general manager, H. H. Wampler.

DAYTON-DOWD CO.—Quincy, Ill. Manufacturer of electric and steam turbine pumps. Business established 1910. President and general manager, H. F. Dayton; vice-president and sales manager, W. C. Dowd; secretary, C. N. Adams; treasurer, W. B. Dayton. Main office and factory, Quincy, Ill. Branch offices, 90 West St., New York, N. Y.; 30 N. Michigan Ave., Chicago, Ill.; 708 Schofield Bldg., Cleveland, Ohio; Hurt Bldg., Atlanta, Ga.; 1304 Pennsylvania Bldg., Philadelphia, Pa. Sales representatives, John Fensom Co., Richmond, Va.; Reeves & Skinner Marley Co., St. Louis, Mo.; E. G. Dewald, Salt Lake City, Utah; Morgan-Gerrish Co., Minneapolis, Minn.; Reed Engineering & Sales Co., 1344 G.N.W., Washington, D. C.; Moore Handley Hardware Co., Birmingham, Ala.; Crawford & Cameron, Farmers Bank Bldg., Pittsburgh, Pa.

DAYTON FAN & MOTOR CO.—Monument & Meigs Sts., Dayton, Ohio. Manufacturer of electric fans and motors. President and general manager, Ernest Boehme; secretary and treasurer, M. D. Larkin.

DAYTON MFG. CO., THE.—Dayton, Ohio. Manufacturer of car lighting and marine lighting fixtures, locomotive headlights and brass and bronze goods. President and general manager, J. Kirby, Jr.; vice-presidents, N. Emmons and Joseph Leidenger; secretary and treasurer, H. D. Hendrick.

DAYTON MECHANICAL TIE CO.—703-6 Commercial Bldg., Dayton, Ohio. Manufacturer of steel electric railway ties. Business established 1917. President and general manager, T. A. Fenneding; vice-president, W. S. McConnaughey; secretary, treasurer and sales manager, R. J. Wells. Sales representative, Colonial Machinery Co., Ltd., Cowansville, Que., Can.

DAYTON MONEYWEIGHT. — Trade name for electrically lighted computing scales manufactured by the Moneyweight Scale Co., 326 W. Madison St., Chicago, Ill.

DAYTON MONEYWEIGHT SCALE CO.—Dayton, Ohio. Manufacturer of electrically lighted scales. Sales representative, Computing Scale Co., 336 W. Madison St., Chicago, Ill.

DAYTON PUMP & MFG. CO., THE.—Dayton, Ohio. Manufacturer of electric house and water system pumps. Business established 1908. President, F. M. Tait; vice-president, A. J. Pocock; secretary, treasurer and associate general manager, R. E. Engle; sales manager, Herbert Glass. Main office and factory, Webster St., Dayton, Ohio. Branch offices and warehouses, 4th & Harrison Sts., San Francisco, Cal.; 923 Market St., Wilmington, Del.; Kernersville, N. C. District offices, 31 Peachtree Arcade, Atlanta, Ga.; 160 E. 44th St., New York, N. Y.; 965 Woodward Ave., Detroit, Mich.; 701 3rd National Bank Bldg., St. Louis, Mo.; 414 Brisbane Bldg., Buffalo N. Y.; 606 Common St., New Orleans, La.; 300 Builders Exchange Bldg., Minneapolis, Minn.; Pittsburgh, Pa., Sales representatives. Canadian Fairbanks, Morse & Co., Montreal, Can.; Wm. Van Horganhuyze 124 Heineman St., San Antonia, Tex.

DAYTON STEEL FOUNDRY CO.—Dayton, Ohio. Manufacturer of truck wheels.

DAZEY CHURN & MFG. CO.—Warne & Carter Aves., St. Louis, Mo. Manufacturer of electric churns. Business established 1906. President, N. P. Dazey; secretary, J. P. Dazey; sales manager, Evans Dazey.

D-C, or D.C.—Abbreviations for direct current. The form d-c. is preferred when used adjectively, as a d-c. generator, d-c. relay. D. C. is the older form. Present practice tends toward spelling out direct current, unless used adjectively as above.

D.D.—Trade name for plugs and receptacles manufactured by the Bryant Electric Co., Bridgeport, Conn.

DEAD BEAT.—A term applied to indicating instruments whose pointers are prevented from swinging back and forth after deflection. It is produced by heavily damping the moving element. See under Instruments, electrical measuring.

DEAD EASY.—Trade name for electric air pumps manufactured by the Globe Mfg. Co., Battle Creek, Mich.

DEAD END.—The terminal attachment of a wire or cable of an open wire line. It takes the pull of the spans.

DEAD-END EYES.—This is a special form of eye which can be fastened to the end of a wire or cable on a pole line. It is particularly adapted to the support of high-tension wires at crossings, for anchoring heavy wires at sharp turns or where they terminate to run into underground cable.

Manufacturers:

Hickey & Schneider, Inc., 434-43 E Jersey St., Elizabeth, N. J. "H & S."

Honewell Insulation & Mfg. Co., Inc. Hopewell, Va.

HUBBARD & CO., Pittsburgh, Pa. See this company's entry under Nuts, eye. —Adv.

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

LINE MATERIAL CO., S. Milwaukee Wis. (See display adv., page 1278.)

Matthews & Brother, Inc., W. N., 2912 Easton, Ave., St. Louis, Mo.

Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont. Can. "Peirce."

DEAD MAN.—A dead man is sometimes used in overhead line construction to anchor a guy wire. It consists of a log from 8 to 15 in. in diameter and anywhere from 5 to 12 ft. long. A guy rod or in some cases the guy wire itself is passed through the log and secured on the other side. The log is then buried horizontally to a depth of from 4 to 7 ft., depending upon the character of the soil and the load it must carry. This method of anchoring is not used as much now as formerly, because many good types of guy anchors are now available that require much less digging than is necessary for a dead man. See Anchors, guy.

DEAD NUMBERS.—In every telephone exchange, automatic and manual, there are some call numbers which are not assigned to any subscriber, either because they are spare numbers, or the telephone which previously had it is disconnected, or the number of the telephone has been changed. It is customary to run all dead numbers, especially those which are likely to be called, through "dead number" trunks to a desk where a clerk can inform the calling subscriber of the conditions.

DEAGAN, INC., J. C.—1770 Berteau Ave., Chicago, Ill. Manufacturer of electrically operated musical instruments. Business established 1880. President, J. C. Deagan, Sr.; vice-president, secretary and general manager, J. C. Deagan, Jr.; treasurer, Ella Deagan; sales manager, M. L. Jones.

DEALER, ELECTRICAL.—A term used in the industry to designate a retail electrical merchant. In 1920 there were 6721 electrical dealers in the United States, whose merchandising activities were confined almost entirely to electrical goods. There were also approximately 29,000 retailers in other fields handling electrical products. There were in addition 3410 electric central stations operating retail electrical departments. Also see Contracting, electrical.

DEALERS ELECTRIC LIGHTING CO.—500 E. 40th St., Chicago, Ill. Manufacturer of storage batteries and lamp clamps. President, Howard Glen; secretary, F. A. Emmons.

DEAN.—Trade name for electric valve control manufactured by the Cutler-Hammer Mfg. Co., 12th St. & St. Paul Ave., Milwaukee, Wis.

DEAN.—Trade name for boiler tube cleaners manufactured by the William B. Pierce Co., 45 N. Division St., Buffalo, N. Y.

DEAN.—Trade name for electric ash hoist manufactured by Washburn & Granger, Inc., 50 Church St., New York, N. Y.

DEAN BROS. STEAM PUMP WORKS.—Indianapolis, Ind. Manufacturers of electric and steam pumps. President, Edward H. Dean; vice-president, Stuart Dean; secretary and treasurer, John C Dean. Main office and factory, 323 W. 10th St., Indianapolis, Ind. Branch office, 141 Broadway, New York, N. Y.

DEANE.—Trade name for electric sterilizers, cooking, heating and labor-saving devices manufactured by the Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y.

DEAN'S.—Trade name for boiler-tube cleaners manufactured by the Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y.

DEARBORN CHEMICAL CO.—Chicago, Ill. Manufacturer of lubricating oil and grease, water treating compounds and rust preventatives. Business established about 1890. President, Robert F. Carr; vice-presidents, George R. Carr, J. D. Purcell and G. W. Spear; secretary, W. A. Converse; treasurer, F. L. Baker; general manager, George R. Carr. Main office, 332 S. Michigan Ave., Chicago, Ill. Factories, Chicago, Ill., and Toronto, Ont., Canada. Branch offices and warehouses, 731 Majestic Bldg., Denver, Colo.; 816 E. 3rd St., Los Angeles, Cal.; 299 Broadway, New York, N. Y.; 727 Frisco Bldg., St. Louis, Mo.; Sheldon Bldg., San Francisco, Cal. District offices, 1407 Candler Bldg., Atlanta, Ga.; John Hancock Bldg., Boston, Mass.; 302 Morgan Bldg., Buffalo, N. Y.; 2001 Union Central Bldg., Cincinnati, Ohio; 1273 W. 111th St., Cleveland, Ohio; 1321 Majestic Bldg., Detroit, Mich.; Fletcher-American Bank Bldg., Indianapolis, Ind.; 1109 Park Ave., Kansas City, Mo.; 696 Prospect Ave., Milwaukee, Wis.; 309 Jefferson Bldg., Peoria, Ill.; 574 The Bourse, Philadelphia, Pa.; 1622 Farmers Bank Bldg., Pittsburgh, Pa.; 1262 Grand Ave., St. Paul, Minn.; Syracuse, N. Y.; Washington, D. C.; Toronto, Ont., Canada.

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DECARIE BOILER & INCINERATOR CO.—3324-30 St. Hubert St., Montreal, Que., Can. Manufacturer of boilers, economizers and other boiler room equipment. Business established 1915. Secretary and treasurer, A. S. Decarie; general manager, F. L. Decarie.

DECATUR PUMP & MFG. CO.—634 E Cerro Gordo St., Decatur, Ill. Manufacturer of electric pumps, pump governors, switches, etc.

DECKER ART STUDIOS, M. R.—4026 N. Keeler Ave., Chicago, Ill. Manufacturers of portable electric lamps and parchment lamp shades. President and treasurer, M. R. Decker; vice-president, C. R. Decker; secretary, Miss Harriet Bowe; sales manager, A. J. Decker.

DECOHERER.—See Coherers and decoherers, radio.

DECOMPOSITION VOLTAGE. — The voltage disappearing in an electrolytic cell in doing chemical work. The energy thus absorbed (volts×amperes) is equal to the chemical work done, and cannot therefore appear as the evolution of sensible heat in the cell. It can be calculated with considerable accuracy by adding up the heat absorbed in the chemical reactions or changes produced, expressing this in calories per gram-equivalent weight of chemical change involved, and dividing by the constant 23,050, the thermochemical equivalent of one volt (96,500 joules=23,050 calories). Example: If water, H_2O, is decomposed into H_2 and O, 69,000 calories is absorbed, or 34,500 per chemical equivalent of change. The decomposition voltage is therefore 34,500/23,050=1.5 volts.

DECORA.—Trade name for illuminating glassware manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

DECORATIVE LIGHTING SPECIALTIES.—See Lighting specialties.

DECORATORS SUPPLY CO.—2547 Archer Ave., Chicago, Ill. Manufacturer of electric lighting fixtures. President, Oscar Spindler; secretary and treasure, W. T Foster.

DECREMENT, LOGARITHMIC.—A term used to characterize the rate of decrease of the wave emitted by a damped-wave radio transmitting station. It is defined as the logarithm of the ratio of one current peak to the one which occurs one cycle later. According to the United States radio laws, the logarithmic decrement of a transmitting station shall not be greater than 0.2. See Radio laws and regulations of the United States.

DECREMETERS, RADIO.—Instruments for measuring the logarithmic decrement of damped electromagnetic waves, such as are emitted by a damped-wave radio transmitting station. A decremeter is necessary to make sure that the decrement is within the prescribed limits.

Manufacturers:

Doolittle Co., F. M., 817 Chapel St., New Haven, Conn.
Simon, Emil J., 217 Broadway, New York, N. Y.

DEDENDA.—Trade name for car gongs manufactured by the J. G. Brill Co., 62nd St. & Woodland Ave., Philadelphia, Pa.

DEE ELECTRIC CO.—79 W. Monroe St., Chicago, Ill. Manufacturer of fire alarm thermostats. Business established 1920. General manager, David G. Dee.

DEER CO., INC., THE A. J.—Hornell N. Y. Manufacturer of electric meat and food choppers, grinders, roasters, slicers and peanut butter machines. Business established 1905. President, treasurer and general manager, A. J. Deer; vice-president and sales manager, L. G. Robbins; secretary, T. A. Dean. Main office and factory, Hornell, N. Y. Branch offices New York, N. Y.; Brooklyn, N. Y.; Boston, Mass.; Chicago, Ill.; Detroit, Mich.; Pittsburgh, Pa.; Indianapolis, Ind.; St. Louis, Mo.; San Francisco, Cal.; Los Angeles, Cal.; Philadelphia, Pa.; Buffalo, N. Y.; Cleveland, Ohio.

DEFECTOMETER. — Trade name for magneto testing apparatus manufactured by Paul G. Niehoff & Co., Inc., 232-242 E. Ohio St., Chicago, Ill.

DEFENDER.—Trade name for boiler room instruments manufactured by the Defender Automatic Regulator Co., St. Louis, Mo.

DEFENDER AUTOMATIC REGULATOR CO.—St. Louis, Mo. Manufacturer of boiler room instruments.

DEFIANCE PACKLESS VALVE CO.—431 S. Dearborn St., Chicago, Ill. Manufacturer of valves. President, L. J. Kadeski; vice-president, O. J. Deschauer; secretary, J. D. Gray; treasurer, B. F. Kowalewski.

DEFIANCE WELDING CO., THE.—700 Phelps Ave., Defiance, Ohio. Manufacturer of acid aprons for storage battery service stations, electroplaters, etc. Business established 1912. President, H. D. Bokop; vice-president, A. W. Martin; secretary treasurer and general manager, F. A. Bokop.

DEFLECTORS, ARC.—In rupturing a circuit carrying a heavy current or a very high voltage, usually direct current, a large and destructive arc is formed just where the circuit is broken. In order to prevent destruction of the arcing contacts and give them relatively long life baffles or arc deflectors are used which divert the arc away from the arcing metal or carbon contacts.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.

DEFLECTORS, AUTOMOBILE HEADLIGHT.—See Controls, automobile headlight.

DEFLECTORS, CAR HEATER.—Usually a sheet of steel fastened over electric heaters to prevent pocketing of the heat as under seat cushions.

Manufacturers:

Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y.

DE FOREST, LEE, INC.—451 3rd St. San Francisco, Cal. Manufacturer of radio telephone and telegraph equipment. Business established 1920. President, Lee de Forest; vice-president, treasurer and general manager, R. M. Klein; secretary, C. W. Eastin; sales manager, Charles Grubbs.

DE FOREST RADIO TELEPHONE & TELEGRAPH CO.—1415 Sedgwick Ave., New York, N. Y. Manufacturer of radio equipment. Business established 1913. President and secretary, Lee de Forest; treasurer and general manager, Charles Gilbert. Factory, San Francisco, Cal.

DEGREE, ELECTRICAL.—A 360th part of the distance from a point on one pole of an electrical machine to the corresponding point of the next pole of like sign. In a two-pole machine, the electrical and the actual degrees are identical; in a four-pole machine the electrical degree is one-half of the actual; with six poles, it is one-third, etc.

DEHYDRATION OF FUSED SALTS.—Electrochemically, the evolution of hydrogen and oxygen by passing current through a fused salt. The water contained therein is thus decomposed, and perfectly anhydrous fused salts are thus obtained. This is a usual preliminary to electrolyzing the salt to separate it into its ultimate constituents.

DEK-A-RO.—Trade name for lighting fixtures manufactured by the Highlands Mfg. Co., Muncie, Ind.

DE LAVAL FURNACE.—One of the earliest electric furnaces designed for the electrothermic reduction of zinc ores.

DE LAVAL SEPARATOR CO.—165 Broadway, New York, N. Y. Manufacturer of electric cream separators.

DE LAVAL STEAM TURBINE CO.—Trenton, N. J. Manufacturer of electric blowers, generators, pumps, etc. Vice-president and general manager, F. W. Kennedy; sales manager, H. L. Watson. Main office, Nottingham Way, Trenton, N. J. Branch offices, Peoples Gas Bldg., Chicago, Ill.; Seattle, Wash. Sales representatives, Dravo-Doyle Co., Philadelphia, Pa.; Pittsburgh, Pa.; Cleveland, Ohio; Indianapolis, Ind.; Turbine Equipment Co., New York, N. Y.; Power Equipment Co., Boston, Mass.; Thermal Efficiency Co., Kansas City, Mo.; Burford, Hall & Smith, Birmingham, Ala.; Herzog Electric & Engineering Co., San Francisco, Cal.; H. J. Rich Co., Duluth, Minn.; Walter Casianedo, New Orleans, La.; Advance Machinery & Supply Co., Denver, Colo.; J. U. Jones Dallas, Tex.; J. R. Purser, Charlotte, N. C.; Salt Lake Hardware Co., Salt Lake City, Utah; Turbine Equipment Co., Toronto, Ont.,; E. Laurie Co., Montreal, Que.; Taylor Engineering Co., Vancouver, B. C., Can.

DE LA VERGNE MACHINE CO.—East 138th St., New York, N. Y. Manufacturer of oil engines.

DELAWARE HARD FIBRE CO.—Wilmington, Del. Manufacturer of fiber specialties. President, Mrs. Anna Swift Rupert; secretary and treasurer, Charles G. Rupert; general manager, Frank Rupert; sales manager, J. K. Johnston. Main office, Wilmington, Del. Branch office, 50 Church St., New York, N. Y. Sales representatives, A. J. Coxe Co., 564-70 W. Monroe St., Chicago, Ill.; F. K. Simmons Electric Co., Fuller Bldg., 108 18th St., Philadelphia, Pa.

DELCO-LIGHT CO. — Dayton, Ohio. Manufacturer of farm lighting and power plants, power stands and water systems. President, Col. E. A. Deeds; vice-president, C. F. Kettering; secretary and treasurer, R. D. Funkhouser; general manager, R. H. Grant.

DELICA WHITE.—Trade name for illuminating glassware manufactured by the Pittsburgh Lamp Brass & Glass Co., Pittsburgh, Pa.

DELITE.—Trade name for electric washing machines and vacuum cleaners, manufactured by the Delite Mfg. Co., Bryan, Ohio.

DELITE MFG. CO., THE.—Bryan, Ohio Manufacturer of electric washing machines and vacuum cleaners. President, E. C. Carroll; secretary, H. E. Huffman.

DELLMAN.—Trade name for welding compounds manufactured by the Century Tool & Metal Co., 180 N. Market St., Chicago, Ill.

DELTA.—Trade name for vehicle lamps manufactured by the Delta Electric Co., Marion, Ind.

DELTA.—Trade name for galvanometers manufactured by Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.

DELTA.—Trade name for electric traveling cranes manufactured by the New Jersey Foundry & Machine Co., 90 West St., New York, N. Y.

DELTA CONNECTION.—An arrangement of a three-phase system in which the three individual phase circuits are connected in series is called a delta connection. Also see Ring connection.

DELTA ELECTRIC CO.—Marion, Ind Manufacturer of lamps and dry batteries. Main office, Marion, Ind. Branch offices, Times Square Bldg., New York, N. Y.; Rialto Bldg., San Francisco, Cal. Sales representative, Bissett & Webb Ltd., Winnipeg, Man., Can.

DELTA-STAR ELECTRIC CO.—Chicago Ill. Manufacturer of high-tension switching and protective equipment. Business established 1908. President and general manager, H. W. Young; secretary and treasurer, A. S. Pearl. Main office and factory, 2433-53 Fulton St., Chicago, Ill. Branch offices, 25 Broad St., New York, N. Y.; 76 Pearl St., Boston, Mass.; E. & B. Bldg., Rochester, N. Y.; City Bank Bldg., Syracuse, N. Y.; 601 Ellicott Square, Buffalo, N. Y.; 518 Traction Bldg., Indianapolis, Ind.; Railway Exchange, St. Louis, Mo.; 59 Broadway, Salt Lake, Utah; Hodge Bldg., Seattle, Wash.; 1333 Realty Trust Philadelphia, Pa.; 1633 Tremont St., Denver, Colo.; Union Arcade, Pittsburgh, Pa.; 67 Yonge St., Toronto, Ont., Can.

DELTABESTON.—Trade name for wire manufactured by the D & W Fuse Works of General Electric Co., Providence, R. I.

DELTATAPE.—Trade name for asbestos tape manufactured by the D & W Fuse Works of General Electric Co., Providence, R. I.

DE LUXE.—Trade name for receiving transformers manufactured by the Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

De LUXE.—Trade name for violet-ray apparatus manufactured by the Master Electric Co., 113 S. Jefferson St., Chicago, Ill.

DE LUXE.—Trade name for decorative electric fans manufactured by L. Plaut & Co., 434 E. 23rd St., New York, N. Y.

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DE LUXE.—Trade name for motor-driven desk type sewing machines manufactured by the Singer Sewing Machine Co., 149 Broadway, New York, N. Y.

DE LUXE.—Trade name for farm lighting plants manufactured by the Stearns Motor Mfg. Co., Box 252, Ludington, Mich.

DE LUXE.—Trade name for power plant tanks manufactured by the United Conveyor Corp., Old Colony Bldg., Chicago, Ill.

DE LUXE.—Trade name for electric washing machine manufactured by the White Lily Mfg. Co., Davenport, Iowa.

DE LUXE WAYNE.—Trade name for electric vibrator manufactured by the Shelton Electric Co., 16 E. 42nd St., New York, N. Y.

DELUXLITE.—Trade name for lighting fixture made by the Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

DEMAGNETIZATION.—The process of removing the magnetism from a magnetic substance. Several methods may be used. The best one is to subject the magnet to a series of cycles in an alternating magnetic field which is at first strong and then gradually decreases in intensity until it is zero. A second method is by heating to a red heat. By bringing the poles of the magnet into contact with like poles or by reversing the directions of the motions by which its magnetism was originally imparted, the same results may often be accomplished.

DEMAGNETIZERS, TOOL.—When hardened steel work is removed from a magnetic tool it retains some magnetism. This is not objectionable in ordinary work, but in such cases as pawls, gages and similar parts this magnetism must be removed. This is done by a demagnetizer, which imposes a field of opposite polarity upon the magnetized part. This may be done by either a direct or an alternating field. An alternating current by rapid reversals of polarity obtains the desired result. A direct current must be flashed on and off by a switching device. The commercial a-c. devices are of two forms. One is simply an encased hollow coil. The work is drawn or dropped through the core of the energized coil which subjects it to the alternating field. The other is a horseshoe electromagnet generally placed inside a box, on the cover of which are two flat plates of soft iron forming the pole faces of the magnet. The pieces to be demagnetized are laid across the plates and a current sent through the coil. The pieces are thus quickly demagnetized. The d-c. demagnetizers are generally used in connection with magnetic chucks or other d-c. magnets, their purpose being to demagnetize the iron or steel parts of the magnets. They are essentially a switch which when thrown in one direction energizes the coils of the magnet, magnetizing the iron parts; upon throwing the switch in the opposite direction the current is reversed an instant and neutralizes the magnetism in the iron.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brewster Co., Inc., The William, 30 Church St., New York, N. Y. "Demagnetool."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York, N. Y. "Bull Dog."
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Heald Machine Co., The, 10 New Bond St., Worcester, Mass.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

DEMAGNETIZERS, WATCH.—A watch whose main spring has become magnetized keeps time very inaccurately. Watch demagnetizers for use with alternating-current supply consist of a hollow coil of a number of turns of wire. When the coil is energized the periodic reversals of the current produce corresponding reversals in the polarity of the magnetic field, which has an effect such as to demagnetize any object held within that field. A watch, knife or other small object can be almost instantly demagnetized when held within the energized coil. Direct-current demagnetizers are in principle the same, but are equipped with an auxiliary commutating or equivalent device which in effect produces an alternating field.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Quick Action Ignition Co., South Bend, Ind.

DEMAGNETOOL.—Trade name for demagnetizers manufactured by the William Brewster Co., Inc., 30 Church St., New York, N. Y.

DEMAND-FACTOR.—The electric lamps, motors and other appliances in a consumer's premises are used at different hours and rarely all at the same time. The ratio of the maximum demand of the installation to the total connected load is called the demand-factor. Thus, if a house has a connected load of 4,000 watts and a maximum demand of 2,000 watts, the demand-factor is 50%.

DEMAND, MAXIMUM.—The maximum amount of electric power taken by a consumer during a given time is known as his "maximum demand." Certain systems of rates for electric service make a charge based on the maximum demand, in addition to the charge for electricity consumed. The maximum demand is measured over a prescribed time interval by means of demand meters or demand indicators. See Meters, demand.

DEMCO.—Trade name for panels, panelboards, switchboards, switches, etc., manufactured by the Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal.

DEMOREST PROCESS.—A process for the electrolytic extraction of antimony, which see.

DENNISON MFG. CO.—Framingham, Mass. Manufacturer of tags, labels and similar specialties. Business established 1844. President, Henry S. Dennison; vice-president, Horace Lockwood; treasurer, Harold B. Hayden; sales managers, M. B. Freeman, C. E. Benson.

DENTAL ELECTRICAL CONTROL BOARDS, PANELS OR CABINETS.—Small electrical switchboards for the electrical control of devices used in connection with dental work. They are often mounted in a cabinet that also encloses a small motor-driven air compressor and storage tanks. The control board or panel generally has control rheostats and switches together with a voltmeter and pilot lamp. Several instruments, such as special lamps, cautery electrodes, wax spatulas, hot-air blowers, etc., are all controlled from the same panel. The cabinet also serves to hold other special electrodes, lamps and instruments.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y. "Columbia."
Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

DENTAL ENGINES, ELECTRICAL.—A suspended electric motor with a flexible shaft for operating hand tools used by a dentist working on teeth. It generally is a universal motor and is controlled by a foot-operated switch. Drills, grinding and polishing disks, brushes, etc., are operated by the motor.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y. "Ritter."
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."

DENTAL INSTRUMENTS AND APPLIANCES, ELECTRICAL, NOT OTHERWISE LISTED.—This classification includes such devices as air compressors, spray-bottle warmers, and electrosterilization or ionization outfits, which are not listed elsewhere under separate headings.

Manufacturers:

Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y. (Electric pulp tester.) "Columbia."
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y. "Ritter."

DENTAL LABORATORY APPLIANCES, ELECTRICAL.—This classification includes various appliances for use in the dental laboratory not listed under a separate heading. Such devices as lathes, porcelain muffles, air pumps, pulp testers, and magnifying radioscopes come under this general heading.

Manufacturers:

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. (See display adv. page 1294.)
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Betz Co., Frank S., Hoffman St., Hammond, Ind.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y. "Ritter."
Santiseptic Mfg. Co., 26 Bay St., New Brighton, Staten Island, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Weeks Mfg. Co., H. G., Hamilton, Ohio.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."

DENTAL STERILIZERS.—See Sterilizers, electric, dental.

DENTAL X-RAY EQUIPMENT.—See X-ray dental chairs; also X-ray units or sets, dental.

DENTALITE.—Trade name for dental lamp manufactured by the Anderson Electric & Equipment Co., 154-160 Whiting St., Chicago, Ill.

DENTALYTE.—Trade name for dental lamp manufactured by the Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y.

DENVER ENGINEERING WORKS CO. THE.—30th & Blake Sts., Denver, Colo. Manufacturer of electric hoists. Business established 1895. President and general manager, Frank E. Shepard; vice-president and treasurer, Edwin S. Kassler, Jr. Sales representatives, Salt Lake Hardware Co., Salt Lake City, Utah; Collins & Webb, Los Angeles, Cal.

DENVER FIRE CLAY CO.—Denver, Colo. Manufacturer of fire brick, oil burners, etc. President, H. O. Bosworth; vice-president, J. Clairs Evans; secretary and treasurer, H. Landenberger. Main office and factory, Denver, Colo. Branch offices, Salt Lake City, Utah; Chemists Bldg., New York, N. Y.

DENVER SIREN.—Trade name for electric sirens for fire alarms, curfews and general signaling service manufactured by the Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

DENVER TRAFFIC SIGNAL & MFG. CO., THE.—1835 Williams St., Denver, Colo. Manufacturer of automobile traffic signals. Business established 1916. President, treasurer and general manager, Edwin H. Roberts; secretary, L. M. Roberts.

DENZAR.—Trade name for office and store lighting unit manufactured by the Beardslee Chandelier Mfg. Co., 216 S. Jefferson St., Chicago, Ill.

DEPOLARIZATION.—Usually, the suppression of gas evolution at an electrode by placing upon the electrode or in the electrolyte some chemical reagent which will react with and thus absorb, or prevent the evolution of the gas. In the Leclanche primary cell, the cathode is surrounded by lumps of manganese dioxide, MnO_2, which by being reduced to MnO furnishes oxygen to unite with the hydrogen which would otherwise be liberated and polarize the cell by covering over the cathode and hindering the passage of current.

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DEPOLARIZERS. — Substances which when placed upon an electrode, or in the electrolyte in contact with the electrode, suppress the evolution of gas upon the electrode and thus prevent the gas bubbles from covering the plate, producing increased resistance and generating back electromotive force.

DEPOSITION.—The electrolytic action in which metal in solution is precipitated and deposited upon the surface of an electrode. This is more correctly called electrodeposition, but very commonly known as electroplating, which see.

DERAILERS OR DERAILS, CAR TRACK.—A device for throwing car wheels from the track. Derails are a safety device and are installed as a part of an interlocking system of protection or they may be thrown in an emergency by hand. They are placed at points of unusual danger, such as the approaches to railroad crossings or swing bridges. Their function is to detail the train, in case danger signals have been ignored, rather than let it run into the much more serious danger of a collision or plunge into the open draw of a bridge. Derails vary in design from a simple switch placed in one rail of the track and operated by a hand lever to highly specialized electrical apparatus working automatically or through the tower of an interlocking plant.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Cleveland Frog & Crossing Co., Cleveland, Ohio. "Porter."
Q & C Co., The, 90 West St., New York, N. Y. "Q & C."
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Ramapo Iron Works, Hillburn, N. Y.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Superior."
Wharton, Jr. & Co., Inc., William, Easton, Pa.

DERBY.—Trade name for electric release box designed to close fire doors, etc., manufactured by the American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.

DERBY.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DERBY FIRE SENTINEL.—Trade name for fire alarm rheostat made by the American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y.

DERF MFG. CO., INC.—9 Walker St., New York, N. Y. Manufacturer of spark plugs. Business established 1918. President and general manager, Frederick Gerken, Jr.; vice-president, H. C. Woodruff; secretary and treasurer, Joseph L. Egan. Exclusive distributor, Derf Sales Co., 1311 S. Figueroa St., Los Angeles, Cal.

DERRICKS, ELECTRIC.—Motor-operated derricks are coming into use on large construction jobs where electric power is available. The derrick itself is practically the same whether steam-engine or motor-driven and, in the smaller sizes, as the hand-operated derrick. The motor is connected to the hoisting drum on the derrick through rope drive or belting or else the hoisting rope passes over a pulley to the drum which is connected to the motor shaft by a clutch. Electric drive has many advantages over engine drive, including simplicity and ease of operation by even unskilled operatives, elimination of fire risk, fuel and water for the boiler, and economy due to operation only when power is needed without maintaining an attendant to keep up a fire all night to prevent freezing of the boiler.

Manufacturers:

American Hoist & Derrick Co., St. Paul, Minn.
Bedford Foundry & Machine Co., Bedford, Ind.
Clyde Iron Works, 27th Ave., W. & Michigan St., Duluth, Minn. (Exclusive distributor, Clyde Iron Works Sales Co.)

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

DESERT.—Trade name for power transmission belting manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

DESIGN PATENTS.—See Patents, design.

DESIGNATION STRIP.—A strip of meta on a telephone switchboard near switchboard jacks made to hold labels showing the kind of circuits attached to the jacks, or their destination.

DESK FANS, LAMPS, TELEPHONES.—See Fans, desk and bracket; Lamps, desk; Telephones, desk stand.

DESK-FLEX.—Trade name for desk lamp manufactured by the Aladdin Mfg. Co., Muncie, Ind.

DESK, TELEPHONE, CHECKING.—This is a desk which is used in suburban or in intercity traffic work to record the calls for which payment is to be made. Subscribers who have flat-rate service between the points handled do not call through it or are passed free by the use of a discriminating time or other signal.

DESK, TELEPHONE, INFORMATION.—This is the desk at which the information clerk (operator) works. It is equipped with a directory, card files, etc., and trunk lines from the switchboard.

DESKOLITE.—Trade name for desk lamp manufactured by the Ovalite Co., 313 E. 22nd St., New York, N. Y.

DESKS, TELEPHONE, CHIEF OPERATOR'S, MONITOR'S AND SUPERVISOR'S—The chief operator's desk is usually located in the operating room in such a position as to command a view of the entire room. As the chief operator has charge of employing new operators, preparing reports, attending to complaints, keeping records of individual work and conduct of the operating force and supervising some calls, the desk is a combination of writing desk and telephone equipment. The telephone equipment is used for monitor or supervisory work and permits the person at the desk to talk to any of the operators, or to listen to their work and conversation without their knowledge. Special equipment is required in order that the connections may be completed without the usual click being noticed.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen STs., Chicago, Ill. (See display adv. page 1327.)
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

DESKS, TELEPHONE, WIRE CHIEF'S—Wire chief's desks are used in smaller exchanges and in some large exchanges to provide a convenient arrangement of testing equipment and instruments necessary in line maintenance and trouble finding. It is merely a desk located near the distributing frames and other apparatus in the terminal room. The desk is equipped with all the necessary keys, line jacks, testing circuits, voltmeter, lamps, bridge connections, etc., and enables the wire chief to determine the approximate place and cause of trouble. In some large exchanges a separate test panel is used in place of the desk.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Stromberg-Carlson Telephone Mfg. Co. 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

DES MOINES ELATERITE.—Trade name for insulating paints manufactured by the Elaterite Paint & Mfg. Co., W. 11th & Market Sts., Des Moines, Iowa.

DESMOND INCANDESCENT LAMP CO.—719-21 Bergen Ave., Jersey City, N. J. Manufacturer of incandescent lamps.

DESMOND-STEPHAN MFG. CO.—Urbana, Ohio. Manufacturer of grinding and emery wheel dressers. President, George McConnell.

DESPATCH MFG. CO.—116-122 1st Ave. N., Minneapolis, Minn. Manufacturer of electric cooking and heating appliances. President and treasurer, A. E. Grapp; vice-president, R. E. Ahlberg; secretary, H. L. Grapp.

DETECTIVE DICTOGRAPH. — Trade name for telephonic listeners for detectives manufactured by the Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.

DETECTOR, SUBMARINE.—A telephonic device used to tell from which direction an underwater sound is coming. Two microphone cells are placed on the submerged forward part of a ship, one on the right side and the other on the left side. One transmitter actuates a receiver worn on one ear of the observer. The other microphone cell actuates another receiver worn by the same observer on the other ear. All underwater sounds are thus heard by the observer. He listens to that particular sound in which he is interested and cuts out each receiver alternately. If the sound is equal in loudness in both ears, the source is straight ahead. If it is louder in the right ear, the source is off to the right. By turning the ship to the right or left the direction can be ascertained. For manufacturers, see Telephonic detectors for submarines.

DETECTORS, FIRE.—See Alarms, fire.

DETECTORS, GROUND.—These are devices used in connection with ungrounded circuits to indicate an accidental connection to ground. D-c. ground detectors are essentially differentially wound d-c. voltmeters; one end of each coil is grounded and the other two ends are connected (through incandescent lamps) respectively to the two sides of the system. For low-voltage a-c. circuits ground detectors are also differentially wound voltmeters connected as indicated above. On high-voltage a-c. circuits electrostatic instruments are used. For single-phase systems, the electrostatic detector consists of three vanes, two fixed and one movable; the two fixed vanes are connected to the two respective sides of the circuit and the movable vane is grounded. When an accidental ground occurs on either side of the line, the corresponding fixed vane and the movable vane become of like polarity, hence the movable vane deflects and indicates a ground. If the instrument is calibrated, the deflection will give an indication of the character or completeness of the ground. For three-phase systems a similar device is used; there are three fixed vanes and a spherical movable vane which is grounded. Another type of ground detector has been developed for voltages from 15,000 to 100,000, which indicates a ground by the absence of a luminous discharge. This detector consists of a rarefied-gas bulb into which are sealed two electrodes, one connected to one side of line, while the other is grounded. In normal operation the charging current to ground produces a luminous discharge in the bulb; when the line is grounded, however, the potential of the two electrodes is the same and the discharge ceases.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of electrostatic ground detectors including single and polyphase instruments. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

DETECTORS, RADIO.—A device for detecting and rectifying the high-frequency energy absorbed at a radio receiving station. There are many devices used as detectors, the most common of which are the crystal detector and the electron tube, the latter being by far the superior and now most used.

In the crystal detector, use is made of rectifying action which exists at the point of contact of certain crystals with a metal wire. Some of the crystalline substances possessing this property are carborundum, galena ore, iron pyrites and silicon. In the electron tube detector use is made of the rectifying action which exists between the grid and filament or of the nonlinear char-

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acteristics of the grid-voltage plate-current curve. See Electron tubes for further details.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "Jove."
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill. "Amplifigon."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Crystaloi."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
General Radio Co., 11 Windsor St., Cambridge, Mass.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y. "Meraco."
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
Parkin Mfg. Co., San Rafael, Cal.
Radio Electric Co., The, 3807 5th Ave., Pittsburgh, Pa.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Simon, Emil J., 217 Broadway, New York, N. Y.
Wireless Mfg. Co., 619 4th St., N. W., Canton, Ohio. "Wimco."
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

DETECTORS, TERMINAL OR POLARITY.—Before connecting direct-current circuits for storage-battery and electrochemical work it is often necessary to determine the polarity of the circuits. If the circuit is remote from the power source or for other reasons difficult to trace as to polarity, a terminal or polarity detector may be used for this determination. These detectors are simple in construction and usually small and compact so that they may be conveniently carried about in the pocket.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Manhattan."

DETECTORS, WATCHMEN'S TIME.—These are portable mechanical devices, the purpose of which is to produce an accurate record of the watchman's patrol. They are often called watchmen's portable clocks. They record, on sealed dials, the time of each visit the watchman makes to each station. The paper dial upon which the record is kept is mounted in a small case with a clock which rotates the dial, the device being carried on a belt by the watchman in making his rounds. The record is usually embossed on the dial by inserting a key or other simple device permanently attached at the various stations on the beat. As each embossed symbol generally a number or letter, is different the paper dial provides an accurate record of each visit to each station and the time of the visit. To prevent tampering with the recording device the instruments are usually so constructed as to register on the dial any attempt to open or otherwise tamper with the instrument.

Electrical watchmen's recording systems are in many respects superior to these portable clocks, though the latter are in considerable use. For electrical systems see Clocks, electric, watchmen's time recording; also Boxes, watchmen's signal.

Manufacturers:

American Watchman's Clock Co., 150 Nassau St., New York, N. Y. "American."
American Watchman's Time Detector Co., 3403 Perkins Ave., Cleveland, Ohio. "Cleveland Magneto."
Eco Clock Co., 197 Congress St., Boston, Mass.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Hardinge Bros., Chicago, Ill.
Hausberg, E. O., 49 Maiden Lane, New York, N. Y. "Guardian."

DETERIORATION OF ELECTROLYTE—The gradual accumulation of impurities in an electrolyte which renders it more and more difficult to plate pure metal from it When the contamination has reached a certain point it becomes necessary to remove part or all of the electrolyte for purification. Older practice was to remove it all, at long intervals; more modern practice is to remove a part at frequent intervals.

DETINNING.—The removal of the thin coating of tin on tin scrap, in order to save the tin and make the iron or steel fit for use in a steel furnace. The tin scrap is put into crates, and immersed as anode in a solution containing tin salts and also usually other metallic salts, such as sodium chloride, to make it more conducting. Metallic tin dissolved at the anode is plated out on a suitable cathode, as spongy or mossy tin, which is collected, washed, pressed, and melted down.

DETONATORS, ELECTRIC BLASTING—A cylindrical copper shell having at one end a charge of fulminate of mercury (a powerful explosive). Two insulated copper wires held together by a sulphur bridge are inserted in the other end of the tube. A fine fuse wire across the wire ends is surrounded by gun-cotton. A current of electricity heats the fuse wire, ignites the gun-cotton and explodes the fulminate, which sets off the main blasting charge. These detonators are often called fuse caps or priming caps. Similar detonators are also used in exploding naval and military shells and bombs.

Manufacturers:

Aetna Explosives Co., Inc., 120 Broadway, New York, N. Y. "Lion."
Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.
Du Pont de Nemours & Co., E. I. Du Pont Bldg., Wilmington, Del. "Victor," "Pul Up," "U. S. Standard."
New York Blasting Supply Co., 11 Broadway, New York, N. Y. "Nuyork."

DETRICK CO., M. H.—155 E. Superior St., Chicago, Ill. Manufacturer of fire brick and ash conveyors. President, M. H. Detrick; vice-president, W. Classman; secretary, L. Ryan; treasurer and general manager, L. Hosbein.

DETRICK-HAGAN.—Trade name for ash conveyors manufactured by the M. H. Detrick Co., 155 E. Superior St., Chicago, Ill.

DETROIT.—Trade name for steam traps manufactured by the American Blower Co., Detroit, Mich.

DETROIT.—Trade name for boilers tanks, feed water heaters and separators manufactured by John Brennan & Co., 24th St. & M. C. R. R., Detroit, Mich.

DETROIT.—Trade name for electrically lighted computing and weighing scales manufactured by the Detroit Automatic Scale Co., 32 Antietam St., Detroit, Mich.

DETROIT.—Trade name for spark coils manufactured by the Detroit Coil Co., 439-447 Fort St., E., Detroit, Mich.

DETROIT.—Trade name for electric furnaces made by the Detroit Electric Furnace Co., 642 Book Bldg., Detroit, Mich.

DETROIT.—Trade name for electric branding irons made by the Detroit Electrical Branding Iron Co., 205 Griswold St., Detroit, Mich.

DETROIT.—Trade name for electric hoisting machinery made by the Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich.

DETROIT.—Trade name for rubber-covered wires manufactured by the Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich.

DETROIT.—Trade name for oiling devices manufactured by the Detroit Lubricator Co., Trumbull, Lincoln, Marquette & Viaduct, Detroit, Mich.

DETROIT.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Parkersburg, W. Va.

DETROIT AUTOMATIC SCALE CO.—32 Antietam St., Detroit, Mich. Manufacturer of electrically lighted computing and weighing scales. Subsidiary of Computing-Tabulating-Recording Co., 50 Broad St., New York, N. Y.

DETROIT COIL CO.—Detroit, Mich. Manufacturer of spark coils and battery switches. Business established 1911. President, treasurer and general manager, C. C. Cleverdon; vice-president, J. R. Cleverdon; secretary, J. F. Stobbe. Main office and factory, 439-447 Fort St., E., Detroit, Mich. Branch office, Canadian Coil Co., Ltd., Walkerville, Ont., Can.

DETROIT ELECTRIC CO.—Detroit, Mich. Manufacturer of electric pleasure vehicles.

DETROIT ELECTRIC FURNACE CO.—642 Book Bldg., Detroit, Mich. Manufacturer of electric furnaces. Business established 1918. President and general manager, E. L. Crosby; vice-president, O. F. Flumerfelt; secretary, E. J. Raybould; treasurer, C. B. Bohn.

DETROIT ELECTRICAL BRANDING IRON CO.—205 Griswold St., Detroit, Mich. Manufacturer of electric branding irons. Business established 1920. President, A E. Gutman; vice-president, C. V. Zimmerman; secretary, A. C. Wortley; treasurer, Joseph B. Goldberg; general manager, G. S. Totten.

DETROIT HOIST & MACHINE CO.—Morrow & Marston Sts., Detroit, Mich. Manufacturer of compressed air and electric hoisting machinery. Business established 1905. President and general manager, J. C. Fleming; vice-president, Theodore Beyster; secretary and treasurer, F. J. Martin.

DETROIT INSULATED WIRE CO.—Wesson Ave. & Albert St., Detroit, Mich. Manufacturer of rubber-covered wires. President, J. H. Hunter; vice-president, J. G. Splane; treasurer, W. G. Dalgleish; sales manager, C. C. Gray. Sales representatives, William P. Crockett Co., 411 S. Jefferson St., Chicago, Ill.; L. A. Woolley, Inc., 83 Ellicott St., Buffalo, N. Y.; R. S. Wakefield, 222 Interurban Bldg., Dallas, Tex.; L. P. Clark, 1307 Race St., Philadelphia, Pa.; Robertson Supply Co., 2317 1st Ave., Birmingham, Ala.; Davis-Cottrell Co., 332 1st Ave., Birmingham, Ala.; Baker-Joslyn Co., 183 1st St., San Francisco, Cal.; 330 Azusa St., Los Angeles, Cal.; 526 1st Ave., S., Seattle, Wash.

DETROIT LUBRICATOR CO.—Trumbull Lincoln, Marquette & Viaduct, Detroit, Mich. Manufacturer of oiling devices. President and general manager, C. H. Hodges; vice-presidents, C. B. Hodges, H. I. Lord, F. C. Blanchard; secretary and treasurer, F. W. Hodge; sales manager, H. I. Lord.

DETROIT OAK BELTING CO.—Detroit, Mich. Manufacturer of leather belting. Main office and factory, Detroit, Mich. Branch offices, Cleveland, Ohio; Atlanta, Ga.

DETROIT PRESSED STEEL CO.—6660 Mt. Elliott Ave., Detroit, Mich. Manufacturer of wheels for electric vehicles and trucks and steel stampings. President, Hobert B. Hoyt; vice-president, Carl H. L. Flintermann; treasurer, Rudolph Flintermann; secretary, Howard A. Coffin.

DETROIT SHOW CASE CO.—1654-1700 W. Fort St., Detroit, Mich. Manufacturer of showcases for electrical stores. President. John Petz; vice-president, Edward

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Bland; secretary and treasurer, Herbert Malott.

DETROIT STEEL CASTING CO.—Detroit, Mich. Manufacturer of steel castings for electrical machinery.

DETROIT STOKER CO.—Detroit, Mich Manufacturer of boiler furnaces and mechanical stokers. Business established 1900. President and general manager, W. H. Rea; vice-president, J. W. Thompson; secretary and treasurer, W. H. Riecks. Main office, Woodward & Horton Aves., Detroit, Mich. Branch offices, New York, N. Y.; Boston, Mass.; Philadelphia, Pa.; Cleveland, Ohio; Chicago, Ill.; Atlanta, Ga.; Cincinnati, Ohio.

DETROIT TWIST DRILL CO.—Detroit Mich. Manufacturer of twist drills, reamers and special tools. Business established 1894. President, Muir B. Snow; vice-president, Lewis H. Jones; treasurer, H. H. Sanger; secretary, P. C. Hill. Main office and factory, Fort St. West at 14th St., Detroit, Mich. Branch office, 45 Warren St., New York, N. Y.

DETROIT VELOCITY.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

DEUSE, J. S.—Chester, Conn. Manufacturer of electricians' and bell hangers' bits, gimlets, etc. Business established 1867.

DeVEAU.—Trade name for electric signaling and telephone apparatus manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

DeVEAU INTERTALK.—Trade name for intercommunicating telephones manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

DeVEAU INTERTALK MAGNIPHONE—Trade name for loud-speaking telephone manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

DEVERALL PERFECTION MFG. CO.—Caton Ave. & E. 8th St., Brooklyn, N. Y. Manufacturer of oilers. President, I. Zimmermann; secretary, L. Zimmermann; treasurer, J. Zimmermann.

DEVIATION OR DISTORTION FACTOR.—The deviation or distortion-factor of a wave is the ratio of the maximum difference between corresponding ordinates of the wave and of the equivalent sine wave of equal length, to the maximum ordinate of the equivalent sine wave when the waves are superposed in such a way as to make this maximum difference as small as possible.

DE VILBISS MFG. CO., THE.—3750 Detroit Ave., Toledo, Ohio. Manufacturer of pneumatic paint spraying machines. Business established 1888.

DEVINE CO., J. P.—Buffalo, N. Y. Manufacturer of vacuum drying and impregnating apparatus for electrical work. President, J. P. Devine; vice-president, C. P. Devine; treasurer, H. B. Lauman; sales manager, L. W. Graves. Main office, 1372 Clinton St., Buffalo, N. Y. Branch office, 50 E. 42nd St., New York, N. Y. Sales representative, C. B. Acheson, 1368 Peoples Gas Bldg., Chicago, Ill.

DEVO.—Trade name for gaskets manufactured by the Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J.

DEVOE ELECTRIC SWITCH CO., THE—414 Notre Dame St., W., Montreal, Que., Can. Manufacturer of knife switches, switchboards, panelboards, steel and wood cabinets and other electrical specialties. Business established 1902. General manager, R. Moncel.

DE VRY CORP.—Chicago, Ill. Manufacturer of generators, motion-picture machines and stereopticons. Business established 1910. President, Herman A. De Vry; vice-president and secretary, Bernard De-Vry; treasurer and general manager, H. C. Isbell; sales manager, A. E. Gundelach. Main office, 1250 Marianna St., Chicago Ill. Branch office, 141 W. 42nd St., New York, N. Y. Sales representatives, Schweig-Engel Film Corp., 4927 Delmar Blvd., St. Louis, Mo.; Atlas Educational Film Co., 821 Market St., San Francisco, Cal.; John W. Graham & Co., Spokane Wash.; Service Film & Supply Co., 393 Oak St., Portland, Ore.; W. H. Shurtliff Co., 514 Cliff Bldg., Salt Lake City, Utah; Equitable Film Corp., 928 Main St., Kansas City, Mo.; Harcol Film Co., 330 Camp St., New Orleans, La.; D. F. Parker, 1928 Main St., Dallas, Tex.; J. A. Edwards, 4639 Wentworth Ave., S., Minneapolis, Minn.; John T. Millen, 724 Penobscot Bldg., Detroit, Mich.; Visual Equipment Co., 306 Youngerman Bldg., Des Moines, Iowa; Pittsburgh Commercial Motion Picture Co., 1010 Forbes St., Pittsburgh, Pa.; Lewy Studios, 217 N. Liberty St., Baltimore, Md.; E. F. Farrington, 1108 Boylston St., Boston, Mass.

DEWES CO., THE A.—199 Lafayette St. New York, N. Y. Manufacturer of flexible metallic conduit and armored cable. Business established 1906. President, W. L. Lyman; vice-president, O. D. Frost; secretary, treasurer and general manager. Charles Fisk; sales manager, O. N. Dunbar. Sales representative, D-E Distributing Co., 9 S. Clinton St., Chicago, Ill.

DEWSBERRY, R. A.—1932-36 W. Lake St., Chicago, Ill. Manufacturer of motor-driven ice cream freezers.

DEXTER CO., THE.—Fairfield, Iowa. Manufacturer of electric washing machines. Business established 1903. President, L. O. Gaines; vice-president, W. H. George; secretary, treasurer and general manager, R. D. Hunt; sales manager, J. W. Ward. Branch offices and warehouses, Toledo, Ohio; Albany, N. Y.; Peoria, Ill. Sales representatives, Fairbanks, Morse & Co., Kansas City, Mo., and St. Louis, Mo.; Lee Coit Andreesen Hardware Co., Omaha, Neb.; Janney, Semple, Hill & Co., Minneapolis, Minn.; M. Seller & Co., Portland, Ore.; Spokane, Wash.; Seattle, Wash.; General Paper & Supply Co., Madison, Wis.

DEXTER-REYNOLDS MFG. CO., INC.—128 N. Wells St., Chicago, Ill. Manufacturer of electric washing machines and cleats. Business established 1921. President and sales manager, C. H. Reynolds; secretary, L. N. Kerrigan; treasurer, A. L. Dexter.

DEXTRO.—Trade name for grease cups manufactured by the Lunkenheimer Co. Cincinnati, Ohio.

DE ZENG STANDARD CO.—Camden, N. J. Manufacturer of diagnostic lamps for eye, ear and throat.

DFC.—Trade name for fire brick, oil burners, etc., manufactured by the Denver Fire Clay Co., Denver, Colo.

D. G. D. P.—Abbreviation for deep-grooved double-petticoat as applied to insulators of distribution lines. For triple-petticoat types the form D. G. T. P. is used.

D. H. EGYPTIAN.—Trade name for fiber specialties manufactured by the Delaware Hard Fibre Co., Wilmington, Del.

DIAL, CALLING, AUTOMATIC TELEPHONE.—That part of an automatic calling device which is rotated by the subscriber in sending a call. A numbered plate is placed under the moving part to indicate the proper number. The act of calling a number is known as "dialing." The proper procedure to operate a dial calling device in making a call in an automatic system is as follows:

To dial "354", remove the receiver from the hook, place the finger in the dial hole marked "3", turn the dial clockwise until the finger strikes the finger stop, remove the finger and let the dial rotate back freely until it stops; then place the finger in the hole marked "5", turn the dial again to the finger stop and let it return freely to normal; repeat the operation lastly from the hole marked "4." If the dial is hastened or hindered in its rotation back to normal, it may cause a wrong number to be secured, or no number at all. If such a mistake be made, hang up the receiver for one second, remove it again and dial the number over again.

DIALS, ELECTRICAL INSTRUMENT.—Dials are graduated plates, strips of paper or other surfaces over which the pointer of an instrument moves. On indicating instruments the dials are very commonly called scales. On some resistance boxes and potentiometers the value of the resistance in the circuit is also indicated on circular dials. Dials on switchboard instruments are often illuminated to facilitate reading at a distance. For the same reason some dials are black with white figures

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (For radio.) (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Crowe Name Plate & Engraving Co., 1749 Grace St., Chicago, Ill.
Electro-Chemical Engraving Co., The 440-458 19th St., Brooklyn, N. Y.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Metallograph Corp., The, 1100 Brook Ave., New York, N. Y.
Parkin Mfg. Co., San Rafael, Cal.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
Western Radio Electric Co., 550 S. Flower St., Los Angeles, Cal. "Wesrad."

DIALS, LUMINOUS.—Watch, clock and instrument dials are made luminous by coating the numbers or scale and the hands or indicating pointer with a compound which absorbs light and when in darkness gives off a phosphorescent glow. These compounds, the exact nature of which is a trade secret, in the cheaper grades contain no radium but in the better grades a very minute quantity of that substance is used. The radium compounds have much greater luminous power and life.

DIALS, WATT-HOUR METER.—These are the enameled and graduated circles over which the hands move, or on which is indicated the amount of energy that has been delivered. The dial hands are the rotating pointers that move over the dials. The dial face is the enameled plate upon which the dials are graduated. It contains four or five circular dials.

Manufacturers:

Crowe Name Plate & Engraving Co., 1749 Grace St., Chicago, Ill.
Electro-Chemical Engraving Co., The, 440-458 19th St., Brooklyn, N. Y.
Metallograph Corp., The, 1100 Brook Ave., New York, N. Y.
Premier Metal Etching Co., 14th St. & Van Alst Ave., Long Island City, N. Y. "Premier."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

DIAMAGNETIC BODIES.—Those whose permeability is less than unity. The permeability of free space is taken as unity. Bismuth is an example of diamagnetic substances. Also see Permeability.

DIAMO-CARBO.—Trade name for grinding wheel dressers manufactured by the Desmond-Stephan Mfg. Co., Urbana, Ohio.

DIAMOND.—Trade name for motor-driven paper cutter for printers manufactured by the Challenge Machinery Co., Grand Haven, Mich.

DIAMOND.—Trade name for lightning rods manufactured by the Diamond Cable Co., Bourbon, Ind.

DIAMOND.—Trade name for chains and sprockets for power transmission manufactured by the Diamond Chain & Mfg. Co., 502 Kentucky Ave., Indianapolis, Ind.

DIAMOND.—Trade name for Christmas tree lighting outfits, flashlights and flashlight batteries manufactured by the Diamond Electric Specialties Corp., 101-103 S. Orange Ave., Newark, N. J.

DIAMOND.—Trade name for cable clamps and other specialties manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

DIAMOND.—Trade name for soot blowers manufactured by the Diamond Power Specialty Co., Detroit, Mich., and Diamond Specialty Co., Windsor, Ont., Can.

DIAMOND.—Trade name for lighting reflectors manufactured by Klemm & Co., 132 N. 5th St., Philadelphia, Pa.

DIAMOND.—Trade name for power transmission chains manufactured by the Philadelphia Gear Works, E. Vine St., Philadelphia, Pa.

DIAMOND.—Trade name for safety appliances and first aid equipment manufactured by the Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa.

DIAMOND.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DIAMOND BRAND.—Trade name for cedar poles and posts produced by the W. G. Chaney Co., Peyton Bldg., Spokane, Wash.

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DIAMOND C.—Trade name for switch boxes, switchboards and panelboards manufactured by the Consolidated Electric Mfg. Co., Inc., 223-25 N. 13th St., Philadelphia, Pa.

DIAMOND CABLE CO.—Bourbon, Ind. Manufacturer of lightning rods. Business established 1910. President, Charles A. Wood; vice-president, George F. Kiger; secretary and treasurer, D. S. Bowman.

DIAMOND CHAIN & MFG. CO.—502 Kentucky Ave., Indianapolis, Ind. Manufacturer of chains and sprockets for power transmission. Business established 1890. President, L. M. Wainwright; vice-president, G. A. Wainwright; secretary and treasurer, A. D. Johnson; general manager, D. McWorkman; sales manager, T. J. King.

DIAMOND CUPPED BEARING CO.—130 Manhattan St., New York, N. Y. Manufacturer of jewel bearings for electrical instruments. President, D. C. Satterwhite; treasurer, Joseph G. Wyman.

DIAMOND DETROIT.—Trade name for soldering coppers manufactured by the Motor Products Corp., Detroit, Mich.

DIAMOND DRILL CARBON, THE.—53 Park Row, New York, N. Y. Manufacturer of raw mica and diamonds for industrial purposes. Business established 1907. President, Arthur A. Glass; vice-president, I. Henry Hirsch; secretary, Harry A. Bloomberg; treasurer and general manager, J. H. Hirsch.

DIAMOND E.—Trade name for service entrance fittings manufactured by the Standard Specialty Mfg. Co., Cleveland, Ohio.

DIAMOND ELECTRIC SPECIALTIES CORP.—Newark, N. J. Manufacturer of Christmas tree lighting outfits, flashlights and flashlight batteries. Business established 1912. President and treasurer, F. M. Rosenfeld; secretary and sales manager, W. D. Kahn. Main office, 101 S. Orange Ave., Newark, N. J. Branch office, 109 N. Dearborn St., Chicago, Ill.

DIAMOND EXPANSION BOLT CO.—New York, N. Y. Manufacturer of pole-line hardware, etc. W. M. Stoker, sole owner. Main office, 90 West St., New York, N. Y. Branch offices, 126 N. 10th St., Philadelphia, Pa.; 156 2nd St., San Francisco, Cal.; 180 N. Market St., Chicago, Ill.; 1735 Boatmen's Bank Bldg., St. Louis, Mo.; 290 St. Paul St., W., Montreal, Que., Can.; 403 Keewayden Bldg., Winnipeg, Man., Can.

DIAMOND F.—Trade name for fiber and fiber products manufactured by the Diamond State Fibre Co., Bridgeport, Pa.

DIAMOND GRID.—Trade name for storage batteries manufactured by the Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.

DIAMOND H.—Trade name for switches and automobile accessories manufactured by the Hart Mfg. Co., 230 Hamilton St., Hartford, Conn.

DIAMOND N.—Trade name for stone drills manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

DIAMOND N-Y.—Trade name for expansion shields manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

DIAMOND OIL CO.—1538 Land Title Bldg., Philadelphia, Pa. Manufacturer of protective paints.

DIAMOND POWER SPECIALTY CO.—Detroit, Mich. Manufacturer of soot blowers. Branch offices, Boston, Mass.; Pittsburgh, Pa.; Hartford, Conn.; Atlanta, Ga.; New Orleans, La.; Philadelphia, Pa.; New York, N. Y.; Washington, D. C.; Memphis, Tenn.; Houston, Tex.; Chicago, Ill.; Kansas City, Mo.; Denver, Colo.; Buffalo, N. Y.; Milwaukee, Wis.; San Francisco, Cal.; Seattle, Wash.; St. Louis, Mo.; Indianapolis, Ind.; Cincinnati, Ohio.

DIAMOND REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-86 W. 106th St., Cleveland, Ohio.

DIAMOND RUBBER CO., THE.—Akron, Ohio. Manufacturer of belting, switchboard matting, molded insulation, packing and other rubber products. Branch offices, 263 Peachtree, St., Atlanta, Ga.; 867 Boylston St., Boston, Mass.; 1925 Michigan Ave., Chicago, Ill.; 1011 E. 15th St., Kansas City, Mo.; 1780 Broadway, New York, N. Y.; 233 Water St., Norfolk, Va.; 519 N. Broad St., Philadelphia, Pa.; Garrison Ave. & Locust St., St. Louis, Mo.; 401 Mission St., San Francisco, Cal.; 115 King St., Seattle, Wash.; 1201 Young St., Dallas, Tex.

DIAMOND SPECIALTY CO.—Windsor, Ont., Can. Manufacturer of soot blowers.

DIAMOND STATE FIBRE CO.—Bridgeport, Pa. Manufacturer of fiber and fiber products. Sales manager, L. T. McCloskey. Main office, Bridgeport, Pa. Mills and factories, Bridgeport, Pa.; Elsmere, Del.; West Conshohocken, Pa.; Chicago, Ill.; Toronto, Ont., Can. Branch offices and warehouses, 1656 Besley Ct., Chicago, Ill.; 826 Drexel Bldg., Philadelphia, Pa.; 38 Chardon St., Boston, Mass.; 455 King St., W., Toronto, Ont., Can. District offices, 612 Star Bldg., St. Louis, Mo.; 720 Delaware St., Kansas City, Mo.; 820 Lumber Exchange Bldg., Minneapolis, Minn.; 803 Railway Exchange Bldg., Milwaukee, Wis.; 1003 Merchants Bank Bldg., Indianapolis, Ind.; 309 Hodges Bldg., Detroit, Mich.; 211 Palmetto Bldg., Greenville, S. C.; 413 Chamber of Commerce Bldg., Rochester, N. Y.; 422 Common St., New Orleans, La.; 117 Mechanic St., Newark, N. J.; 1008 Hippodrome Bldg., Cleveland, Ohio; Hearst Bldg., San Francisco, Cal.; Mutual Fire Insurance Bldg., Washington, D. C. Sales representative, George A. Verner & Son, 621 Charles Bldg., Denver, Colo.

DIAMOND X.—Trade name for guy clamps manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

DIAMONDS FOR INDUSTRIAL PURPOSES.—The diamond is the hardest known material and is, therefore, of value for certain industrial purposes. The diamonds so used are the carbonado or black diamond and very small or defective white diamonds of little or no value as jewels. The extreme hardness of the diamond makes it useful for cutting hard substances and consequently its chief industrial applications are as drill points in certain ore and rock drills, as abrasive wheel dressers, as glass cutters, as dies for drawing wire, etc. Also see Wire-drawing dies.

Manufacturers:

Diamond Drill Carbon Co., The, 53 Park Row, New York, N. Y. "Boytz."

DIANA.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DIAPHRAGM CELLS.—Electrolytic cells in which it is necessary to separate the anode and cathode compartments by means of a porous diaphragm to prevent the products in the two compartments from mixing. The materials from which the diaphragm may be made are numerous: clay, cement, asbestos, canvas, paper, etc.

DIAPHRAGM SOUNDER.—An attachment for main-line telegraph relays which so increases the sound made by the relay armature that the signals may be read without the addition of a locally operated reading sounder.

DIAPHRAGMS, ELECTROLYTIC CELL.—Porous partitions used in electrolytic cells to keep the anode solution (anolyte) apart from the cathode solution (catholyte.) They are made of unglazed porcelain and quite frequently in large-scale work of asbestos board impregnated with sulphur to stiffen it. Their porosity allows the solutions on the two sides to mix in the capillary passages of the partition and the electric current thus passes freely from solution to solution, but the two solutions are prevented from mixing freely with each other; they can only mix very slowly by diffusion in the capillary passages.

Manufacturers:

Asbestos Fibre Spinning Co., North Wales, Pa. (Asbestos)

DICK CO., A. B.—736 W. Jackson Blvd., Chicago, Ill. Manufacturer of motor-driven mimeograph and letter folding machines.

DICK CO., INC., R. & J.—Passaic, N. J. Manufacturer of power transmission belting. Main office and factory, Passaic, N. J. Branch offices, 55 Barclay St., New York, N. Y.; 136 N. 7th St., Philadelphia, Pa.; 62 Forsyth St., Kansas City, Mo.; 711 Tchoupitoulas St., New Orleans, La.; 320 Market St., Newark, N. J.; 63 W. Lake St., Chicago, Ill.; 111 St. Clair Ave., Cleveland, Ohio; Maritime Bldg., Seattle, Wash; 557 Mission St., San Francisco, Cal.; 920 N. Main St., St. Louis, Mo.

DICKBELT.—Trade name for balata belting manufactured by the R. & J. Dick Co., Inc., Passaic, N. J.

DICKE TOOL CO., THE.—Downers Grove, Ill. Manufacturer of telegraph, telephone and cable construction tools. Business established 1886. C. H. Dicke, owner.

DICKS-PONTIUS CO.—123-131 Wayne Ave., Dayton, Ohio. Manufacturer of sealing wax. Business established 1867. President, R. H. Dicks; secretary and treasurer, M. W. Dicks. Factories, Dayton, Ohio, and Columbia City, Ind.

DICTAGRAPH.—Trade name for phonograph dictating system manufactured by the Columbia Graphaphone Co., Woolworth Bldg., New York, N. Y.

DICTATING MACHINES, PHONOGRAPH.—These machines are primarily designed to save the lost time and expense incident to the stenographic-notes system. No knowledge of stenography is necessary when these machines are used; the operator need be a careful typist only and is able to devote her entire time to the typing of letters, reports, etc., thereby eliminating the lost time due to waiting for letters and taking short-hand notes of them. Her "load-factor" is thereby materially improved. The machines consist of a motor-driven wax cylinder upon which one may record speech by talking against a diaphragm, which causes a needle traveling along the wax cylinder to record the sound vibration upon the cylinder surface. Start, stop, and repeat controls allow the dictator to control the cylinder at will. The cylinders are then put into a phonograph or reproducing machine. They can be shaved smooth after use so that they may be used a number of times before becoming too thin for further use. These machines are much used in large offices where they are a great convenience and source of economy.

Manufacturers:

Columbia Graphaphone Co., Woolworth Bldg., New York, N. Y. "Dictagraph."

Edison, Inc., Thomas A., Orange, N. J. "Ediphone."

DICTOGRAPH.—Trade name for intercommunicating telephones manufactured by the Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.

DICTOGRAPH PRODUCTS CORP.—New York, N. Y. Manufacturer of intercommunicating telephone systems, hearing devices for the deaf, telephonic listeners, etc. President, Charles H. Lehman; vice-president, Edgar Lowe; secretary and treasurer, H. M. Delanoie. Main office, 220 W. 42nd St., New York, N. Y. Factory, Jamaica, Long Island, N. Y. Branch offices, Boston, Mass.; Pittsburgh, Pa.; Washington, D. C.; San Francisco, Cal.; Kansas City, Mo.; Philadelphia, Pa.; Los Angeles, Cal.; New Orleans, La.; 14 E. Jackson Blvd., Chicago, Ill.; Montreal, Que., Can.

DIE STOCKS.—See Stocks, die, conduit and pipe threading.

DIEHL MFG. CO., THE.—Elizabethport, N. J. Manufacturer of generators, motors, fans, and car ventilators. President and general manager, Hjalmar Hertz. Main office and factory, Elizabethport, N. J. Branch offices, Singer Bldg., New York, N. Y.; 586 Atlantic Ave., Boston, Mass.; 1305 Race St., Philadelphia, Pa.; 107 W. Jackson Blvd., Chicago, Ill.

DIELAC.—Trade name for insulating material manufactured by the Dielectric Mfg. Co., St. Louis, Mo.

DIELECTRIC.—Any medium or substance along which, or through which, electric charges are distributed with extreme slowness. Dielectrics are insulators. When a dielectric is subjected to a difference of potential some energy is stored in the dielectric. A dielectric may thus be thought of as an electrically elastic material which is displaced by the electric pressure, i. e., voltage. This energy is stored in the dielectric by what is known as the displacement current. The air, porcelain, glass, rubber, mica, paraffin, etc., are dielectrics much used in electrical engineering.

DIELECTRIC ABSORPTION.—When a condenser is connected to a constant source of e.m.f. the instantaneous charge is always followed by a small and steadily decreasing flow of electricity into the condenser. The additional charge seems to be absorbed by the dielectric. If the con-

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denser is discharged the first discharge is followed by a continuously decreasing current. The maximum charge in a condenser which is alternately charged and discharged varies with the frequency of the charge. This phenomenon is analogous to the viscosity of a liquid and it is sometimes called "dielectric viscosity."

DIELECTRIC CONSTANT.—That property of any substance which modifies the interaction of two electrified bodies immersed in, or separated by, this substance. It is a fundamental entity, and distinguishes electric units from mechanical units. For free space the dielectric constant k is $1/(9\times10^{20})$ in the electromagnetic units and $1/(9\times10^{11})$ in the practical units. The term "specific inductive capacity" was formerly used in place of dielectric constant.

DIELECTRIC CONSTANT, RELATIVE.—The relative dielectric constant or specific inductive capacity of a substance is defined as the ratio of its dielectric constant to the dielectric constant of free space. The following are relative dielectric constants often referred to:

Air	1.0059
Paraffin wax	2.00 to 2.3
Hard rubber	2.00 to 3.1
Mica	6 to 8
Commercial mica	2.5 to 5.9
Glass	6.6 to 9.9
Paper	1.7 to 2.6
Oiled muslin	3.5 to 5.5

DIELECTRIC HYSTERESIS.—A name applied to energy losses in dielectrics, other than those due to the leakage current. These losses are explained on the assumption that the molecules of the dielectric have a frictional resistance the overcoming of which converts some of the applied energy into heat. Later experiments cast some doubt on this explanation and indicate that the loss is due to leakage currents solely.

DIELECTRIC LOSS IN POWER CABLES.—At voltages above 10,000, there is a loss in the insulation of lead-covered cables which under some conditions becomes a matter of considerable importance. With varnished cambric and certain types of compounds used in oiled paper, the dielectric loss may be as much as the loss due to the flow of current in the conductor. This adds to the heat generated and reduces the safe carrying capacity of the cable greatly. The dielectric loss increases as the temperature of the cable increases, and above a certain critical point the heat added by the dielectric loss raises the temperature continuously until the insulation is charred and a burnout results. In recent years manufacturers of cable have made great improvements in cable compounds which have reduced this danger to a minimum.

DIELECTRIC MFG. CO.—224 S. Vandeventer Ave., St. Louis, Mo. Manufacturer of insulating compounds, paints, varnishes, wood preservatives, etc. Business established 1902. President, J. J. Kessler; sales manager, A. H. Kessler.

DIELECTRIC STRENGTH.—When a dielectric is subjected to an increasing voltage a value of voltage is finally reached at which the dielectric loses its insulating property. The dielectric breaks down or is punctured. The maximum difference of potential per centimeter thickness which the dielectric can stand without rupture is called its dielectric strength. The dielectric strength depends upon many different factors: (a) nature of dielectric, (b) distribution of dielectric flux, (c) thickness of dielectric, (d) previous treatment.

DI-EL-ITE.—Trade name for resistance units manufactured by the Wirt Co., 5221 Greene St., Philadelphia, Pa.

DIENER MFG. CO., G. W.—400 Monticello Ave., Chicago, Ill. Manufacturer of fire extinguishers. President, George W. Diener; secretary, H. W. Diener.

DI-EN-KEY.—Trade name for expansion shields manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

DIE-SINKING TOOLS AND OUTFITS.—The hand-controlled die-sinking outfits are small hand drills, motor-driven through flexible shafting, the drill being guided by hand. The drills are of many types and sizes suitable to the varied character of the work. Under this classification are also included the large reproducing, enlarging and reducing machines. These ingeniously reproduce and enlarge or reduce with accuracy any given pattern, the reproduction being made on metal, wood or composition. They are used not only for die-sinking but also for making accurate molds for metal, insulation and glassware.

Manufacturers:

Bushnell Mfg. Co., 2926 Telegraph Ave., Berkeley, Cal.
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Hickey & Schneider, Inc., 434-48 E. Jersey St., Elizabeth, N. J. "H & S."
Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."

DIES, ARMATURE CORE.—The laminations for armature cores are generally cut from the sheet in a punch press. The slots in the armature are usually cut in the same manner or in a notching machine. The steel dies used for this purpose in the presses, though simple in construction, are of importance due to their extensive use in the manufacture of motors, generators, transformers, and other apparatus using similar laminated cores.

Manufacturers:

Atcheson Tool & Die Co., 609 N. 4th St., Columbus, Ohio.
Midwest Mfg. Co., 117 N. Wells St., Chicago, Ill.
Modern Tool, Die & Machine Co., The, Columbus, Ohio. "Modern."

DIES FOR MOLDED INSULATION.—Molded insulation has come into very extensive use due not only to its insulating properties, but the further advantage which it possesses that it may be molded into a one-piece part thus eliminating the many small pieces of an equivalent built-up part. The parts must frequently be very exact in their dimensions and are consequently pressed in dies. Due to the great variety of the molded forms these dies are usually of special design suitable to the form and material of the part.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bucher-Smith Co., East Liverpool, Ohio.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Kuhn & Jacob Machine Tool Co., 28 Wood St., Trenton, N. J.
Moise-Klinker Co., 369 Market St., San Francisco, Cal.
Parkin Mfg. Co., San Rafael, Cal.
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

DIES, PIPE-THREAD CUTTING.—A steel or iron block having in a central opening spiral steel edges for cutting a thread on a pipe by placing the die in a stock or holder with double end handles, and turning it over the end of the pipe. Even though the die body is of iron the spiral cutting edges or chasers are of steel. The die holders are sometimes made in multiple forms, that is, to hold three or four dies for convenience in working where only three or four different sizes of pipe or conduit are used, as in electrical work. Die holders are also made for use in lathes and screw machines. Also see Stocks, die.

Manufacturers:

American Tap & Die Co., Greenfield, Mass. "Eagle."
Armstrong Mfg. Co., The, Bridgeport, Conn.
BORDEN CO., THE, Warren, Ohio. "Beaver", "Square-End".
Carpenter Tap & Die Co., The J. M., Pawtucket, R. I.
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Geometric Tool Co., The, Blake & Valley Sts., New Haven, Conn. "Geometric."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "Acorn", "Green River", "Lightning", "Little Giant", "G. T. D.", "O. K."
Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can. "Little Giant", "Green River", "Lightning", "O. K.", "Greenfield", "Acorn."
Ideal Tool & Mfg. Co., Beaver Falls, Pa. "Ideal."
Keystone Die Stock Co., 652 W. 47th St., Chicago, Ill.
Landis Machine Co., Waynesboro, Pa.
Midwest Mfg. Co., 117 N. Wells St., Chicago, Ill.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
Nye Tool & Machine Works, The, 108-28 N. Jefferson St., Chicago, Ill.
Rapid Tool & Machine Co., Ltd., 174 St. Joseph St., Lachine, Que., Can.
Toledo Pipe Threading Machine Co., The, Toledo, Ohio.
Winter Bros. Co., Wrentham, Mass. "Thistle Brand."

DIES, WIRE-DRAWING.—See Wire-drawing dies.

DIETZEL PROCESS.—A process proposed for the electrolytic refining of silver high in copper; it is in reality a combination of a process for electrolytically dissolving the bullion as anode, the silver being deposited from the resulting solution by cementation on copper in other vessels; when the desilverized liquors are run to the cathode compartment of the electrolytic cell for the deposition of the copper at the same time more silver is being dissolved at the anode.

DIETZGEN CO., EUGENE.—Chicago, Ill. Manufacturer of drawing materials. Business established 1893. President, Joseph Dietzgen; vice-president, O. L. Baumbach; secretary and treasurer, W. H. Lerch; general manager, A. Fred Allin. Main office, 166 W. Monroe St., Chicago, Ill. Branch offices, 218 E. 23rd St., New York, N. Y.; 18 1st St., San Francisco, Cal.; 615 Common St., New Orleans, La.; 805 Liberty Ave., Pittsburgh, Pa.; 807 Chestnut St., Philadelphia, Pa.; 407 10th St., N. W., Washington, D. C.

DIFFERENCE OF ELECTRIC POTENTIAL.—The difference of potential between two points due to an electric field is the work which would be done by the field in moving a unit positive charge from one point to the other. The potential of one point, B, is said to be higher than that of the other, C, if the field does work upon a positive charge which moves from B to C. The difference of potential between two points is commonly expressed by $V_b - V_c = E$. The unit difference of potential in the practical system is the volt. The potential difference between two points is one volt when it requires an expenditure of one joule of work to move one coulomb from the point of higher to the point of lower potential. Also see Volt.

DIFFERENCE OF MAGNETIC POTENTIAL.—The potential of a point P_1 is m/d_1 and of P_2 is m/d_2. The difference of potential between the two points is measured by the work required to move unit magnet pole from P_2 to P_1 against the magnetic force. The difference of magnetic potential is evidently $V_1 - V_2 = m/d_1 - m/d_2$. Difference of magnetic potential between two points in a magnetic circuit and magnetomotive force are physically the same quantities. Magnetomotive force is the difference of magnetic potential along a line of induction in the field back to the same point .

DIFFERENTIAL RELAY.—A relay composed of a differential magnet, constructed so that equal currents in the two windings produce neutralizing magnetic fields. In telegraph differential relays, the armature is held in a central position by the action of springs and is attracted to either side only at the time a difference in current value exists.

DIFFERENTIAL STEEL CAR CO.—Findlay, Ohio. Manufacturer of electric dumping cars for power plant and mine service. Business established 1915. President and treasurer, H. Fort Flowers; vice-president, Leon Fraser; secretary and sales manager, Shelley G. Hughes. Branch office 141 Broadway, New York, N. Y.

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DIFFERENTIAL WINDING FOR GENERATOR OR MOTOR.—A method of connecting the shunt and series fields of a compound wound motor or generator so that these fields will oppose each other.

DIFFRACTION.—The breaking up of a beam of light into its component colors or waves of different wave length, due to interference of the rays when deflected at the edge of an opaque body or through a narrow slit. Also see Refraction.

DIFFUSERS, AUTOMOBILE HEADLIGHT.—A general term applied to a class of devices sometimes used in automobile headlights for the purpose of scattering the beam or shaft of light given by the usual parabolic reflector. This diffusion may be accomplished by frosted or roughened glass in front of the reflector, or by a frosted lamp in the reflector. The object of this diffusion as originally proposed was to reduce the danger from glare in the eyes of opposing drivers, but this plan is now generally not approved by experts or by headlight laws based on the specifications of the Illuminating Engineering Society, and the Society of Automotive Engineers, drafted by their Headlight Committees. This is because it has been found that if enough light is thrown on the road with a diffusing device, so much is scattered around where it cannot be avoided by the eye of the opposing driver that the glare is very serious.

DIFFUSION COEFFICIENT OF DIAPHRAGMS.—The rate at which a solution on one side of a diaphragm can diffuse through it into the solution on the other side. This property depends on the porosity of the diaphragm and the size of the pores.

DIFFUSION, ELECTRIC AND MAGNETIC.—A state of being diffused, spread out or dispersed. It is applied to the flow of an electric current through a conducting body of irregular cross section, where the current tends to spread out in every direction and hence has varying densities. When applied to electric waves it refers to their dispersion in every direction through the ether. With magnetic flux or lines of force it is the spread or extent of the magnetic field outside of the direct path between poles.

DIFFUSION OF FLUIDS.—The mixing of one fluid with another without mechanical agitation; or, in more exact words, the equalization of the concentration of a substance throughout the whole space occupied by it. Example: A strong solution of a salt tends to diffuse into a weak solution with which it may be in contact, making a uniform solution of the whole.

DIGGERS AND DIGGING TOOLS, POLE OR POST HOLE.—See Augers, earth; Bars, digging and tamping; Boring machines, earth; Shovels and spoons, pole or post hole; Spades, pole or post hole.

DILCO.—Trade name for incandescent lamps manufactured by the Desmond Incandescent Lamp Co., 719-21 Bergen Ave., Jersey City, N. J.

DILG MFG. & TRADING CO.—27 E. 125th St., New York, N. Y. Manufacturer of electric fans, motors, generators, buffers and polishing machines.

DILL MFG. CO., THE.—694 E. 82nd St., Cleveland, Ohio. Manufacturer of electrical boxes. Business established 1909. President, J. D. Williamson; vice-president and general manager, E. F. Tobold; secretary and sales manager, A. E. Bronson; treasurer, A. P. Williamson.

DILLON ELECTRIC CO.—Mahoning Rd. & 11th St., N. E., Canton, Ohio. Manufacturer of electric buffers and grinders. President and general manager, Charles A. Dillon; vice-president, Howard R. Dillon; secretary, A. Forest Kring; treasurer, Edward W. Snyder.

DILLON STEAM BOILER WORKS, D. M.—Fitchburg, Mass. Manufacturer of boilers, smoke stacks, penstocks and other power plant equipment. President, D. M. Dillon; vice-president and secretary, D. F. Dillon; treasurer, F. N. Dillon. Main office and factory, Fitchburg, Mass. Branch office, 30 Church St., New York, N. Y.

DILUTION LAW.—As an electrolytic solution is diluted, between opposite parallel conducting plates, its electrical conductance tends to approach a maximum constant value. This is supposed to indicate the approach to complete dissociation of the solute—stated in terms of the dissociation theory.

DIM-A-LITE.—Trade name for regulating fixture socket and lamp socket dimming attachment manufactured by the Wirt Co., 5221 Greene St., Philadelphia, Pa.

DIMIT.—Trade name for automobile headlight dimmers manufactured by the Suburban Lighting Co., Toledo, Ohio.

DIMMERS, AUTOMOBILE AND CAR HEADLIGHT.—A device for reducing the brightness or candlepower of a headlight in order to reduce the blinding glare or dazzle in the eyes of those facing it. Dimming is usually resorted to when the automobile or interurban car enters a city or town whose street lighting eliminates the need for high illuminating power in the headlight. It is sometimes accomplished by reducing the voltage on the lamp by resistance or by the use of small lamps not in the focus of the reflector. Headlight dimming should not be confused with deflecting and diffusing schemes, which are distinctly different attempts to solve the glare problem. (Also see Headlights, electric, automobile.)

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The Benjamin Regulite controls the pressure of current from the Ford car magneto to the lamps. Prevents lamps being burned out through excess voltage and prevents lamps interfering with the ignition. Further information sent on request.—Adv.



Benjamin Regulite

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."

Clamert Mfg. Co., Pittsburgh, Pa. "Tirrill."

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Golden Glow."

Morse, Frank W., 289 Congress St., Boston, Mass.

NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)

Shaler Co., C. A., 22 Jefferson St., Waupun, Wis.

Suburban Lighting Co., Toledo, Ohio. "Dimit."

DIMMERS, LAMP SOCKET.—These are devices for turning down or "dimming" a single incandescent lamp. They are made with a standard medium lamp base to fit into any ordinary socket, and at the other end are provided with a similar socket. They contain a compact adjustable resistor in series with the lamp. The resistance is varied either continuously or in steps by a pair of pull chains. These dimmers are usually limited to 40 watts or less. They are a great convenience in hallways, bathrooms, nurseries, etc., where a small light is desired that can be quickly turned up to full candlepower. For dimming sockets that may be permanently attached to fixtures see Sockets, dimming or regulating.

Manufacturers:

Anylite Electric Co., Wall St., Fort Wayne, Ind. "Anylite."

Wirt Co., 5221 Greene St., Philadelphia, Pa. "Dim-A-Lite."

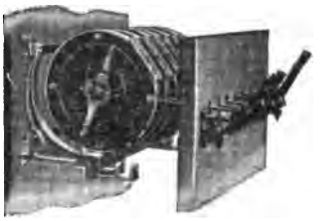
DIMMERS, THEATER OR STAGE.—A theater dimmer is a rheostat in series with a group of incandescent lamps used either for theater stage or auditorium lighting. Rheostats for this service are of the sliding contact type and have a very large number of steps so that the change in illumination is gradual. A separate rheostat may be provided for each circuit, but the operating levers are usually arranged so that any group or all of the rheostats may be operated at one time by a master lever, for instance, all the auditorium lights except the emergency lights. Where multicolor or polychrome lighting is used, the dimming resistance for the lamps of one color may be increased, while that of another color is reduced to produce a gradual transition from one color to another or to produce a composite color.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Dimmers have been in service since electricity was first used for stage lighting. The large and heavy dimmers known to pioneer electricians have long since given way to circular plate dimmers. The latest design of dimmer plate can be provided, where necessary, with a resistor on each side of the base. This really makes one plate equal to two of the older type. Each side may be used as a dimmer for a separate group of carbon-filament or tungsten lamps, or one of these plates may be used as a complete two-wire or three-wire dimmer. The contact buttons are of punched copper, ground smooth, so that there is very little friction between them and the contact lever. Operation is very easy. The terminals are of brass and are mounted on the circumference of the plate, where they are easily accessible. The well-known rack and pinion drive, first employed on Cutler-Hammer dimmers, is used for moving the brushes over the contact segments. The length of the operating levers makes it possible to obtain very gradual movement without jerky motions and consequent



A Bank of C-H Theater Dimmers

poor dimming effects. As every C-H Dimmer Plate is a complete self-contained piece of apparatus, it can be removed or replaced easily, and can be operated alone or in connection with others by individual or master levers; 110 steps of resistor are provided. The capacities of dimmers vary in lamp wattage from 450 to 13,200 watts. A few plates or many may be installed, according to requirements. More may be added, as occasion may require. Two types of dimmers are manufactured—interlocking and noninterlocking. The interlocking mechanism enables any number of plates to be operated at one time by means of a master lever. Noninterlocking dimmers must be operated by individual levers. In cases where a dimmer is desired simply for the purpose of controlling a number of separate lighting circuits, as in a church or public hall, the noninterlocking type will usually answer all requirements; but in theaters, moving-picture houses, lodge rooms and wherever impressive lighting effects are desired, interlocking dimmers should be used. The interlock makes it possible to secure gradual changes and blendings of color, which would otherwise be impossible of attainment. By means of the C-H interlocking mechanism, individual levers may be set at points giving various degrees of illumination, and then all picked up, one after another, by employing the master lever or wheel alone. See display adv. pages 1225-1230.—Adv.

Electrical Products Corp, 1128-34 W. 16th St., Los Angeles, Cal.

Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.

NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)

Pennefather, James S., 358 W. 43rd St., New York, N. Y.

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

DINGS MAGNETIC SEPARATOR CO.—Milwaukee, Wis. Manufacturer of magnetic separators and electromagnets. President, R. A. Manegold; vice-president, F. W. Manegold; secretary, W. E. Wehr; sales manager, P. R. Hines. Main office and factory, 800 Smith St., Milwaukee, Wis. Branch offices, 32 E. 42nd St., New York, N. Y.; 1718 California Ave., Denver Colo.; 18 Columbia St., W., Detroit, Mich.; 905 4th Ave., Richmond, Va.

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DINKEYS, POLE.—Small two-wheeled carts used for moving poles in line construction. A dinkey is usually made to carry one pole only, the pole lying across the top of the cart.

Manufacturers:

Dicke Tool Co., The, Downer's Grove, Ill.

DIPLOMA.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DIRECT CURRENT.—The name applied to an electric current that flows continuously in the same direction. Electric primary and storage cells are sources of direct e. m. f. and produce direct currents. A direct current may be continuous or pulsating, but ordinarily a continuous or nonpulsating current is implied. The term "undirectional current" is sometimes used in place of "direct current." The abbreviation d-c. is often used for direct current, especially when used adjectively, as d-c. motor, d-c. circuit.

DIRECT SEPARATOR CO.—Syracuse, N. Y. Manufacturer of steam separators.

DIRECTION FINDERS, RADIO.—Radio direction finders consist of a loop antenna free to turn on a calibrated circular scale, and a sensitive receiving apparatus. They make it possible to determine accurately the direction from which signals being received are sent. They are often called radio compasses. For a more detailed description see Compasses, Radio.

DIRECTION FINDING, RADIO.—Certain radio antennas have directional characteristics which make it possible for the receiving station to determine the direction of the transmitting station. Loop antennas are best adapted for direction finding. They receive best when placed with their plane in line with the transmitting station and poorest when perpendicular to that line. A number of direction-finding or radio-compass stations have been established at seaports. Signals from a vessel at sea are received simultaneously upon two loops several miles apart and directions determined which enable the exact location of the ship to be calculated.

DIRECTION OF CURRENT FLOW.—The direction in which an electric current is assumed to flow is from a positively electrified body to a negatively electrified body. This is based on the assumption that the positive state or positive potential is higher than the corresponding negative potential or state. It is only a convenience to ascribe this as the actual direction. Also see Current, electric.

DIRECTION OF MAGNETIC FLUX.—The direction in which magnetic lines of force are conventionally assumed to flow when passing on the outside of a magnet is out from the north-seeking pole through the air, re-entering the south-seeking pole. Within the magnet the direction of flow is from south to north poles.

DIRIGO.—Trade name for tanks, penstocks and towers made by Stevens Tank & Tower Co., 9-23 Center St., Auburn, Ma.

DISCHARGERS, ELECTROSTATIC.—See Neutralizers, static electricity.

DISCHARGERS, RADIO. — See.. Spark gaps, radio.

DISCONNECT.—The act of severing a telephone connection. It involves restoring to normal the apparatus used to connect the two telephones. The term may also be applied to severing the connection of any electric circuit, although the more common expression is "to open" the circuit. A disconnecting switch is sometimes called a disconnect or a disconnector.

DISCONNECTING SWITCHES.—See Switches, disconnecting.

DISCONNECTIVES, EMERGENCY, FOR DISTRIBUTION CIRCUITS.—In a-c. systems the lines cannot be arranged to cut out a section automatically except by the use of relays and oil switches. The expense of these is justified only on important transmission networks. The usual procedure in distributing circuits is, therefore, to operate each main branch or a feeder independently from one source of supply. At all points where branches from other circuits are accessible they are brought together and equipped with emergency disconnectives on a pole top or in a manhole. In case of trouble on the normal source of supply, the repair man opens the disconnectives at that point and closes them at the emergency point, thus restoring service on branches of the circuit which are not involved in the trouble.

On overhead circuits the disconnectives may be fuse boxes, disconnecting type single-conductor porcelain potheads, or knife switches. Oil switches, disconnecting potheads, or pothead switching boxes are used for underground circuits. It is rarely necessary to interrupt any considerable flow of current in handling emergency disconnectives, and oil switches are required only where large loads are involved.

DISCONNECTORS OR DISCONNECTS.—See Switches, disconnecting.

DISFICO.—Trade name for fiber insulation manufactured by the Diamond State Fibre Co., Bridgeport, Pa.

DISHES, CHAFING, ELECTRIC.—Electrically heated covered dishes for use on the table for cooking or warming food served directly from the dish. They are mostly used for light meals, such as in cooking fudge, rarebits, macaroni and various creamed dishes. The dishes are made to add to the attractiveness of the table and are usually of copper, highly polished, or are given a heavy nickel or silver plating.

Manufacturers:

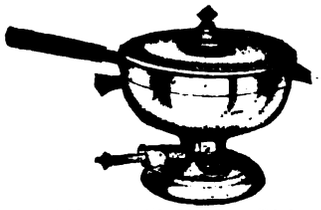
AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" chafing dish, in two designs. Made of heavy copper finished in polished nickel, double tin lined and equipped with safety fuse plug to prevent burning out element. Ebony finished wood handles. Complete with a 6-ft. twin conductor, gray silk cord, detachable plugs and attachment plug. —Adv.

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

EDISON ELECTRIC APLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. The chafing dish illustrated is constructed throughout of heavy sheet copper, nickel plated and polished. It is 10½ ins. high and 9 ins. in diameter. The design is a mission style of splendid design. The heating element is located in center of water pan making it most efficient. Two heats are obtained by inserting switch in either receptacle. In addition to the chafing dish shown, two more, different in design, are manufactured. The capacity of the food pan in all is 4½ pints. Wattage, 450 and 225. Comes complete with cord, attachment plug and interchangeable plug. See display adv. page 1292-3. —Adv.



"Hotpoint" Chafing Dish

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Manning, Bowman & Co., Meriden, Conn.

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

DISHWARMERS, ELECTRIC.—See Warmers, plate or dish.

DISHWASHERS, MOTOR-DRIVEN, HOTEL TYPE.—These are motor-driven machines operating in most cases on the same principles as the household types described in the next classification. For hotels, restaurants, clubhouses, institutions, etc., these represent much economy in labor cost of kitchen assistants. They are built in various capacities, some being able to contain several hundred dishes at one time. They are almost invariably permanently connected to the plumbing system so that hot water can be supplied and soiled water drained off by merely turning the proper valves. Where large baskets are used to contain the dishes, a simple form of hoist is sometimes provided to lift the baskets out of the steaming tank and also to lower freshly loaded baskets into it.

Manufacturers:

Blakeslee & Co., G. S., Cicero, Ill. "Niagara," "U. S.", "Rotary."

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. "Autosan." (Exclusive distributors, Couch & Dean, 1480 Broadway, New York, N. Y.)

Crescent Washing Machine Co., New Rochelle, N. Y. "Crescent."

Dunn Mfg. Co., 180 N. Dearborn St., Chicago, Ill. "Dunn's."

Fearless Dishwasher Co., Inc., 175-179 Colvin St., Rochester, N. Y. "Fearless."

Hamilton-Low Co., Jersey City, N. J. "P. D.", "Vortex", "Champion."

Insinger Co., 4651 Stenton Ave., Philadelphia, Pa.

MERMAID DISH WASHER CO., 61 Hubbard St., Middletown, Conn. See Dishwashers, motor driven, household type. —Adv.

Redmon, Edgar & Redmon, 218 S. 1st St., W., Cedar Rapids, Iowa. "E Z Way."

Success Dish Washing Machine Co., The, 640 Cushman St., Wooster, Ohio. "Success."

Street & Co., F. G., 132 Nassau St., New York, N. Y. "Victor."

Tupper Mfg. Co., 1122 W. 47th St., Seattle, Wash. "Tupper."

Walker Bros. Co., 225 Walton St., Syracuse, N. Y.

DISHWASHERS, MOTOR-DRIVEN, HOUSEHOLD TYPE.—Medium-sized metal tanks into which dishes in wooden or metal baskets are placed. A motor-driven pump forces hot soapy water around the dishes or, as in another type, the motor operates gears by which motion is imparted to the dish racks, thus moving the dishes through the hot soapy water in the tank. In some machines the dishes are also rinsed, after the washing water has been drained off, by spraying hot clean water among or over the dishes. Some types of household dishwashers are portable, being mounted on casters so they may be moved into an out-of-the-way corner in the kitchen when not in use; these require the water to be drained off into a pail. Others are permanently connected to the plumbing so that the hot water may be poured in by merely turning a faucet and the drain water run off to the soil pipe by opening a valve without lifting any water in either case.

Household dishwashers prove a source of economy in large households, as they may eliminate the need for a servant. In any case they are a means of performing one of the most disagreeable household duties and doing it in a far more sanitary manner than can be done by the ordinary methods using a quickly soiled (and usually foul-smelling) dishcloth in a pan of greasy water with little or no subsequent rinsing, but depending on the final drying with a dishtowel of questionable cleanliness to wipe off the greasy film on the dishes.

In the electric dishwasher the dishes are set on edge in baskets so that the spray can reach every part of their surface. Very hot water with a little soap will loosen any grease, egg or other dried stain in a few minutes. The soiled water is drained off and clean, hot water sprayed or splashed over the dishes, rinsing them effectively. The heat of the tank will itself dry the dishes if they are left standing in it for a few minutes. They are then ready to be put away without having been touched by any cloth or even by the hands during the washing, rinsing and drying processes. The power consumption of such a dishwasher seldom exceeds 300 watts, since only a small (fractional-horsepower) motor need be used.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

Blakeslee & Co., G. S., Cicero, Ill. "Niagara," "U. S.", "Rotary."

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

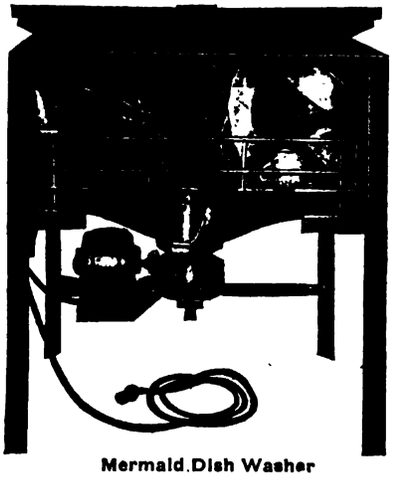
Conover Mfg. Co., 565 W. Van Buren St., Chicago, Ill. "Queen of the Kitchen."

Dow Mfg. Co., Braintree, Mass. "P. D. Q."

Dunn Mfg. Co., 180 N. Dearborn St., Chicago, Ill. "Dunn's."

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FITZGERALD MFG. CO., THE, Torrington, Conn. "Star."
Happy Home Industries, Madison Bldg., Detroit. Mich. "Happy Home."
Hollis, R. E., 551 N. Parkside Ave., Chicago, Ill. "Hollis."
Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y. "Easy Done."
International X-Ray Corp, 326 Broadway, New York, N. Y.
Jewel Electric & Mfg. Co., 5426 N. Broadway, Chicago, Ill.
MERMAID DISH WASHER CO., 61 Hubbard St., Middletown, Conn. The "Mermaid" dish washer consists of a copper tank 28 ins. long, 18 ins. wide, and 12 ins. deep, set upon four sturdy angle iron legs. Into this tank fits a substantial electrically welded steel wire tray of special design, in which the soiled dishes are loosely nested. The center of the washing pan or tank, at the bottom, has a conical depression



Mermaid Dish Washer

into which fits a two-bladed dasher, driven through a worm gear by a ¼ h. p. motor. Below the dasher, at the front, is a drain of ample diameter. Dishes, glassware and tinware may all be washed together, the time required for washing each trayful being from four to six minutes. The machine is self-cleaning and will not clog or sour. If desired, it may be attached permanently to the plumbing by any plumber at slight expense.—Adv.
Redmon, Edgar & Redmon, 218 S. 1st St., W., Cedar Rapids, Iowa, "EZ-Way."
Tupper Mfg. Co., Seattle, Wash.
Walker Bros. Co., 225 Walton St., Syracuse, N. Y.
Whirlpool Mfg. Co., 1629 Chestnut St., Philadelphia, Pa. "Whirlpool."

DISINFECTORS FOR CLOTHING, BEDDING, ETC.—These devices are used for disinfecting clothing and bedding in camps or in hospitals, also for sterilizing dressings or similar materials. The larger types are steam-operated only; the smaller types sometimes use electrical heating elements. The device usually consists of a jacketed cylinder or similar chamber in which the material is placed, and various devices for control of the temperature, pressure and circulation of the gas or steam. The chamber is generally operated with a partial vacuum.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American" (Kinyoun-Francis type).

DISINTEGRATION OF ELECTRODES.—The crumbling or deterioration of structure caused by uneven attack of the electrolytic action thereon. It is particularly noticeable in carbon electrodes used as anodes in sulphate solutions, where one part of the carbon, perhaps a part of the binder, is attacked by the electrolytic action, and the whole electrode soon breaks down into a sandy or granular residue.

DISK ARMATURE.—An armature having a core quite thin in a direction parallel to the shaft with the active conductors disposed on the flat ends. The disk armature revolves between poles whose cores are parallel to the shaft. It is almost an obsolete form.

DISK STOVES, ELECTRIC.—See Stoves, electric, disk or table.

DISKS, ARMATURE.—Thin circular sheets of electrical iron or steel from which the core of a rotating armature is built after notches have been cut in for forming the slots. See Armature punchings.

DISKS, GRAPHITE, RESISTANCE.—If a number of plates or disks of graphite, piled into a column, are placed in an electric circuit and pressure applied to the ends, it will be found that the resistance of the pile will vary approximately inversely as the pressure applied. This principle is utilized in certain types of rheostats known as the compression type. They have the advantage of an almost perfectly uniform variation in resistance and comparatively small bulk. The disks are generally circular in shape and of thickness and diameter suitable to the type of rheostat. They usually are mounted on an insulated rod, within a tube or in some laboratory forms simply lie in an open trough. Extra disks or plates of graphite should be available to replace any that may be broken.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

DISPATCHERS, ELEVATOR.—In the simple types these are push-button signaling systems by which the starter for a group of elevators may indicate to the individual operators by means of a bell, buzzer or lamp signal, when to start up or down on their trips. In dispatching systems that are more or less automatic the equipment becomes somewhat more complex. In one outfit the operation is entirely automatic; the equipment consists of a small motor-generator set that gives at definite time intervals a low-voltage signal for each car in turn, both at the bottom and top of the shaft, so that operation of the cars is timed with precision. The time interval can be adjusted to suit the heavier traffic at times of starting and quitting work, noon-hour traffic, etc., and individual cars can be cut out of the signal cycle. Such an automatic dispatcher may be installed in the office of the superintendent of the building and may have as an auxiliary a signal system to show visually by lamps the position of each car at all times.

Manufacturers:

Lockwood & Almquist, Inc., 218 E. 42nd St., New York, N. Y.

DISPATCHING OF RAILROAD TRAINS BY TELEPHONE.—The movement of steam railroad trains by telegraph was begun in the year 1850, and in the early eighties of the past century, shortly after the telephone was introduced, the use of the telephone for train dispatching purposes was adopted on small sections of railroad in various parts of the country It was not, however, until 1907 that the telephone was extensively applied to train operation on large trunk railroads. At the present time, perhaps 60% of the railroad mileage of the United States and Canada is so operated.

Telegraph apparatus is simpler and less expensive than telephone equipment, but telegraph operation requires specially trained Morse operators, while the telephone may be used by any intelligent person with normal voice and hearing. Also, trainmen themselves may by means of the telephone talk directly with dispatchers and officials when occasion demands.

Although satisfactory telephone service requires that a pair of wires be used as a circuit, while the telegraph requires but a single wire, telephone engineers have developed systems whereby a pair of telephone wires may be used as a telephone circuit and simultaneously, as one or two telegraph circuits; this is known as a composite system. In railroad service combinations of physical and phantom telephone circuits are also widely used.

Selective calling devices, which were in use as early as 1890, have within the past fifteen years been improved so that today there are various d-c. and a-c. types of selector in use on railroad telephone dispatching circuits. Dispatchers at terminal offices are provided with calling keys, which send out combinations of impulses designed to ring a bell at any desired way station, thus attracting the attention of the operator in charge. Recent improvements in selector circuits and apparatus developed by Rhoads make possible an "answer back" signal, enabling the dispatcher to know positively whether or not the signal bell at a station called has operated.

In the interest of economy of line wire the development of telephone train dispatching has been closely identified with advances made in telephony and telegraphy. The greater the number of talking and telegraph circuits that may be obtained with a given number of line wires, the greater is the economy in main line wires required. Standard telephone repeating coils, retardation coils and condenser arrangements are used in hooking up circuits for simultaneous telephone and telegraph use.

The Telegraph and Telephone Division of the American Railroad Association now has ready for distribution to its members standard circuit diagrams for connecting up telephone train dispatching circuits.

DISPERSION, COEFFICIENT OF.—The ratio of the total flux per pole developed by the excitation of a generator or motor to the flux which is useful by cutting the armature conductors. In salient-pole machines, the value of this coefficient is generally between 1.10 and 1.25. It is also called the "leakage coefficient."

DISPLACEMENT CURRENT.—When a circuit containing a condenser has a source of alternating current applied to it an electric strain is set up in the insulating medium of the condenser which reverses in direction for every alternation of the current. This electric strain is called electric displacement and its variation gives rise to a so-called displacement current.

DISPLAY BOARDS, FIXTURES, RACKS AND STANDS.—This classification includes all such fixtures, racks, boards or stands upon which one or more articles may be displayed, applying particulaly to those designed for electrical goods, such as automobile lamps, flashlights, wire samples, fuses, wiring fittings and supplies, etc. Much thought has been given to the design and manufacture of such display equipment so that the articles may be attractively and effectively exhibited in the windows and in the interior of electric shops. Also see Tables, display.

Manufacturers:

Acme Level & Mfg. Co., Toledo, Ohio. "Dunbar."
Bulletin Machine Co., 10-16 Lock St., Buffalo, N. Y. (Display boards.)
Heller & Co., W. C., Montpelier, Ohio.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
PERRY ROTARY FIXTURE CO., INC., Meridian, Miss.
Stevens & Co., 375 Broadway, New York, N. Y. "Heller."

DISPLAY STAGE LIGHTING CO.—314 W. 44th St., New York, N. Y. Manufacturer of stage lighting equipment. President, John Higham; vice-president, M. E. Kelly; secretary and treasurer, W. E. Price.

DISRUPTIVE CRITICAL VOLTAGE.—The voltage to neutral at which the disruptive voltage gradient is reached at the surface of a conductor.

DISRUPTIVE VOLTAGE GRADIENT.—The voltage gradient at the surface of the conductor at which a silent discharge will take place. It depends upon several factors. See Corona.

DISSOCIATION.—A chemical term designating the spontaneous breaking down of a compound into two or more constituents, without the aid of any other chemical agency. Examples: By heat alone, calcium carbonate is broken up into calcium oxide and carbon dioxide; at a high temperature an iodine molecule, I_2, breaks down into iodine atoms, 2I; at very high temperatures, water vapor dissociates partially into oxygen and hydrogen gas.

DISSOCIATION THEORY.—A theory of the nature of solutions, which regards salts dissolved in a solvent as being more or less dissociated into their constituent parts. As usually set forth, only such solutions are considered dissociated as are electrolytically conducting, and the dissociation is predicated as being into the ionic constituents, that is, into such constituent parts as would constitute the ions when an electrolyzing current was passed through the solution. For this reason it is usually called the ionization theory, since the assumed decomposition is not identical with ordinary chemical dissociation, and the use of the latter term is confusing and a misnomer. Modern thought regards the

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"ionization" as also unreal, since it predicates the existence of ions before an electrolyzing current is applied. Both terms are, therefore, fanciful, and both theories are being replaced by the "solvate theory," which regards the solvent as forming compounds with the constituents of the salt dissolved (solute). See Solvate theory.

DISSTON & SONS, INC., HENRY.—Tacony, Philadelphia, Pa. Manufacturer of hand and motor-driven saws. Business established 1840. President and treasurer, Frank Disston; vice-presidents, E. B. Roberts, Henry Disston; William D. Disston, Horace Disston, Hamilton Disston; secretary and general manager, E. B. Roberts; treasurer, Frank Disston; sales manager, Horace Disston. Main office, Tacony, Philadelphia, Pa. Factories, Tacony, Philadelphia, Pa.; Seattle, Wash.; Toronto, Ont., Can. Branch offices, Chicago, Ill.; San Francisco, Cal.; Boston, Mass.; Cincinnati, Ohio; Seattle, Wash.; New Orleans, La.; Memphis, Tenn.; Bangor, Me.; Portland, Ore.; New York, N. Y.; Henry Disston & Sons, Ltd., Toronto, Ont., Can.; Vancouver, B. C., Can.

DISTEEL.—Trade name for wheels for electric vehicles and trucks manufactured by the Detroit Pressed Steel Co., 6660 Mt. Elliott Ave., Detroit, Mich.

DI-STOCK.—Trade name for sleeve twister manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

DISTRIBUTER, TELEGRAPH.—In printing telegraph systems the distributer is a part of the terminal mechanism by means of which the line is distributed consecutively to separate transmitters in operation.

DISTRIBUTER, TEST.—This is a special switch used by the telephone wire chief or a tester to connect to the test connector for testing a subscriber line.

DISTRIBUTER, TRAFFIC.—A device for automatically distributing telephone calls from subscriber lines to a number of "A" operators. It permits any call to go to any idle operator.

DISTRIBUTERS, AUTOMOTIVE IGNITION.—In the modern automobile engine or airplane engine of several cylinders it is necessary to time the ignition of the gas in the various cylinders so that the gas ignites when the piston is in its proper position in the cylinder. This is accomplished by means of a distributer, which consists of a revolving contact that makes contact with a stationary set of contacts so that the electrical circuit is completed to the proper spark plugs in succession and the spark is made in the various cylinders at the proper time and sequence. These distributers are generally made of molded insulating compounds into which the stationary contacts and other metal parts are inserted in the molding process.

Manufacturers:

Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Unisparker."
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

DISTRIBUTION-FACTOR.—See Breadth-factor.

DISTRIBUTION LINES FOR POWER AND LIGHTING.—Distribution lines carry energy at moderate voltages (usually below 5000 volts) from substations, or sometimes direct from the generating station, to a large number of consumers distributed over a large district; the term also applies to similar lines for a street-lighting system. Distribution lines are divided into two classes, underground and overhead.

Underground Lines. The field of operations of the Edison systems having been chosen in the closely built sections of large cities, underground construction became an immediate necessity. The Edison tube was devised as the most economical method in first cost for the pioneering venture. The conductors were sealed inside of 20-ft. lengths of iron pipe which were connected together with flexible terminals that were incased in split sleeves and filled with hot compound. Each tube was terminated at intersection points in circular junction boxes. These boxes were of the surface type and contained fuses by which defective sections were automatically cut out. The tubes were laid on each side of the street where there were enough customers to require it. A position near the curb was chosen to make the service taps short and the excavation for new services as little as possible.

This system was standard for something like 15 years, when the increasing loads made repairs more frequent and the use of Edison tube for additions was gradually discontinued after about the year 1902. The draw-in conduit system with various types of duct had been introduced for a-c. systems and the use of lead-sheathed cable with rubber or oiled-paper insulation, instead of tubes, began.

Cable was found less likely to be affected by occasional overloads and was used for the feeders exclusively after its introduction. The conduit systems which survived were those in which the ducts were of tile, terra cotta, concrete, or other fireproof substance. The early attempts to use creosoted pump log came to grief when cable faults set fire to the ducts.

In conduit systems manholes are provided for jointing purposes and at intersections of lines. Manholes are spaced in straight runs not over 500 ft. apart, this being as far as it is practicable to pull cable in a single length. Manholes must have ample wall space for the joints and junction boxes and 6 ft. headroom for convenience in working. Cable racks are provided by which the cable and joints are supported on the side walls, the brackets often being made detachable for convenience in handling. Manholes are equipped with ladders where they are entered frequently.

In the arrangement of conduit lines the ducts must be sufficient in number to provide space for through lines, for local distribution and for possible future growth for some years ahead. The latter is important, since the cost of a few additional ducts is small when laid at the start, whereas if paving must again be disturbed the cost is excessive. The number of service laterals depends upon the width of the building frontage and laterals should be arranged to minimize the number of handholes. It is usual to bring several into one hole, using iron pipe bends if necessary to make the turn into the buildings.

Junction boxes are installed in low-tension systems in manholes or at one side if the surface type box is used. In primary a-c. distribution systems junction boxes are placed as disconnectives at the points where isolation is required, as at feeder centers and at points where abutting mains of adjacent circuits afford an emergency connection in case of interruption. These boxes are placed in manholes where the circuits are all underground. If the circuits are partly overhead the emergency connection can often be arranged by the use of a disconnecting type pothead at a cable pole.

Where a circuit is carried underground on a route where no further extensions will be required, as in park lighting, or in local service to a stub-ended street, armored cable, laid directly in the ground, or iron pipe with standard lead cable is sometimes installed. Where armored cable is used a creosoted plank is laid above it to protect it from subsequent excavations, if such openings are likely to be made.

Overhead Lines. The use of overhead construction for series lighting naturally followed the precedents set in telegraph circuits which had been in use many years. The practice of carrying wires on crossarms with glass insulators was readily applicable and only slight change in the size of the insulator was needed to adapt it to the higher voltages of series systems. The first a-c. systems were quite generally installed overhead, as they were largely in districts where such construction was permissible. In some cases Edison tube systems were also extended overhead into districts not far away from the congested business section.

Overhead construction made it feasible to extend service to residence districts on a profitable basis, while there were parts of underground territory as established by ordinance where no service could be given because of the first cost of extensions.

With the rapid expansion of telephone systems following the introduction of party-line service about the year 1900, the policy of joint pole construction demanded attention, and in many cities the pole plants were gradually merged as the system was extended and reconstructed. The power circuits are placed above telephone circuits, the highest voltages being placed on the top arm. The amount of vertical space to be reserved for each company is arranged by agreement and this, together with the necessary clearance from ground and the neutral space between the spaces of the two systems, fixes the length of the pole required. The top diameter is also agreed upon according to the combined loads to be carried by the pole. For line poles 7-in. tops are generally used, while at corners 8-in. tops are standard.

Where there are competing power or telephone companies joint arrangements are more complicated and in such cities it is not uncommon to find double sets of poles. However, there are a few cases of joint arrangement where poles are occupied by four power and telephone companies.

Wood poles have been employed almost exclusively for distribution lines, chestnut being used extensively in the eastern states, northern cedar in the middle western states and western cedar in western states. Pine and cypress have been used to some extent in southern states. The supply of chestnut and northern cedar is rapidly diminishing, and the western cedar is taking its place.

Wood poles have a great advantage where work must be done, as it is on distributing circuits, with the line alive. The security of the men and the greater facility in climbing make the wood pole a practical necessity.

Northern cedar has a natural taper of about 1 in. in 5 ft. of length, a 7-in.-top pole 35 ft. long having a diameter of 13 ins. at a point 5 ft. from the butt. A western cedar pole has a taper of 1 in. in 9 to 10 ft., so that its diameter 5 ft. from the butt is only 10.5 ins. with a 7-in. top. Such poles are, however, about 40% stronger than northern cedar and it is usual to select poles having 8-in. tops and 11 to 12-in. butts (at ground line) for service where 7-in. 35-ft. northern cedar would be satisfactory.

In placing poles and selecting routes for overhead lines, it is customary to utilize alleys as far as possible, thus eliminating objection to poles in parkways and in front of residences. Where alleys are not included in the block this result is sometimes accomplished by agreement of property owners to allow poles to be placed on rear lot lines instead of in parkways in front. Poles are placed opposite party lot lines as far as practicable and in such manner as not to interfere with garage doors, gates, windows, fire escapes and the like.

Lighting transformers up to 75 kw. are hung on a line pole, but power transformers of 40 kw. and larger require a platform supported by two or three poles set about 12 ft. apart. Such an overhead platform is required as much for accessibility for construction and maintenance purposes as for mechanical strength. The poles for transformer platforms are usually set in a concrete reinforcement.

Corner poles and dead-ends must be well guyed to carry the unbalanced tension of line wires. This is done by galvanized stranded cable of steel of ¼ to ½ in. diameter, carried from the top of the pole to an anchor or guy stub near by. The guy is insulated from ground by a strain insulator, and is attached by a loop through the eye in the anchor rod, the ends of which are clamped securely back to the main strand.

Crossarms are of southern pine or western fir, the latter having the advantage that it is free from knots and is straight-grained. Pins are of locust, this being the strongest and most durable wood available. Elm, oak and eucalyptus have been used as substitutes when locust was scarce. The standard pin for distribution work is 9 ins. long with a 1½-in. shank. The arms are bored ⅛-in. larger to allow for seasoning after boring.

All braces, bolts and hardware are galvanized to prolong their life and preserve the appearance of the construction.

Insulators are of the type known as deep-grooved, double petticoat (D. G. D. P.) and are of glass or porcelain, glass normally being the cheaper. Porcelain in different colored glazes is used by some to distinguish the different voltages and systems. Some use porcelain for primary lines and glass for secondary for purposes of identification.

Secondary lines are carried on racks on the side of the pole in some cases. This makes a sightly form of construction which is found serviceable in residence districts.

DIVERSITY-FACTOR.—Where a group of users of electricity takes its supply from the same source, the demands of the several users are not coincident and the maximum demand made at one time by the

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group is less than the sum of the maximum demands of the users. The ratio of the sum of these individual demands to the coincident maximum demand is called the diversity-factor. For residences, the diversity-factor is about 3.

DIVINE BROS. CO.—Utica, N. Y. Manufacturer of electric glue heaters and polishing and buffing wheels. President, N. H. Divine; secretary and treasurer, O. J. McKeown; general sales manager, C. A. S. Howlett.

DIXIE.—Trade name for adjustable electric lamp manufactured by Sophus Berendsen, Inc., 365 1st Ave., New York, N. Y.

DIXIE.—Trade name for storage batteries manufactured by the Dixie Battery & Mfg. Co., Pine Bluff, Ark. (Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.)

DIXIE.—Trade name for storage batteries made by the Dixie Storage Battery Co., 1412-1419 Lafayette Ave., Baltimore, Md.

DIXIE.—Trade name for annunciators manufactured by Edwards & Co., Inc., 140th & Exterior Sts., New York, N. Y.

DIXIE.—Trade name for high-pressure piston packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

DIXIE.—Trade name for leather belting manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

DIXIE.—Trade name for storage batteries manufactured by the F. V. L. Smith Battery Co., 10½ Auburn Ave., Atlanta, Ga.

DIXIE.—Trade name for ignition magneto generators manufactured by the Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

DIXIE.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DIXIE BATTERY & MFG. CO.—Pine Bluff, Ark. Manufacturer of storage batteries. Business established 1919. President and general manager, Byron C. Fowles; vice-president, W. W. Taylor; secretary, N. J. Gantt, Jr.; treasurer, I. L. Hathaway. Exclusive distributor, Fidelity Electric Co., 1906 Pine St., St. Louis, Mo.

DIXIE BRAND.—Trade name for southern white cedar poles produced by Willis H. Gilbert, 710 Conway Bldg., Chicago, Ill.

DIXIE STORAGE BATTERY CO.—1412-1419 Lafayette Ave., Baltimore, Md. Manufacturer of storage batteries. Business established 1920. President, Dr. A. C. Smick; secretary, W. E. Borhaven; treasurer, C. P. Anger; general manager, M. F. W. Weidmeyer; sales manager, L. T. Holland.

DIXON CRUCIBLE CO., JOSEPH.—Jersey City, N. J. Manufacturer of graphite brushes, graphite for lubrication, lubricating compounds, resistance rods, etc. Business established 1827. President, George T. Smith; vice-president, J. H. Schermerhorn; secretary, Harry Dailey; treasurer, William Koester. Main office and factory, Jersey City, N. Y. Branch offices, New York, N. Y.; Chicago, Ill.; St Louis, Mo.; San Francisco, Cal.; Buffalo, N. Y.; Atlanta, Ga.; Philadelphia, Pa.; Boston, Mass.

D-LIGHT.—Trade name for lighting unit manufactured by Lorin W. Young, Inc., 214 E. 40th St., New York, N. Y.

DO IT ELECTRICALLY.—Official slogan of the Society for Electrical Development, Inc.

D. O. A.—Trade name for cable terminals manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

DOBECO.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

DOBROWOLSKY GENERATOR.—A three-wire generator in which the unbalanced current in the neutral is led back to the armature through one or more slip rings and one or more balancing coils. See Generator, three-wire.

DOCKENDORFF & CO., INC., J. E.—20 Broad St., New York, N. Y. Manufacturer of insulating paints, oxyacetylene welding outfits, etc.

DODGE.—Trade name for electric hot plates manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

DODGE BROS.—66 E. 1st St., Salt Lake City, Utah. Manufacturers of electric ore protectors. Business established 1914. Sole owner, C. R. Dodge.

DODGE MFG. CO.—Mishawaka, Ind. Manufacturer of oil engines. Exclusive distributor, Oil Engine Division, Dodge Sales & Engineering Co., Mishawaka, Ind.

DODGE'S.—Trade name for electric cord protectors made by Dodge Bros., 66 E. 1st St., Salt Lake City, Utah.

DO-DI.—Trade name for finished brass and bronze castings made by the Doehler Die-Casting Co., Court & Huntington Sts., Brooklyn, N. Y.

DOE ELECTRICAL DEVICE CO.—Kent Ohio. Manufacturer of dry batteries, flashlights and hearing devices for the deaf. President, Walter S. Doe; vice-president and treasurer, Albert Dormaier; secretary, Joseph Muenzmay.

DOEHLER DIE-CASTING CO.—Brooklyn, N. Y. Manufacturer of die-castings in white metal alloys. Business established 1906, incorporated 1908. President and general manager, H. H. Doehler; vice-presidents, H. B. Griffin and John Krlaund; secretary, Charles Pack; treasurer, O. A. Schroeder. Main office, Court & Huntington Sts., Brooklyn, N. Y. Factories, Toledo, Ohio, and Chicago, Ill. Branch offices, Boston, Mass.; Cleveland, Ohio; Detroit, Mich.

DOELCAM.—Trade name for oil burners, oxyacetylene welding and cutting outfits, and sand-blast equipment, made by the Macleod Co., 2232-38 Bogen St., Cincinnati, Ohio.

DOES MORE.—Trade name for lighting and power plants manufactured by the Cushman Motor Works, 932 N. 21st St., Lincoln, Neb.

DOLE VALVE CO., THE.—1923-1933 Carroll Ave., Chicago, Ill. Manufacturer of pipe couplings. President, Andrew R. Dole; vice-president, Arthur Dole; secretary, John L. Dole; treasurer and manager, F. H. Tweed.

D'OLIER CENTRIFUGAL PUMP & MACHINE CO.—400 Morris Bldg., Philadelphia, Pa. Manufacturer of centrifugal pumps. President, William L. D'Olier; vice-president, Henry DeHuff; treasurer, George A. Hopkins. Factory, Jersey City, N. J.

DO-LITE.—Trade name for babbitt-lined aluminum bearings made by the Doehler Die-Casting Co., Court & Huntington Sts., Brooklyn, N. Y.

DOLLIES, SINGLE AND TANDEM WHEEL.—The dolly is a simple device being essentially nothing more than a small frame or platform mounted on a steel wheel or wheels. It is used to facilitate the moving of heavy objects, machinery, poles, etc. The tandem-wheel dolly differs from the more common single-wheel type in that it has two wheels set in tandem. This type of dolly is usually equipped with grooved or flanged wheels for running on track. They often also have fittings for tying two dollies together to form a truck so that large loads of poles or other material may be piled upon them and transported along the track.

Manufacturer:

Dicke Tool Co., The, Downers Grove, Ill.

DOLPH CO., JOHN C.—168 Emmett St., Newark, N. J. Manufacturer of insulating compounds and varnishes. Business established 1910. President, John C. Dolph; vice-president, Arthur K. Wing; secretary, F. M. P. Pearse; treasurer, C. E. Force. Sales representatives, L. L. Fleig & Co., Inc., 212 W. Austin Ave., Chicago, Ill., and Caxton Bldg., Cleveland, Ohio; E. O. Oeters & Co., 605 Arch St., Philadelphia, Pa.; Baker-Joslyn Co., San Francisco, Cal., Los Angeles, Cal., and Seattle, Wash.

DOLPHIN.—Trade name for insulated wire and cable made by the Atlantic Insulated Wire & Cable Co., 52 Vanderbilt Ave., New York, N. Y.

DOLPHIN.—Trade name for power transmission belting manufactured by the H. N. Cook Belting Co., Howard & Fremont Sts., San Francisco, Cal.

DOMANCO.—Trade name for electric irons manufactured by the Dover Mfg. Co., Dover, Ohio.

DOMES, ART GLASS.—Lamp shades approximately hemispherical in shape made up of art glass leaded together and placed over a lamp or cluster of lamps with the open side downward to throw the light downward. The term is also loosely used to designate large art glass shades of conical or pyramid form. The most extensive application of art glass domes in lighting in the past has been over dining-room tables. The term dome is usually applied only to the larger art glass shades, 12 ins. in diameter or more.

Manufacturers:

Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y. "Equalite."
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
COLONIAL ART GLASS CO., Meriden, Conn.
Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Royal Art Glass Co., 243 Canal St., New York, N. Y.
Standard Art Glass Co., 237 Lafayette St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., Cedar Rapids, Iowa. "Stelco."
Steuben Glass Works, Corning, N. Y. "Aurene," "Calcite."
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.
Wrought Iron & Art Glass Fixture Co., 195 Canal St., New York, N. Y.

DOMES, MISCELLANEOUS GLASS.—Shades or reflectors made of other than art glass, approximately hemispherical in shape, and placed over the light source to throw light downward. In the illuminating engineering and glass manufacturing field the term dome is applied to a class of shade and reflector somewhat larger in diameter in proportion to depth than bowl reflectors. While these reflectors may vary considerably from a true hemisphere in shape, being more commonly half elliptical in section, the description "approximately hemispherical" fits them more closely than any other brief designation. The opal dome reflector has been the one most commonly used over large kerosene lamps for many years. Similar domes are sometimes used over clusters of incandescent lamps.

Manufacturers:

Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y. "Equalite."
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Keystone Art Glass Co., 333 N. 5th St., Philadelphia, Pa.
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.

DOMESTIC.—Trade name for electric pressing irons manufactured by the Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill.

DOMESTIC.—Trade name for small motors manufactured by the Domestic Electric Co., 1071 Power Ave., Cleveland, Ohio.

DOMESTIC.—Trade name for electric washing machines manufactured by the Domestic Laundry Equipment Co., 224 W. 26th St., New York, N. Y.

DOMESTIC.—Trade name for vacuum cleaner brushes manufactured by the Torrington Co., National Sweeper Division, Torrington, Conn.

DOMESTIC ELECTRIC CO., THE.—Cleveland, Ohio. Manufacturer of small motors. Business established 1915. President and general manager, C. A. Duffner; vice-president, M. H. Spielman; secretary and treasurer, A. N. Kellogg; sales manager, W. H. Lamar.

DOMESTIC LAUNDRY EQUIPMENT CORP.—224 W. 26th St., New York, N. Y. Manufacturer of electric laundry equipment. President, A. E. Morford; treasurer, J. Judelson; sales manager, M. E. Rosenbaum. Main office, 224 W. 26th St., New York, N. Y. Branch offices, Land Title Bldg., Philadelphia, Pa.; 6 Beacon St., Boston, Mass.

DOMESTIC STOKER & MFG. CO.—519 Atlas Block, Salt Lake City, Utah. Manufacturer of domestic stokers. Business established 1920. President and general manager, Lloyd Garrison; secretary and treasurer, Guy H. Holmes.

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DOMESTIC TUNGSTEN LAMP CO. INC.—418-20 10th St., West New York. N. J. Manufacturer of tungsten lamps. President, Hugo Muller; secretary and treasurer, Otto Kohler; sales manager, Fred Walter.

DOMINION.—Trade name for commutator brushes, brush holders, etc., manufactured by the Dominion Carbon Brush Co., 38 Duke St., Toronto, Ont., Can.

DOMINION ASBESTOS & RUBBER CORP.—New York, N. Y. Manufacturer of asbestos and rubber products for insulating purposes. Business established 1917. President, William M. Meek; vice-president, Herbert Cole; secretary and treasurer, G. A. Beech. Main office, 154 Nassau St., New York, N. Y. Factories, New York, N. Y.; Philadelphia, Pa.; Stratford, Conn. Branch offices and warehouses, 67 Murray St., New York, N. Y.; 110 Walnut St., Philadelphia, Pa.; 116 S. Frederick St., Baltimore, Md.; 312 City Hall Ave., Norfolk, Va.; 410 Plum St., Cincinnati, Ohio; 320 Market St., San Francisco, Cal. District offices, 701 Pontiac Bldg., St. Louis, Mo.; 927 Higgins Bldg., Los Angeles, Cal.

DOMINION CARBON BRUSH CO.—38 Duke St., Toronto, Ont., Can. Manufacturer of commutator brushes, brush holders, etc. Business established 1920. Partnership; G. A. Kingstone, J. R. Tate and H. C. Barber.

DOMINION ELECTRIC SWITCH BOX CO.—60 Sumach St., Toronto, Ont., Can. Manufacturer of switches and boxes for electrical purposes. Business established 1916. W. G. Scoon, sole owner.

DOMINION MACHINE & TOOL CO. LTD.—77 Peter St., Toronto, Ont., Can. Manufacturer of sheet metal stampings. H. S. Gartside, general manager.

DOMINION STEEL PRODUCTS CO. LTD.—Brantford, Ont., Can. Manufacturer of coil winding machines, brass and bronze castings and motor speed reduction gears. President and general manager W. P. Kellett; vice-president, J. H. Fisher; secretary and treasurer, Miss M. F. McGrau; sales manager, C. H. Fischer.

DOMINO.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DONAHOE.—Trade name for switchboard pilot lamps manufactured by the Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.

DONGAN ELECTRIC MFG. CO.—2987 Franklin St., Detroit, Mich. Manufacturer of electrical measuring instruments and transformers. Business established 1909. President, L. J. Hicks; vice-president, E. G. Hicks; secretary and treasurer, G. J. Scherling. Sales representatives, R. J. Smyth, 229 W. 42nd St., New York, N. Y.; Sierra Electric Co., 515 Market St., San Francisco, Cal.; Herbert Bryan, The Bourse, Philadelphia, Pa.; George T. Wescott Co., 645 Washington Blvd., Chicago, Ill.; R. F. McCarthy, 10 High St., Boston, Mass.; S. H. Stover, 609 Chamber of Commerce, Pittsburgh, Pa.; Brown & Hall. 1515 Pine St., St. Louis, Mo.

DONLEY BROS. CO., THE.—E. 74th St & Aetna Rd., Cleveland, Ohio. Manufacturer of meter boxes, manhole covers, etc. General manager, George W. Donley.

DONNELLY.—Trade name for lineman's pole climbers manufactured by the Blakeslee Forging Co., Plantsville, Conn.

DOOLITTLE CO., F. M.—817 Chapel St. New Haven, Conn. Manufacturer of radio apparatus.

DOOR OPENERS AND CLOSERS, GARAGE, MOTOR-OPERATED.—Attachment for installation on garage doors, by which, upon pressing a button, an electric motor opens or closes the door by actuating chains or levers, the motor circuit being automatically opened when the operation is completed. These openers may be controlled from any desired point, in commercial garages commonly from several points to avoid delay in opening and closing the doors. Private garages may be equipped with a control operating from two points, from a pendent switch which can be reached by the motorist when sitting at the wheel of the car inside the garage, and from a key switch outside the door.

Manufacturers:

Allith-Prouty Co., Danville, Ill. "Electromatic."
Carter-Crane Controls, 122 S. Michigan Ave., Chicago, Ill.
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Cesco."
Lovejoy Automatic Door Opener Co., Laramie, Wyo.
Quincy Elevator Gate Co., Quincy, Ill. "Quincy."

DOOR OPENERS AND CLOSERS, MISCELLANEOUS, MOTOR-OPERATED.—Appliances for installation on doors so that the closing of a circuit to a motor will cause the motor to actuate chains or levers to open or close the door, the current to the motor being cut off when the operation is completed. They are of particular advantage where the control can be located within an office and the services of a doorman eliminated. They are also used on very heavy doors, bulkheads or fire doors in warehouses, refrigerating rooms, fire-engine houses, on ships, or where automatic control of doors is desirable.

Manufacturers:

Carter-Crane Controls, 122 S. Michigan Ave., Chicago, Ill.
Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J. "Norton."
Lovejoy Automatic Door Opener Co., Laramie, Wyo.
Quincy Elevator Gate Co., Quincy, Ill. ("Quincy" elevator gate or door)

DOOR OPENERS, HOUSE, ELECTROMAGNETIC.—Devices in which the striker or latch is drawn back by the armature of an electromagnet energized when a push button is pressed. Springs bearing against the door are thus released to open the door. When these openers were first introduced dry batteries were generally used as the source of current, but they have been largely replaced by the more convenient and less troublesome bell-ringing transformer. They are almost exclusively used in apartment houses, the control button being located together with the speaking tube or vestibule telephone in the hallway, kitchen or other room of the apartment.

Door openers of the same general type are also used for office doors, especially those leading from reception rooms. In some cases such door openers have been controlled by contacts in a door mat or rug before the door, so that a visitor on nearing the door finds it opening to welcome him.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Corbin Division, P. & F., of American Hardware Corp., New Britain, Conn "Corbin."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Manhattan," "Mesco."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Standard Lock Co., 111-113 Himrod St., Brooklyn, N. Y. "Champion."

DOOR-OPERATING DEVICES, ELECTRIC CAR.—Mechanism to remotely control through suitable levers, shafts, rods bell cranks, etc., the operation of car doors either manually or by means of suitable compressed-air cylinders, piping and control valves. These devices are of a great many kinds suited to different types of cars. The compressed-air type is used chiefly on elevated and subway rapid transit cars.

Manufacturers:

Brill Co., The J. G., 62nd St., & Woodland Ave., Philadelphia, Pa.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

DOOR SWITCHES.—See Switches, door.

DOOR TRIPS, ALARM.—An electrical contacting device for use over a door to indicate by the closing of an electric circuit through a bell or buzzer that the door is being opened. A hinged piece of metal on the lower part of the device is struck by the upper edge of the door when opened, thus closing the circuit. The trip is silent while the door is open and also in closing the door. These devices are much used on the doors to small stores, shops, etc., in which the storekeeper may be in a back room or yard and needs a signal to advise when a customer has entered.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Lovejoy Automatic Door Opener Co., Laramie, Wyo.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.

DORIC LITE.—Trade name for commercial lighting units manufactured by the Lighting Studios Co., 220 W. 42nd St., New York, N. Y.

DOSSERT & CO.—242 W. 41st St., New York, N. Y. Manufacturer of solderless connectors. Business established 1904. President and general manager, H. B. Logan; vice-president, J. J. Deck; secretary, treasurer and sales manager, D. J. Fitch. Sales representative, H. B. Squires Co., 583 Howard St., San Francisco, Cal.

DOUBLE-CURRENT TELEGRAPHY.—In long line telegraphy the working speed is sometimes increased by the use of a double-current system which sends impulses from opposite poles of the battery over the line. A polarized relay is always used and one side or contact of the relay sends "spacing" current, which may be a negative impulse, while the other contact sends "marking" or positive current, which actuates the receiving apparatus.

DOUBLE-DELTA CONNECTION.—This is a connection of transformers by which a delta three-phase system is connected to a six-phase system. The secondaries of the transformers consist of two coils each. Three coils, one from each transformer, are connected in delta.

DOUBLE DISSOLVING.—Trade name for stereopticons manufactured by the Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill.

DOUBLE JET.—Trade name for blow torches manufactured by the Turner Brass Works, Sycamore, Ill.

DOUBLE SAFETY SIGNAL CO.—192 N. Clark St., Chicago, Ill. Manufacturer of electric automobile signals. President, I. V. Edgerton.

DOUBLE SERVICE.—Trade name for packing manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

DOUBLE TROLLEY.—A system used for a few street-railway systems in which two trolley wires are used for each car track, one being connected to the positive feeder, the other to the negative. This forms a complete metallic circuit and eliminates electrolysis of ground piping, but increases overhead trolley troubles and makes an unsightly construction. The system is used in only a few cities where the city authorities will not permit the ground return through the rails which is almost universally used elsewhere.

DOUBLEDAY-HILL ELECTRIC CO.—Pittsburgh, Pa. Manufacturer of commutator rings, armature coils and bearings. President, C. Phillips Hill; vice-president and treasurer, G. Brown Hill; secretary, G. Frank Slocum; sales manager, H. H. Tully. Main office, 719-21 Liberty Ave., Pittsburgh, Pa. Branch offices, 715 12th St., N. W., Washington, D. C.; 5952-54 Baum Blvd., East Liberty, Pa.

DOUBLEX.—Trade name for strain insulators manufactured by J. H. Parker & Son, Parkersburg, W. Va.

DOVER.—Trade name for electric pressing and soldering irons manufactured by the Dover Mfg. Co., Dover, Ohio.

DOVER BOILER WORKS.—Dover, N. J. Manufacturers of fire tube boilers, chimneys, tanks, etc. Sole owner, W. F. Burch. Branch office, 50 Church St., New York, N. Y.

DOVER MFG. CO., THE.—Dover, Ohio. Manufacturer of electric irons and appliances. President and general manager, Charles T. Johnson-Vea. Branch office, 480 Lexington Ave., New York, N. Y.

DOW CELL.—An electrolytic cell for the production of bromine from brines carrying $MgBr_2$ in solution.

DOW CHEMICAL CO., THE.—Midland, Mich. Manufacturer of chemicals. Business established 1890. President and gen-

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eral manager, H. H. Dow; vice-president and secretary, J. T. Pardee; treasurer, J. S. Crider; sales manager, G. L. Camp. Main office, Midland, Mich. Factories, Midland, Mich., and Mt. Pleasant, Mich. Branch office and warehouse, 90 West St., New York, N. Y.

DOW, INC., L. B.—Keene, N. H. Manufacturer of water turbines, pulleys and other power transmission equipment.

DOW MFG. CO.—Braintree, Mass. Manufacturer of electric dishwashers.

DOWNEY CO., GILBERT H.—7 S. 17th St., Philadelphia, Pa. Manufacturer of electrical insulating materials and wires. Business established 1908. President and general manager, Gilbert H. Downey; secretary and treasurer, William Downey.

DOWNIE.—Trade name for electric pumps manufactured by the Keystone Driller Co., Beaver Falls, Pa.

DOWNING.—Trade name for high-tension switches manufactured by the Pacific Electric Mfg. Co., 827-833 Folsom St., San Francisco, Cal.

DOWNINGTOWN IRON WORKS, INC.—Downingtown, Pa. Manufacturer of cooling towers, gas producers and other steel plate construction. President, Charles B. Fairweather; secretary, Penrose M. Davis; treasurer, Parke L. Plank.

DOYLE.—Trade name for electric sheet and press plate heaters manufactured by Britton & Doyle, 205 Caxton Bldg., Cleveland, Ohio.

DOYLE-DACOSTA MFG. CO.—Easton Pa. Manufacturer of ignition, armature, field, transformer and other coils. President and treasurer, William L. Doyle; vice-president, T. A. H. Hay; secretary, George B. Sherry.

D.P.D.T.—An abbreviation for double-pole double-throw, referring to switches, especially knife switches.

D.P.S.T.—An abbreviation used in speaking of switches, meaning double-pole, single-throw; it is used mostly with knife switches.

DRAFT, MECHANICAL.—Mechanical draft in fuel-burning power plants permits higher drafts to be employed than when natural draft is depended upon, thus allowing higher rates of combustion to be used and eliminating dependence upon atmospheric conditions. An increase in station capacity of 50% continuous and 200 to 300% intermittently is usually feasible after adopting mechanical draft.

Artificial draft may be developed by the use of forced-draft or induced-draft blowers or both, or by the use of steam jets. The two former are the only methods employed by electric central stations of any size.

Steam jets consist of a number of jets placed in the base of the stack or underneath or above the fuel bed. The steam jet is extremely wasteful of steam, using anywhere up to 15% of the boiler capacity, and is only a makeshift at best.

When a forced-draft blower is used, air is forced through the fuel bed by the pressure exerted by the blower. In many plants the heated air that has cooled the turbogenerator is passed to the blower with a resulting increase in furnace efficiency due to the higher temperature of the incoming air. With forced draft alone, the stack is depended upon to carry off the furnace gases.

When induced draft is used, the furnace gases are drawn through the induced-draft blower, which is located between the outlet of the boiler gas passages and the stack. All gas from the furnace passes through the blower, so that the induced-draft blower is always larger than a forced-draft blower for the same boiler.

Forced draft is indicated when increased steaming capacity is required of existing boilers and when the stack has sufficient area to carry off the larger volume of gas. Forced draft is almost indespensible with the underfeed type of stoker even at light loads; for a full load and above, forced draft is always resorted to. The cost of forced draft is usually about 10 to 20% that for a corresponding increase in stack capacity.

When economizers are used, induced draft is employed to draw the furnace gases through the economizer, unless there is ample stack capacity. To the induced-draft installation should be credited increased life to furnace refractories, higher combustion efficiency and a saving in the cost of the stack. Induced draft is often used where forced draft would not work well, as with some types of chain-grate stokers.

In many cases, large plants especially, using underfeed stokers and economizers, both forced and induced draft is employed, the former for forcing the huge quantities of air through the thick fuel beds and the latter for drawing off the gases through the economizer. It is well under these circumstances to synchronize the engines or motors driving the two blowers so that they work together at all times. If this is not done automatically by a regulator, a pressure may build up in the furnace and damage the brickwork or a vacuum may be created. An automatic regulator that changes the two blowers in unison overcomes these objectionable possibilities.

Blowers may be installed one per furnace, or one large blower may supply air to several furnaces. The former arrangement has the advantage of flexibility and reliability, permitting each furnace to be operated as a unit. Individuality seems to be finding more and more favor, boilers, turbine and auxiliaries now being operated as a composite unit in many large stations. The high load-factor of central-station service permits this where the lower load-factor of the average industrial plant imposes an entirely different set of conditions.

Mechanical blowers for power plant work are usually of the multivane type as they operate at high speed and are well suited therefore to direct connection to motors and engines. Both forms of drive find favor, although, while there may be little choice as regards the forced-draft blower, the induced-draft blower is almost invariably motor-driven because it is located out of ready reach of steam pipes, among dirt and where frequent inspection is unlikely. So far as concerns ease of speed regulation, the steam engine is, perhaps, the more preferable.

DRAFT TUBE.—A tube used to carry away the water from a hydraulic turbine into the tailrace. With a reaction wheel it permits the utilization of the full head by the action of the draft or suction pull exerted on the wheel by the water leaving through the tube, from which all the air has been exhausted. It gradually increases in diameter so as to gradually decrease the velocity of the water after it is discharged from the turbine.

DRAGON.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DRAKE.—Trade name for electric vibrator manufactured by the Drake Electric Works, 3027 Lincoln Ave., Chicago, Ill.

DRAKE.—Trade name for electric cigar lighters and humidifiers manufactured by the Drake Mfg. Co., Milwaukee, Wis.

DRAKE ELECTRIC WORKS.—3027 Lincoln Ave., Chicago, Ill. Manufacturer of electric vibrators. Partnership, J. A. Kuehl and C. H. Fielder.

DRAKE MFG. CO.—Milwaukee, Wis. Manufacturer of electric cigar lighters and humidifiers. Business established 1908. Clarke S. Drake, sole owner.

DREADNAUGHT.—Trade name for portable lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

DREADNAUGHT.—Trade name for torches manufactured by the P. Wall Mfg. Supply Co., 706 Preble Ave., Pittsburgh, Pa.

DREADNOUGHT.—Trade name for pliers manufactured by Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.

DREDGES, ELECTRICALLY OPERATED.—The main field for the application of the electrically operated dredge has been in gold mining, for which it has many advantages over the steam type, especially in elimination of fuel and suitable boiler-feed water. The most common form of dredge for this purpose is the continuous conveyor type. They usually receive their power from a power station some distance away and their equipment consequently includes a-c. motors supplied through step-down transformers. Electric dredges have also been used in irrigation and other canal construction and maintenance.

Manufacturers:

Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Bucyrus Co., South Milwaukee, Wis. "Bucyrus."

DRENDELL ELECTRICAL & MFG. CO.—1345 Howard St., San Francisco, Cal. Manufacturer of panels, panelboards, switchboards, switches and fittings. President and general manager, G. Gensler; vice-president, treasurer and sales manager, L. Siebert; secretary, J. Dunn.

DRESALAMP.—Trade name for boudoir lamp manufactured by the Aladdin Mfg. Co., Muncie, Ind.

DRESALITE.—Trade name for boudoir lamp manufactured by H. G. McFaddin & Co., 38 Warren St., New York, N. Y.

DRESSERS, GRINDING WHEEL.—The surface of grinding and polishing wheels becomes clogged with the material ground and in grinding hard materials, such as steel tools, the wheel surface wears unevenly and must be dressed or trued to a flat rough face. The dresser used is a small hand tool which generally has a small cutting wheel set in one end. The grinding wheel is set in motion and the cutting wheel held against it until the desired surface is obtained. The cutting wheels are of several types suitable for the various kinds of grinding and polishing wheels. The common types have a surface made up of teeth-like or prong cutters or are made up of disk-like wheels with sinusoidal cutting edges. Some types utilize a diamond or stick of abrasive compound, such as carborundum, instead of a cutting wheel.

Manufacturers:

Bay State Stamping Co., 380 Chandler St., Worcester, Mass.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa. "Truedge," "Gruva," "Gardi," "Huntington."
Desmond-Stephan Mfg. Co., Urbana, Ohio. "Diamo-Carbo," "Huntington," "Magazine," "Sherman."
Warren Axe & Tool Co., Warren, Pa.
Western Tool & Mfg. Co., Springfield, Ohio. "Champion."

DRESSERS, LEAD CABLE.—A small hand tool made of hard wood for smoothing the sleeves used in lead cable joints. It consists of a handle with an extension having a rounded edge which is used for the smoothing operation.

Manufacturer:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

DRIERS, ARMATURE AND COIL.—See Ovens, electric, armature, field and transformer; also Ovens, electric, drying and impregnating.

DRIERS, BLUEPRINT, ELECTRIC.—See Blueprint driers, electric.

DRIERS, CLOTHES, ELECTRIC.—A galvanized iron or metal enclosure fitted with racks, which are drawn out while the clothes are hung on rods supported by the racks. When one rack is full it is pushed into the drier and another is pulled out and filled. Underneath are electric heating elements controlled by switches mounted on the outside. The electrically heated driers have the advantage over the gas and coal types that they are absolutely clean and free from odor, as well as having compactness with a resultant economy in floor space. The outfits sometimes include a small exhaust fan which produces a strong air current through the drying compartment. Where space is valuable, in apartment buildings, hotels, commercial laundries and similar buildings, these driers have found their chief use.

Manufacturers:

Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill. "Chicago."
Domestic Laundry Equipment Co., 224 W. 26th St., New York, N. Y.
MARLOW MFG. CO., 1836 Euclid Ave., Cleveland, Ohio. "Marlow." (Also combined with washing machine.)

When writing to manufacturers please mention the
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Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Scientific Heater Co., The, Cleveland, Ohio. "Scientific."
Sieben Merchandising Co., 614 Gumbel Bldg., Kansas City, Mo. "Sieben."

DRIERS, ELECTRIC, MISCELLANEOUS.—Equipment heated by electric heating elements for drying photographic prints, dyed or printed cloths, objects or materials previously treated with coats of japan, varnish, enamel or paint, and for many special industrial purposes where this quick and clean method of drying is particularly suitable. These driers may depend on convection currents of hot air rising from the heaters or on a combination of heated air and breeze blown on the material by an electric fan or blower.

Manufacturers:

Burke & James, 240 E. Ontario St., Chicago, Ill. (Photographic.) "Rexo."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Eastman Kodak Co., Rochester, N. Y. ("Majestic" photograph.)
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia, Pa. ("Proctor" driers for electrical porcelain and spark plugs.)
Raymond Co., The, Saugatuck, Conn.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. "Triplex." (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

DRIERS, GLOVE, ELECTRIC.—Apparatus for drying gloves on electrically heated forms, after being cleaned and also in some processes of manufacture. Their exact heat control makes this type of drier particularly applicable to this work ano they are also much safer than any fuel-burning driers.

Manufacturer:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

DRIERS, HAIR, ELECTRIC.—Devices arranged to heat air by means of electric heating elements and then cause this air to be used in drying the hair. In some driers the air rises from the bottom of a tall can of proper height. In another equipment a motor-operated fan blows the air against a number of heating elements and out through a tube outlet. These driers are used in barber shops and hairdressing establishments. They may be either hand devices or mounted on a portable stand, the latter type being generally of greater capacity and used chiefly in hairdressing parlors, where they are extensively used because of the time economy which they effect.

Manufacturers:

ARNOLD ELECTRIC CO., Racine, Wis. "Arnold."
Barbers' Electric Specialty Co., The, 4204 Troost Ave., Kansas City, Mo. "Coffman, The Original."
Bosch, Herman J., Hotel Biltmore, New York, N. Y. "Noiseless."
Camp Co., La Crosse, Wis. "Invincible."
Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill. "Standard."
Claxo Co., The, Iowa City, Iowa.
Electric Clipper Co., The, 537 Grand Ave., Kansas City, Mo.
GEIER CO., P. A., THE, 5112 St. Clair Ave., Cleveland, Ohio. "Royal."
Halliwell & Co., 62 E. 12th St., New York, N. Y.
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "Cyclone."
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Moore Electric Corp., 202 S. State St., Chicago, Ill. (Exclusive distributor, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.)
Racine Electric Co., Bridge & Ontario St., Racine, Wis.
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y. "Foen."
Siegfried, G., 130 N. State St., Chicago, Ill.
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."
Thome, Mathias, 22 W. Monroe St., Chicago, Ill. "Shelton," "Bertman."
WISCONSIN ELECTRIC CO., Racine, Wis. The "Dumore" electric hair drier is a sturdy appliance, light and easy to handle. Has a highly polished aluminum case. All moving parts are enclosed, making it impossible to catch or snarl the hair. The "Dumore" is fitted with a detachable heating unit, instantly removable without tools. Cord attaches to lamp socket. One turn of switch gives hot air blast; another turn gives cold air. Net weight, 4½ lbs. See display adv. page 1311.—Adv.


Dumore Hair Drier

DRIERS, HAND AND FACE, ELECTRIC.—Appliances, equipped with motor-driven fan and heating elements through which air is forced for drying the hands and face. They are controlled by a pedal-operated spring switch at the base of the stand on which the outfit is mounted. This switch closes both the heating and blower circuits, which are opened automatically when the foot pressure is released from the pedal. The air outlet is set about 3½ ft. from the floor and is adjustable so that the air blast is about horizontal for drying the hands or inclined upward for drying the face. These driers are used in semipublic and private washrooms in offices, factories, hotels, club houses, dance halls, railway stations, etc. They are a very sanitary method of drying and dispense with the troubles connected with providing towels.

In the original types heating elements alone were provided without a blower It was found that addition of the blower reduces the power consumption and hastens drying.

Manufacturers:

Groton Electrical Devices, Inc., Main St., Groton, N. Y. "Airdry," "Electric Towel."
Moore Electric Corp., 202 S. State St., Chicago, Ill. (Exclusive distributor, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.)

DRIERS, SHOE, ELECTRIC.—Portable motor-driven fan and heating element in enclosing case having a handle for manipulating or provided with a clamp for fastening to the shoe rest. The air forced through heating element passes out through a tube which is directed upon the shoe by the operator. This portable type is used in shoe shining and cleaning establishments. Stationary driers of a different type, generally similar to a rack on which the shoes are dried by hot air rising from electric heating elements placed below the racks, are used in shoe factories.

Manufacturers:

Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill. "Standard."
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "Cyclone."
Millner Co., 1706 N. 12th St., St. Louis, Mo. "Millner."
S. U. E. Co., 89 Beach St., Boston, Mass. "Unitize."
United Shoe Machinery Corp., 205 Lincoln St., Boston, Mass.
WISCONSIN ELECTRIC CO., 16th St. & Junction Ave., Racine, Wis. "Dumore." (See display adv. page 1311.)

DRILL SETS, ELECTROPNEUMATIC ROCK.—These drill sets are used in mines or quarries where the drilling is done at a considerable distance from the central power plant. Long compressed-air lines are likely to have much leakage and are otherwise troublesome, especially in winter; where only a few drills are needed it is, therefore, not economical to run the air line a great distance or to keep large compressors running at the power house for the few drills. Portable motor-driven compressors are used for this purpose and supply sufficient air for a group of drills through short lengths of air hose. The set is attended by the workmen and is operated only when the drills are to be used. The drills employed are standard air drills, operated by the air pressure acting on alternate sides of the piston, and combine a hammer action and slow rotation.

DRILLING MACHINES.—See Boring machines.

DRILLS, ELECTRIC, BENCH AND SENSITIVE.—Electric bench drills are equipped with a motor and feed control in the head of the device and can be clamped to the bench. Sensitive drills are especially adapted for the use of watchmakers, jewelers, instrument makers, etc.; their feed control has a spring balance so extremely sensitive that delicate work can be drilled accurately. Motors for these devices are of the fractional-horsepower high-speed type. The bench drills are sometimes made as gang drills, that is, several drills operating together and controlled as a unit. The smaller drills are often equipped with a universal motor so they may be used interchangeably with either alternating or direct-current supply.

Manufacturers:

Arnold Electric Tool Co., Inc., Fort Trumbull Bldg., New London, Conn.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Champion Blower & Forge Co., The Lancaster, Pa. "Champion."
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."
Cincinnati Electrical Tool Co., The, 1501-3-5 Freeman Ave., Cincinnati, Ohio. "Cincinnati."
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
High Speed Hammer Co., Inc., The, 313 Norton St., Rochester, N. Y.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.
U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U.S."
Washburn Shops, The, Worcester, Mass. "Washburn."
WISCONSIN ELECTRIC CO., Racine, Wis. The "Dumore" bench drill is accurate on fine and sensitive work, compact, efficient, durable and economical. The Model 2-AD drill (figure below), is a time saver on small parts. It is equipped with a universal motor, which operates on either a-c. or d-c. circuits, and has an adjustable table that may be placed at any desired point within its range, also swinging entirely out of the way for drilling on the base. Drilling capacity is 3/16 in. in steel and 13/64 in. in brass and alloys. Each drill is furnished with ten feet of reinforced portable cord, switch, plug and chuck. See display adv. page 1311.—Adv.


Dumore Bench Drill

Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

DRILLS, ELECTRIC, MISCELLANEOUS.—This classification includes electrically driven drills not listed elsewhere in this book, particularly such drills as are too

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special in their application for separate listings; for instance, surgical drills for drilling bone, or various other such special devices.

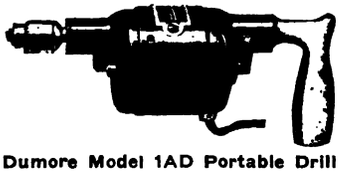
Manufacturers:

Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."
Hoosier Drilling Machine Co., Goshen, Ind. "Hoosier."
Keystone Driller Co., Beaver Falls, Pa. "Keystone."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."

DRILLS, ELECTRIC, PORTABLE.—Portable electric drills are the most widely used portable electric tool on the market. The general form consists of a compact enclosed motor with handles on the case for directing the drill, and a conveniently located switch for controlling the speed. In most drills a projecting drill chuck is geared to the motor, various gear ratios being used, depending on the capacity of the drill. Many drills have two speeds that are easily obtained by the operator. For wood boring only, some light, high-speed drills are made which have no gears but are driven direct from the motor. The larger sizes for metal drilling, which are made up to 2½ ins. capacity in steel, are usually equipped with a screw feed attachment and are arranged to be clamped to an "old man" stand, or held in position while drilling. Motors of the universal type, d-c. series motors, and a-c. induction motors for single, two and three-phase circuits are regularly supplied. Another type of portable drill which also comes under this classification consists of a portable motor, usually mounted on a truck, which is connected through a flexible shaft and suitable reduction gearing to the drill spindle. Both types of drills are sometimes used for other purposes than drilling, such as driving screws, tightening nuts, and in some cases grinding, the chuck permitting attachment of the proper tool.

Manufacturers:

Air-Way Electric Appliance Corp., Toledo, Ohio.
Arnold Electric Tool Co., Inc., Fort Trumbull Bldg., New London, Conn.
Black & Decker Mfg. Co., The, Towson Heights, Baltimore, Md.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."
Cincinnati Electrical Tool Co., The, 1501-3-5 Freeman Ave., Cincinnati, Ohio. "Cincinnati."
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Gilfillan Bros., Inc., Los Angeles, Cal.
Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.
Hisey-Wolf Machine Co., The, Colerain & Marshall Aves. Cincinnati, Ohio. "Hisey."
Knight Engineering & Sales Co., 441 E. 3rd St., Los Angeles, Cal. "One-Hand-Y."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marvin Electric Drill Co., 443 State St., Binghamton, N. Y.
Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."
Petersen Mfg. Co., A. H., 1614 Fratney St., Milwaukee, Wis. "Hole Shooter."
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill. "Ryerson-Conradson."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Electric Tool Co., The, Cincinnati, Ohio. "Standard."
Stenman Electric Valve Grinder Co., 42 Southbridge St., Worcester, Mass. "HusKee."
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.
Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."
U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U. S."
WISCONSIN ELECTRIC CO., Racine, Wis. The "Dumore" Model 1-AD portable drill (figure below), is intended for the fast drilling and countersinking of



Dumore Model 1AD Portable Drill

small holes; handy, efficient, economical. Equipped with universal motor, which operates on either a-c. or d-c. circuits. Length 10 ins. Capacity in steel is 3/16 in.; in brass and alloys, 13/64 in. Diameter of motor, 3⅜ ins. Spindle offset from center of motor, 25/32 in. Drive, helical gears. Handle is of aluminum. Net weight, 4¾ lbs. Complete with ten feet of reinforced portable cord, plug, switch and chuck. See display adv. page 1311.—Adv.

DRILLS, ELECTRIC PORTABLE, HAMMER TYPE.—The hammer type drill depends upon the chipping action of the drill point for its drilling action, the device being in many respects an automatic chisel and operating like a small rock drill. To produce the sharp blow necessary the drill is actuated by a spring, the drill point being drawn back against the spring and released either by a motor-driven cam or by a solenoid. In some types the drill point is rotated through a small angle after each blow. These drills are made as a hand tool, sometimes provided with a breast rest. They use a fractional-horsepower motor taking about as much power as the portable electric drills of the revolving type, and are used for drilling brick, stone, concrete, etc.

Manufacturers:

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."

DRILLS, ELECTRIC, PORTABLE, RAILWAY TRACK.—Light-weight compact drilling machines so constructed that they can be readily transported from place to place by one or two men. On electric railway track work they usually draw their power from the trolley line supplying the cars. Such machines are used for many purposes and vary from small motor-driven drills used to bore vertical spike holes in ties and readily operated by one man, to more powerful and heavier machines that can be used for drilling bolt or bond-terminal holes in heavy rails.

Manufacturers:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."
Electric-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
GENERAL ELECTRIC CO., Schenectady, N. Y. Drills of several designs and other bonding tools described with a complete line of rail bonds in Bulletin 44002A. See adv. pages 1203-1223.—Adv.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. "Thor."
Morse Twist Drill & Machine Co., New Bedford, Mass.
Stow Flexible Shaft Co., 3446-54 Ludlow St., Philadelphia, Pa.

DRILLS, ELECTRIC, ROCK.—Rock drills are used on many kinds of rock and under various conditions. As a result there are many types, each particularly adapted to some class of work. The bits for the hard rock are usually fluted, for the softer rocks and coal they are twisted. In use the drills generally combine a slow rotation and a rapid hammer action, the hammer making about 1000 strokes a minute. Electric rock drills are usually motor-driven through gearing. They are much more economical than air drills and are easier to handle and maintain. The efficiency remains practically constant throughout their life, while with an air drill it decreases as the piston and valves wear. Some of the electric drills are quite portable, while others designed for heavy work are mounted on a weighted tripod. In some cases, such as for drilling wells, motors as large as 75 hp. are used; they are securely mounted and drive the drill through gearing.

Manufacturers:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
GENERAL ELECTRIC CO., Schenectady, N. Y. Fort Wayne electric rock drill of the rotary hammer type, operated by a fully enclosed, splashproof motor. The drill steel rotates and receives about 1,700 blows per minute. An adjustable belt tightener permits a wide variation in speed of the drill. Will drill holes up to 12 ft. in depth finishing at 1¼ in. diameter. Power consumption 1½ to 2½ hp. Motors are d-c. or a-c., single phase excepted, and are interchangeable. Drill can be handled by two men, heaviest part weighing about 300 lbs. (Bulletin 48902.) See adv. pages 1203-1223.—Adv.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Electric Air."
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

DRILLS, ELECTRICIANS' AUTOMATIC BREAST AND HAND.—Drills operated automatically by a helix when pressure is applied to the handle. Breast drills are arranged to be manually operated by crank and gear and with plate on the brace against which breast pressure may be applied. These drills are widely used by electricians in house and building wiring.

Manufacturers:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Cincinnati Tool Co., Norwood, Cincinnati, Ohio. "Hargrave."
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Goodell-Pratt Co., Greenfield, Mass. "Mr. Punch."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Neil & Smith Electric Tool Co., 813-815 Broadway, Cincinnati, Ohio. "Ideal."
SMITH & HEMENWAY CO., INC., Irvington, N. J.

DRILLS, HAMMER AND SPRING, BRICK AND STONE.—Drills for use in brick or stone operated manually by crank and geared so as to strike a given number of blows at the drill point for every turn of the crank. They are used to drill holes for conduit and armored cable, for expansion bolts and similar fastenings, for insulators, machinery and other heavy equipment. For frequent use and certain special uses these drills are sometimes provided with stands or other bracing equipment to facilitate the drilling operation.

Manufacturers:

Barrett Sales Co., 568 W. Washington Blvd., Chicago, Ill.
Chicago Expansion Bolt Co., 324 W. Washington St., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Daugherty-Smith-Phillips Co., 1537 Cortland St., Chicago, Ill. "Phillips."
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Diamond N," "Rapid Fire."
Duffy Mfg. Co., 214 W. Grand Ave., Chicago, Ill. "Star."
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Mayhew Steel Products Co., Inc., 291 Broadway, New York, N. Y. "Mayhew."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Star."

When writing to manufacturers please mention the
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Village Blacksmith Folks, The, Watertown, Wis. (Brick and stone.)
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

DRILLS, PLASTER.—Drills having specially formed points for drilling in plaster and sometimes equipped with a funnel-like cup fastened at the chuck to catch the falling plaster. This attachment is generally used when wiring an old house or on alteration and repair jobs, where the making of much mess would be seriously objected to.

Manufacturers:

Mayhew Steel Products Co., Inc., 291 Broadway, New York, N. Y. "Mayhew."

DRILLS, TRACK, HAND-OPERATED.—Hand drills for drilling holes in track rails or ties are made in several types. The drill is supported in such a manner from the rail that the drill point presses against the rail or tie to be drilled. A common type consists of the supporting device and a hand lever attached through a ratchet to the drill. More elaborate types have a vertical frame supporting a shaft which is turned through bevel gears by hand cranks, the drill being in turn driven by the vertical shaft.

Manufacturers:

Aldon Co., The, 3338 Ravenswood Ave., Chicago, Ill. "Beland," "Standard."
Bird-Archer Co., The, 90 West St., New York, N. Y. "Baco."
GENERAL ELECTRIC CO., Schenectady, N. Y. Drills of several designs and other bonding tools described with a complete line of rail bonds in Bulletin 44002A.—Adv.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass. "IXL."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

DRILLS, TWIST.—Twist drills are made from rectangular tool steel stock, drop-forged and twisted while hot to give the desired general form, then machined and ground to the final form. They are largely used for drilling at high speed through cast iron and other common metals. They are extensively used by electrical manufacturers and also by other electrical concerns in their machine and repair shops.

Manufacturers:

Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio. "Paragon."
Detroit Twist Drill Co., Fort St. West at 14th St., Detroit, Mich. "Graham."
Fastfeed Drill & Tool Corp., Toledo, Ohio. "Fastfeed."
Morse Twist Drill & Machine Co., New Bedford, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B," "Hercules."
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont., Can.

DRINK MIXERS.—See Mixers, drink.

DRIVE & TWIST.—Trade name for guy anchors manufactured by the Gund Mfg. Co., LaCrosse, Wis.

DRIVER-HARRIS CO.—Harrison, N. J Manufacturer of resistance wire and materials. President, Frank L. Driver; vice-presidents, Leon O. Hart, Frank L. Driver, Jr.; vice-president and sales manager, Arlington Bensel; secretary, Miss Minnie Harris; treasurer, Percival E. Reeves; general manager, Frank L. Driver. Main office, Harrison, N. J. Factories, Harrison, N. J.; Walkerville, Ont., Can. Branch offices, 28 S. Jefferson St., Chicago, Ill.; 1249 Washington Bldg., Detroit, Mich.; Walkerville, Ont., Can. Sales representatives, Strong, Carlisle & Hammond, Cleveland, Ohio.

DRIWAL.—Trade name for waterproofing cement manufactured by the Billings-Chapin Co., 1153 E. 40th St., Cleveland, Ohio.

DROP, IMPEDANCE. — See Impedance drop.

DROP, REACTANCE. — See Reactance drop.

DROP, RESISTANCE. — See Resistance voltage; Copper drop.

DROPS, ANNUNCIATOR.—A lever controlled by an armature and electromagnetic coil at one end and provided with a plate or tag holder at the other. Used in annunciators where upon energizing the coil by pressing a button or otherwise the lever throws the tag or plate into view. Also see Annunciators.

Manufacturers:

Auth Electrical Specialty Co., 422 E 53rd St., New York, N. Y.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo. (For railroad service only.)
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

DROPS, BURGLAR ALARM.—A lever controlled by an armature and electromagnet coil at one end and arranged so that when the circuit is closed through the coil, by the operation of a door or window spring or other means, the drop, operated by the coil, falls and holds a local circuit closed through a bell or other alarm until the drop is raised. These drops are really a type of relay. For other types see Relays, burglar alarm.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.

DROPS, TELEPHONE SWITCHBOARD.—An annunciator used as a signal on manual switchboards. It consists of an electromagnet with an armature and a catch. The latter releases a shutter which falls and exposes a number. The shutter is restored by hand or by the insertion of the plug (in the case of the line drop) or by the operation of the listening key (in the case of the clearing-out drop on the cord circuit). The mechanically self-restoring drop or plug-restoring drop has a mechanical connection between jack and drop. The electrical self-restoring drop has a restoring electromagnet to pull the shutter to normal. A line drop is a drop connected normally to a subscriber line. It falls when the subscriber rings central and is used also on toll lines. The clearing-out drop is used on a cord circuit to notify the operator when a subscriber rings off, either for disconnection or to ask for further attention.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

DRUALITE.—Trade name for farm lighting and power plants manufactured by the Drury Engineering Co., 1713 1st Ave., Evansville, Ind.

DRUID.—Trade name for heavy weight, light density Regent glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

DRURY ENGINEERING CO.—1713 1st Ave., Evansville, Ind. Manufacturer of farm lighting and power plants. Business established 1918. President and general manager, Thomas W. Drury; vice-president, Louis A. Dans; secretary, Charles F. Dickmann; treasurer, William A. Koch.

DRY BATTERY OR DRY CELL.—A much used type of Leclanché primary cell in which the electrolyte is contained in a porous filling between the electrodes. The cell is sealed and from external appearance seems entirely dry. See Batteries; also Batteries, primary, dry.

D. S.—Trade name for cable terminals manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

D. S. L. RAY.—Trade name for stage border lights manufactured by the Display Stage Lighting Co., 314 W. 44th St., New York, N. Y.

DTS.—Trade name for automobile signals manufactured by the Denver Traffic Signal & Mfg. Co., 1835 Williams St., Denver, Colo.

DUALITE.—Trade name for double-filament incandescent lamps manufactured by the Whitelite Electric Co., 368-70 Broome St., New York, N. Y.

DUBILIER CONDENSER CO., INC.—217 Centre St., New York, N. Y. Manufacturer of static condensers. Business established 1917. President, William Dubilier; vice-president and sales manager, John Firth; secretary, treasurer and general manager, Cloyd Marshall.

DUBLARM.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa.

DUBOIS IRON WORKS.—805 N. Brady St., Du Bois, Pa. Manufacturer of gas and gasoline engines, electric and steam reciprocating pumps. President, John E. Du Bois; vice-president, W. C. Pentz; secretary and treasurer, E. A. Badger.

DUCHESS.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

DUCHESS.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DUCK, J. J.—436 St. Clair St., Toledo, Ohio. Manufacturer of conduit box bushings and knockout seals.

DUCKWORTH CHAIN & MFG. CO.—41 Mill St., Springfield, Mass. Manufacturer of power transmission chains.

DUCT-FEET.—The combined length of the individual cableways or ducts of an underground conduit line. It equals the length of the conduit line in feet multiplied by the number of ducts. This gives a better idea of the amount of actual conduit construction in any run than giving the length of the conduit alone.

DUCTS, AIR.—Ventilating ducts for cooling electrical machines and air-blast transformers by the passage of air through them. Such ducts are commonly provided in armature cores and in field cores of large turbogenerators, certain railway motors, etc.

DUCTS, UNDERGROUND.—The several cableways in an underground conduit line are termed ducts. The ducts are made of clay tile, concrete or fiber. Tile conduit is made in one, two, four, six, eight, nine and twelve-duct formations. The multiple-duct formations save labor in laying, but are suitable only for telephone or telegraph systems and power systems having smaller loads. In large power systems a cable burnout is likely to damage the duct wall and injure the cables in adjoining ducts. The use of single duct gives a double wall between adjacent ducts and better protection. With concrete and fiber ducts, which are always made as single ducts, the structure is made fireproof by filling the spaces between adjoining ducts with concrete. With concrete ducts this makes a solid structure which is a very substantial protection from burnouts and mechanical injury.

DUCTS, VENTILATING.—Canals or passageways provided in electrical machines for the flow of air or fluid to assist in carrying away the heat generated by the iron and copper losses. These are often made by putting spacers at desired intervals between the laminations of armature cores and similarly in some field cores. Like construction is employed in large air-blast and oil-immersed transformers.

DUDLO MFG. CO. — Wall St., Fort Wayne, Ind. Manufacturer of enameled wire, high-tension coils and insulating materials. Business established 1910. President, W. E. Mossman; vice-president, B. P. Mossman; secretary and treasurer, G. A. Jacobs; sales manager, D. J. Jackson.

DUFF MFG. CO., THE.—Pittsburgh, Pa. Manufacturer of jacks. Business established 1883. President, J. R. McGinley; vice-president, treasurer and general manager, T. A. McGinley; secretary, F. O. Graham; sales manager, E. A. Johnson. Main office and factory, Preble Ave. (North Side Station), Pittsburgh, Pa. Branch offices, 50 Church St., New York, N. Y.; Peoples Gas Bldg., Chicago, Ill.; Candler Bldg., Atlanta, Ga.; Monadnock Bldg., San Francisco, Cal.; Book Bldg., Detroit, Mich.

DU-5.—Trade name for lighting generators for motorcycles manufactured by the Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

DUFFY MFG. CO.—214 W. Grand Ave., Chicago, Ill. Manufacturer of spring and hammer drills and other electricians' tools. President and treasurer, D. U. Wasson; vice-president, G. B. Hessemer; secretary and general manager, E. G. Hessemer.

DUGGAN.—Trade name for porcelain cleats manufactured by the Imperial Porcelain Works, Trenton, N. J.

DUJARDIN-PLANTE' PLATES.—A type of storage-battery plates consisting of parallel lead strips welded together at the ends.

DUKE.—Trade name for oiling device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

DUKE.—Trade name for grease cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

DUMBWAITERS, ELECTRIC. — Small-capacity electrically operated and controlled elevators to meet the demands of high apartment buildings, hotels, department stores, large restaurants, etc., in sending packages, food and other matter from floor to floor. Push buttons are used almost invariably to control the car. The elaborateness of the control system depends on the service for which the dumbwaiter is used. If it operates only between two floors, a single button at each floor suffices to start the car to the other floor where it stops automatically. If it operates between the main floor and any of the other floors, as in an apartment building, the main-floor control panel usually has a limit button for each floor, while at each floor there may be only one button to return the car to the main floor. If the car may operate from any floor to any floor, which is not very common, the control system becomes somewhat intricate and requires a system of interlocks to prevent confusion and accidents; these usually prevent starting the car while any door to the shaft is open. A signal system is often provided with dumbwaiters, which may consist of bells or buzzers or these combined with indicating lamps.

Manufacturers:

Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.
Kimball Bros. Co., 9th St. & 11th Ave., Council Bluffs, Iowa. "Kimball."
Nock & Garside Elevator Co., The, 1850 Wazee St., Denver, Colo.
Olson-Boettger Electric Mfg. Co., 413 N. Franklin St., St. Paul, Minn.
Otis Elevator Co., 260 11th Ave., New York, N. Y.
PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.
See Electric Elevator Co., A. B., 220 Broadway, New York, N. Y.
Speidel, J. G., Reading, Pa. "Columbia."
Storm Mfg. Co., The, 40-50 Vesey St., Newark, N. J. "Storm."
Warner Elevator Mfg. Co., The, 2600 Spring Grove Ave., Cincinnati, Ohio.
Warsaw Elevator Co., P. O. Box 889, Warsaw, N. Y.

DUMORE.—Trade name for electric driers, grinders, drills, cloth cutting machines, motors, etc., manufactured by the Wisconsin Electric Co., 16th St. & Junction Ave., Racine, Wis.

DUNBAR.—Trade name for display racks manufactured by the Acme Level & Mfg. Co., Toledo, Ohio.

DUNBAR & CO.—2652 W. Lake St., Chicago, Ill. Manufacturers of electric corn poppers and peanut roasters. Proprietor, Charles F. Dunbar.

DUNBAR BROS. CO., THE.—80 South St., Bristol, Conn. Manufacturer of springs. Business established 1845. President, Edward G. Dunbar; vice-president, Winthrop W. Dunbar; secretary and treasurer, Charles E. Dunbar.

DUNBAR, HUBERT C.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of paper cartons for packing small electrical products. Business established 1904. Factories, Chicago, Ill.; South Bend, Ind.; Anderson, Ind.

DUNCAN ELECTRIC MFG. CO.—Lafayette, Ind. Manufacturer of watt-hour meters and transformers. Business established 1901. President and general manager, Thomas Duncan; vice-president, C. L. Ricketts; secretary, Frederick Holmes; treasurer, George L. Cragg; sales manager, Frank W. Pyle.

DUNCAN ELECTRICAL CO., LTD.—2 Inspector St., Montreal, Que., Can. Manufacturer of electrical wiring devices. Charles Duncan, managing director.

DUNKLE CO., ARTHUR J.—50 Church St., New York, N. Y. Manufacturer of automobile signals. Business established 1904. Arthur J. Dunkle, sole owner.

DUNLAP CO., JOHN.—Carnegie, Pa. Manufacturer of steel reflectors and shade holders. Business established 1839. President, W. A. Dunlap; treasurer, J. H. Dunlap; secretary, James Boyd.

DUNN MFG. CO.—180 N. Dearborn St., Chicago, Ill. Manufacturer of electric dishwashers. President, M. J. Kelly; secretary, William H. Dunn; treasurer, H. R. Phelan.

DUNN MFG. CO., W. E.—Holland, Mich. Manufacturer of motor-driven machinery for making concrete products. President, W. E. Dunn.

DUNNING & BOSCHERT PRESS CO. INC.—Syracuse, N. Y. Manufacturer of motor-driven insulation, mica, baling presses, etc. President, R. E. Boschert; vice-president, W. S. Dunning; secretary and treasurer, C. A. Dunning.

DUNTLEY, J. W.—1004 Michigan Ave., Chicago, Ill. Manufacturer of automobile ignition systems. J. W. Duntley, sole owner.

DUNTON CO., THE M. W.—Providence, R. I. Manufacturer of soldering salts, etc.

DUO.—Trade name for die stocks manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp., of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

DUOGRAPH.—Trade name for oxy-acetylene welding machines manufactured by the Davis-Bournonville Co., Jersey City, N. J.

DUO-LATERAL.—Trade name for radio tuning coils manufactured by Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

DUO-LATERAL COILS.—Trade name for radio inductances manufactured by the Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.

DUO POINT.—Trade name for electric household irons made by the Central Flat-Iron Mfg. Co., Johnson City, N. Y.

DUO SAFETY.—Trade name for shipping tags manufactured by the International Tag Co., 319-329 N. Whipple St., Chicago, Ill.

DUPARQUET, HUOT & MONEUSE CO.—New York, N. Y. Manufacturer of heavy-duty electric cooking and heating devices. Business established 1852. President, treasurer and general manager, George P. Ahner; vice-president, E. J. Moneuse; secretary, A. F. Moneuse; treasurer, Louis H. Huot. Main office, 108-114 W. 22nd St., New York, N. Y. Branch offices, 312 W. Ontario St., Chicago, Ill.; 90 North St., Boston, Mass.

DUPLEX.—Trade name for gaskets manufactured by Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.

DUPLEX.—Trade name for expansion shields and anchor bolts manufactured by the Barrett Sales Co., 568 W. Washington Blvd., Chicago, Ill.

DUPLEX.—Trade name for street-lighting mastarms manufactured by the Buffalo Specialty Co., 375 Ellicott St., Buffalo, N. Y.

DUPLEX.—Trade name for electric grinder manufactured by the F. W. Cochrane Mfg. Co., 5329 S. Vermont Ave., Los Angeles, Cal.

DUPLEX.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

DUPLEX.—Trade name for electric washing machines manufactured by the Domestic Laundry Equipment Co., 224 W. 26th St., New York, N. Y.

DUPLEX.—Trade name for burglar alarm systems for banks manufactured by the Duplex Electric Co., 75-77 Grand St., New York, N. Y.

DUPLEX.—Trade name for chains for pull sockets manufactured by the Hatheway Mfg. Co., Bostwick Ave., Bridgeport, Conn.

DUPLEX.—Trade name for wet batteries manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

DUPLEX.—Trade name for electric blueprint paper coating machines manufactured by the C. F. Pease Co., 829 N. Franklin St., Chicago, Ill.

DUPLEX.—Trade name for photographic arc lamps manufactured by M. J. Wohl & Co., Inc., Payntar Ave. & Hancock St., Long Island City, N. Y.

DUPLEX, BRIDGE.—In telegraphy a system in which the receiving instrument at each station is connected across two impedances, one in series with the line wire and the other in series with the artificial line in such manner that no electrical change in the receiver circuit is effected by outgoing signals.

DUPLEX, DIFFERENTIAL.—In telegraphy a duplex system in which at each station one of two portions of the receiving instrument are connected in series with the line wire and the other in series with an artificial line of such electrical characteristics that the effects upon the receiver of currents passing through the main and artificial lines, as a result of outgoing signals, are neutralized. This is sometimes called single-current duplex, inasmuch as only one pole of the battery is ever connected to the line, and the relays are operated by an unbalance of current in their windings.

DUPLEX ELECTRIC CO.—75-77 Grand St., New York, N. Y. Manufacturer of burglar alarm systems for banks. Treasurer and general manager, J. P. Williams.

DUPLEX LIGHTING WORKS OF GENERAL ELECTRIC CO.—6 W. 48th St., New York, N. Y. Manufacturer of duplex lighting fixtures and fixture switches. Rex J. Cole, general manager.

DUPLEX, POLAR.—In telegraphy a duplex system in which the sending key operates a pole changer which alternately connects battery of opposite polarity to the line. One half of the polar receiving relay is connected in series with the line and the other in series with the artificial line, thus the reversal of the sending current has no effect on the relay, which only responds to a reversal of the receiving current.

DUPLEX STORAGE BATTERY CO.—Beaver Dam, Wis. Manufacturer of storage batteries, farm lighting and power plants. Business established 1919. President, J. W. Deniger; vice-president, H. T. Schickel; secretary and treasurer, M. A. Jacobs; general manager, Peter M. Kettenhofen. Sales representatives, Raymond Livingston, 709 Cobbs Bldg., Seattle, Wash.; W. S. M. Pinkham, St. Augustine, Fla.

DUPLEXALITE.—Trade name for duplex lighting fixtures manufactured by the Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can., and Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y.

DU PONT DE NEMOURS & CO., E. I.—Wilmington, Del. Manufacturer of electric blasting apparatus, car curtains and upholstery materials, chemicals, paints, varnishes, etc. President, Irenee Du Pont; secretary, Alexis Du Pont; treasurer, F. D. Brown; sales manager, F. D. Brown. Main office, Du Pont Bldg., Wilmington, Del. Branch offices, 21 E. 40th St., New York, N. Y.; Harvey Bldg., Boston, Mass.; Dime Bank Bldg., Detroit, Mich.; Gugle Bldg., Columbus, Ohio; McCormick Bldg., Chicago, Ill.; Chronicle Bldg., San Francisco, Cal.

DURABLE.—Trade name for duplex steam pumps manufactured by the Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.

DURACORD.—Trade name for flexible portable cord, cables and extension lamp manufactured by the Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I.

DURADUCT.—Trade name for flexible nonmetallic conduit manufactured by the Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I.

DURAGRAPH.—Trade name for electric time recorders manufactured by the Automatic Time Stamp Co., 160 Congress St., Boston, Mass.

DURALECTRIC.—Trade name for electric cigar lighters made by the Duralectric Corp., Jamestown, N. Y.

DURALECTRIC CORP., THE.—Jamestown, N. Y. Manufacturer of electric cigar lighters and bell-ringing transformers. Business established 1919. President, D. B. Clark; vice-president, W. D. Osgood; secretary and treasurer, W. C. Allison; general manager, W. N. Daniel. Main office, Mount Tabor Bldg., Jamestown, N. Y. Factory, Bemus Point, N. Y. Branch office, 340 Munsey Bldg., Washington, D. C. District representative, G. H. Pickard, 9 S. Clinton St., Chicago, Ill.

DURAMETALLIC. — Trade name for packing for pistons, valves, rods, etc., manufactured by the New Era Mfg. Co., Inc., 730 Cobb Ave., Kalamazoo, Mich.

DURANOID-CONDENSITE.—Trade name for molded insulation manufactured by the Duranoid Mfg. Co., 213-221 Chestnut St., Newark, N. J.

DURANOID MFG. CO., THE.—213-221 Chestnut St., Newark, N. J. Manufacturer of molded insulation. President, William B. Swinnell; treasurer, Henry T. Meyer.

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DURANT MFG. CO.—655-665 Buffum St., Milwaukee, Wis. Manufacturer of electric revolution counting machines. Business established 1879. President, William K. Winkler; vice-president, Henry O. Winkler; secretary and treasurer, Douglas F. McKey.

DURASOTE.—Trade name for wood preservatives manufactured by the Page & Hill Co., 814 Plymouth Bldg., Minneapolis, Minn.

DURATEX.—Trade name for telephone cords and switchboard cords manufactured by the Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

DURO.—Trade name for electric well pumps and pumping systems manufactured by the Burnett-Larsh Mfg. Co., 537-545 E. Monument Ave., Dayton, Ohio.

DURO.—Trade name for blowoff valves manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

DURO.—Trade name for babbitt metal manufactured by the Muzzy-Lyon Co., Detroit, Mich.

DUTCH BOY.—Trade name for babbitt metal, solder, etc., manufactured by the National Lead Co., 111 Broadway, New York, N. Y.

DUTCH BRAND.—Trade name for soldering paste and friction tape manufactured by the Van Cleef Bros., 77th St. & Woodlawn Ave., Chicago, Ill.

DUXBAK.—Trade name for belting and belt lacing manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

DWARF.—Trade name for grease cups manufactured by the Williams Valve Co., Cincinnati, Ohio.

DYKE.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Inc., Parkersburg, W. Va.

DYNAMIC ELECTRICITY.—A term used in referring to electricity in motion, as distinguished from "static electricity," which is electricity at rest.

DYNAMO.—An abbreviation of the term "dynamoelectric machine" used to designate an electric generator or motor in which electromagnets usually provide the magnetic field. The word "dynamo" was formerly in much wider usage than at present. Although used for either generator or motor, it has come to be applied mostly to the generator and especially to the d-c. generator. Present practice avoids ambiguity by speaking of generators and motors as such and very seldom as dynamos. Also see Generator; also Motor.

DYNAMOELECTRIC MACHINE.—A machine employing electromagnetic induction for converting mechanical energy into electrical energy in the form of electric currents, or the reverse. It may be a generator or motor or a combination of both these elements in one machine. For further details see Machines, dynamoelectric.

DYNAMO SPECIAL.—Trade name for sheet steel for electrical purposes manufactured by the American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa.

DYNAMO TENDERS' OILERS.—See Oilers, engineers', dynamo and motor tenders'.

DYNAMOMETERS, MOTOR AND ENGINE TESTING.—Strictly speaking a dynamometer is any apparatus for the measurement of force. The term is commonly used to designate any apparatus for measuring the torque of a machine whose power output is to be determined. They are commonly classed as absorption and transmission. The absorption type is one in which the energy transmitted by the machine under test is directly dissipated. The best example is the prony brake. The transmission type is merely an intermediate contrivance which transmits, and at the same time measures or indicates, the torque exerted by the machine tested to another machine which ultimately dissipates the energy. Examples are the lever, torsion and cradle dynamometers.

The Prony Brake is an absorption dynamometer consisting of a brake band which is applied directly on the pulley of the motor or engine to be tested and a spring or platform balance for measuring the force exerted. For small machines the band is a belt or rope, one end of which is attached to the spring balance, then it is passed over the pulley and the other end is weighted. The resulting tension on the belt is registered on the spring balance. From this tension and from the diameter and speed of the pulley the power output can be calculated.

In using the weighted belt brake, the pulley should preferably be driven towards the balance. The force under these conditions will be the difference between the weights and the balance reading.

For testing larger machines the band is of steel, lined with blocks of wood or other material, and provided with clamping screws for tightening around the pulley. To the band is attached a lever of known length which rests on a knife edge on a platform balance. The friction between the pulley and the band tends to rotate the brake and this tendency is counteracted by the pressure of the balance. If F is the force in pounds exerted on the balance, L the length in feet of the lever from the center of the pulley to the point at which force is measured, n is the speed of the pulley in r. p. m., then the output in horsepower is:

$$\text{Output} = 2\pi LFn/33{,}000$$

If it is desired to measure the torque only, then $T = FL$ for the beam brake, and FR, where R is the radius of the pulley for the belt brake, and F is the difference between the weight and balance reading when the pulley is rotated as suggested above.

The Torsion Dynamometer is some form of helical spring or elastic shaft which connects the motor under test with the driving machine. The spring or shaft is first calibrated statically by noting the torque due to a known weight at the end of a long lever at right angles to the axis of the spring and the corresponding angular twist. When in use, the angular displacement can be measured by electrical or optical means.

Other Types of Dynamometer. The resistance of fluids to the fanning and propelling action of blades is also utilized in another type of absorption dynamometer. One form operates on the principle of the centrifugal pump and cradle dynamometer combined. The casing is supported by the pump shaft and prevented from rotation by a brake arm resting on a knife edge on platform scales. The torque is measured exactly as with the prony brake.

The Westinghouse hydraulic dynamometer differs from the centrifugal pump type merely in construction. It is essentially a double-flow pump, the double-flow principle eliminating end thrust. The torque is measured exactly as with the other type.

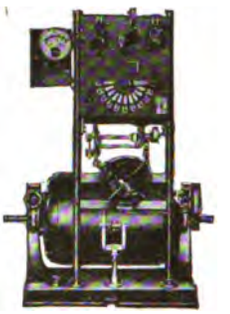
The resistance to the fanning action of blades rotating in air is sometimes employed in testing high-speed machines. Fan-brake dynamometers, as these are called, must be calibrated independently since the resistance of the air varies approximately as the cube of the speed and also with barometric pressure.

The electric generator is perhaps the most convenient and accurate dynamometer for testing high-speed engines and motors. The losses of the generator are first carefully measured, and these together with the electrical output, which is easily measured, gives the power output of the driving machine.

A special form of the electric dynamometer consists of an electric generator, usually of the d-c. type, whose frame is mounted in ball bearings concentric with its shaft so that the frame is movable through a small angle. The frame is provided with a weighing scale or an arm on which weights may be placed to measure the torque delivered to the dynamometer by the machine being tested. Changes in load are made by changes in the electrical load of the generator. This dynamometer may be reversed in its operation, the generator being used as a motor to drive the machine under test.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto Ont., Can.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. The Sprague electric dynamometer is recognized as the standard laboratory equipment for the testing of internal combustion engines by manufacturers, technical schools and U. S. Government experimental stations. It is a machine for measuring torque. The engine in test is coupled to the internally revolving rotor of the dynamometer, which transmits the full torque exerted by the engine to the external field or oscillating frame by electromagnetic interaction. The oscillating frame is balanced on ball bearing pedestals and is restrained from revolving by the scales on which the torque is measured. Horsepower, being a product of torque and speed a simple formula gives the desired result. HP = Pounds pull on scales × RPM ÷ 1000, with some scale arrangements. With others the divisor is 3000. An important feature is the ability of the dynamometer to run as a transmission dynamometer for starting the engines in test, and also for measuring the friction horsepower and so determining the mechanical efficiency. Fitted with automatic control and a wide range rheostat capacity, these dynamometers are capable of variation in load and speed through a range as great as can



Sprague Dynamometer

be carried by any engine within the maximum capacity of the dynamometer. Operated as a generator or brake, the speed can be controlled from practically a standstill up to a maximum of 2500 to 4500 RPM, depending upon the particular dynamometer in use, and by fine and gradual increments. The power of the engine which is coupled to the dynamometer is converted by the latter into electrical energy and this is in turn dissipated outside the dynamometer, in a resistor, as heat. It is possible, however, to reclaim the energy by returning it to a direct current shop system. The Sprague company is prepared to furnish with the dynamometers the accessories essential to the proper equipment of a dynamometer laboratory including scales, tachometers, speed counters, engine bed plates with adjustable engine supports, flexible coupling apparatus and suitable equipment for measuring fuel consumption. See display adv. pages 1306-7.—Adv.

DYNAMOTORS.—These are direct-current machines having one magnetic field and either two armatures or one armature with two independent windings and commutators. The function of a dynamotor is to change d-c. power from one voltage to another. One armature winding takes power as a motor and drives the other as a generator. The ratio of the voltages is approximaely constant and the voltage supplied by the generator winding can be controlled slightly by shifting the brushes or by changing the voltage supplied to the motor winding. Dynamotors are very frequently machines of small rating and are used to supply current for wire telegraphy and experimental work. Larger machines are used for electroplating work that is supplied from 110 or 220-volt d-c. circuits.

Manufacturers:

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Marble-Card Electric Co., Gladstone, Mich.
Munning & Co., A. P., Church St., Matawan, N. J.

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Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio. "RWB."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y.
ROTH BROS & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)

DYNE.—A unit that enters the definitions of many electrical units is the unit of force. It is a matter of common experience that if bodies are let fall freely their velocity increases from the time they are released until they strike the earth. Whenever a force acts continually upon a body it accelerates its velocity. The acceleration produced is a measure of the force acting. The dyne is the force which will cause an acceleration of one centimeter per second in a gram mass.

Since measurements show that gravity will produce an acceleration of 980 centimeters per second, it follows that the force of gravity must equal 980 dynes. This is true only at sea level, however, since the force of gravity varies with the latitude and elevation. The dyne is known as the absolute unit of force; about 444,793 dynes equal one pound avoirdupois. The dyne is a very small unit and it has been suggested that 10^7 dyne be used as the unit. Likewise the force of gravity on one gram and kilogram masses is called the gram and kilogram force, respectively.

E

E.—Symbol for electromotive force or voltage in formulas especially. The capital letter is used when a fixed or average value of e.m.f is referred to; the small letter e is used when instantaneous values are referred to.

E. A. LABORATORIES, INC.—Myrtle Ave. & Spencer St., Brooklyn, N. Y. Manufacturer of motor-driven automobile horns. President, Emanuel Auflero; vice-president, M. Auflero; secretary, William Von Elm.

E. & B. MFG. CO., THE.—965 Woodward Ave., Detroit, Mich. Business established 1918. President, George L. Ennen; vice-president, William H. Albers; secretary and treasurer, Albert P. Erz.

EADE, JOHN E.—1245 Eddy St., Providence, R. I. Manufacturer of pull chain acorns.

EAGER ELECTRIC CO., THE.—Watertown, N. Y. Manufacturer of motor-generator sets, electrogalvanizing equipment, generators, etc. Business established 1901. President and general manager, Henry Eager; vice-president, Herman Engesser; secretary, treasurer and sales manager, H. Robert Eager. Sales representatives, Frederic B. Stevens, Detroit, Mich.; Boissier Electric Co., Long Island City, N. Y.; Meaker Galvanizing Co., 1249 Fulton St., Chicago, Ill.

EAGLE.—Trade name for belt lacing manufactured by the American Lace Leather Co., Inc., Richmond, Va.

EAGLE.—Trade name for taps and dies manufactured by the American Tap & Die Co., Greenfield, Mass.

EAGLE.—Trade name for gasoline engines manufactured by the Eagle Mfg. Co., 624 Winnebago St., Appleton, Wis.

EAGLE.—Trade name for oilers manufactured by the Eagle Mfg. Co., Wellsburg, W. Va.

EAGLE.—Trade name for power plant ejectors manufactured by the Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y.

EAGLE BOLT & FORGING CO., THE.—1435 E. 45th St., Cleveland, Ohio. Manufacturer of eye and clevis bolts and special forgings. Business established 1904. Treasurer and general manager, W. P. Young.

EAGLE BRAND.—Trade name for pipe threading tools manufactured by the American Tap & Die Co., Greenfield, Mass.

EAGLE BRAND.—Trade name for insulated wires and cables manufactured by the Marion Insulated Wire & Rubber Co., Marion, Ind.

EAGLE MFG. CO., THE.—624 Winnebago St., Appleton, Wis. Manufacturer of gasoline engines. Business established 1888.

EAGLE MFG. CO.—Wellsburg, W. Va. Manufacturer of illuminating glassware and oiling devices. Business established 1894. President, H. W. Paull; vice-president, C. B. Ott; secretary, S. O. Paull; treasurer, James Paull.

EAGLE-PICHER LEAD CO.—Chicago, Ill. Manufacturer of lead oxides, solder, sheet tubing, etc. Main office, 208 S. LaSalle St., Chicago, Ill. Factories, Cincinnati, Ohio; Chicago, Ill.; Hillsboro, Ill.; Joplin, Mo.; Newark, N. J.; Galena, Kans.; Henryetta, Okla.; St. Louis, Mo. Branch offices, 1030 Broadway, Cincinnati, Ohio; 101 Park Ave., New York, N. Y.; 4th & Cherry Sts., Philadelphia, Pa.; 359 Guilford Ave., Baltimore, Md.; 66 Delaware Ave., Buffalo, N. Y.; 1407 Arrott Bldg., Pittsburgh, Pa.; 1413 Schofield Bldg., Cleveland, Ohio; 2119 Railway Exchange Bldg., St. Louis, Mo.; 301 Finance Bldg., Kansas City, Mo.; Builders Exchange, Minneapolis, Minn.; Builders and Traders Exchange, Detroit, Mich.; 416 Gravier St., New Orleans, La.; Joplin, Mo.

EAGLE SMELTING & REFINING WORKS, LTD.—41-45 Prince St., Montreal, Que., Can. Manufacturer of babbitt metal, solder, brass and bronze castings. President and general manager, Joseph Merson; secretary and treasurer, Peter Merson.

EARL.—Trade name for packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

EARL MFG. CO., INC.—4332 N. Gratz St., Philadelphia, Pa. Manufacturer of electric vibrators and hair cutters.

EARLL, CHARLES I.—York, Pa. Manufacturer of trolley catchers and retrievers. Business established 1902. Proprietor, Charles I. Earll; secretary and treasurer, M. M. Lambert.

EARLY CO., EDWARD E.—1129 5th St., N. W., Canton, Ohio. Manufacturer of commutator cement. Business established 1910. President, treasurer and general manager, Edward E. Early; vice-president, M. A. Early; secretary, Edith E. Early; sales manager, Kramer Early.

EARNMORE.—Trade name for electric corn poppers manufactured by C. Cretors & Co., 620 W. 27th St., Chicago, Ill.

EAR-PHONE.—Trade name for hearing device for the deaf manufactured by the Globe Phone Mfg. Co., Reading, Mass.

EARS, TROLLEY, CLAMPING.—See Clamps, trolley.

EARS, TROLLEY, CLINCH.—A device for supporting the trolley wires in electric railway systems. The ear usually consists of a bronze casting grooved to receive the trolley wire, around which the lips of the groove are clinched so as to support the wire from above and offer unobstructed passage for the trolley wheel below. The ear is in turn supported by the trolley hanger, usually by means of a threaded boss into which the hanger stud is screwed. A popular form has an extruded metal grooved or runner portion for clinching around the trolley wire, riveted to a malleable iron threaded boss.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Materials Co., The, North East, Pa.
OHIO BRASS CO., THE, Mansfield, Ohio. Various styles of mechanical trolley clamps as well as cast bronze and extruded brass clinch ears. O-B extruded ears, due to unusual manufacturing process, have made remarkable records for long life.—Adv.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can., "Peirce."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

EARS, TROLLEY, FEEDER AND STRAIN.—The feeder ear is a modification of the standard trolley ear, having, in addition, a boss into which the feeder wire is held by means of solder or set screws. The strain ear is a modification of the trolley ear, having, in addition, lugs or eyes into which anchor guy wires may be attached.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can., "Peirce."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

EARS, TROLLEY, SPLICING.—Trolley ears for splicing the wire are more commonly called splicers. See Splicers, trolley wire; also see Sleeves, trolley wire splicing.

EARTH.—In electrical work the earth is regarded as possessing zero potential. To earth means to connect a circuit to the earth; this expression is used more frequently abroad than in the United States, where the more common expression "to ground" is employed.

EARTH AUGERS.—See Augers, earth, pole or post holes.

EARTH-BORING MACHINES.—See Boring machines, earth, pole or post hole.

EARTH CURRENTS.—Currents circulating in the earth and frequently causing disturbance with other circuits that utilize the earth as part of their normal circuit. Earth currents may be due to stray currents from electric railway or grounded power circuits, or due to current circulating in the earth especially at times when there is disturbance in the magnetic and electrical and equilibrium of the earth as a unit mass. The latter earth currents are especially noticed at times of very active displays of the aurora borealis or "northern lights."

EASCO.—Trade name for asbestos products made by the Eastern Asbestos Co., 503 Turks Head Bldg., Providence, R. I.

EASIEST WAY.—Trade name for electric washing machines made by the Easiest Way Mfg. Co., Sandusky, Ohio.

EASIEST WAY MFG. CO., THE.—Sandusky, Ohio. Manufacturer of electric washing machines. Business established 1912. President, treasurer, and general manager, J. F. Donahue; vice-president, C. Faber Donahue; secretary and sales manager, C. Webb Sadler.

EAST HAMPTON BELL CO., THE.—East Hampton, Conn. Manufacturer of bells, trolley wheels, bushings and axles. Business established 1837. President, A. A. Bevin; secretary, treasurer and general manager, M. S. Purple.

EAST JERSEY PIPE CO.—Paterson, N. J. Manufacturer of fractional horsepower and induction motors, boilers, tanks, etc.

EASTER ELECTRIC CO., THE.—827 14th St., Denver, Colo. Manufacturer of high-frequency electrotherapeutic apparatus. President and general manager, W. H. Easter; vice-president, Frank G. Easter; secretary and treasurer, Miss Ruth Easter; sales manager, Thomas Easter.

EASTERN ASBESTOS CO.—503 Turks Head Bldg., Providence, R. I. Manufacturer of asbestos products. Business established 1920. Manager, P. O. Baker.

EASTERN BRASS WORKS.—221-23 Thirteenth Ave., Newark, N. J. Manufacturer of lighting fixtures and fixture fit-

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tings and parts. Business established 1900. President, Richard O. Pfeiffer; vice-president, O. Jaehnig; secretary, J. J. Ott; treasurer, J. Rail. Sales representatives, Eastern Sales Co., 45 Warren St., New York, N. Y.

EASTERN FELT CO.—Winchester, Mass. Manufacturer of felts and felt polishing wheels. President, Daniel Murphy; vice-president, Patrick Noonan; secretary, Patrick T. Walsh; treasurer and general manager, Thomas J. Donnelly.

EASTERN MALLEABLE IRON CO., THE.—Naugatuck, Conn. Manufacturer of insulation pins, brackets and breakarms for electric lighting, electric railways, telephone and telegraph service. Business established 1913. President, Harris Whittemore; vice-president, C. L. Berger; secretary and general manager, E. Mannweiler; treasurer, George B. Woolson. Main office, Naugatuck, Conn. Factory, Union City, Conn. Branch offices, Bridgeport Malleable Iron Works, Bridgeport, Conn.; Naugatuck Malleable Iron Works, Naugatuck, Conn.; Troy Malleable Iron Works, Troy, N. Y.; Vulcan Iron Works, New Britain, Conn.; Wilmington Malleable Iron Works, Wilmington, Del.

EASTERN PARTS MFG. CO., INC.—135 Spring St., New York, N. Y. Manufacturer of ignition specialties. President, Joseph Prosky; vice-president, Benjamin Frankel; secretary, Ph. Frankel; treasurer, A. Stern; general manager, S. S. Wolfson. Factory, Brooklyn, N. Y. Branch office and warehouse, 738 W. Pico St., Los Angeles, Cal.

EASTERN PRECISION ELECTRICAL INSTRUMENT CO.—69-71 Observer St., Rockville Centre, N. Y. Manufacturer of radio equipment, electrical toys, screw machine products, etc. Business established 1920. President and general manager, H. W. H. Stillwell; secretary and treasurer, E. Adam.

EASTERN SIGNAL & SUPPLY CO.—50 Church St., New York, N. Y. Manufacturer of wet batteries. President and treasurer, E. M. Deems. Factory, Boonton, N. J.

EASTERN SPECIALTY CO.—3551 N. 5th St., Philadelphia, Pa. Manufacturer of jewel bearings for electrical instruments, and electrical testing instruments.

EASTERN TUBE & TOOL CO., INC.—594 Johnson Ave., Brooklyn, N. Y. Manufacturer of flexible steel and non-metallic conduit and armored cable. Business established 1907. President, E. J. Sutliffe; vice-president, A. P. Hinsky; secretary and general manager, Edwin J. Schneider; treasurer, C. H. Bradt; sales manager, I. G. Trattler. Sales representatives, William H. Beaven, Birmingham, Ala.; Charles S. Broward, P. O. Box 713, Atlanta, Ga.; Craven & Hopkins, Philadelphia, Pa.; A. W. Marshall Co., Detroit, Mich.; Keeler White Co., San Francisco, Cal; William A. Hendrickson, Boston, Mass.; Ohio Distributing Co., 223 Lomax Pl., Chicago, Ill.; Powers Electric Sales Co., New York, N. Y.; R. J. Smyth, 102 Fulton St., New York, N. Y.; C. H. Wallis & Co., St. Louis, Mo.; H. B. Hutchings, Montreal, Que., Can.

EASTMAN KODAK CO.—Rochester, N. Y. Manufacturers of electric tacking irons, photograph driers and other photographic apparatus.

EASTMAN MACHINE CO.—Buffalo, N. Y. Manufacturer of electric cloth cutting machines. President and general manager, Wade Stevenson; vice-president, Geoffrey Stevenson; secretary, August Becker; treasurer, C. R. Stevenson. Main office and factory, Washington & Goodell Sts., Buffalo, N. Y. Branch offices, New York, N. Y.; Chicago, Ill.; Baltimore, Md.; Philadelphia, Pa.; New Orleans, La.; Detroit, Mich.; Boston, Mass.; Cleveland, Ohio; San Francisco, Cal.; St. Louis, Mo.

EASTON CAR & CONSTRUCTION CO.—Easton, Pa. Manufacturer of industrial railway equipment. Business established 1914. President and general manager, W. E. Farrell; vice-president and sales manager, A. M. Farrier; secretary and treasurer, R. C. Haggerty. Main office and factory, Easton, Pa. Branch offices, 50 Church St., New York, N. Y.; 403 Vinton Bldg., Detroit, Mich.; 654 Railway Exchange Bldg., Chicago, Ill.; Oliver Bldg., Pittsburgh, Pa.

EASY.—Trade name for pipe pushers manufactured by the Easy Mfg. Co., David City, Neb.

EASY.—Trade name for vacuum type electric washing machine manufactured by the Syracuse Washing Machine Corp., 507 E. Water St., Syracuse, N. Y.

EASY-CLEANED.—Trade name for feed water heaters manufactured by the Houston, Stanwood & Gamble Co., Cincinnati, Ohio.

EASY DONE.—Trade name for electric dishwashers manufactured by the Hyfield Mfg. Co., 21 Walker St., New York, N. Y.

EASYLITE.—Trade name for socket attachments manufactured by the A. E. Rittenhouse Co., Honeoye Falls, N. Y.

EASY MFG. CO., THE.—David City, Neb. Manufacturer of pipe pushers.

EASY READ.—Trade name for engine indicator manufactured by the Bacharach Industrial Instrument Co., 422 1st Ave., Pittsburgh, Pa.

EATON.—Trade name for electric furnaces and industrial ovens manufactured by the Eaton Electric Furnace Co., Taunton, Mass.

EATON ELECTRIC FURNACE CO., THE.—Taunton, Mass. Manufacturer of electric furnaces and industrial ovens. President, Harry B. Eaton; treasurer, John Ashworth; secretary, James A. Fairfield.

EATON ELECTRICAL MFG. CO.—555 W. Monroe St., Chicago, Ill. Manufacturer of switchboards, panels, panelboards, switches, electrical boxes and cabinets, etc. Business established 1918. President, treasurer and general manager, C. L. Eaton; vice-president, L. E. Pepin; secretary, F. L. Pratt.

E-B.—Trade name for wire terminal and cable lugs manufactured by the H. H. Eby Mfg. Co., 13th & Wallace Sts., Philadelphia, Pa.

EBB.—Abbreviation for Extra Best Best iron wire, which see.

EBONITE.—See Rubber (hard) rods, sheets, tubes, tubing, etc.

EBONITE.—Trade name for gaskets and piston packing manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

EBY MFG. CO., H. H.—13th & Wallace Sts., Philadelphia, Pa. Manufacturer of wire drawing dies, armatures, electrical advertising specialties and novelties, coils, condensers, rheostats, etc. Business established 1920. Hugh H. Eby, sole owner.

E. C. & M.—Trade name for electrical control equipment, lifting magnets, etc., manufactured by the Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio.

ECCO.—Trade name for telephone wire manufactured by the Electric Cable Co., Yonkers, N. Y.

ECCO.—Trade name for rubber-covered wire manufactured by the Habirshaw Electric Cable Co., Point St., Yonkers, N. Y.

ECHO.—Trade name for electric automobile horns manufactured by the Warner Electric Co., Muncie, Ind.

ECK DYNAMO & MOTOR CO.—Belleville, N. J. Manufacturer of electric fans, motors, generators and motor-generators. Business established 1897. President, A. Bourgeois; vice-president and treasurer, W. J. Wallace; secretary, C. H. Krueger. Main office and factory, Mill & Main Sts., Belleville, N. J. Branch office, 32 Warren St., New York, N. Y. Sales representatives, Sweeten & O'Donnell Co., Ltd., 1213 Race St., Philadelphia, Pa.; Tompkins Stoddard Co., 136 Federal St., Boston, Mass.

ECLIPSE.—Trade name for cord adjusters manufactured by J. W. Carter, Abilene, Tex.

ECLIPSE.—Trade name for pneumatic painting equipment manufactured by the Eclipse Air Brush Co., 79 Orange St., Newark, N. J.

ECLIPSE.—Trade name for electric vacuum cleaners manufactured by the Eclipse Machine Co., Sidney, Ohio.

ECLIPSE.—Trade name for electric valve grinders made by the Eclipse Valve Grinder Co., 20th & Oak Sts., Kansas City, Mo.

ECLIPSE.—Trade name for pocket and battery ammeters manufactured by the Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.

ECLIPSE.—Trade name for motors manufactured by the Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.

ECLIPSE.—Trade name for steam specialties and valves manufactured by the Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill.

ECLIPSE.—Trade name for polishing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

ECLIPSE.—Trade name for electric vacuum pumps manufactured by the Frederick Post Co., 319 S. Wabash Ave., Chicago, Ill.

ECLIPSE.—Trade name for electric time recording clocks and heaters manufactured by the George D. Roper Corp., Eclipse Gas Stove Division, 707 S. Main St., Rockford, Ill.

ECLIPSE.—Trade name for nail pullers and glass cutters manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

ECLIPSE.—Trade name for bells, gongs and buzzers manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

ECLIPSE AIR BRUSH CO.—79 Orange St., Newark, N. J. Manufacturer of pneumatic painting equipment. Business established 1910. President, Howard W. Beach; secretary and treasurer, Willard C. Beach.

ECLIPSE ELECTRIC MFG. CO.—Northwestern Furniture Exposition Bldg., St. Paul, Minn. Manufacturer of electric portable lamps and silk shades. President, H. T. Hudson.

ECLIPSE LIGHT CO.—583-87 Broadway, New York, N. Y. Manufacturer of lighting fixtures. Business established 1911. President and general manager, Louis B. London; vice-president and sales manager, Edward L. Silverman; secretary and treasurer, Horace London.

ECLIPSE MACHINE CO.—Sidney, Ohio. Manufacturer of electric vacuum cleaners. Business established 1912. President, L. M. Studevant; vice-president, A. J. Hess; secretary, treasurer and general manager, W. C. Horr; sales manager, E. C. Brown. Sales representatives, A. Hedeman, 453 Washington St., Boston, Mass.; Panama Lamp & Commercial Co., 525 Mission St., San Francisco, Cal.; L. P. Gillon, Detroit, Mich.; I. W. Sanford, 1446 Hunter Ave., Columbus, Ohio; Hight & Stout, 345 5th Ave., New York, N. Y.

ECLIPSE MFG. CO.—424 N. Meridian St., Indianapolis, Ind. Manufacturer of spark plugs. Business established 1914. President and treasurer, W. S. Brown; vice-president; W. S. Brown, Jr.; secretary, R. M. Franklin; sales manager, A. H. Vayo.

ECLIPSE VALVE GRINDER CO.—20th & Oak St., Kansas City, Mo. Manufacturer of electric valve grinders. Business established 1917. President, treasurer and general manager, F. W. Fratt; secretary, G. Ellsworth.

ECO CLOCK CO.—Boston, Mass. Manufacturer of electric, mechanical and portable watchman's time recording and detecting clocks. Business established 1888. President, Robert W. Deane; vice-president and general manager, Lesley L. Kennedy; secretary, Philip S. Hill; treasurer, E. T. Magoffin. Main office and factory, 197 Congress St., Boston, Mass. Branch offices, Walton Bldg., Atlanta, Ga.; 26 Cortland St., New York, N. Y.

ECONOMIC.—Trade name for fire tube boilers manufactured by the Erie City Iron Works, Erie, Pa.

ECONOMIC.—Trade name for electric coffee roasters manufactured by the Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.

ECONOMICAL ELECTRIC LAMP DIVISION OF THE NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—25 W. Broadway, New York, N. Y. L. Lobenthal, general manager.

ECONOMIZERS, BOILER OR FUEL.—The purpose of the economizer is to absorb heat that has passed the boiler heating surfaces and would escape up the stack and to utilize it for heating the boiler feed water or water for other, such as industrial purposes. It is called economizer because it conserves considerable fuel. The economizer installation is indicated whenever there is a large amount of waste heat available and when there is a demand for hot water.

Large central stations, having adopted high rates of combustion, have found the economizer necessary to turn the high stack temperatures to usefulness. Another fact favoring the economizer is that as higher steam pressures and temperatures are adopted, the stack temperatures also become higher, therefore, resulting in higher stack losses. The economizer absorbs this heat.

The economizer is much cheaper than boiler heating surface. Boiler capacity is increased between 15 and 40% by the addition of economizer surface. Feed water enters the boiler almost at steam temperature so that steam pressures are steadier, and the wear and tear on boilers is less due to less sudden temperature changes. The large water storage capacity of the

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economizer also acts somewhat as a feed-water purifier, which is fortunate since a little scale on economizer tubes will not cause bags and hazards as is the case when they occur on the boiler tubes.

The high load-factors of central stations make the investment in an economizer a very profitable one in most cases, and makes high boiler ratings economical where otherwise economy would have to be sacrificed for increased capacity.

Manufacturers:

Decarie Boiler & Incinerator Co., 3324-30 St. Hubert St., Montreal, Que., Can.
Green Fuel Economizer Co., Beacon, N. Y.
Power Specialty Co., 111 Broadway, New York, N. Y. "Foster."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

ECONOMY.—Trade name for telephone bracket manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

ECONOMY.—Trade name for fixture hangers manufactured by the M. B. Austin Co., 108-16 S. Desplaines St., Chicago, Ill.

ECONOMY.—Trade name for oil and grease cups manufactured by the American Injector Co., 175 14th Ave., Detroit, Mich.

ECONOMY.—Trade name for bond plug manufactured by the American Mine Door Co., Canton, Ohio.

ECONOMY.—Trade name for drafting tables, boards, etc., manufactured by the Economy Drawing Table & Mfg. Co., S. Center St., Adrian, Mich.

ECONOMY.—Trade name for box connectors and box and fixture hangers manufactured by the Economy Electric Specialty Co., 6937 S. Halsted St., Chicago, Ill.

ECONOMY.—Trade name for renewable cartridge and plug fuses manufactured by the Economy Fuse & Mfg. Co., 2717 Greenview Ave., Chicago, Ill., and the Economy Fuse & Mfg. Co. of Canada, Ltd., Montreal, Que., Can.

ECONOMY.—Trade name for electric pumps manufactured by the Economy Pumping Machinery Co., 122-124 Curtis St., Chicago, Ill.

ECONOMY.—Trade name for socket attachment manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

ECONOMY.—Trade name for turbogenerators, turbine-driven pumps, blowers, turbines and reduction gears, manufactured by the Kerr Turbine Co., Wellsville, N. Y.

ECONOMY.—Trade name for enameled rigid conduit manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

ECONOMY APPLIANCE CO.—517 Marsh-Place Bldg., Waterloo, Iowa. Manufacturer of meter reading and recording devices. President, H. H. Caughlan; secretary, A. R. Mutton; treasurer, M. A. Harrison.

ECONOMY COILS.—See Coils, economy, arc lamps.

ECONOMY DRAWING TABLE & MFG. CO.—S. Center St., Adrian, Mich. Manufacturer of drafting tables, boards, etc. Business established 1916. President, R. G. Manning; vice-president, Clarke E. Baldwin; secretary and treasurer, M. Straub; general manager, Harold E. Smith.

ECONOMY ELECTRIC SPECIALTY CO.—6937 S. Halsted St., Chicago, Ill. Manufacturer of box connectors and box and fixture hangers. C. Buckels, sole owner.

ECONOMY ENGINEERING CO.—Chicago, Ill. Manufacturer of portable elevators. President, George M. French; secretary and sales manager, T. A. Duffey; treasurer and general manager, W. B. Parey. Main office, 2635 W. VanBuren St., Chicago, Ill. Branch office, Grand Central Palace, New York, N. Y.

ECONOMY FUSE & MFG. CO.—Chicago, Ill. Manufacturer of renewable and non-renewable fuses, molded insulation, and electrical specialties. President, treasurer and general manager, A. L. Eustice; sales manager, A. E. Tregenza. Main office and factory, 2717 Greenview Ave., Chicago, Ill. Branch offices, 1202 Healy Bldg., Atlanta, Ga.; 803 Lexington Bldg., Baltimore, Md.; 425 Rice Bldg., Boston, Mass.; 1044 Prudential Bldg., Buffalo, N. Y.; 2610 Union Central Bldg., Cincinnati, Ohio; 608 S. Dearborn St., Chicago, Ill.; 316 The Arcade, Cleveland, Ohio; 205 Commonwealth Bldg., Denver, Colo.; 1012 Majestic Bldg., Detroit, Mich.; 1205 Commerce Bldg., Kansas City, Mo.; 1213 Majestic Bldg., Milwaukee, Wis.; 802 Plymouth Bldg., Minneapolis, Minn.; 30 Church St., New York, N. Y.; 523 Widener Bldg., Philadelphia, Pa.; 2223 Farmers Bank Bldg., Pittsburgh, Pa.; 415 Frisco Bldg., St. Louis, Mo.; 443 Rialto Bldg., San Francisco, Cal.; 710 White Bldg., Seattle, Wash.; 1927 W. 36th St., Los Angeles, Cal.; 505 Unity Bldg., Montreal, Que., Can.

ECONOMY FUSE & MFG. CO. OF CANADA, LTD.—Montreal, Que., Can. Manufacturer of fuses. Business established 1913. President, A. L. Eustice; manager, J. J. Sorber.

ECONOMY LIGHT.—Trade name for lighting fixtures manufactured by the H. S. Whiting Co., Inc., 104 E. 41st St., New York, N. Y.

ECONOMY MFG. CO.—616 W. Monroe St., Chicago, Ill. Manufacturer of terminals for automobile primary and secondary wire. F. J. Liska, sole owner.

ECONOMY PUMPING MACHINERY CO.—122-124 N. Curtis St., Chicago, Ill. Manufacturer of electric pumps. President and treasurer, R. H. Thomas; vice-president and secretary, W. W. Huggins.

EDCO.—Trade name for electric motors and generators manufactured by the Electric Dynamic Co., Ave. A & North St., Bayonne, N. J.

EDDY CURRENT COEFFICIENT.—This is the factor depending upon the resistivity of the circuit by which the square of the product of the maximum flux density, frequency and thickness of the laminations must be multiplied to give the eddy current loss per cu. cm. of iron in ergs per second. Compare with Hysteresis coefficient, and also see Eddy current loss.

EDDY CURRENT LOSS.—The development of eddy currents is in accordance with Joule's law, i. e., it is proportional to the product of the square of the current by the resistance of the circuit through which it flows. To reduce this loss in iron which is subject to varying flux, it is laminated or made into thin sheets, the oxide coating or insulating varnish on the laminations increasing the resistance and thus reducing the eddy current loss. The power consumed by eddy currents per cu. cm. of iron is given by: $W_e = \epsilon \lambda^2 f^2 B^2_m$ ergs per second, where B_m is the maximum flux density, λ is the thickness of the laminations, f is the frequency in cycles per second, and ϵ is the eddy-current coefficient and varies inversely as the resistivity. The average value for ϵ is for standard annealed sheet steel 2.2×10^{-4}, and for annealed silicon sheet steel 0.65×10^{-4}.

EDDY CURRENTS.—These are electric currents induced in a conductor by the varying or fluctuating magnetic flux which penetrates the conductor. The iron and steel parts of electric machinery are conductors and when the magnetic flux that penetrates these parts varies in any way an e. m. f. is induced which causes currents to flow in obedience to Ohm's law. These currents, which generally do no useful work but dissipate energy, are called eddy currents or Foucault currents.

In some instances eddy currents are used in the operation of the apparatus; thus in all meters which contain damping or drag magnets the reaction between the eddy currents and the magnets retards or damps the motion of the rotating element. In induction furnaces the eddy currents produced by a rapidly varying flux through the substance to be melted generate sufficient heat for fusing it. (See Eddy current loss).

EDELMANN & CO., E.—2638-56 N. Crawford Ave., Chicago, Ill. Manufacturers of hydrometer syringes, automobile specialties, etc. President and treasurer, E. Edelmann; vice-president and secretary, B. Koral.

EDEN.—Trade name for electric washing machines manufactured by the Gillespie-Eden Corp., 7 Dey St., New York, N. Y.

EDES MFG. CO., THE.—Water St., Plymouth, Mass. Manufacturer of zinc anodes, plates, rods, etc. Business established 1855. President, Edwin L. Edes; vice-president, Alton D. Edes; treasurer, Oliver L. Edes.

EDGE-GLOW.—Trade name for electric signs manufactured by T. L. Robinson & Co., 105 W. Monroe St., Chicago, Ill.

EDGEMONT.—Trade name for friction clutches manufactured by the Edgemont Machine Co., Dayton, Ohio.

EDGEMONT MACHINE CO., THE.—Dayton, Ohio. Manufacturer of friction clutches. President, W. P. Coffman; secretary, O. B. Coffman; treasurer, J. I. Coffman.

EDIPHONE.—Trade name for phonographic dictating systems manufactured by Thomas A. Edison, Inc., Orange, N. J.

EDISON.—Trade name for electric heating, cooking and labor-saving appliances manufactured by the Edison Electric Appliance Co., Inc., 5660 W. Taylor St., Chicago, Ill., and Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can.

EDISON.—Trade name for storage batteries and portable lighting outfits manufactured by the Edison Storage Battery Co., Orange, N. J.

EDISON.—Trade name for wet batteries manufactured by Thomas A. Edison, Inc., Belmont Ave., Bloomfield, N. J.

EDISON.—Trade name for motion-picture machines manufactured by the McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill.

EDISON-BROWN.—Trade name for rail bonds manufactured by Harold P. Brown, 120 Liberty St., New York, N. Y.

EDISON EFFECT.—An effect first noticed and described by Edison, after whom it was named. It is a flow of current that takes place in an incandescent lamp when a metal plate or electrode is placed near one of the terminals of the filament. A flow of current is detected from the plate to the filament.

EDISON ELECTRIC APPLIANCE CO., INC.—Chicago, Ill. Manufacturer of electric cooking, heating and labor-saving appliances. Business established 1918. President, George A. Hughes; vice-president, A. K. Baylor; secretary and treasurer, E. R. Murphy; appliance manager, J. D. A. Cross; range manager, P. L. Miles. Main office, 5660 W. Taylor St., Chicago, Ill. Factories, Chicago, Ill., and Ontario, Cal. Branch offices, Ontario, Cal.; 24-26 Peachtree Arcade, Atlanta, Ga.; 140-142 6th Ave., New York, N. Y.; 147 Regent St., Salt Lake City, Utah.

EDISON LAMP WORKS OF GENERAL ELECTRIC CO.—Harrison, N. J. Manufacturers of incandescent lamps and foot-candle meters. Main office, Harrison, N. J. Factories, Ampere, N. J.; Belleville, N. J.; East Boston, Mass.; Fort Wayne, Ind.; Harrison, N. J.; New Brunswick, N. J.; Newark, N. J.; Oakland, Cal.; Scranton, Pa.; St. Louis, Mo. Branch offices carrying stock, Citizens & Southern Bank Bldg., Atlanta, Ga.; 84 State St., Boston, Mass.; Monadnock Block, Chicago, Ill.; Provident Bank Bldg., Cincinnati, Ohio; 1st National Bank Bldg., Denver, Colo.; Dwight Bldg., Kansas City, Mo.; Corporation Bldg., Los Angeles, Cal.; 410 3rd Ave., N., Minneapolis, Minn.; Maison-Blanche Bldg., New Orleans, La.; Witherspoon Bldg., Philadelphia, Pa.; Equitable Bldg., New York, N. Y.; Oliver Bldg., Pittsburgh, Pa.; Electric Bldg., Portland, Ore.; Pierce Bldg., St. Louis, Mo.; Newhouse Bldg., Salt Lake City, Utah; Rialto Bldg., San Francisco, Cal. District offices, Lexington St. Bldg., Baltimore, Md.; Brown-Marx Bldg., Birmingham, Ala.; Electric Bldg., Buffalo, N. Y.; Butte, Mont.; Charleston National Bank Bldg., Charleston, W. Va.; Commercial National Bank Bldg., Charlotte, N. C.; James Bldg., Chattanooga, Tenn.; Illuminating Bldg., Cleveland, Ohio; Hartman Bldg., Columbus, Ohio; Dayton Savings & Trust Bldg., Dayton, Ohio; Hippee Bldg., Des Moines, Iowa; Dime Savings Bank Bldg., Detroit, Mich.; Fidelity Bldg., Duluth, Minn.; Hulett Bldg., Elmira, N. Y.; Commerce Bldg., Erie, Pa.; 1600 Broadway, Fort Wayne, Ind.; Commercial Savings Bank Bldg., Grand Rapids, Mich.; Hartford National Bank Bldg., Hartford, Conn.; Traction Terminal Bldg., Indianapolis, Ind.; Heard National Bank Bldg., Jacksonville, Fla.; Miners Bank Bldg., Joplin, Mo.; Burwell Bldg., Knoxville, Tenn.; Southern Trust Bldg., Little Rock, Ark.; Starks Bldg., Louisville, Ky.; Exchange Bldg., Memphis, Tenn.; Public Service Bldg., Milwaukee, Wis.; Stahlman Bldg., Nashville, Tenn.; 2nd National Bank Bldg., New Haven, Conn.; Gluck Bldg., Niagara Falls, N. Y.; Electric Bldg., Omaha, Neb.; Turks Head Bldg., Providence, R. I.; Virginia Railway & Power Bldg., Richmond, Va.; Granite Bldg., Rochester, N. Y.; Colman Bldg., Seattle, Wash.; Schenectady, N. Y.; Paulsen Bldg., Spokane, Wash.; 3rd National Bank Bldg., Springfield, Mass.; Onondaga County Savings Bank Bldg., Syracuse, N. Y.; Commercial National Bank

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Bldg., Washington, D. C.; Spitzer Bldg., Toledo, Ohio; State Mutual Bldg., Worcester, Mass.; Stambaugh Bldg., Youngstown, Ohio. Sales representative for Texas, Oklahoma and Arizona, Southwest General Electric Co., Dallas, Tex.; El Paso, Tex.; Houston, Tex.; Oklahoma City, Okla.; San Antonio, Tex.

EDISON MAZDA.—Trade-mark for incandescent lamps manufactured by the Edison Lamp Works of General Electric Co., Harrison, N. J.

EDISON STORAGE BATTERY CO.—Orange, N. J. Manufacturer of storage batteries, ignition outfits, farm lighting and power plants, portable lighting outfits and lamps. President, Thomas A. Edison; vice-president, S. B. Mambert; vice-president and general manager, Frank D. Fagan; secretary, Arthur Mudd; treasurer, H. F. Miller. Main office, Orange, N. J. Factories, Orange and Silver Lake, N. J. Branch offices, 3000 Indiana Ave., Chicago, Ill.; 247 W. 35th St., New York, N. Y.; Buffalo, N. Y.; Philadelphia, Pa.; Washington, D. C.; New Haven, Conn.; Pittsburgh, Pa.; Detroit, Mich.; Cleveland, Ohio; Denver, Colo.; St. Louis, Mo.; Boston, Mass.; Atlanta, Ga.; Kansas City, Mo.; New Orleans, La.; San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.

EDISON, THOMAS ALVA.—Thomas A. Edison, born at Milan, Ohio, in 1847, is justly acclaimed as the foremost American inventor, whose genius has been manifested in many of the most important electrical devices, among which is the incandescent lamp which was produced October 21, 1879, and has been justly designated as epoch making. He is also famous for his invention of the phonograph, his developments in telegraphy and countless other inventions, many of which have been revolutionary in their character. The invention of the incandescent lamp was the beginning of a great Edison group of industries originally established at his Menlo Park laboratory. Here were also manufactured generators to supply current required for the operation of incandescent circuits.

At the age of 12 he became a trainboy on the Detroit & Port Huron branch of the Grand Trunk Railway. At the age of 15 he became a telegraph operator at Mount Clemens, Mich. While in Indianapolis, in 1864, he invented an automatic telegraph repeater. Later he went to Boston, where he invented a commercial stock indicator, for which he received $40,000, enabling him to establish an extensive laboratory at Newark, N. J. In 1876 he established his laboratory at Menlo Park, N. J., where he invented his carbon telephone transmitter. In 1877 Edison invented the phonograph, which for the first time in human history recorded vocal speech and instrumental sounds for reproduction. On October 21, 1879, Edison invented an incandescent electric lamp which he kept intact for 40 hours, and in 1881 he exhibited a successful bamboo filament lamp in Paris. On September 4, 1882, the first Edison central station in New York City went into operation. Moving his laboratory to West Orange, N. J., he established there a large plant for electrical experimentation and invention. Among his more important inventions may be named the phonograph, a telephone for long-distance transmission, a system of duplex telegraphy (which he subsequently developed into quadruplex and sextuplex transmission), the carbon telephone transmitter, the microtasemeter, the aerophone, megaphone, the incandescent electric lamp, the kinetoscope and a nickel-iron storage battery of rugged construction. Edison also invented a disk phonograph with a diamond-point reproducer and other improvements. In 1913 by synchronizing his phonograph and kinetoscope he produced realistic talking motion pictures. Since the commencement of the European War in 1914 he has designed, built and operated successfully several benzol plants, two carbolic acid plants, and other chemical plants for making myrbane, aniline oil, aniline salt and paraphenylenediamine.

While still continuing his research and invention, Mr. Edison has developed an extensive group of manufacturing plants at West Orange, N. J., prominent among which is the Edison phonograph factory and the plant for the production of Edison storage batteries.

Mr. Edison has received innumerable degrees and marks of recognition, the latter including the Albert gold medal of the Royal Society of Arts of England and the John Fritz gold medal of the four national engineering societies of America. During the late war he was appointed by President Wilson as head of the Naval Consulting Board and gave a great deal of his time to this work.

Various organizations bear his name, notably the Association of Edison Illuminating Companies and the Edison Pioneers, whose membership is composed of men associated with him in his work and enterprises up to 1885. Mr. Edison is an honorary member of a large number of societies.

EDISON, INC., THOMAS A.—Orange, N. J. Manufacturer of electrically operated phonographic dictating machines, phonographs and wet batteries and renewals. Business established 1889. President and general manager, Charles Edison; vice-president, L. W. McChesney; secretary, M. B. Walsh; sales manager, R. E. Trout. Main office, Orange, N. J. Factory, Bloomfield, N. J. Branch offices, 2044 Railway Exchange Bldg., St. Louis, Mo.; 752 Peoples Gas Bldg., Chicago, Ill.; 1205 Hobart Bldg., San Francisco, Cal.

EDISON-DICK.—Trade name for motor-driven mimeograph and letter folding machines manufactured by the A. B. Dick Co., 736 W. Jackson Blvd., Chicago, Ill.

EDMANDS, WALTER S.—21-27 Pearl St., Boston, Mass. Manufacturer of electric light baths and bakers. Business established 1904.

EDMONDS ELEVATOR CO., THE.—Cleveland, Ohio. Manufacturer of electric passenger and freight elevators. Business established 1875.

EDMUNDS CO., LTD., J. H.—225 Richmond St., W., Toronto, Ont., Can. Manufacturer of lighting fixtures. President and general manager, J. A. Wilson; secretary and treasurer, W. J. Scevior; sales manager, David Wilson.

EDMUNDSLITE.—Trade name for commercial lighting unit manufactured by the J. H. Edmunds Co., Ltd., 225 Richmond St., W., Toronto, Ont., Can.

EDSH.—Trade name for lamp guards and fixture stems manufactured by the Electrical Dealers Supply House, 162 W. Randolph St., Chicago, Ill.

EDUCATION, ELECTRICAL.—To the widespread extent of electrical education is due in large measure the rapid progress of the electrical industry. If it had not been that our colleges and schools took up general and special courses on electrical subjects, the knowledge of things electrical would have spread slowly and consequently electrical developments would have been very seriously retarded. The early investigators of electricity and magnetism found but few scattered references to electrical phenomena, as did those who began to apply the principles that had been discovered to the invention of electrical apparatus, machinery and appliances. Gradually the study of electrical phenomena was introduced into books and courses on physics. An elementary knowledge of electrical manifestations was slowly disseminated among the students of colleges and secondary schools.

During the eighties of the last century, it became recognized that the application of the principles of electrical science must be along engineering lines of a special nature. This conclusion was emphasized with the development of alternating-current circuits and equipment, a knowledge of which involved higher mathematics and physics. The organization of the American Institute of Electrical Engineers in 1884 marked the beginnings of electrical engineering as a distinct branch of engineering in general. Within the next ten or dozen years many colleges that had already introduced technological courses began developing a special course in electrical engineering, in some cases this being a subdivision of or outgrowth from the course in mechanical engineering, but in many others an offshoot from the course in physics. Today nearly every technical school and college has a general course in electrical engineering and some colleges also have specialized courses in certain branches of the general subject, such as electrochemical engineering, electric railway engineering, telephone engineering, illuminating engineering, etc., these courses being supplemtary or optional studies in the general course as a rule.

There is no need to discuss here the value of a college education. The prolonged debate on that subject has been settled in favor of collegiate training. Self-education has its advantages for the man of genius and determination, but unfortunately there are few Edisons; self-training is the most enduring and effective, and every one must depend on it to a large extent even after receiving a college education. But to do so entirely is a waste of valuable time and is apt, moreover, to overlook essential fundamentals.

If it is desired to get a thorough grasp of electrical engineering, for instance, there is no better way than to devote some four years to a college training wherein the preliminary studies of mathematics, physics and chemistry and the general principles underlying all engineering can be mastered; then a special study can be made of electrical science and art as applied in modern electrical engineering practice. The progress in electrical work has been so great, however, that no student can expect to become a specialist in any one branch of electrical engineering through a regular four-year course on this subject. Nearly all such courses are planned to deal with the general principles of electrical engineering, leaving it to the student either by post-graduate work or by practical employment in an electrical organization to acquire mastery of the practice in any specialized branch.

It was felt that a list of American and Canadian colleges and schools in which electrical engineering and other electrical subjects are taught would prove of value. The following lists have been prepared on information obtained directly from each of the institutions, except in a few cases where no information was obtainable in this manner, in which cases the name of the institution is given without additional facts. Such additional information, however, is of value in giving not only a survey of the general status of electrical courses and institutions but also because it may aid in the selection of the school to which a student may find it desirable to go.

The total number of students taking the full collegiate course in electrical engineering in the institutions listed is about 14,000. Since the close of the World War the attendance in all colleges has increased a great deal. Men who saw service in either the army or navy were impressed with the need for special training and the attendance in all technical schools has increased materially so as to tax the facilities of the institutions in a great many cases.

Colleges Giving Complete Courses in Electrical Engineering. The list of colleges and schools given below includes only those schools of recognized standing giving a complete collegiate course in electrical engineering leading to a degree. The length of the course is four years unless otherwise stated. A large percentage of the colleges confer upon a student the degree of Bachelor of Science in Electrical Engineering upon satisfactory completion of the course. Some colleges confer other degrees, such as Bachelor of Arts, Bachelor of Engineering, Electrical Engineer, Master of Engineering and Doctor of Engineering, the latter three being given only for longer courses or for recognized success in the engineering field.

Questionnaires were sent out to the colleges and schools and the information given has been taken from the replies. In a few cases incomplete or no information was given and the corresponding entries are necessarily brief. Each entry has been condensed to give only the most important facts and the schools are arranged geographically for ease of reference. The number of professors and instructors is the number devoting all or the major part of their time to electrical subjects. The name of the professor given is that of the head of the electrical department or of other faculty members with the title professor, associate and assistant professors being omitted. The number of students enrolled in the electrical engineering course for the first semester of the 1920-1921 year is given, as well as the annual tuition and fees.

Alabama:

Alabama Polytechnic Institute, Electrical Engineering Department, Auburn, Ala. B. S. degree; 3 professors and instructors; A. St. C. Dunstan, professor; number of students, 400; tuition free to residents of Alabama, $36 to nonresidents.

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University of Alabama, College of Engineering, University, Ala. B. S. degree; 2 professors; Arthur R, Rauder, professor; number of students, 63; tuition free to residents of Alabama.

Arizona:

University of Arizona, College of Mines and Engineering, Department of Electrical Engineering, Tucson, Ariz. B. S. degree; Paul Cloke, professor; number of students, 45; tuition for nonresidents, $30; fees vary.

Arkansas:

University of Arkansas, College of Engineering, Department of Electrical Engineering, Fayetteville, Ark. B. E. E. and E. E. degrees; 5 professors and instructors; W. N. Gladson, dean; W. B. Stelzner, professor; number of students, 67; tuition free; term matriculation fee, $7; laboratory fees, $2 per course.

California:

California Institute of Technology, Department of Electrical Engineering, Pasadena, Cal. B. S. degree; 4 professors; Royal W. Sorenson, professor; number of students, 130; tuition, $200, fees, student body, $7.50; chemistry deposit, $10.

Stanford University, Department of Engineering, Stanford University, Cal.

University of California, Department of Mechanical and Electrical Engineering, Berkeley, Cal. B. S. degree; 4 professors and instructors; Geo. L. Greves, professor; number of students, 285; tuition free; fees, $10 to $15.

Colorado:

Colorado State Agricultural College, Division of Mechanical Arts, Fort Collins, Colo.

University of Colorado, College of Engineering, Department of Electrical Engineering, Boulder, Colo. B. S. degree; 6 professors and instructors; H. S. Evans, professor; number of students, 157; tuition, $66.

University of Denver, School of Electrical Engineering, Denver, Colo. B. S. degree; 3 professors and instructors; R. E. Nyswander, professor; number of students, 35; tuition, $150; fees, $15.

Connecticut:

Yale University, Sheffield, Scientific School, New Haven, Conn. B. S. and E. E. degrees; 15 professors and instructors; Charles F. Scott, professor; number of students, 103; tuition, $300; laboratory fees, minimum, $7.50, maximum $45.

District of Columbia:

Catholic University of America, School of Science, Washington, D. C. B. S. degree; 3 professors and instructors; Thomas J. MacKavanagh, professor; number of students, 50; tuition, $200.

Florida:

University of Florida, College of Engineering, Gainesville, Fla. B. S. degree; 2 professors; J. R. Benton, professor; number of students, 24; tuition free to residents of Florida; entrance fee $10.

Georgia:

Georgia School of Technology, Electrical Engineering Department, Atlanta, Ga. B. S. degree; 7 professors and instructors; T. W. Fitzgerald, professor; number of students, 610; tuition, $58. A 5-year course is also given to co-operative students who attend classes for 4 weeks and then work for 4 weeks for industrial concerns. Number of co-operative students, 115.

University of Georgia, Department of Electrical Engineering, Athens, Ga. B. S. degree; professor, W. H. Davenport tuition, free to residents of Georgia.

Idaho:

University of Idaho, Engineering College, Moscow, Idaho. B. S. degree; 2 professors and instructors; J. Hugo Johnson, professor; number of students, 33; tuition, free.

Illinois:

Armour Institute of Technology, Department of Electrical Engineering, 3300 Federal St., Chicago, Ill. B. S. degree; 6 professors; E. H. Freeman, professor; number of students, 141; tuition, $200; fees: shops $30, chemistry $12.50, matriculation, $5.

Lewis Institute, Engineering Department, 1949 W. Madison St., Chicago, Ill. B. S. degree; 8 professors and instructors; F. A. Rogers, professor; number of students, 250; tuition and fees, approximately $75.

Loyola University, St. Ignatius College, The Arts and Science Department, Pilsen Station, Chicago, Ill. 6 professors and instructors; Professor Forbes; number of students, 50; tuition, $100.

Northwestern University, College of Engineering, Evanston, Ill. 5-year course; E. E. degree; 10 professors and instructors; J. F. Hayford, director; tuition, $200.

University of Illinois, College of Engineering, Urbana, Ill. B. S. degree; 9 professors and instructors; Ellery B. Paine, professor in charge, and Prof. Morgan Brooks; number of students, 433; tuition, $50.

Indiana:

Purdue University, School of Electrical Engineering, W. Lafayette, Ind. B. S. degree; 12 professors and instructors; C. Francis Harding, professor; number of students, 506; tuition and fees, $51 for residents of Indiana, $86 for nonresidents.

Rose Polytechnical Institute, Electrical Engineering Department, Terre Haute, Ind. B. S. degree; 3 professors and instructors; C. C. Knipmeyer, professor; number of students, 79; tuition, $175.

University of Notre Dame, Department of Electrical Engineering, Notre Dame, Ind. E. E. degree; 3 professors and instructors; J. A. Caparo, professor; number of students, 80; tuition, $150; fees, $30.

Iowa:

Iowa State College, Electrical Engineering Department, Ames, Ia. B. S. degree; 7 professors and instructors; F. A. Fish, professor; number of students, 332; tuition free for Iowa residents, $51 to others; incidental fees, $18; laboratory fees vary.

State University of Iowa, Department of Electrical Engineering in the College of Applied Science, Iowa City, Ia. B. E. degree; 4 professors and instructors; A. H. Ford, professor; tuition, $40; fees, $15, Matriculation fee, $10.

Kansas:

Kansas State Agricultural College, Electrical Engineering Department, Division of Engineering, Manhattan, Kans. B. S. degree; 4 professors and instructors; C. E. Reid, professor; number of students, 240; fees, $23.

University of Kansas, School of Engineering, Electrical Engineering Department, Lawrence, Kans. B. S. degree; 4 professors and instructors; Geo. C. Shaad, professor; number of students, 160; tuition and fees, $40 for residents of Kansas, $60 for nonresidents.

Kentucky:

University of Kentucky, School of Engineering, Lexington, Ky.

Louisiana:

Louisiana Industrial Institute, Ruston, La. B. S. degree; 4 professors and instructors; W. L. Mitchell, superintendent, mechanical and electrical engineering course; tuition free to residents of Louisiana, $30 to nonresidents; fees vary.

Tulane University of Louisiana, College of Technology, New Orleans, La. B. E. degree; 2 professors and instructors; Douglas Anderson, professor; number of students, 131; tuition, $125; fees, $40 to $60.

Maine:

University of Maine, College of Technology, Orono, Maine. B. S. degree; 4 professors and instructors; W. E. Barrows, professor; number of students, 165; tuition, $90 for Maine residents, $160 to nonresidents; fees vary.

Maryland:

The Johns Hopkins University, Department of Engineering, Baltimore, Md. B. E. degree; 6 professors and instructors; J. B. Whitehead, professor; number of students, 110; tuition, $200; fees, about $75.

University of Maryland, Department of Electrical Engineering, College of Engineering, College Park, Md. B. S. degree; 10 professors and instructors; Myron Creese, professor; number of students, 45; tuition, $385 (includes board and lodging).

Massachusetts:

Harvard University, Harvard Engineering School, Cambridge 38, Mass. S. B. degree; 6 professors and instructors; Comfort A. Adams, professor; number of students, 80; tuition, $200.

Massachusetts Institute of Technology, Electrical Engineering Department; Cambridge, Mass. B. S. degree; 23 professors and instructors; Dugald Caleb Jackson, professor; tuition, $300.

Tufts College Engineering School, Tufts College, 57, Mass. B. S. degree; 4 professors and instructors; M. S. Munro, assistant professor; number of students, 185; tuition, $225; fees, $25.

Worcester Polytechnic Institute, Department of Electrical Engineering, Worcester, Mass. B. S. degree; 7 professors and instructors; H. S. Smith, professor; number of students, 180; tuition, $200.

Michigan:

Michigan Agricultural College, Department of Electrical Engineering, East Lansing, Mich. B. S. degree; 5 professors and instructors; A. R. Sawyer, professor; number of students, 149; tuition, free; incidental fees, $60 to $75.

University of Detroit, Engineering Department, 350 E. Jefferson Ave., Detroit, Mich. 5-year course; B. S. and B. E. E. degrees; 2 professors; H. O. Warner, professor; number of students, 45; tuition, $125, matriculation fee, $5.

University of Michigan, College of Engineering and Architecture, Ann Arbor, Mich. B. S. degree; 12 professors and instructors; J. C. Parker, professor; number of students, 250; tuition, $95 to Michigan residents; $120 to nonresidents.

Minnesota:

University of Minnesota, College of Engineering and Architecture, Minneapolis, Minn. B. E. E. degree; 8 professors and instructors; G. D. Shepardson, professor; number of students, 343; tuition, $90 for residents of Minnesota; $120 for nonresidents.

Mississippi:

Mississippi Agricultural and Mechanical College, School of Engineering, Agricultural College, Miss. B. S. degree; 2 professors; L. L. Patterson, professor; number of students, 44; tuition free to residents of Mississippi.

Missouri:

University of Missouri, School of Engineering, Columbia, Mo. B. S. degree; 3 professors and instructors; A. C. Lanier, professor; number of students, 181; tuition free; fees, $40.

Washington University, School of Engineering, St. Louis, Mo. B. S. degree; 3 professors and instructors; Walter L. Upson, professor; number of students, 80; tuition and fees, $160 approximately.

Montana:

Billings Polytechnic Institute, Electrical Department, Polytechnic P. O., Mont. Associate degree; Glenn E. West, professor; number of students, 18; tuition, $440; laboratory fee, $5.

Montana State College, Electrical Engineering Department, Bozeman, Mont. B. S. degree; 2 professors; J. A. Thaler, professor; number of students, 82; tuition free; fees vary.

Nebraska:

University of Nebraska, Electrical Engineering Department, College of Engineering, Station A, Lincoln, Neb. B. S. degree; 4 professors and instructors; O. J. Ferguson, professor; number of students, 206; tuition free; laboratory and incidental fees normal.

Nevada:

University of Nevada, College of Engineering, Department of Electrical Engineering, Reno, Nev. B. S. degree; 2 professors; Stanley G. Palmer, professor; number of students, 35; tuition free, fees vary from $1 to $10.

New Hampshire:

New Hampshire College, Electrical Engineering Department, Durham, N. H. B. S. degree; 3 professors and instructors; L. W. Hitchcock, professor; number of students, 87; tuition, $75; fees, $36.

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New Jersey:

The Newark Technical School, College of Engineering, 367 High St., Newark, N. J. B. S. degree; 3 professors and instructors; James C. Peet, professor; number of students, 50; tuition, $130 for residents of New Jersey; $250 for nonresidents.

Princeton University, School of Electrical Engineering, Princeton, N. J. Only a 2 year post-graduate course; E. E. degree.

Rutgers College, Department of Electrical Engineering, New Brunswick, N. J. B. S. degree; Frank F. Thompson, professor; number of students, 58; tuition, $150; fees, $40.

Stevens Institute of Technology, Department of Electrical Engineering, Castle Point, Hoboken, N. J. M. E. degree; 5 professors and instructors; Louis Alan Hazeltine, professor; number of students, 860; tuition, $275; fees, $75.

New Mexico:

New Mexico College of Agriculture and Mechanical Arts, School of Engineering, Department of Electrical Engineering, State College, N. M. B. S. degree; 2 professors and instructors; R. W. Goddard, professor; number of students, 29; tuition free.

New York:

Columbia University, Schools of Mines, Engineering and Chemistry, New York City. 6-year course; E. E. degree; 4 professors; Walter I. Slichter, professor; number of students, 27; tuition and fees, $325.

Cooper Union for the Advancement of Science and Art, 8th St., and 4th Ave., New York City. 4-year day course, 5-year evening course; B. S. degree; 3 professors and instructors; Francis M. Hartman, professor; number of students (day) 45, (evening) 272; tuition free.

Cornell University, College of Engineering, Ithaca, N. Y. E. E. degree; 21 professors and instructors; Alex Gray and V. Karapetoff, professors; number of students, 225; tuition, $200.

New York University, College of Engineering, University Heights, New York, N. Y. B. S. degree; 3 professors; J. L. Arnold, S. K. Barrett and W. A. Miller, professors; number of students, 25; tuition, $240.

Polytechnic Institute of Brooklyn, Department of Electrical Engineering, Brooklyn, N. Y. E. E. degree; 4 professors and instructors; Robin Beach, associate professor and acting head of department; number of students, 100; tuition, $250.

Rensselaer Polytechnic Institute, Department of Electrical Engineering. Troy, N. Y. 4-year course. E. E. degree; graduate courses, 1-year, M. E. E. degree; 3-year, D. E. degree; 6 professors and instructors; W. L. Robb, professor; number of students, 265; tuition, $250.

Syracuse University, L. C. Smith College of Applied Science, Syracuse, N. Y. E. E. degree; 3 professors; W. P. Graham, professor; number of students, 110; tuition, $214.

Union College, Departments of Electrical Engineering, Schenectady, N. Y. B. S degree; Ernst J. Berg, professor; number of students, 220; tuition and fees, $250.

North Carolina:

North Carolina State College of Agriculture and Engineering, Department of Electrical Engineering, West Raleigh, N. C. B. E. degree; 3 professors and instructors; W. Hand Browne, Jr., professor; number of students, 165; tuition and fees, $330 (this also includes room rent, board and uniform).

Trinity College, Department of Engineering, Durham, N. C. A. B. degree; 3 professors and instructors; C. W. Edwards, acting professor; number of students, 14.

University of North Carolina, Department of Electrical Engineering, Chapel Hill, N. C. B. S. degree; 3 professors and instructors; P. H. Daggett, professor; number of students, 97; tuition, $60; fees, $40.

North Dakota:

University of North Dakota, College of Engineering, Grand Forks, N. D. B. S. and E. E. degrees; D. R. Jenkins, professor; tuition and fees, $20 to $25 per semester.

Ohio:

Case School of Applied Science, Cleveland, Ohio. B. S. degree; 5 professors; H. B. Dates, professor; number of students, 150; tuition, $200.

Municipal University of Akron, Engineering College, Akron, Ohio. 5-year course; E. E. degree; J. T. Walther, professor; number of students, 20; tuition, $20 for residents, $120 for nonresidents.

Ohio Northern University, College of Engineering, Ada, Ohio.

Ohio State University, Department of Electrical Engineering, College of Engineering, Columbus, Ohio. B. E. E. degree; 6 professors and instructors; F. C. Caldwell and C. A. Wright, professors; number of students, 370; tuition, $30 for residents of Ohio, $50 for nonresidents.

University of Cincinnati, College of Engineering and Commerce, Cincinnati, Ohio. 5-year course; E. E. degree; 6 professors and instructors; A. M. Wilson, professor; tuition, $200. The cooperative course is given here; each student spends half of his time in the actual practice of engineering, and half in attendance at the university.

Oklahoma:

Oklahoma Agricultural and Mechanical College, Department of Electrical Engineering, Stillwater, Okla. B. S. degree; 2 professors and instructors; W. C. Lane, professor; number of students, 68; tuition free.

University of Oklahoma, School of Electrical Engineering, Norman, Okla. B. S. degree; 4 professors and instructors; F. G. Tappan, professor; number of students, 105; tuition free to residents of Oklahoma; fees about $20.

Oregon:

Oregon Agricultural College, Department of Electrical Engineering, School of Engineering, Carvallis, Ore. B. S. degree; 6 professors and instructors; R. H. Dearborn, professor; number of students, 220; tuition free; laboratory fees, $6.

Pennsylvania:

Bucknell University, Department of Electrical Engineering, Lewisburg, Pa. B. S. degree; 4 professors and instructors; W. K. Rhodes, profesor; number of students, 90; tuition, $252 including room; fees, $15 per semester.

Carnegie Institute of Technology, Department of Electrical Engineering, Pittsburgh, Pa. B. S. degree; 5 professors and instructors; A. J. Wurts, professor; number of students, 113; tuition, $135.

Drexel Institute, Department of Electrical Engineering, Philadelphia, Pa. B. S. degree; 2 professors; Robert Disque, professor; number of students, 60; tuition, $200.

Lafayette College, Department of Electrical Engineering, Easton, Pa. B. S. degree; Morland King, associate professor; 1 instructor; number of students, 50; tuition, $250; laboratory fees, $5 to $15 per semester.

Lehigh University, Department of Electrical Engineering, Bethlehem, Pa. E. E. degree; 6 professors; Wm. Estv, professor; number of students, 125; tuition, $300; registration fee, $10.

Pennsylvania State College, Department of Electrical Engineering, State College, Pa. B. S. degree; 13 professors and instructors; C. L. Kinsloe, professor; number of students, 430; tuition, $50.

Swarthmore College, Engineering Department, Swarthmore, Pa. B. A degree; one professor—Lewis Fussell; number of students, 28; tuition and fees, $250.

University of Pennsylvania, Towne Scientific School, Philadelphia, Pa. B. S. degree; 4 professors and instructors; Harold Pender, professor; number of students, 126; tuition and fees, $300.

University of Pittsburgh, School of Engineering, Pittsburgh Pa.

Villanova College, Villanova School of Technology, Villanova, Pa. B. S degree; 2 professors and instructors; Chas. A. McGeehan, professor; number of students, 56; tuition and fees, $500.

Rhode Island:

Rhode Island State College, Department of Electrical Engineering, Kingston, R. I. B. S. degree; 2 professors; W. Anderson, professor; number of students, 40; tuition free to residents of Rhode Island.

South Carolina:

Clemson Agricultural College, Engineering Department, Clemson, S. C.

Tennessee:

University of Tennessee, College of Engineering, Knoxville, Tenn. B. S. degree; Chas. A. Perkins, professor; number of students, 40; tuition free; fees, about $30.

Vanderbilt University, School of Engineering, Nashville, Tenn. B. E. degree.

Texas:

Agricultural and Mechanical College of Texas, Department of Electrical Engineering, College Station, Tex. B. S. degree; 8 professors and instructors; F. C. Bolton, professor; number of students, 268; tuition free; fees, $40.

The Rice Institute, Houston, Tex. B. S. degree; 2 professors and instructors; number of students, 60; tuition free.

University of Texas, Department of Electrical Engineering, University Station, Austin, Tex. B. S. degree; 4 professors and instructors; J. M. Bryant, professor; tuition free; nominal laboratory fees.

Vermont:

University of Vermont, Electrical Engineering Department, College of Engineering, Burlington, Vt. B. S. degree; 4 professors and instructors; W. H. Freedman, professor.

Virginia:

University of Virginia, Department of Engineering, School of Electrical Engineering, University, Va. E. E. degree; Walter Sheldon Rodman, professor; number of students, 26; tuition and fees for residents of Virginia, $133, for non-residents, $215.

Virginia Military Institute, Lexington, Va. 2-year course; B. S. degree; 3 professors and instructors; Col. Francis Mallory, professor; number of students, 55; tuition and fees, $655 (including board and lodging).

Virginia Polytechnic Institute, Electrical Engineering Department. Blackburg, Va. B. S. degree; 2 professors and instructors; S. R. Pritchard, professor; number of students, 181; tuition, $432.50; includes heat, light, contingent, uniform, meals and laundry.

Washington:

University of Washington, Department of Electrical Engineering, College of Engineering, Seattle, Wash. B. S. degree; 7 professors and instructors; C. E. Magnusson, professor; number of students, 298; tuition, $10 per quarter.

Washington State College, Department of Mechanical and Electrical Engineering, Pullman, Wash. B. S. degree; 3 professors and instructors; H. V. Carpenter, professor; number of students, 147.

West Virginia:

West Virginia University, Department of Electrical Engineering, College of Engineering, Morgantown, W. Va. B. S. and M. S. degrees; 2 professors; A. H. Forman, professor; number of students, 99; tuition, $24 for residents of West Virginia, $100 for nonresidents.

Wisconsin:

Marquette University, College of Applied Science and Engineering, Milwaukee, Wis. 5-year co-operative course; E. E. degree; 4 professors and instructors; John F. H. Douglas, professor; number of students, 87; tuition, $160. Co-operative students attend classes for 2 weeks and for 2 weeks work in shops.

School of Engineering of Milwaukee, College of Electrical Engineering. 373 Broadway, Milwaukee, Wis. Course, 36 months, or 12 terms of 3 months each; B. S. degree; 10 professors and instructors; C. G. Brown, professor; number of students, 404; tuition, $250 first year; $225 others years.

University of Wisconsin, Department of Electrical Engineering. College of Engineering, Madison, Wis. B. S. degree; 12 professors and instructors; Edward Bennett, J. T. Rood, C. M. Jansky, professors; number of students, 325; tuition, $30 to residents of Wisconsin, $154 to nonresidents.

Wyoming:

University of Wyoming, Division of Mechanical and Electrical Engineering, Laramie, Wyo. B. S. degree; 2 professors; E. G. Hoefer, professor; number of students, 30; tuition, $12.

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Canada:

McGill University, Department of Electrical Engineering, Montreal, Que. B. S. degree; 8 professors and instructors; Professor Herdt; number of students, 112; tuition, $210.

Queen's University, Kingston, Ont. B. S. degree; 2 professors—D. M. Jemmett and R. L. Davis; number of students, 80; tuition and fees, $105 to $125.

University of Alberta, Department of Electrical Engineering, Edmonton, Alta. B. S. degree; number of students, 5; tuition, $75. (Only two years of course now given; third year begins in fall of 1921, when full professor will be appointed).

University of Manitoba, Department of Electrical Engineering, Winnipeg, Man. B. S. degree; 2 professors; E. P. Fetherstonhaugh, professor; number of students, 120; tuition, first year $55, second year $65, third and fourth years, $80.

University of New Brunswick, Department of Applied Science, Fredericton, N. B. B. S. degree; 9 professors and instructors; A. Foster Baird, professor; number of students, 26; tuition, $75.

University of Toronto, Faculty of Applied Science and Engineering, Toronto, Ont. B. A. Sc. degree; 4 professors and instructors; T. R. Roseburgh, professor; number of students, 216; tuition, $120.

Schools and Colleges Giving Special Courses, Evening Schools, Trade and Vocational Schools. The following list of schools, grouped geographically, includes those schools giving courses of less than collegiate grade, such as two-year courses that do not lead to a degree, or evening courses for practical men. Trade schools and vocational schools, most of which give day courses, are also included. It will be noted that some high schools are included. This list does not include all high schools having electrical courses but merely some of those in which the course is a practical one on the order of a trade school course. Evening courses of similar nature are also given. The information given has been obtained from replies to letters sent to the institutions.

Alabama:

Alabama Polytechnic Institute, Electrical Engineering Department, Auburn, Ala. Two-year course in applied electricity.

Tuskegee Normal and Industrial Institute, Tuskegee Institute, Ala. Three-year course in applied electricity for colored men.

University of Alabama, College of Engineering, University, Ala. Two-year course given during the day.

Arizona:

University of Arizona, College of Mines and Engineering, Department of Electrical Engineering, Tucson, Ariz. Evening course.

Arkansas:

University of Arkansas, College of Engineering, Department of Electrical Engineering, Fayetteville, Ark. Courses in power-plant engineering and elementary electrical engineering given during the day.

California:

California School of Mechanical Arts, 16th and Utah Sts., San Francisco, Cal. (Affiliated with the Wilmerding School of Industrial Arts.) Day classes; 4-year course; general and apprentice courses which include all kinds of electrical machinery construction, auto ignition, conduit work, and wiring; tuition free; number of students, 65.

The Preston Schol of Industry, Ione, Cal., post office, Waterman, Cal. One-year course in practical electricity.

Wilmerding School of Industrial Arts, San Francisco, Cal. See California School of Mechanical Arts.

Colorado:

University of Colorado, College of Engineering, Department of Electrical Engineering, Boulder, Colo. Electrical courses for disabled soldiers under Federal Board for Vocational Education. Special day classes in residence throughout the year.

Connecticut:

Boardman Trade School, 95 Broadway, New Haven, Conn. Day classes; 2½-year course for apprentices; evening class on electrical theory for practical electricians; tuition, free to residents of New Haven.

Hillyer Institute, Educational Department of the Y. M. C. A., Hartford, Conn. A 32-week evening course in electricity, both a-c. and d-c.

State Trade School, New Britain, Conn. Day and evening classes; 3 year course for apprentices in house wiring, maintenance work, motor and generator repairing, etc.; tuition, free to residents of Connecticut; number of students, 35.

District of Columbia:

McKinley Manual Training School, Electrical Department, Washington, D. C. Day and evening classes; theoretical course in the fundamentals of electricity and a course in electrical shop work, wiring, armature winding, motor and generator repairs, etc.; evening course in radio.

Georgia:

Georgia School of Technology, Electrical Engineering, Department, Atlanta, Ga. Evening course in practical elementary electricity.

Illinois:

Ambu Engineering Institute, 2632 Prairie Ave., Chicago, Ill. Day and evening classes in automotive electricity. Day course (8 weeks) tuition $175. Evening course (24 weeks).

Armour Institute of Technology, Department of Electrical Engineering, 3300 Federal St., Chicago, Ill. Evening courses in elementary and theoretical electricity.

Bradley Polytechnic Institute, Science Division, Peoria, Ill. Two-year course; 11 professors and instructors; Jennie M. Constance, professor; number of students, 10; tuition, $75; fees, $22. Also one-year day course and evening course.

Central Y. M. C. A. Technical School, Chicago, Ill. Evening classes in illuminating engineering and applied electricity.

Chicago Central Station Institute, 72 W. Adams St., Chicago, Ill. One-year special course combining classroom instruction and practical experience in the supporting companies; open to high-school graduates. The course includes the study of electrical theory applied more directly to the central-station industry. Salary received while taking this course, $60 to $75 per per month. Tuition, $10 per month.

Chicago Public High Schools. Evening classes; courses in wiring, electrical maintenance, armature winding, electric shop practice; tuition free; registration fee, $1. Day classes in regular high school course cover same subjects; tuition free. Given at following schools; Crane, Lane, Lake, Phillips, Englewood, Austin, Senn, Harrison, Schurz, Tilden and Bowen. Also day school part-time course in automobile mechanics, including electric vehicles, at South Division Continuation School.

Coyne Trade and Engineering Schools, 89-51 E. Illinois St., Chicago, Ill. Day and evening practical trade courses in electricity, including wiring, dynamo and motor construction, repairing and maintenance.

Lewis Institute, Engineering Dept., 1949 W. Madison St., Chicago, Ill. Evening courses.

Indiana:

Arsenal Technical Schools, Indianapolis, Ind. Two-year general electrical course for boys.

University of Notre Dame, Department of Electrical Engineering, Notre Dame, Ind. Two-year course given during the day.

Iowa:

Iowa State College, Electrical Engineering Department, Ames, Iowa. Evening and summer courses for artisans only.

Kansas:

Haskell Institute, United States Indian Training School, Lawrence, Kans. Course in wiring, line construction and practical caring for motors, transformers, etc.

Louisiana:

Louisiana Industrial Institute, Ruston, La. Two-year course; B. I. degree.

Tulane University of Louisiana, College of Technology, New Orleans, La. Evening course for electricians and powerhouse men.

Maryland:

The Johns Hopkins University, Department of Engineering, Baltimore, Md. Evening course in elementary theory and practice.

Massachusetts:

Beverly Evening Industrial School, Beverly, Mass. Evening courses in care, operation and repair of generators and motors (a-c. and d-c.) for men employed at trade during day.

New Bedford Vocational School, Acushnet Ave. and Cannon St., New Bedford, Mass. Four-year day course on fundamental principles of electricity, electrical fittings and appliances, construction, testing and care of motor and generators, telephones, batteries and switchboards. Evening classes in house wiring and radio for beginners and for men already in the trade. Tuition free.

The Technical High School, Springfield, Mass. One-year course in general electrical work; also evening trade school courses in house wiring, electrical measurements and automobile ignition.

Worcester Boys Trade School, Electrical Department, Worcester, Mass. Day and evening classes; 4-year day course in electrical work for boys over 14; evening classes in electricity for men already engaged in the trade; tuition free to residents of Worcester; $135 for non-resident day students, $32 for non-resident night students.

Michigan:

Detroit Institute of Technology, School of Engineering, Detroit Y. M. C. A., Detroit, Mich. Day, evening and summer classes; one-year day course and two-year evening course in electrical technology; short courses in armature winding, wiring, automotive electricity, elementary electricity and magnetism, d-c. and a-c. machinery, and radio; number of students, 15; tuition, $220.

Minnesota:

William Hood Dunwoody Industrial Institute, Minneapolis, Minn. Day, evening, extension and part-time classes. Regular two-year day course for grammar school graduates over 15; includes elementary and practical work; tuition, free to residents of Minnesota; fees, registration and laboratory, $10; tuition and fees for non-residents, $30 per month. Short day courses of 1 to 9 months in practical work for mechanics over 18 who have had experience in the trade; tuition, free for residents of Minnesota; fees, registration, $6; laboratory fee $5 per month; tuition and fees for nonresidents, $30 per month. Evening classes for men employed in electrical industries; elementary principles and some practical work. Also part-time courses similar to those in regular day school.

University of Minnesota, Minneapolis, Minn. Evening course.

Mississippi:

Okalona Industrial School, Okalona, Miss. Four-year trade course in engineering subjects; electrical work given in last 2 years.

Missouri:

David Ranken, Jr., School of Mechanical Trades, St. Louis, Mo. Two-year practical day course; tuition $45; number of students, 140. Evening classes in electrical principles, wiring, and armature winding; tuition $20 a season for two evenings a week; $40 for 4 evenings a week; number of students, 140.

Washington University, School of Engineering, St. Louis, Mo. Evening course.

Montana:

Billings Polytechnic Institute, School of Engineering, Polytechnic P. O., Billings, Mont. Day classes; four-year course in elementary electrical engineering; tuition $440; number of students, 20. Also day courses in academic and practical electricity.

New Jersey:

College of Technology, Newark, N. J. Special course for vocational training of wounded soldiers.

Evening Technical and Industrial High School, Jersey City, N. J. Evening classes for residents of Jersey City engaged in the trade; three-year course; also short courses (3 to 6 months) in fundamentals, wiring, motors and generators, measurements, etc.; number of students, 168.

Newark Technical School, 367 High St., Newark, N. J. Four-year evening course in technical electricity for high school graduates; tuition, $25 per year.

School of Industrial Arts, Trenton, N. J. Evening classes; four-year course in electrical engineering; tuition nominal for residents of Trenton.

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New Mexico:

New Mexico College of Agriculture and Mechanical Arts, State College, N. M. Two-year day course in automotive electricity.

New York:

Baron de Hirsch Trade School, 222 E. 64th St., New York, N. Y. Six-month day course in wiring. Classes open only to Jews, 16 years of age; tuition free.

Brooklyn Evening Technical and Trade School, 7th Avenue and 4th Street, Brooklyn, N. Y.; Two-year course in wiring and installation; 3-year course in electrical engineering.

Brooklyn Vocational School for Boys, Nassau and Jay Sts., Brooklyn, N. Y. Two-year trade course in wiring and installation, distribution and maintenance.

Elm Vocational School, Buffalo, N. Y. Two-year day course includes automotive electricity; evening trade courses for journeymen and apprentices in the trades; tuition free; number of students (day) 45, (evening) 75.

Mechanics Institute, 20 W. 44th St., New York, N. Y. Evening classes for men engaged in trade during day; tuition free.

Murray Hill Vocational School, 237 E. 37th St., New York, N. Y. Day and evening course on practice and theory; tuition free; number of students (day) 160, (evening) 150.

New York Electrical School, 39 W. 17th St., New York, N. Y. Day and night classes in theoretical and applied electrical engineering and installation and maintenance work, also automotive electricity; tuition, $190.

New York Public High Schools, New York City. Evening classes in electrical installation and practice. Length of course 120 evenings. Given in 15 schools throughout the city.

New York Trade School, First Ave., 67th and 68th Sts., New York, N. Y. Day and evening classes in electrical wiring; 14-week day course; evenings three terms of 6 months each; tuition, day $60; evening $20 per terms; number of students, 130.

Pratt Institute, School of Science and Technology, Brooklyn, N. Y. Two-year course; 5 professors and instructors; A. L. Cook, head of dept.; number of students, 144; tuition, $117. Also evening course in elementary electricity.

Rochester Athenaeum and Mechanics Institute, Rochester, N. Y. Two-year day courses in industrial electricity and electrical construction; tuition, $150. Evening classes in electricity; tuition nominal.

Saunders Trade School, Yonkers, N. Y. Day classes; 4-year and a 2-year technical course in electrical design; tuition free to residents; $120 to nonresidents.

Union College, Electrical Engineering Department, Schenectady, N. Y. Evening courses.

Vocational School for Boys, 5th Ave. and 138th St., New York, N. Y. Two-year course in wiring and installation.

North Dakota:

North Dakota School of Science, Wahpeton, N. D. Two-year course in electrical engineering; tuition free; fees $12.50 per term. Also one-year trade course in wiring and installation; similar course in telephony; 12-week course in auto ignition systems; evening class in telegraphy.

Ohio:

East Technical High School, Cleveland, Ohio. Day and evening classes in electrical theory, practical construction, testing and design; day course open to high-school students; tuition free; number of students (day) 65, (evening) 150.

Ohio Mechanics Institute, Cincinnati, O. Two-year course; no degree; V. E. Muncy, professor; number of students, 40; tuition, $80.

Toledo University, College of Industrial Science, Toledo, Ohio. Two-year course in electrical engineering, both day and evening school; also first 2 years of standard 4-year electrical engineering course. Number of students, 60; tuition, $4 to residents; $50 to nonresidents.

Trades High School, Columbus, Ohio. Day, evening and co-operative courses in fundamental and practical electrical work; tuition free.

Y. M. C. A., Department of Education, Elm and Canal Sts., Cincinnati, Ohio. Two-year evening course in electricity; tuition, $40 first year, $45 second; number of students, 25.

Pennsylvania:

Carnegie Institute of Technology, Division of Industries, Schenley Park, Pittsburgh, Pa. Day and evening classes in electrical wiring; 2-year day course; 4-year evening course. Special day and evening courses for men with considerable experience in the trade.

Drexel Institute, 32nd and Chestnut Sts., Philadelphia, Pa. Evening classes; 2-year course in electrical engineering; short courses in electricity and magnetism; direct currents and alternating currents; power transmission; power-plant engineering; applied electricity; practical telephony; tuition, one evening weekly, per term of 4½ months, $15, each additional evening, per term, $7.50; matriculation fee, $10.

Thaddeus Stevens Industrial School of Pennsylvania, Lancaster, Pa. Three-year course on fundamentals of electricity and practical applications.

Williamson Free School of Mechanical Trades, Williamson School P. O. (Delaware County), Pa. Three-year course in steam and electrical operating engineering.

Tennessee:

Crockett Technical High School, Memphis, Tenn. Two-year day course on fundamentals of electricity and practical applications; 9-month evening course, similar but condensed.

University of Tennessee, College of Engineering, Knoxville, Tenn. Evening courses for artisans.

Texas:

Agricultural and Mechanical College of Texas, Department of Electrical Engineering, College Station, Tex. Two-year day course for electricians.

Grubbs Vocational College, Arlington, Tex. Eight-week day course in automotive electricity; number of students, 26; tuition, $10.

Virginia:

The Miller Manual Labor School of Albemarle County, Miller School, Va. One-year course in general electricity.

St. Paul Normal and Industrial School, Lawrenceville, Va. Three-year trade course.

Virginia Mechanics' Institute, Richmond, Va. Evening classes; two-year electrical trade course; 4-year course in practical electricity; also separate classes in elementary electricity; d-c. machines, a-c. machines; electrical engineering problems, automobile electricity. Tuition, $10 per class.

Wisconsin:

Boys' Technical High School, 345 Virginia St., Milwaukee, Wis. Day and evening classes; special trade course in electrical work for boys of 16; tuition free to resident students.

School of Engineering of Milwaukee, Milwaukee, Wis.; Institute of Electrotechnics; course equivalent to technical high school course. School of Practical Electricity; practical course for boys and young men. School of Automotive Electrotechnics; course for automobile and aircraft electricians. School of Electrical and Mechanical Drafting; 6 month to one-year course.

Stout Institute, Industrial Arts Department, Menomonie, Wis. Day classes; course in practical electricity; two-year course offered to journeymen tradesmen; both to prepare men to teach in the vocational schools in the state.

West Virginia:

West Virginia University, Department of Electrical Engineering, College of Engineering, Morgantown, W. Va. Evening courses for practical electricians.

Canada:

Acadia University, Applied Science Department, Wolfville, N. S. Two-year course; tuition, $125.

Central Technical School, Lippincott and Hardbord Sts., Toronto, Ont. Four-year day and night courses, and special one-year courses in electricity, including elementary theory, d-c. and a-c. theory. Number of students (night) 450, (special) 40.

Dalhousie University, Halifax, N. S. Two-year course.

Mount Allison University, Sackville, New Brunswick, Canada. Two-year course in electrical engineering, may be completed at McGill University or the Nova Scotia Technical College.

University of Saskatchewan, Saskatoon, Sask. Two-year course in electrical engineering.

University of St. Francis Xavier's College, Antigonish, N. S. Two-year course.

Schools and Colleges Giving Correspondence Courses. The following list of schools giving correspondence courses is not limited to regular correspondence schools only, but includes several universities and colleges having extension courses. Where information is available the nature of the course and the cost is given.

American School of Correspondence, 58th St. and Drexel Ave., Chicago, Illinois. Complete electrical engineering course; also courses in electromechanical engineering, telephone engineering, radio, and wire telegraphy. Courses also arranged in certain branches, as electric wiring, distribution engineering, steam-electrical power plants, manufacturing electrical appliances and machinery, and electric railways. Cost of complete electrical course, $113. Other courses in proportion. Approximately 4,000 students enrolled.

Branch School of Engineering, Joseph G., 542 S. Dearborn St., Chicago, Ill. Course in electrical engineering; tuition, $75; number of students, 1,000.

Carnegie College, Rogers, Ohio. Course in electrical engineering; tuition fee under special tuition plan $25 for 3 years; number of students enrolled, 100 to 200.

Chicago Engineering Works, 1916 Sunnyside Ave., Chicago, Ill. Course in practical electricity; regular cost of course $125.

William Hood Dunwoody Industrial Institute, Minneapolis, Minn. Correspondence courses in general electricity for men employed in electrical industries; registration fee, $5.

Fort Wayne Correspondence School, Fort Wayne, Ind. Course in electrical measuring instruments and meters; cost of course, $69.50; number of students enrolled, approximately 2,500.

International Correspondence Schools, Scranton, Pa. Complete electrical engineering course; also courses in operating, designing and elementary electrical engineering, lighting, interior wiring, power-house engineering, electric car operation and maintenance, electrical and mechanical shop courses, electrical salesmanship, power-house and substation operation. Approximately 12,000 courses sold in 1920. Prices, $45 to $155 per course.

Iowa State College, Electrical Engineering Department, Ames, Iowa. Correspondence courses for artisans only.

Ohio State University, Department of Electrical Engineering, College of Engineering, Columbus, O. Correspondence course in industrial illumination.

University of Arizona, College of Mines and Engineering, Department of Electrical Engineering, Tucson, Ariz. Correspondence course.

University of Arkansas, College of Engineering, Department of Electrical Engineering, Fayetteville, Ark. Correspondence course in power plant engineering and elementary electrical engineering.

University of California, Department of Mechanical and Electrical Engineering, Berkeley, Cal. Elementary course given by correspondence.

University of Wisconsin, Department of Electrical Engineering, College of Engineering, Madison, Wis. Correspondence course.

EDWARD VALVE & MFG. CO., THE.—East Chicago, Ind. Manufacturer of valves, axles, metal castings, etc. Business established 1908. President and general manager, Olaf E. Oleson; vice-presidents, A. D. Bailey, J. W. Morton; secretary and treasurer, Guy W. Lunn. Main office and factory, 1200 W. 145th St., East Chicago, Ind. Branch offices and warehouses, 161 Devonshire St., Boston, Mass.; Colonial Trust Bldg., Philadelphia, Pa.; 511 Wood St., Pittsburgh, Pa.; Rialto Bldg., San Francisco, Cal. District office, 50 Church St., New York, N. Y.

EDWARDS & CO., INC.—New York, N. Y. Manufacturer of fire and burglar alarm systems, time recording systems, annunciators, etc. Business established 1872. President and treasurer, R. Edwards, Jr., vice-president and secretary, William J.

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Smith. Main office, 140th & Exterior Sts., New York, N. Y. Branch office, 1160 Monadnock Block, Chicago, Ill. Sales representatives, H. C. Biglin, 41 Fairlee St., Atlanta, Ga.; J. G. Pomeroy, 833 Sanfernando Bldg., Los Angeles, Cal.; Cochrane, Stephenson & Co., Winnipeg, Man., Can.; Canada Fittings Co., Montreal, Que., Can.; Felix J. Commagere; Strand Bldg., New Orleans, La.; Harry S. Davis; Andrus Bldg., Minneapolis, Minn.; A. F. McCarthy Co., 10 High St., Boston, Mass.

EDWARDS LIGHTING FIXTURE CO.—20 E. Lake St., Chicago, Ill. Manufacturer of lighting fixtures and fixture fittings. Business established 1914. President, L. V. Hult; vice-president, M. Stutzenstein; secretary, J. Z. Silbert; treasurer, L. Plucinski.

EDWARDS X-RAY CORP.—Indianapolis Ind. Manufacturer of X-ray apparatus. Business established 1910. President, Edwin L. Edwards; vice-president and general manager, William H. Test; secretary, William A. Lumpfe; treasurer, James B. Nelson. Main office, 111-113 N. New Jersey St., Indianapolis, Ind. Branch office, 50 E. 42nd St., New York, N. Y.

E.E.—Abbreviation for electrical engineer. This is used almost exclusively as applying to the degree conferred by a college of electrical engineering on its graduates who have attained such standing in the profession as to be entitled to recognition as electrical engineers.

E. E. B.—Trade name for candles for electric candelbra manufactured by Edmund E. Bechtold, 1926 S. Wabash Ave., Chicago, Ill.

EFFECTIVE RESISTANCE.—The effective resistance of an a-c. circuit is the ratio of the in-phase component of the e.m.f. to the current. It is that resistance by which the total current must be multiplied to give the in-phase component of e. m. f.

EFFECTIVE VALUE.—The effective value of an alternating current or e.m.f is the square root of the mean of the squares of the instantaneous values. If the alternating current is a simple sine wave, the effective value equals $1/\sqrt{2}$ of the maximum value $I=I_m/\sqrt{2}=0.707I_m$. Similarly $E=0.707\,E_m$. The effective value is also called the "root-mean-square" value (abbreviated r.m.s.); occasionally also the "virtual" value, especially in Great Britain. Nearly all a-c. ammeters and voltmeters indicate effective values. Unless otherwise specified, the numerical value of an alternating current refers to its r.m.s. value. The heat developed by an alternating current in a resistance is proportional to the square of the effective value.

EFFICIENCY.—Trade name for conduit, cable and wire hanging and mounting devices manufactured by the Efficiency Electric Co., East Palestine, Ohio.

EFFICIENCY, ALL-DAY.—The ratio of the total useful energy given out to the total energy taken in by a machine or apparatus during a period of one day. This efficiency is particularly important where a machine is running all day and carries a load near full value only a minor part of the time. Obviously, in such a case the losses in the machine, at small loads especially, should be very low. For example, in a transformer that is in service all day but carries no load a large part of the time the input during the no-load period represents the core losses and these should be small, else the all-day efficiency will be very low.

EFFICIENCY, ALL-DAY, TRANSFORMER.—In the matter of efficiency a transformer differs from most types of apparatus in that it is in operation continuously and that during part of the time it may be delivering no energy, while still receiving it. It is thus important to know, as its efficiency, the ratio of watt-hours output to watt-hours input during the 24 hours. This is the "all-day efficiency" or the energy efficiency of the transformer.

EFFICIENCY ELECTRIC CO., THE.—East Palestine, Ohio. Manufacturer of conduit, cable and wire hanging and mounting devices. Business established 1917. President, John Morgan; vice-president, A. J. Wayman; secretary, L. M. Kyes; treasurer, J. C. Chamberlin.

EFFICIENCY, ELECTRICAL.—The ratio of the net electrical output from a generator to the total electrical power developed in its armature, or the ratio of the total electrical input to a motor minus its electrical losses to the total electrical input.

EFFICIENCY, ELECTROCHEMICAL.—In electrolytic processes, the proportion which the useful products obtained bear to the amounts which the current passing should by calculation produce. In electric furnaces, the proportion of the energy of the current which is usefully applied to do the desired thermal work. The former kind of efficiency is often called ampere efficiency; the latter, thermal efficiency.

EFFICIENCY, MACHINE.—The ratio of the useful output to the total input of a machine. There are two kinds of efficiency, viz., directly measured and conventional. The first is that efficiency which is determined by direct measurements of the output and the input; the latter, that found by taking the ratio of the output to the output plus the internal losses, or the ratio of the input minus the losses to the input, where, in either case, conventional values are assumed for one or more of the losses.

EFFICIENCY, MECHANICAL.—In a generator, the ratio of the total mechanical power delivered minus the mechanical losses to the total mechanical power delivered; in a motor, the ratio of the mechanical power output to total mechanical power developed. The mechanical losses are friction of the bearings, friction of brushes, and windage.

EFFICIENCY OF CONVERSION.—In a generator, the ratio of the total electrical power developed to the total mechanical input; in a motor, the ratio of the total mechanical power developed to the total electrical input.

EGAN & EGAN.—21 E. 40th S., New York, N. Y. Manufacturer of lighting fixtures.

EGG BEATERS, ELECTRIC.—Stands having a fractional-horsepower motor, a beater or paddle geared to the motor shaft and a bowl in which the beater or paddle is turned by the motor. Used in bakeries, pastry shops, hotels, restaurants, large residences, etc. In commercial use its speed gives it a decided advantage over the hand-driven beaters. In most cases the beater paddle may be replaced by others specially suited for mixing cake batter, cream fillings, frostings and other pastry mixtures. The entire outfit is usually finished in white enamel or nickel plating and makes a very sanitary as well as economical appliance.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.
Kollins Kitchen Kraft, 501 Monadnock Block, Chicago, Ill. "Kollins."

EGG BOILERS, ELECTRIC.—A small liquid heater or receptacle having a heating element in the base and equipped with a wire basket in which eggs to be boiled are placed and lowered into the receptacle. Current connection is provided through a cord and plug. They draw a very low current as only a very small quantity of water is heated, the eggs occupying a good part of the volume of the cup.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
Landers, Frary & Clark, New Britain, Conn. "Universal."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Manning, Bowman & Co., Meriden, Conn.
Weeks Mfg. Co., H. G., Hamilton, Ohio.

EGG TESTERS OR CANDLERS, ELECTRIC.—A wood or metal cabinet containing an incandescent lamp and provided with openings in which eggs may be placed, the light shining through making it possible to determine their condition as they appear almost translucent when in good condition. The term "candler" is a survival of the old outfits in which candles were used for illumination.

Manufacturers:

Gaylor, Frank W., 30 Barclay St., New York, N. Y. "Firefly."
Grant Mfg. Co., 208 N. Wells St., Chicago, Ill. "Da-Lite."
Lo-Glo Electric Incubator Co., Inc., 76 Greenwich St., New York, N. Y. "Lo-Glo."

EGGERS POLE & SUPPLY CO.—Spokane, Wash. Producer of cedar poles, posts and reinforcing sleeves. Business established 1919. President, secretary and general manager, George C. Eggers; vice-president and treasurer, Paul A. Schedler. Main office, 610 Paulsen Bldg., Spokane, Wash. Branch offices, 1931 Milwaukee, Ave., Chicago, Ill.

EGYPTIAN.—Trade name for fiber products manufactured by the Delaware Hard Fibre Co., Wilmington, Del.

EGYPTIAN LACQUER MFG. CO., THE.—New York, N. Y. Manufacturer of metal lacquers and lacquer enamels. Main office, 5 E. 40th St., New York, N. Y. Factory, Kearny, N. J. Branch office, 12 S. Clinton St., Chicago, Ill.

EHRLICH ELECTRIC TRUCK CO.—839 W. Lake St., Chicago, Ill. Manufacturer of electric trucks. President, John W. Pearson; secretary, John W. Favorite; treasurer, W. R. Bell.

EHRLICHTRIC.—Trade name for lighting fixtures manufactured by Gaites, Peace & Co., Inc., 204 Willoughby St., Brooklyn, N. Y.

18TH CENTURY.—Trade name for annunciators manufactured by Edwards & Co., Inc., 140th & Exterior Sts., New York, N. Y.

1819 ORIGINAL.—Trade name for tinners' shears manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

EISEMANN MAGNETO CORP.—Brooklyn, N. Y. Manufacturer of magnetos. Business established 1910. President, William N. Shaw; secretary and treasurer, F. S. Jerome; general manager, Charles E. Davis; sales manager, A. T. LeBlanc. Main office and factory, 32 33rd St., Brooklyn, N. Y. Branch offices, 80 Willis Ave., W., Detroit, Mich.; 1469 S. Michigan Ave., Chicago, Ill.

EISENDRATH GLOVE CO.—Armitage & Elston Aves., Chicago, Ill. Manufacturer of linemen's leather gloves.

EISLER ENGINEERING CO., CHARLES.—15 Kirk Pl., Newark, N. J. Manufacturer of incandescent lamp-making machinery.

EJECTORS, POWER PLANT.—An ejector is a device for pumping or ejecting water or other thin liquid from a tank or boiler. The operation of the device depends upon the suction action of a current of steam or other fluid through a pipe It is generally made as a pipe fitting having a discharge outlet, a steam inlet and a suction inlet through which the water or other liquid is drawn by the suction of the steam jet.

Manufacturers:

American Injector Co., Detroit, Mich.
Chaplin Fulton Mfg. Co., The, 28-34 Penn Ave., Pittsburgh, Pa.
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott."
Griffiths & Son, James A., 1315-17 Buttonwood St., Philadelphia, Pa.
Hancock Inspirator Co., The, 119 W. 40th St., New York, N. Y.
Hayden & Derby Mfg. Co., 119 W. 40th St., New York, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Randle Machinery Co., The, Powers St. & C.H. & D.R.R., Cincinnati, Ohio. "Leader."
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa. "S & K."
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Eagle."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

EKLA.—Trade name for skeleton gongs manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

ELALCO.—Trade name for monel metal manufactured by the Electrical Alloy Co., Morristown, N. J.

ELASTANCE.—A name proposed for the reciprocal of capacitance. As its unit is proposed the daraf (farad spelled backwards) since it would be the reciprocal of the farad. See Capacitance, also Farad.

ELASTIC.—Trade name for gaskets manufactured by the Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J.

ELASTICAP CO., THE.—739 Garden St., Hoboken, N. J. Manufacturer of wire splice insulators. Business established 1920. President and general manager, J. C. Farr; vice-president, J. B. Hamilton; secretary, A. T. Bruce; treasurer, E. C. Farr. Sales representative, A. F. McCarthy Co., 10 High St., Boston, Mass.

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ELASTIVITY.—The specific elastance of a substance and numerically equal to the elastance offered by a unit cube of the substance as measured between a pair of opposed parallel faces. In the C. G. S. electric system it is the reciprocal of permittivity. Analogous to electric resistivity.

ELASTOID FIBRE CO., THE.—Waltham, Mass. Manufacturer of lamp and switch cap linings, fuse tubes, etc. N. Marshall, president. Sales representatives, Chase Electric Co., 105 S. Dearborn St., Chicago, Ill.

ELATERITE PAINT & MFG. CO., THE.—W. 11th & Market Sts., Des Moines, Iowa. Manufacturer of insulating paints. Business established 1905. President, William H. Smith; vice-president, M. L. Smith; secretary and treasurer, Frank M. Carrell.

ELBEE ELECTRIC SALES CO.—180 N. Dearborn St., Chicago, Ill. Manufacturer of socket attachments. Partnership, G. D. Bernhardt and M. R. Leeb.

ELBOWS, METAL RACEWAY OR MOLDING.—The channel form of metal raceway or molding is such as to lend itself to some bending in the plane of the sides but if bent in the plane of the base or capping the molding is badly deformed or will crack, and the capping does not make a tight fit. As a consequence, metal molding is not usually bent but an elbow fitting is used. This elbow is a casting or pressed steel fitting which is the same in cross-section as the straight strip but slightly larger so that the strip may be snugly fitted into the elbow. Elbows for 90° bends both in the plane of the base and the plane of the sides are furnished.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.

ELBOWS, RIGID CONDUIT.—Though conduit may be bent into almost any desired form elbows are sometimes used for turns in the pipe, as too many turns make it extremely difficult to draw the wires through the conduit. The formed elbow avoids this difficulty and permits sharper turns. The elbow is usually made with a detachable cover, the wires being drawn through the conduit and out at the open elbow and reinserted into the next section of conduit. Elbows may also be used as outlets, in which case the detachable cover is replaced by a suitable porcelain fitting.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
CENTRAL TUBE CO., First National Bank Bldg., Pittsburgh, Pa. "Central Black," "Central Special," "Central White."
Garland Mfg. Co., West Pittsburgh, Pa. "Galvaduct," "Loricated."
National Conduit Co., Ltd., Dufferin & Queen Sts., Toronto, Ont., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Steelduct Co., The, 213-17 Dollar Bank Bldg., Youngstown, Ohio.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T & B" bushed elbows are fitted with brass floor couplings. There are four sizes: ½ in., with ⅞ in. rad. and 1 in. offset; ¾ in., with 1⅛ in. rad., 1½ in. offset; 1 in., with 1¼ in. rad., 1⅝ in. offset; 1¼ in., with 1½ in. rad., 2 in. offset. The above measurements are approximate. "T & B" Split Elbows are made in three sizes—for ½, ¾ and 1 in. conduit.—Adv.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V.V."

ELDRED.—Trade name for molybdenum wire manufactured by the Commercial Research Co., 18 E. 41st St., New York, N. Y.

ELDREDGE ELECTRIC MFG. CO.—3 Post Office Sq., Springfield, Mass. Manufacturer of ammeters, voltammeters and voltmeters. President, treasurer and general manager, A. C. Wright; vice-president, N. B. Ellison; secretary, R. A. Wright. Sales representatives, A. M. Thompson, 425 Hammond Bldg., Detroit, Mich.; S. F. Wilber, 955 Post St., San Francisco, Cal.

ELDRIDGE MFG. CO.—Boston, Mass. Manufacturer of electric trucks.

ELECTORA.—Trade name for electric motors for piano players made by the Motor Player Corp., 536 Lakeshore Drive, Chicago, Ill.

ELECTRA.—Trade name for lightning rods and points made by the Electra Lightning Rod Co., 30 N. La Salle St., Chicago, Ill.

ELECTRA.—Trade name for electric ranges manufactured by Moffats, Ltd., Denison Ave., Weston, Ont., Can.

ELECTRA LIGHTNING ROD CO.—30 N. La Salle St., Chicago, Ill. Manufacturer of lightning rods and lightning conducting cable. Business established 1902. President and general manager, F. E. Stehlik; vice-president, D. C. Swenson; secretary and treasurer, J. S. Swenson. Factory, Cresco, Iowa.

ELECTRIC.—Trade name for soldering compound made by the John F. Walsh Co., 28 Renne Ave., Pittsfield, Mass.

ELECTRIC.—Trade name for soldering sticks manufactured by the John F. Walsh Co., 170 North St., Pittsfield, Mass.

ELECTRIC APPARATUS CO.—127 S. Green St., Chicago, Ill. Manufacturer of steel cabinets, panelboards and switchboards. President, G. W. Berthold; secretary and treasurer, E. E. Berthold.

ELECTRIC APPLIANCE CO.—Chicago, Ill. Manufacturer of vaporproof and watertight receptacles and lighting fixtures. Business established 1891. President, W. W. Low; secretary and treasurer, T. S. Stacey; sales manager, R. S. Mitten. Main office and factory, 701-709 W. Jackson Blvd., Chicago, Ill. Branch offices, 807 Mission St., San Francisco, Cal.; 409-11 Browder St., Dallas, Tex.; 408 Canal St., New Orleans, La.

ELECTRIC ARC CUTTING & WELDING CO.—152-58 Jelliff Ave., Newark, N. J. Manufacturer of electric cutting and welding outfits. Business established 1918. President, A. L. Livermore; secretary and treasurer, A. D. T. Libby; general manager, C. J. Holslag; sales manager, E. C. Wright. Factories, Newark, N. J., London, England. Sales representatives, Blackman-Hill-McKee Machinery Co., 1513 N. Broadway, St. Louis, Mo.; Columbian Steel Tank Co., 1601 W. 12th St., Kansas City, Mo.; Crescent City Machine & Mfg. Co., New Orleans, La.; A. D. Fishel Co., Illuminating Bldg., Cleveland, Ohio; Ludlow Jordan, 1026 Empire Bldg., Atlanta, Ga.; E. A. Kinsey Co., 331-335 Fourth St., W., Cincinnati, Ohio; Rush Machinery Co., 932 Oliver Bldg., Pittsburgh, Pa.; Swind Machinery Co., Widener Bldg., Philadelphia, Pa.; F. E. Satterlee & Co., 118-20 Washington Ave., N. Minneapolis, Minn. Charles A. Strelinger Co., 43-51 Larned St., E., Detroit, Mich.; Vonnegut Machinery Co., 43 S. Meridian St., Indianapolis, Ind.; P. W. Wendt Co., McCormick Bldg., Chicago, Ill.; Allied Machinery Co., 49 Chambers St., New York, N. Y.; International Equipment Co., Ltd., Transportation Bldg., Montreal, Que., Can.

ELECTRIC AUTOMATIC CIGAR LIGHTER CO.—556 W. 27th St., New York, N. Y. Manufacturer of electric cigar lighters. Business established 1915. President, William Donald Mitchell; vice-president, Alexander H. Burgess; secretary, treasurer and general manager, John H. Valentine.

ELECTRIC BLOWER CO.—352 Atlantic Ave., Boston, Mass. Manufacturer of motors and motor-generators, armatures, controllers, motor-driven ventilating sets and blowers. Business established 1907. F. A. MacCallum, owner.

ELECTRIC BOILER CORP.—491 Main St., Cambridge, Mass. Manufacturer of automatically controlled electric hot water boilers. Business established 1920. President, R. Ashton; treasurer, J. S. Nicholl; general manager, C. W. Whitmore.

ELECTRIC BOILERETTE.—Trade name for electric water heaters manufactured by the Electric Boiler Corp., 491 Main St., Cambridge, Mass.

ELECTRIC BOX & COVER CO., INC.—29 Ave. C., Newark, N. J. Manufacturer of metal stampings, outlet boxes and covers. Sales manager, Albert J. Slap.

ELECTRIC BRAZING & WELDING MACHINE CO., INC.—New York, N. Y. Manufacturer of brazing outfits, coil winding machines and tool demagnetizers. Business established 1918. President, A. M. Sheard; secretary and sales manager, A. A. Probeck; treasurer, James M. Vincent; general manager, George A. Thornton. Main office, 30 Church St., New York, N. Y. Factory, Jersey City, N. J. Branch office, 124 Myrtle Ave., Jersey City, N. J.

ELECTRIC CABLE CO., THE.—Yonkers, N. Y. Manufacturer of telephone wire.

ELECTRIC CIRCUIT.—A system of conductors along which an electric current can flow is called an electric circuit. It is said to be closed when it is connected to a source of e.m.f. and current is flowing. It is an open circuit when there is a break or some of the conductors are disconnected.

ELECTRIC CLIPPER CO., THE.—537 Grand Ave., Kansas City, Mo. Manufacturer of motor-driven hair cutter and vibrator. Business established 1919. President, C. F. Lutes; vice-president, A. C. Flack; secretary and general manager, T. W. Clemments; treasurer, A. D. Crooks; sales manager, C. N. Sanders. Sales representatives, Electric Clipper Sales Co., Lawler, Iowa; A. M. Lutes, 46 Raines Park, Rochester, N. Y.

ELECTRIC CO., THE.—94 Allyn St., Hartford, Conn. Manufacturer of current taps. Exclusive distributor, Watts & Barry, Inc., 50 Church St., New York, N. Y.

ELECTRIC CONTROLLER & MFG. CO., THE.—Cleveland, Ohio. Manufacturer of electric control equipment, lifting magnets, etc. Business established 1898. President, Claiborne Pirtle; vice-president, H. F. Stratton; secretary and treasurer, P. C. Clark; sales manager, F. R. Fishback. Main office and factory, 2700 E. 79th St., Cleveland, Ohio. Branch offices, 50 Church St., New York, N. Y.; Oliver Bldg., Pittsburgh, Pa.; Brown-Marx Bldg., Birmingham, Ala.; 49 Federal St., Boston, Mass.; First National Bank Bldg., Cincinnati, Ohio; Witherspoon Bldg., Philadelphia, Pa.; Call Bldg., San Francisco, Cal.; Conway Bldg., Chicago, Ill.; Dime Bank Bldg., Detroit, Mich.; Traders Bank Bldg., Toronto, Ont., Can.; 208 N. Broadway, St. Louis, Mo.; 524 First Ave., S., Seattle, Wash.; Boston Bldg., Salt Lake City, Utah. Sales representative, O. E. Thomas Co., Los Angeles, Cal.

ELECTRIC CONTROLLER CO.—Indianapolis, Ind. Manufacturer of electric incubators and brooders, water heaters, heating pads and other controlled electrical specialties. Business established 1915. President, Dr. A. C. Burrell; vice-president, H. E. Welchel; secretary, E. B. Fishel; treasurer, C. O. Burrell; general manager, M. E. Dugger; sales manager, T. B. Scott. Main office, Central Ave. & 10th St., Indianapolis, Ind. Factory, Indianapolis, Ind. Branch office, San Francisco, Cal. Exclusive distributor, Meyer-Stisser Co., 32 Light St., Baltimore, Md.

ELECTRIC COOKING.—See Cooking (Cookery), electric.

ELECTRIC CURRENT.—See Current, electric.

ELECTRIC DISPLACEMENT.—This is a term due to Maxwell who explained the storing of energy in a dielectric by assuming that when the dielectric is subjected to a difference of potential a displacement of electricity takes place along the lines of electric intensity. For a given difference of potential the displacement is directly proportional to the dielectric constant of the medium. Numerically the electric displacement is equal to $1/(4\pi)$ times the product of the dielectric constant by the electric intensity. Another name for electric displacement is electrostatic induction. Unit electric displacement, or electrostatic induction, is the displacement in a medium whose dielectric constant is unity at a point where the electric intensity is 4π units.

ELECTRIC EQUIPMENT CO., INC.—1240 S. Hope St., Los Angeles, Cal. Manufacturer of magnet charges. Business established 1910. President, R. R. Thomas; vice-president and general manager, H. S. Mason; secretary and treasurer, J. L. Thornton.

ELECTRIC-EYED BOGGY BEARS.—Trade name for electric novelties manufactured by the Elektra Toy & Novelty Co., Inc., 400 Lafayette St., New York, N. Y.

ELECTRIC FIELD.—An electric field is any region where a particle of electricity is acted on by a force. The intensity or strength of the field is measured by the force exerted on unit positive charge. An electric field exists within every substance

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subjected to a difference of electric pressure; within every dielectric in the vicinity of an electric current or static charge; and within every dielectric within which there is a varying magnetic field.

ELECTRIC FIELD INTENSITY.—The property of the electric field which causes a force to be exerted upon an electrified body at that point. It is measured by the ratio of the force acting on the electrified body at the point to the quantity of electricity on the body. The unit of electric field intensity is the intensity which gives rise to a force of one dyne on a unit charge. The intensity of the electric field at a distance d from a charge q is $q/(kd^2)$. The electric field intensity is a directed quantity (or vector) and the resultant field intensity due to several charges may be calculated by geometric addition. First find the magnitude and direction of each component intensity separately, then combine by the polygon method of combining forces.

ELECTRIC FLUX.—By electric flux across any area in the dielectric is meant the total displacement in the area. Unit electric flux is the flux through unit area at a point where the displacement is unity. Also see Magnetic flux.

ELECTRIC FLUX DENSITY.—By electric flux density is meant the displacement across unit area.

ELECTRIC FURNACE ASSOCIATION.—An association of electric furnace owners, operators, and builders, as well as manufacturers of accessories and supplies, organized in March, 1919, for the advancement of electric furnace products. Its membership is composed of about twelve corporate members and 50 individual members. Two general meetings are held each year in various cities of the country, and the papers and discussions presented at these meetings are published in pamphlet form.

The officers for 1920-1921 are: President, Acheson Smith, Niagara Falls, N. Y.; vice-presidents, C. H. Booth, 326 W. Madison St., Chicago, Ill.; H. L. Hess, Baltimore, Md.; treasurer, F. J. Ryan, Franklin Trust Bldg., Philadelphia, Pa.; secretary, C. G. Schuederberg, Box 911, Pittsburgh, Pa.; assistant secretary, Harry P. Martin, Niagara Falls, N. Y.; directors, F. J. Tone, Niagara Falls, N. Y.; C. A. Winder, Schenectady, N. Y.; H. G. Weindenthal, Cleveland, Ohio; A. T. Hinckley, Niagara Falls, N. Y., and the officers of the Association.

ELECTRIC FURNACE CO., THE.—Alliance, Ohio. Manufacturer of electric furnaces. Business established 1911. President, T. F. Baily; vice-president, F. T. Cope; treasurer, E. G. Ernst; sales manager, R. F. Benzinger. Main office, Alliance, Ohio. Factory, Salem, Ohio. Branch offices, 301 Frisco Bldg., St. Louis, Mo.; 15 Park Row, New York, N. Y. Sales representative, Gunn Carle & Co., 444 Market St., San Francisco, Cal.

ELECTRIC FURNACE CONSTRUCTION CO.—908 Chestnut St., Philadelphia, Pa. Manufacturer of electric furnaces. Business established 1917. President, Frank Hodson; vice-president, Frank W. Brooke, secretary and treasurer, Herbert H. Twose. Sales representative, A. S. Lindstrom, 519 California St., San Francisco, Cal.

ELECTRIC FUSEGUARD CO., INC.—60 Shipman St., Newark, N. J. Manufacturer of fuses and boxes for electrical purposes. Business established 1914. President and general manager, William D. Ligon.

ELECTRIC GLASS CO.—505 N. St. Clair St., Toledo, Ohio. Manufacturer of miniature incandescent lamps.

ELECTRIC HAMMER CO.—Louisville, Ky. Manufacturer of motor-driven hammers.

ELECTRIC HEAT CONTROL CO.—2711 Church Ave., Cleveland, Ohio. Manufacturer of temperature regulators and transformers. Business established 1914 as King Electric & Mfg. Co.; incorporated 1920 as Progressive Electric Products Co. President, James G. Varley; secretary, John A. Nally; treasurer and general manager, A. Longoria.

ELECTRIC HEAT UNIT CO.—1504 S. Grand Ave., St. Louis, Mo. Manufacturer of electric heating elements. Business established 1920. President, Louis Wertheimer; vice-president, David Blum; secretary, Sydney Salkey; treasurer, Frank Sale.

ELECTRIC HEATING & MFG. CO.—Westlake & Republican Sts., Seattle, Wash. Manufacturer of electric cooking and heating devices. Business established 1915. President, Philip F. Apfel; vice-president, James G. Eddy; secretary and treasurer, A. M. Stevens; general manager, P. F. Apfel; sales manager, H. Stern.

ELECTRIC HEATING APPARATUS CO.—Newark, N. J. Manufacturer of electric furnaces and heating appliances. Business established 1912. Secretary and general manager, E. L. Smalley. Main office and factory, 18-34 Nesbitt St., Newark, N. J. Branch office, 25 Church St., New York, N. Y.

ELECTRIC HOIST MANUFACTURERS ASSOCIATION.—Organized in 1917. An association of corporations, firms and individuals actively engaged in the manufacture of electric hoists. The objects of the Association are to advance and protect the interests of the manufacturers of electric hoists in manufacturing, engineering, safety and transportation; to study the economics of the industry; and to promote the standardization of electric hoists. Officers for 1921 are: Chairman, J. B. Adams, The Franklin-Moore Co., Winsted, Conn.; vice-chairman, R. H. McGredy, Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; secretary-treasurer, E. Donald Tolles, 52 Broadway, New York City.

ELECTRIC INSULATION & VARNISH CO., LTD.—New Toronto, Ont., Can. Manufacturer of insulating compounds, cements, cambric, enamels and other insulating materials. Business established 1918. President, John Whitfield; vice-president and general manager, R. J. Bruce; secretary and treasurer, E. K. Bruce; sales manager, J. Weir.

ELECTRIC INTAKE CO.—115 E. Cortlandt St., Jackson, Mich. Manufacturer of automobile heaters.

ELECTRIC LADY.—Trade name for electric washing machines manufactured by the Michigan Washing Machine Co., Muskegon, Mich.

ELECTRIC LAMP & PRODUCTS CO.—512-514 Paterson Plankroad, Jersey City, N. J. Manufacturer of incandescent lamps. President, Anton C. Eggers; vice-president, John H. Goetze; secretary and treasurer, Otto F. Kappelmann; manager, Max A. Kauffmann.

ELECTRIC LIGHTING, DEVELOPMENT OF.—See Lighting, electric, development of.

ELECTRIC LIGHTING, METHODS OF.—See Lighting, Electric, methods of.

ELECTRIC MACHINE CO., THE.—Indianapolis, Ind. Manufacturer of testing machines for automobile generators, etc. Partnership, J. C. Schaf and W. J. Holliday. Sales representatives, N. F. Andruss, 404 Golden Gate Ave., San Francisco, Cal.; Detroit Consolidated Sales Co., 10 Warren Ave., W., Detroit, Mich.

ELECTRIC MAID.—Trade name for electric vacuum cleaners manufactured by the Grinnell Washing Machine Co., Grinnell Iowa.

ELECTRIC MATCH.—Trade name for electric gas lighter manufactured by the Safety Gas Lighter Co., Roanoke, Va.

ELECTRIC MATERIALS CO., THE.—North East, Pa. Manufacturer of commutators, controller parts, trolley wheels, ears and splicers, soldering coppers, metal castings, etc. President, George E. Pierce; vice-president, F. B. Moorhead; secretary, N. P. Fuller; treasurer, O. C. Hirtzel; sales manager, C. P. Donahue.

ELECTRIC MOTOR & ENGINEERING CO., THE.—2nd St., S. W., & B. & O. R. R., Canton, Ohio. Manufacturer of panelboards, switchboards and equipment therefor. Business established 1919. President and general manager, Thomas J. Newman; vice-president, J. W. Jones; secretary, L. W. Booth; treasurer, William M. Hornlein; sales manager, George C. Stiles.

ELECTRIC NOVELTY MFG. CO.—152 Chambers St., New York, N. Y. Manufacturer of portable electric lamps. Business established 1919. General manager, O. S. Garry.

ELECTRIC OUTLET CO., INC.—119 W 40th St., New York, N. Y. Manufacturer of fixture receptacles. E. Cantelo White, president.

ELECTRIC PAGE BOY.—Trade name for loud-speaking telephone manufactured by the Winkler-Reichmann Co., 4801 S. Morgan St., Chicago, Ill.

ELECTRIC PANELBOARD CO.—Rochester, N. Y. Manufacturer of panelboards, switchboards and cabinets. President, John B. Tucker; secretary, Chester T. MacDonald.

ELECTRIC PHONOGRAPH CO.—Kalamazoo, Mich. Manufacturer of electrically operated phonographs. Business established 1918. General manager, E. W. Adams.

ELECTRIC PHONOGRAPH CORP.—4132 Park Ave., New York, N. Y. Manufacturer of electric phonograph lamps and motors. President, W. Thorpe; vice-president, J. H. Watts; secretary and treasurer, H. McGuckin. Factories, Bronx, New York, N. Y., and Mount Vernon, N. Y.

ELECTRIC POTENTIAL.—An electric field exerts a force on an electric charge, hence the condition of a point which determines the amount of work done by the field in moving a unit charge from a given point to an infinite distance is called the potential of the point. The potential is measured in work units, hence the unit potential in the C.G.S. system is the erg. The symbol for potential is V.

ELECTRIC POWER CLUB.—Organized 1908. An association of corporations, firms and individuals actively engaged in the manufacture of electrical power apparatus and control equipment. There are now about 75 members. Aside from the collection and dissemination of statistics and information of value to its members, the principal function of the club is the standardization of electrical machinery. In this connection there is close co-operation between the Electric Power Club and the American Institute of Electrical Engineering and other associations. Effective May, 1919, the membership was divided into working sections, each having its own chairman. The sections are as follows: (1) Transformer Section; (2) Industrial Control Section; (3) Power Switchboard Section; (4) Mining and Industrial Locomotive Section; (5) Motor and Generator Section; (6) Turbo-Driven Apparatus Section; (7) Storage Battery Section; (8) Electric Welding Section; (9) Electric Furnace Section; (10) Portable Electric Tool Section; (11) Electric Measuring and Recording Instrument Section. Members of the Electric Power Club may affiliate themselves with any one or more of these sections. Standardization rules of the club so far adopted are printed in a handbook published by the club. Annual meetings are held during the months of May or June and a fall meeting is usually held in November or December. Officers for 1920 are: President, James Burke, Burke Electric Co., Erie, Pa.; vice-president, A. L. Doremus, Crocker-Wheeler Co., New York, N. Y.; treasurer, R. J. Russell, Century Electric Co., St. Louis, Mo.; secretary, Chas. H. Roth, Roth Bros. & Co., Adams & Loomis Sts., Chicago, Ill.

ELECTRIC POWER EQUIPMENT CORP.—N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. Manufacturer of control switches, switchboard fittings, disconnecting switches, bus supports, choke coils and other high-tension equipment. Business established 1910. President and sales manager, L. Robert Lewis; vice-president, John H. Gledhill; secretary, Nelson S. Moore; treasurer, Francis W. Dinsmore. Sales representatives, P. M. Biedler, 63 Knickerbocker Bldg., Baltimore, Md.; J. J. Costello, 201 Devonshire St., Boston, Mass.; J. W. Fraser & Co., 615 Commercial Bank Bldg., Charlotte, N. C.; A. P. Garnier, 1217 Haas Bldg., Los Angeles, Cal.; R. W. Lillie Corp., 30 Church St., New York, N. Y.; A. S. Lindstrom, 519 California St., San Francisco, Cal.; W. A. McCombs & Co., Union Arcade Bldg., Pittsburgh, Pa.; McCrum & Gillem, 1011 Empire Bldg., Birmingham, Ala.; E. J. Putzell, 403 Board of Trade Bldg., New Orleans, La.; A. L. Searles, Michigan Trust Bldg., Grand Rapids, Mich.; 715 Dime Bank Bldg., Detroit, Mich.; Ferranti Meter & Transformer Mfg. Co., Ltd., 128 Bleury St., Montreal, Que., Can., 26 Noble St., Toronto, Ont., Can.

ELECTRIC PRODUCTS CO., THE.—Cleveland, Ohio. Manufacturer of battery-charging equipment and motor-generators for motion-picture projection. President, M. R. Berry; vice-president and sales manager, V. L. Staley; secretary, T. J. Williams; treasurer, W. G. Wilcox.

ELECTRIC QUESTIONER.—Trade name for electric novelties manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

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ELECTRIC RAILWAY EQUIPMENT CO.—Cincinnati, Ohio. Manufacturer of overhead line material for electric railways and mines, ornamental street lamp posts, etc. Main office, 2900 Cormany Ave., Cincinnati, Ohio. Factories, Cincinnati, Ohio; West Wheeling, Ohio. Branch office, 30 Church St., New York, N. Y.

ELECTRIC RAILWAY IMPROVEMENT CO., THE.—2070 E. 61st Place, Cleveland, Ohio. Manufacturer of electric welding and cutting outfits, bonding tools, rail bonds, etc. Business established 1901. President, Frank H. Neff; vice-president, R. B. Tewksbury; secretary and general manager, W. E. Huber; treasurer, H. S. Stebbins. Sales representatives, Crockwell Mine, c/o Mill Supply Co., Federal Reserve Bank Bldg., St. Louis, Mo.; O. H. Davidson Equipment Co., 1633 Fremont St., Denver, Colo.; Norton Machinery & Supply Co., Norton, Va.; Post Glover Electric Co., 308 W. 4th St., Cincinnati, Ohio; Rogan Bros. Co., Middleboro, Ky.; Banks Supply Co., Huntington, W. Va.; Edward Schenck, 319 Third Ave., Pittsburgh, Pa.; Service Engineering Co. Wheeling, W. Va.; Virginian Electric & Machine Works, Charleston, W. Va.; Shield Electric Co., 149 Broadway, New York, N. Y.; R. W. Jamison, 71 First St., San Francisco, Cal.

ELECTRIC RAILWAYS.—See Railways, electric, development of; Railways, electric, statistics of.

ELECTRIC ROTARY MACHINE CO.—40 S. Clinton St., Chicago, Ill. Manufacturer of motor-driven scrubbing surfacing, polishing and refinishing machines. Business established 1908. President, M. I. Heldman; secretary, Herbert Strauss; general manager, Mason Barlow.

ELECTRIC SALES SERVICE CO.—Berkeley, Cal. Manufacturer of electric heating devices.

ELECTRIC SERVICE SUPPLIES CO.—Philadelphia, Pa. Manufacturer of electric railway equipment and supplies. Business established 1906. President, Charles J. Mayer; vice-president, J. W. Porter; vice-president and treasurer, A. H. Englund; vice-president and sales manager, H. G. Lewis; secretary, Max A. Berg. Main office and factory, 17th & Cambria Sts., Philadelphia, Pa. Branch offices, Monadnock Block, Chicago, Ill.; 50 Church St., New York, N. Y.; 316 N. Washington Ave., Scranton, Pa.; Oliver Bldg., Pittsburgh, Pa.; 88 Broad St., Boston, Mass. Sales representatives, Franklin Sales Co., Denver, Colo.; Grayson Railway Supply Co., St. Louis, Mo.; Gee Electric Co., Wheeling, W. Va.; Virginia Electric & Machine Works, Charleston - Kanawa, W. Va.; Charles L. Ward Co., Kansas City, Mo.

ELECTRIC SIGN FLASHER CO.—519 Baker-Detwiler Bldg., Los Angeles, Cal Manufacturer of magnetic sign flashers.

ELECTRIC SIGNAL MFG. CO., INC.—31 Tremont Ave., Orange, N. J. Manufacturer of electric bells, buzzers and circuit testers. Business established 1919. President, H. H. Meno Kammerhoff; treasurer, A. Scherer.

ELECTRIC SPECIALTY CO.—Stamford, Conn. Manufacturer of electric bottle washers.

ELECTRIC SPECIALTY CO., THE.—233 N. Elm St., Cresco, Iowa. Manufacturer of telephone condensers. Business established 1906. A. L. Peterson, sole owner.

ELECTRIC SPECIALTY MFG. CO.—Cedar Rapids, Iowa. Manufacturer of electric pipe locators and cable testers. Business established 1908. George A. Bishton, general manager.

ELECTRIC SPECIALTY SALES CO.—90 West St., New York, N. Y. Manufacturer of cord adjusters.

ELECTRIC STEEL BOX CO.—541-46 W. Monroe St., Chicago, Ill. Manufacturer of sheet steel, boxes and cabinets for electrical purposes. Business established 1914. President and general manager, H. L. Rodde; secretary and treasurer, Charles H. Lembcke.

ELECTRIC STORAGE BATTERY CO. THE.—Philadelphia, Pa. Manufacturer of storage batteries and battery parts. Business established 1888. President and general manager, Herbert Lloyd; vice-presidents, John R. Williams, Bruce Ford; secretary and treasurer, Walter G. Henderson; sales manager, H. B. Gay. Main office and factory, 19th St. & Allegheny Ave., Philadelphia, Pa. Branch offices, Philadelphia, Pa.; New York, N. Y.; Chicago, Ill.; Minneapolis, Minn.; Denver, Colo.; Rochester, N. Y.; St. Louis, Mo.; Boston, Mass.; Cleveland, Ohio; Atlanta, Ga.; Detroit, Mich.; Kansas City, Mo.; Washington, D. C.; San Francisco, Cal.; Pittsburgh, Pa.; Cincinnati, Ohio; Seattle, Wash. Sales representative, Charles E. Goad Engineering Co., Ltd., 105 Bond St., Toronto, Ont., Can.

ELECTRIC TACHOMETER CORP. THE.—310 N. 11th St., Philadelphia, Pa. Manufacturer of signaling systems, tachometers and other indicating and recording instruments. Business established 1912. President and treasurer, G. Herbert Taylor; vice-president, T. T. Gaff; secretary and general manager, P. Van Santen Kloff; sales manager, Carl O. Kunde. Sales representatives, John P. Rockwood, 95 Liberty St., New York, N. Y.; Charles J. Mundo, Union Arcade Bldg., Pittsburgh, Pa.; P. H. Carey, 870 Woodward Ave., Detroit, Mich.

ELECTRIC TOOL MFG. CO.—Petersburg, Va. Manufacturer of electric calking tools.

ELECTRIC TOWEL.—Trade name for electrical hand and face driers manufactured by the Groton Electrical Devices, Inc., Main St., Groton, N. Y.

ELECTRIC TRACTOR CO.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric tractors.

ELECTRIC VACUUM CLEANER CO. INC.—Ivanhoe Rd., Cleveland, Ohio. Manufacturer of electric vacuum cleaners. Business established 1911. President, Julius Tuteur; treasurer, E. W. Miner; sales manager, H. O. Adams.

ELECTRIC WATER STERILIZER & OZONE CO.—Scottdale, Pa. Manufacturer of electric water sterilizers. President, W. F. Stauffer; vice-president, J. M. Stauffer; secretary, De Read Stauffer; treasurer, F. J. Brown; general manager, H. B. Hartman. Sales representatives, Electrozone Water Sterilizer Co., Manhattan Bldg., Chicago, Ill.; 708 Majestic Bldg., Detroit, Mich.; 512 Wilson Ave., Alhambra, Cal.; Electrified Water & Machine Co., Ervay & Cadiz Sts., Dallas, Tex.

ELECTRIC WEIGHING CO.—180 13th Ave., New York, N. Y. Manufacturer of electric weighing machines and counters. President, E. H. Messiter; vice-president; R. L. Lloyd; secretary and treasurer, H. Gordon Pierce.

ELECTRIC WELDING.—See Welding, review and status of.

ELECTRICAL ALLOY CO., THE.—Morristown, N. J. Manufacturer of electrical alloy resistance materials. Incorporated 1908. President, H. P. Reigart; vice-president and treasurer, F. S. Reigart; general manager, F. V. Lindsey. Main office and factory, Morristown, N. J. Branch office, McKerchy Bldg., Detroit, Mich.

ELECTRICAL & SPECIALTY SUPPLY CO.—9 S. Clinton St., Chicago, Ill. Manufacturer of electric floor scrubbers, vacuum cleaners and vacuum cleaner attachments. Business established 1917. General manager, Grover McHugh; sales manager, H. D. Oakland.

ELECTRICAL ASSOCIATION OF NOVA SCOTIA.—President, W. Murdock; vice-president, P. R. Colpitt; secretary-treasurer, J. T. Dorey, president of Dorey Electrics, Ltd., Halifax.

ELECTRICAL CODES.—There are in wide usage in the United States several codes of rules governing the installation and operation of electrical equipment. Two codes are national in application and very wide in scope: The National Electrical Code, and the National Electrical Safety Code; for some details regarding each see these respective titles. Several of the states have more or less complete electrical rules (see States electrical rules) and likewise many of the cities (see Municipal electrical rules). There are a few electrical codes of special application to particular industries; see Rules for electrical equipment in coal mines, Factory Mutual code, Millers' code, Insurance safety standards. There are also in use special codes dealing specifically with illumination requirements; for these see Lighting codes.

The oldest of these codes is the National Electrical Code, which was first issued under that name in 1897. Prior to that time there were but few rules governing electrical construction; the electrical industry was still in a formative state and the construction requirements that would minimize the hazards incident to the use of electricity were not widely known. The fire insurance interests took the lead in pointing out how the then serious electrical fire hazards could be reduced, the result of numerous national conferences being the National Electrical Code, which since 1897 has been revised at intervals of about two years to keep it abreast of current electrical practice. This code, together with the special and local codes based on it, has had a very salutary influence on electrical installation work as well as on the construction of electrical appliances. Fires from "crossed wires" or other purely electrical causes, once very frequent, are now very rare.

Since the National Electrical Code concerned itself primarily with electrical fire hazards it did not deal to any great extent with electrical accident and life hazards. This matter was taken up by the Bureau of Standards with the result that, after many conferences and hearings, it drew up and published in 1916 the first complete edition of the National Electrical Safety Code. This concerns itself primarily with the reduction of life and accident hazards, especially those connected with outside line construction which had not been covered by other regulations to any appreciable extent. It has already had an important influence in promoting greater safety.

Both these national codes at first met with rather chilly reception by the industry. Later developments have shown them to be highly constructive agencies in making for greater electrical progress. Hazards have been recognized and are guarded against so that electricity is now generally conceded to be the safest as well as most convenient medium for lighting, heating and power.

ELECTRICAL COMMITTEE, N. F. P. A.—The Electrical Committee of the National Fire Protection Association has charge of the preparation of the National Electrical Code. It was first appointed in 1911, and took over the duties and functions of the Electrical Committee of the Underwriters' National Electrical Association. Its membership is largely made up of men who have charge of electrical inspection work for underwriting and municipal bodies, and of representatives from national associations vitally interested in proper electrical installations. The organizations so represented are the following: American Institute of Electrical Engineers, American Electric Railway Association, Bureau of Standards, Electrical Supply Jobbers' Association, National Association of Electrical Inspectors, National Association of Electrical Contractors and Dealers, National Electric Light Association.

The detailed preparation of Code requirements is handled by ten standing committees as follows: Cars and Railways; Devices and Materials; Fixtures, Heaters, Lamps and Signs; Generators and Substations; Grounding; Industrial Applications; Outside Wiring, Building Supply and Services; Signaling Systems, Wireless and Lightning; Theaters, Moving Pictures, Places of Public Assembly and Garages; Wiring Standards and Systems.

The Code is usually revised every two years, at which time public hearings are held and contemplated changes previously issued in the form of a bulletin are considered and interested parties are heard. The next public hearing will probably be held in March, 1922. The chairman of the Committee is Dana Pierce, 25 City Hall Place, New York City, and the secretary is Ralph Sweetland, 141 Milk St., Boston, Mass.

ELECTRICAL CONTRACTING.—See Contracting, electrical.

ELECTRICAL CO-OPERATIVE ASSOCIATION OF THE PROVINCE OF QUEBEC.—President, K. B. Thornton, general manager, Montreal Public Service Corp., Montreal, Que., Can.

ELECTRICAL DEALERS SUPPLY HOUSE, INC.—162 W. Randolph St., Chicago, Ill. Manufacturer of fixture stems. Business established 1920. President, Walter J. Gorman; vice-president, A. A. Wohlgezon; secretary and treasurer; Louis Frantel; sales manager, H. A. Lotzar.

ELECTRICAL DECORATIVE FLOWER CO., INC.—140 W. 116th St., New York, N. Y. Manufacturer of electrically lighted flowers. Business established 1913. President, Louis Hayman; vice-president, L. Baumkel; secretary and treasurer, Elias Lindenberg.

ELECTRICAL DEGREE.—Since a cycle or one complete wave, of any sinusoidal electrical quantity can be represented by one complete rotation of a vector through 360 degrees, one electrical degree corresponds to one 360th of a cycle.

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ELECTRICAL DEVELOPMENT & MACHINE CO.—221 N. 23rd St., Philadelphia, Pa. Manufacturer of high-tension specialties. Business established 1913. President, H. P. Liversidge; secretary, R. H. Wismer; treasurer, W. E. Long; general manager, H. B. Austin; sales manager, William T. Poulterer. Sales representatives, Utility Products Corp., 50 Church St., New York, N. Y.; Midstates Engineering Co., Westminster Bldg., Chicago, Ill.

ELECTRICAL DEVELOPMENT CO.—534 Bienville St., New Orleans, La. Manufacturer of electric fireless cookers and wall cabinets. Lyman C. Reed, president.

ELECTRICAL DEVICES CO.—Mt. Vernon, N. Y. Manufacturer of commutator slotting machines.

ELECTRICAL ENGINEER.—A technically trained man well versed in or who follows the profession of electrical engineering. In a very general way he is skilled in the proper methods of generating, transmitting, distributing and using electrical energy. This naturally gives rise to a large number of phases of the work that require the attention of men trained in or well versed in particular branches of electrical engineering work, so the nature of the work of different electrical engineers is widely varied. They are qualified to design and assume responsibility for the construction of electrical machinery and appliances, electric power plants, distribution and transmission systems, signaling and communication systems, etc. In the proper use of electricity, they are often responsible for the development of special processes of manufacture, the proper selection of motors, control equipment, etc., and for lighting systems and other electrical equipment. Many electrical engineers do original research work that contributes to electrical science in general and others special research work for the perfection of individual apparatus or processes. There are also many professors and instructors of electrical engineering, electrophysics and electrochemistry, all of whom should be classed among electrical engineers. There are still others who by regular employment in electrical work have attained proficiency in the science or art or in the dissemination of information relative to the same.

ELECTRICAL ENGINEERING.—Electrical engineering is now the most scientific of all engineering professions. Its scope covers all phases of electrical activity, both within and without the industry. The design and manufacture of electrical machinery and apparatus, the installation of electrically equipped plants, the design, operation and management of central stations for the generation and distribution of electrical energy, the utilization of electricity for light, heat and power and countless other activities, are all included in the scope of electrical engineering.

And outside of the electrical industry there are few large industries in which electrical equipment is not an important factor. An electrical engineer is now an important auxiliary in many industries which not long ago seemed entirely apart from electrical problems. The quarry, the mine, large factories of all kinds, railroad systems, ships, docks, etc., all need his services. He is a most important part of armies, navies and air services in the equipment and conduct of war. He is a necessary and responsible advisor and official in connection with many of the important problems of our larger cities.

The various branches of electrical engineering are represented by such men as consulting engineers, professors of electrical engineering, chief engineers, managers and other officials associated with electric lighting, railway, telephone, telegraph, power and manufacturing companies and many others interested in other ways in the advancement of the electrical profession and industry in general.

The exact number of men engaged in this profession is difficult to ascertain. It is estimated that at least 20% of the graduates of electrical engineering courses in the universities and colleges do not follow the profession after graduation. On the other hand, many of the eminent engineers of the past and men prominent in the industry today never pursued a course in electrical engineering, but have attained prominence by individual research or development and by constant application and study. The number of engineering graduates is therefore not a true indication. It would seem that the membership of the American Institute of Electrical Engineers, which is an association for the advancement of the theory and practice of electrical engineering and the allied arts and sciences, would be a good indication. While not all engineers are members of the Institute, by far the largest percentage of those actively following the profession are. Their present membership is something over 12,200, so the number of men actively engaged in electrical engineering is probably in that neighborhood or perhaps slightly larger.

Electrical engineering may be said to have begun with the invention of Gramme's dynamo in 1870. Investigation of electrical phenomenon had been carried on extensively by scientific observers from the beginning of the 17th century, but actual applications, except those connected with telegraphy and certain applications of the primary battery, did not make any general appearance until the last half, and not to any important extent until the last quarter, of the 19th century.

Improvement in dynamoelectric machinery and the development of alternating-current machinery and installations greatly enlarged the use of electric lighting. The use of transmitted electric power increased as it became evident that it was more economical, more dependable and more easily controlled than any other. Electrical engineers began to be trained in technical schools and came out with a better preliminary equipment for the profession than many of those pioneer engineers who, with far less educational advantages, had been prominent aids and many of them among the leaders in the foundation of the electrical industry.

In the Telegrapher of Oct. 1, 1869, an advertisement was inserted by Pope, Edison & Co., as electrical engineers. This was the first record, if it may be so described, in America of a firm of practicing electrical engineers. The members of the firm were Thomas A. Edison and Franklin L. Pope.

The growth and importance of engineering branches has been fairly marked or rather followed by the institution of technical schools. In the United States, the Rensselaer Polytechnic Institute was founded in 1824. As a school of theoretic and allied science, it has been almost exclusively devoted to the training of civil engineers. The demand for scientific training in universities led to the foundation of the Sheffield Scientific School at Yale in 1847. The Massachusetts Institute of Technology was chartered in 1861, but because of the Civil War, did not organize its first classes until 1865. The opening of the Stevens Institute of Technology in 1871 and the Sibley College of Mechanical Arts of Cornell University in 1872, was the beginning of the rapid development of schools of technology throughout the United States, in nearly of which electrical engineering is taught.

The American Institute of Electrical Engineers was established in May, 1884, and in 1885 had 300 members and associates, but at that time the profession had not become fully specialized and of its members many, if not most, were mechanical engineers who regarded electrical engineering as a branch or specialty of their main profession. This was the general view at the time just as a quarter century before mechanical engineering had been looked upon as a branch of the profession of civil engineering.

From 1890 on the electrical industry expanded so rapidly that there was imperative call for men of the right training and proper caliber to undertake the putting into concrete form and appropriate application the new ideas that were constantly widening the scope of usefulness of electricity. The need since then has been for closer specialization, and a large number of young men, starting active careers in the last decade of the nineteenth century, made rapid progress to prominence because of specialization in a particular branch of the electrical industry.

Of the electrical engineering graduates, a relatively small percentage became consulting engineers, which is undoubtedly due to the fact that manufacturing, distribution and even the planning and completion of electrical installations are to a large extent organized in strong corporate enterprises. This is necessarily so because the interests involved are colossal, diversified but closely interrelated and depend for their highest success upon their operation under a unified policy as interdependent parts of a harmonized whole.

With achievement, the profession of electrical engineering has been constantly acquiring greater importance, greater dignity and greater responsibility. It is a profession which calls for the highest intellectual qualities or at least such of them as are to contribute to the ever expanding triumphs of electrical science. The vastness of accomplishment already achieved by the profession seems almost like magic, but no one can see more clearly than the engineer himself that the field of progressive endeavor in the discovery of new phenomena in and the making of new applications of electricity is practically limitless.

ELECTRICAL ENGINEERING CO.—922 E. 41st St., Chicago, Ill. Manufacturer of transformers. President, R. A. Connor; secretary and treasurer, G. C. Jensen.

ELECTRICAL ENGINEERS EQUIPMENT CO.—35 S. Desplaines St., Chicago, Ill. Manufacturer of high-tension and substation equipment. Business established 1910. President, F. Woodmansee; secretary, W. McKerrow; treasurer, C. W. Pendell; general manager, E. H. Jacobs; sales manager, R. T. Calloway. Sales representatives, R. Burnham, 21 Park Row, New York, N. Y.; J. C. Barr, 84 State St., Boston, Mass.; Vern W. Shear, 323 Ohio Bldg., Akron, Ohio; Mill Power Supply Co., 434 Church St., Charlotte, N. C.; R. M. Helm, 1309 Union Trust Bldg., Cincinnati, Ohio; T. R. Jennings, 617 Ford Bldg., Detroit, Mich.; A. T. Vick, 1013 Rusk Ave., Houston, Tex.; R. L. Lunt, 716 McKnight Bldg., Minneapolis, Minn.; W. H. Fernholz, Mack Bldg., Milwaukee, Wis.; Rutherford & Uptegraph, 1st National Bank Bldg., Pittsburgh, Pa.; Clapp & Lamoree, 406 San Fernando Bldg., Los Angeles, Cal.; Garland Affalter, Rialto Bldg., San Francisco, Cal.

ELECTRICAL INDUSTRY.—Considered in its entirety, the electrical industry ranks as one of the leading industries of the United States being exceeded only by agriculture and the steam railroads. Based on estimated production for 1920 the standing of the seven leading industries is as follows: (1) Agriculture; (2) railroads; (3) electrical; (4) meat packing and slaughtering; (5) textiles; (6) iron and steel; (7) automobiles.

The electrical industry is really composed of a number of principal branches, each of which is itself an industry of no mean proportions. The manufacturing branch includes the design, development and production of all forms of electrical machinery, apparatus, accessories and supplies used in all of the industries, including the public utilities and agriculture, in all of the professions, in the world of merce, and in the home. The electric public utility branch includes all public or privately owned plants furnishing electric light, heat and power, transportation and communication by telephone, telegraph and radio. The mercantile branch includes all establishments for the purpose of distributing electrical goods, such as jobbers and dealers in their many forms. The construction branch includes all contractors and many engineers.

Since brief historical data will be found separately for each branch under the respective classification for each, no attempt will be made here to consider the early development of the industry as a whole.

It is estimated that the investment in the whole industry is $15,000,000,000, and that there are about 1,500,000 people employed. This latter figure does not include electricians, wiremen, etc., employed by industrial plants in other industries, of which there are several thousands.

Electrical production and income from all branches for 1920 is estimated as follows:

Central stations	$ 900,000,000
Electric railways	800,000,000
Telephone service	550,000,000
Telegraph service	250,000,000
Isolated plants	200,000,000
Miscellaneous	250,000,000
Manufacturing	2,250,000,000
Total	$5,200,000,000

These figures indicate an average expenditure for electric service and products of about $50 for every inhabitant of the United States.

The potential market in the United States is indicated by the 1920 Government census, which shows a population of 105,683,108. Of this number 54,816,209 or 51.9% live in incorporated communities of more than 2,500 inhabitants; 9,864,196 or 9.3% are living in smaller incorporated communities and 41,002,703 or 38.8% are living in country districts. There are 20,481,700

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dwellings in the United States, of which 14,190,540 are not yet wired for electricity. Of these 4,993,490 are within territory served by central-station service. There are 6,362,502 farms in the United States and 340,000 farm-lighting plants in use.

Manufacturing. (For history and detailed statistics see Manufacturing, electrical.) As early as 1850 electrical apparatus appeared in the United States census among the classified industries, when two establishments, engaged primarily in the manufacture of electromagnetic instruments, were reported with products valued at $5,100. In the census report of 1914, 1,030 distinctly electrical establishments were reported, the value of products being shown as $335,170,194. For 1920, the estimated value of products is $2,500,000,000, and the number of establishments over 5,000. The latter figure includes manufacturers who are commonly classified with manufacturers in other industries but who make one or more electrical products.

The total capitalization of electrical manufacturers is estimated at $550,000,000 and the total number of employees engaged in this branch as 203,000.

It is difficult to give a clear idea as to the diversity of electrical products, other than to state that there are upwards of 2,500 separate and distinct classifications of such products. This, of course, does not take into consideration the countless varieties and types of each general classification.

There are at least 50 major lines of products, each one of which would be an industry in itself, if not related to the others. In general, electrical products are often classified according to services for which they are intended. Such classifications with the value of the products for each for the year 1920, are as follows: Industrial, $350,000,000; transportation, $200,000,000; transmission, $150,000,000; generation, $150,000,000; and merchandise, $2,000,000,000. This latter represents only electrical apparatus used in the consumption and utilization of electrical energy in the household, in the commercial and industrial field and on the farm, and the material and devices necessary in the wiring of buildings for such apparatus.

Utilities. (For history and detailed statistics, see entry under each separate class of utility.) The electrical utilities, comprising central-stations, electric railways, telephone systems and telegraph systems, both wire and radio (wireless), constitute the "backbone" of the electrical industry. The total capitalization of these utilities for 1920 was estimated at $12,988,513,479, the number of employees over 900,000, and the value of service rendered during the year estimated at $2,500,000,000.

Statistics covering the period beginning in 1902 bring out some interesting facts regarding the relationship of each class of utility to the other. For instance, in all statistics the proportion which the different items for the telephone and telegraph systems bear to the total for all utilities is surprisingly constant throughout the period. To illustrate: In 1902 the capitalization of telephone companies was 10.5% of the total capitalization of all electric utilities, in 1907 it was 13%, in 1912, 12.2% and in 1917, 11.7%. Likewise in 1902 the income from telephone service represented 18.7% of the total income of all utilities and in 1917 it was 21.4%. On the other hand, there has been, in practically every case, a steady increase in the relative importance of electric light and power business, and just as certain a decrease in the relative importance of practically all items pertaining to the electric railway industry.

The income of central stations for the year 1902 was $85,700,605. In 1907 it reached $175,642,338, an increase of 104.9%. There was a 72% increase between the years 1907 to 1912, and in 1917 the income was $526,894,240, an increase of 514.8% over the income in 1902. The 1920 income, as already stated, was $900,000,000, an increase of 58% over 1917. In 1902 central-station revenue represented 18% of the total revenue of all electric utilities and in 1917 the percentage had increased to 30.3%. Electric railway income in 1902 represented 54% of the total income of all utilities, while in 1917 it had decreased to 42%.

For 1920, central-station revenue is 35% of the total, railway revenue 32%, telephone revenue 22%, and telegraph revenue 10%. So, for the first time in the history of the electrical industry central-station revenues have exceeded those of electric railways.

Financial comparisons further disclose the fact that during the period 1912 to 1917 expenses of all utilities have increased much more rapidly than the income. The total net income of the electric railways actually decreased $6,000,000, or 6.7% during this period. This unsatisfactory showing has been due to the increased costs of materials, higher wages, higher taxes, interest rates, etc., while few increases in fares were made prior in 1918. For the period between 1917 and 1920 an improvement was shown.

Isolated Plants. The value of the production of isolated plants for 1920 is estimated at $200,000,000. While there has been no notable increase in the number of isolated plants in office buildings and factories during the past two years, there has been a most interesting development in such isolated plants as new ships, as well as in farm light and power plants. Of the latter, there were in 1920, 340,000 in service.

In 1914 there were 205,590 industrial establishments that used mechanical power of all kinds. Of this total 21.9% or 4,929,967 hp. was utilized in electric motors by establishments generating their own electrical energy. This would indicate that there were about 45,000 isolated electric plants in 1914 operations solely in connection with industrial enterprises. This figure does not include isolated plants operated by mines, stores, hotels, office buildings, public buildings, schools, etc. There has been little increase in this class of plants during the past few years.

Mercantile and Construction. The mercantile branch of the industry includes all establishments for the purpose of distributing electrical goods. In 1920 there were approximately 500 electrical jobbers, or wholesale distributors, in the United States and Canada, whose business amounted to $400,000,000. During the same year there were 6721 dealers who handled electrical goods exclusively and 28,858 other retail establishments that sold electrical goods. There were also 3410 electric central stations that sold merchandise at retail. For the so-called "merchandising lines," which includes all electrical goods sold by retailers, such as household appliances, lamps, small motors, etc., the usual channel of distribution is from manufacturer to jobber to retailer to consumer. The tendency in the industry is to follow to an increasing extent this method of distribution. For a more detailed analysis of merchandising practice see Merchandising, electrical.

The erection, operation and maintenance of electric power stations and the wiring for electric light and power service in the home, office and factory has called for specialized ability which has led to the rapid development of the engineering and construction, or contracting branches of the industry. A more detailed statement of both engineering and contracting will be found under the headings, Electrical engineering, and Contracting, electrical.

By no means the least important branch of the industry is the publicity branch as represented by the electrical press. Electrical trade and technical publications have been closely identified with the development of the industry from its inception and in later years have, as a natural development, divided themselves into specialized groups covering the activities of individual branches of the industry, or in other instances, one or more functions, such as contracting or merchandising. A complete list of independent electrical publications is given under Periodicals, electrical.

For more detailed treatment of the branches of the industry, see Central-station electricity service; Central-station facts and figures; Contracting, electrical; Electrical engineering; Electrochemical industry; Jobbing and jobbers of electrical supplies; Manufacturing, electrical; Merchandising, electrical; Radio communication, development and status of; Railways, electric, development of; Railways, electric, statistics of; Submarine cable telegraphy; Telegraphy, land line, commercial and technical progress in; Telephony, development of; Telephone service statistics.

ELECTRICAL JOBBING.—See Jobbing and jobbers of electrical supplies.

ELECTRICAL JOURNALS OR PERIODICALS.—See Periodicals, electrical, for a complete list of American and Canadian electrical technical and trade journals having a national circulation.

ELECTRICAL MANUFACTURERS' CLUB, THE.—Organized in 1905. Reorganized under present name in 1911. An association of individuals actively engaged in the manufacture of materials used in connection with the electrical industry. The object of the Club is to gather and disseminate information relating to the broader economic aspects of the industry in the United States. Close affiliation with the Electric Power Club and the Associated Manufacturers of Electrical Supplies is maintained by representation on the Electrical Manufacturers' Council. The membership of the Club is limited to 130; at present there are no vacancies. Regular meetings are held twice a year, usually at Hot Springs, Va., or some similar resort, in May and November.

Officers for 1920-1921 are: President, LeRoy Clark, president, the Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y.; secretary, Fred L. Bishop, general manager, the Hartford Faience Co., Hartford, Conn.; treasurer, S. B. Condit, Jr., president Condit Electrical Mfg. Co., South Boston, Mass.; commissary, F. W. Sanford, Edison Lamp Works of General Electric Co., Harrison, N. J.

ELECTRICAL MANUFACTURERS EQUIPMENT CO.—712 Postal Telegraph Bldg., Chicago, Ill. Manufacturer of coil winding, taping and forming machines. F. B. Segur, sole owner.

ELECTRICAL MANUFACTURING.—See Manufacturing, electrical.

ELECTRICAL MFG. CO., THE.—4149 E 79th St., Cleveland, Ohio. Manufacturer of switches, switchboards, panelboards, etc. Business established 1905. President and general manager, F. T. Kovar; vice-president, J. V. Becka; secretary and treasurer, J. F. Jirka.

ELECTRICAL MEASURING INSTRUMENTS.—See Instruments, electrical measuring.

ELECTRICAL MERCHANDISING.—See Merchandising, electrical, analysis of successful methods for; also Merchandising, electrical, present status and prospects of.

ELECTRICAL PRODUCTS CORP.—1128-34 W. 16th St., Los Angeles, Cal. Manufacturer of stage-lighting equipment, electric signs, incandescent and portable lamps. Business established 1911. President and general manager, Paul D. Howse; vice-president and sales manager, L. R. Lautlerstein; secretary and treasurer, R. H. Malone.

ELECTRICAL PRODUCTS MFG. CO.—69 Sprague St., Providence, R. I. Manufacturer of radio equipment. Business established 1919. President, Frank E. Dyson; vice-president, Thomas P. Ziblin; secretary and general manager, H. A. McAvoy; treasurer, Charles Eddy. Sales representatives, Pacent Electric Co., Inc., 150 Nassau St., New York, N. Y.

ELECTRICAL REFRACTORIES CO. THE.—East Palestine, Ohio. Manufacturer of refractories for electric heating devices. President and sales manager, F. E. Owen; vice-president and general manager, F. C. Simms; secretary and treasurer, C. W. Williams.

ELECTRICAL REFRIGERATING CO., INC., THE.—130 E. 15th St., New York, N. Y. Manufacturer of electric refrigerators. President, E. T. Williams; vice-president and treasurer, William O. Smith; secretary, Henry I. Moody.

ELECTRICAL SAFETY CONFERENCE.—Organized in 1918. A voluntary association of representatives of national organizations interested in questions affecting accident hazards arising from the design, construction and installation of electrical appliances. These organizations are known as co-operating organizations and are at present as follows: The Electrical Manufacturers' Council, representing the Associated Manufacturers of Electrical Supplies and the Electric Power Club; the Bureau of Standards of the United States Government; Underwriters' Laboratories; the National Workmen's Compensation Service Bureau. Each of the foregoing is represented by two members of the Conference.

The purpose is to promote by co-operative effort the orderly, consistent and proper development of practice in electrical manufactures and installations with regard to accident hazards; to serve as a medium of discussion of questions concerning electrical safety; to develop standards for the construction and test of appliances and for their application and installation; to interpret the application of electrical safety codes both in regard to general principles and in regard to particular appliances.

The work of the Conference is conducted chiefly through the medium of specially appointed committees whose members may or may not be members of the Conference itself. These committees investigate special phases of electrical problems within

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the purpose of the Conference as above stated and through co-operative effort with organizations, with industries, and with inspection authorities of insurance organizations, state and municipalities, develop standards for particular classes of apparatus and machinery.

The co-operation and assistance of all organizations and individuals interested in accident prevention and safe practice in the electrical field is invited and solicited. The work at present in progress by subcommittees includes the following subjects: Industrial controllers, rotating machinery, switchboards, circuit breakers. Other topics are under consideration for early attention. Standards adopted by the Conference will be printed for distribution. The Conference holds four regular meetings each year. The present officers are: Chairman, A. H. Moore, General Electric Co., Schenectady, N. Y.; secretary-treasurer, Dana Pierce, 25 City Hall Place, New York, N. Y.

ELECTRICAL SPECIALTY MFG. CO.—51 Beaufort St., Providence, R. I. Manufacturer of conduit outlet boxes and service entrance bushings.

ELECTRICAL SUPPLY JOBBERS ASSOCIATION.—An association made up of corporations, firms and individuals engaged in the business of marketing, distributing and jobbing electrical supplies of all kinds. The present Association was organized in 1909. It is essentially an educational institution, its principal activities being given to gathering statistics on the cost of operation, publicity advertising and the discussion of problems of interest to the jobbing branch of the electrical industry. The membership is now about 200. Franklin Overbagh, 411 S. Clinton St., Chicago, Ill., is general secretary, and Thomas M. Debevoise, 62 Cedar St., New York, N. Y., general counsel. The Association is divided into three divisions, Atlantic, Central and Pacific. F. S. Stow is chairman and E. Donald Tolles, 165 Broadway, New York, N. Y., secretary of the Atlantic Division; W. R. Herstein is chairman of the Central Division; and C. C. Hillis is chairman and Albert H. Elliott, 502 Flatiron Bldg., San Francisco, Cal., secretary of the Pacific Division. The general secretary's office being located in the Central Division, it has no secretary. Meetings of the main body are held twice a year, once in the spring and once in the fall. Divisional meetings are held quarterly at central points. The association publishes a monthly bulletin known as "The Reminder," of which Franklin Overbagh is editor.

In March, 1921, the Association appointed E. Donald Tolles, secretary of the Atlantic Division, to the newly created office of national representative of the Electrical Supply Jobbers Association. As national representative, Mr. Tolles is engaged in a comprehensive campaign to rid the jobbing branch of the electrical industry of various economic wastes.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION.—Secretary, E. Donald Tolles, 52 Broadway, New York, N. Y.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, CENTRAL DIVISION.—No divisional secretary. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION.—Secretary, Albert H. Elliott, 502 Flatiron Bldg., San Francisco, Cal.

ELECTRICAL SUPPLY JOBBING.—See Jobbing and jobbers of electrical supplies.

ELECTRICAL SUPPLY MANUFACTURERS' ASSOCIATION (CANADA).—Secretary, J. A. McKay, Room 206, 110 Church St., Toronto, Ont., Can.

ELECTRICAL TRADE ASSOCIATION OF CANADA.—Secretary, William R. Stavely, Royal Insurance Bldg., Montreal, Que., Can.

ELECTRICIAN.—A person well versed in electrical sciences and arts. This term has been used in this broad sense almost from the beginning of the study of phenomena. In the older days even scientists who investigated electrical phenomena were commonly called electricians. In the United States the term is now generally restricted to an electrical worker experienced in the installation and maintenance of electric wiring and equipment.

ELECTRICITY.—From the earliest observations of electrical phenomena until recently attempts to explain what was taking place have been unsatisfactory, and the nature of electricity has been a mystery.

Benjamin Franklin suggested the theory that electricity is a fluid which exists normally in all bodies. If some of this fluid is removed, the body becomes charged negatively. If an excess of the fluid is present in a body, it is charged positively. Portions of this fluid repel each other but are attracted by matter. Since bodies with less than the normal amount of this fluid repel each other, it would seem, according to this theory, that matter repels matter, which is a conclusion not in accord with Newton's law of gravitation.

Symmer proposed a two-fluid theory assuming the existence of positive and negative fluids which attract each other, but positive repels positive and negative repels negative. Normally these two fluids exist in equal amounts in all bodies and therefore neutralize each other. If some of the negative fluid is removed, or if positive fluid is added to a body, it becomes positively charged, while if positive fluid is removed, or negative fluid added, it is negatively charged.

Faraday and Maxwell conceived of electric charges as strains in the ether in the vicinity of the charged bodies.

Recently a new theory has grown out of experiments on the electric discharge through vacuum tubes and various other phenomena. This is the electron theory. According to this theory electricity consists of exceedingly minute negatively charged particles, originally called corpuscles by J. J. Thomson, but now called electrons. These particles always have the same mass and the same charge no matter from what substance they come. Positive electricity has not been isolated, but the removal of electrons from a body leaves that body positively charged. The application of this theory seems to explain and co-ordinate in a remarkable manner a great number of phenomena which at first appear to be unrelated. (See Electron theory.)

ELECTRICITY IN MARINE AND NAVAL SERVICE.—See Marine and naval applications of electricity.

ELECTRICITY IN THE HOUSEHOLD.—See Household applications of electricity.

ELECTRICITY SUPPLY FROM CENTRAL STATIONS.—See Central-station electricity supply; Central-station facts and figures.

ELECTRIFICATION.—The characteristic property of a substance of exerting a force on small particles after being rubbed with silk, flannel or similar material. This property was first observed on amber, whose Latin name is electrum, from which the word electricity is derived. A body that is electrified is said to be charged with electricity. In 1734 DuFay discovered that there are two kinds of electrification. A glass rod, when rubbed with silk, will repel another glass rod which has been treated the same way. A rod of hard rubber, when rubbed with cat's fur, will repel another rod which has also been rubbed with fur, but it will attract the glass rod electrified as above. These two manifestations indicate two kinds of electricity. Charges like that on the rubber when rubbed with cat's fur are called negative and charges like that on the glass are called positive. In modern electrical theory a body is electrified when it has either an excess or deficiency of electrons. See Electron theory. When a body is electrified, equal amounts of positive and negative electricity are developed. The quantity of the electrification or electric charge is measured by the force it exerts on unit charge. The symbol for charge is q.

The word electrification is also used in a broader sense to refer to the process of equipping a plant, institution or system with electric power in place of some other kind of power. For instance, railroad electrification—equipment of a railroad system with electric locomotives to replace steam locomotives. Factory electrification—replacement of mechanical power transmission within the plant by electric transmission and motor drive of the machinery. In many cases electrification includes change to electric lighting and heating as well as electric power, as in electrification of the home. Also see Steam railroad electrification.

ELECTRIFICATION OF STEAM RAILROADS.—See Steam railroad electrification, development of; Steam railroad electrification, economies and other advantages of.

ELECTRIK MAID BAKE SHOPS.—209 Dakota Bldg., St. Paul, Minn. Manufacturer of electric ovens. Business established 1919. General manager, W. C. Levey; sales manager, Allan L. Firestone.

ELECTRION.—Trade name for farm lighting and power plants manufactured by the Canadian Linderman Co., Ltd., Woodstock, Ont., Can.

ELECTRIS.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

ELECTRO.—Trade name for motor-driven grinders, drills, hammers and other tools manufactured by the Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill.

ELECTROBATER.—Trade name for electric incubator manufactured by the Cyphers Incubator Co., Buffalo, N. Y.

ELECTRO CHEMICAL CO., THE.—111 W. Court St., Dayton, Ohio. Manufacturer of electrolyzers. President, treasurer and general manager, E. E. Niswonger; vice-president, D. R. Niswonger; secretary, H. P. Williamson.

ELECTRO-CHEMICAL ENGRAVING CO., THE.—Brooklyn, N. Y. Manufacturer of electrical instrument dials and name plates for electrical machinery. Business established 1900. President and treasurer, Frederick E. Switzer; vice-presidents, N. L. Jacobus, F. H. Southwick, R. Schlezinger; secretary and sales manager, N. L. Jacobus; treasurer, N. L. Jacobus. Main office, 440-458 19th St., Brooklyn, N. Y. Branch office, 52 Vanderbilt Ave., New York, N. Y.

ELECTRO DYNAMIC CO.—Bayonne, N. J. Manufacturer of electric motors and generators. Business established 1880. President, Henry R. Carse; vice-president, Henry R. Sutphen; secretary, H. A. G. Taylor; treasurer, T. C. Dawson; general manager, C. R. Mudge; sales manager, D. B. Wilson. Main office and factory, Ave. A & North St., Bayonne, N. J. Branch office, Marshall Bldg., Cleveland, Ohio. Sales representatives, Corte Engineering Co., Woolworth Bldg., New York, N. Y.; Coolbaugh & Gledhill, Bulletin Bldg., Philadelphia, Pa.; H. A. Rapelye, Oliver Bldg., Pittsburgh, Pa.; Hodgart & Co., Peoples Gas Bldg., Chicago, Ill.; C. E. Wise, Book Bldg., Detroit, Mich.; A. J. Kutchera, 2nd National Bank Bldg., Wilkes-Barre, Pa.; Irving Samuels, Hunsicker Bldg., Allentown, Pa.; Coolbaugh & Gledhill, 88 Broad St., Boston, Mass.; H. P. Foley Co., 806 12th St., N. W., Washington, D. C.; Coast Equipment Co., Merchants Exchange, San Francisco, Cal.

ELECTRO-MAGNETIC TOOL CO.—Chicago, Ill. Manufacturer of portable electric tools. Business established 1910. President, A. D. Lundy; vice-president and general manager, J. S. Knowlson; secretary, J. N. Hatch; treasurer and sales manager, G. L. Neucomb. Main office and factory, 2902 Carroll Ave., Chicago, Ill. Branch office, 426 Broome St., New York, N. Y.

ELECTRO MAGNETIZER CO.—830 Market St., San Francisco, Cal. Manufacturer of magnetizers.

ELECTRO SERVICE CO.—Marietta, Ga. Manufacturer of lightning arresters and air-break switches. Business established 1919. President and treasurer, G. N. Lemmon; vice-president and secretary, C. E. Bennett; vice-president, E. A. Thornwell. Sales representatives, Memco Engineering & Mfg. Co., New York, N. Y.; R. W. Lillie Corp., Boston, Mass., and New York, N. Y.; Albrecht-Henderson Co., Pittsburgh, Pa.; Mill Power Supply Co., Charlotte, N. C.; E. A. Thornwell, Atlanta, Ga.; W. R. Hendrey Co., Seattle, Wash.

ELECTRO STEAM RADIATOR CO.—18 W. Monroe St., Chicago, Ill. Manufacturer of electric radiators.

ELECTROBESTOS.—Trade name for insulating material manufactured by H. W. Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

ELECTRO-BOIL.—Trade name for electric immersion heater manufactured by the Milwaukee Mfg. Co., 1316 Fond du Lac Ave., Milwaukee, Wis.

ELECTROCARDIOGRAPHS.—Some years ago it was discovered that every muscular contraction is attended by the production of an electric current. It was later found that the current, the action current as it is called, produced by the action of the heart muscles produces differences in potential on the surfaces of the body. This potential difference can be detected by

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extremely sensitive galvanometers; however, the currents are so brief in duration that the ordinary sensitive galvanometers cannot follow them and a special apparatus called the electrocardiograph must be used to study these currents.

The essential parts of this equipment are a galvanometer, a photographic recorder and control equipment. If a wire carrying a current is held in a magnetic field the wire is stretched from a straight line into an arc. This principle is utilized by the galvanometer used in this equipment; the amplitude of the arc being proportional to the strength of the current, the deflection provides a means of measuring the current. This deflection is, of course, very small and is measured by photographing the moving wire through magnifying lenses which magnify 900 times. The photograph is taken on a moving film, time being marked on the film by a shutter which rotates at a known speed. Though these outfits are designed primarily for medical research, their extreme sensitivity and the permanent graphic record obtained makes the instrument of value to the physical laboratory as well. It is, in fact, a highly special type of oscillograph, which see.

Manufacturers:

Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."

ELECTROCHEMICAL EQUIVALENT.—The weight in grams of an element that is liberated through electrolysis by one coulomb of electricity. The electrochemical equivalent of hydrogen is 0.01044 milligrams per coulomb and of oxygen 0.0829.

ELECTROCHEMICAL INDUSTRY.—The industry in which the science of electrochemistry is applied to a large number of commercial processes. Some industrial plants are wholly electrochemical, while others are established chemical or metallurgical plants using more or less electrochemical processes. That branch of the electrochemical industry dealing with the production of primary and storage batteries is very often considered to be also a direct branch of the strictly electrical industry which handles most of the batteries manufactured. Inasmuch as this branch is described under batteries, it will not be discussed further here. The other division of the electrochemical industry, which is by far the most diversified and most important, may be divided into three general branches according to the nature of the processes involved.

The oldest of these three branches is that using electrolytic processes. While this branch had its beginnings over sixty years ago, its development was not possible until the commercial perfection of d-c. generators gave a sufficiently large source of energy. From that time on its development has been rapid and electrolytic processes are constantly applied to countless materials, articles and parts.

Another very important class of processes, whose extensive development has been rather recent, principally within the last six years, is that of electric furnace or electrothermal processes. The recent World War, with its great demand for special alloy steels, aluminum, abrasives and other materials that cannot be produced in other ways, is responsible for this recent very rapid growth. In 1915 there were only 213 electric furnaces operating in the world, while in 1920 it is estimated there were 1390, an increase of 650% in five years. The future development of electric furnace applications is bound to be rapid also, and is limited only by the supply of electrical energy in large quantities and at low cost, and it is therefore closely linked with hydroelectric development.

The third class involves electric discharges through gases, which produce different chemical reactions, according to the nature of the discharge. As yet little progress has been made in this class and its processes are not anywhere near as important from a commercial standpoint as either of the other two classes.

Of the electrolytic processes, probably the oldest and most widely applied is that of electroplating. In electroplating the object which is to receive a coating of metal is employed as a cathode in a solution of a salt of the metal. Many small parts or one large one may be plated at a time, by suspending them from hooks or arranging them so that they are in continuous motion and tumble over each other and present successively all parts of their surfaces to the electroplating action of the current It is estimated that the number of parts treated in this manner daily runs up into millions. The metals deposited include gold and silver, used largely on jewelry and tableware, and nickel, zinc, copper and brass which are used for protective purposes as well as appearance.

The electrolytic refining of metals is also a very important part of the industry. In these processes the starting material is a highly concentrated alloy of the metal, and the purpose is to remove the impurities and recover not only the principal metal in its pure form, but also the foreign metals, especially the precious metals. The impure metal is made the anode and the principle of the process is to dissolve it into the electrolyte from which it is deposited on the cathode in pure form. The precious metals are either not dissolved or, if they are, remain in the electrolyte. Copper is the most important metal refined in this manner, but the processes also include silver, gold, zinc, lead, nickel, iron, tin, bismuth and cadmium.

The electrolysis of water and other solutions to get gases is also accomplished on a commercial scale. Some hydrogen and oxygen are produced in this manner, but the production of chlorine and chlorates is more important. The chief application of electrolytic chlorine is for the manufacture of bleaching powder (chloride of lime). Other important applications are the manufacture of carbon tetrachloride, the detinning of tin scrap with the production of tin tetrachloride, the manufacture of hydrochloric acid, sulphur chloride, acetylene tetrachloride, etc. One use of the chlorate produced is in the manufacture of bichloride phosphate fertilizers.

In electric furnace processes the reaction taking place does not differ from ordinary chemical and metallurgical reactions. The difference is that the heat required for the reaction is produced electrically, but if the same heat would be generated in some other way the reactions would be identical. Its advantages are, however, that a much higher temperature may be produced, and the control of temperature and chemical nature of the atmosphere is much more simple. Its only disadvantage is the cost of energy.

One of the first and most important products of the electric furnace is artificial graphite, first produced by Dr. Acheson. It is used for electrodes in many other electric furnace and electrolytic processes and also as a lubricant, polish, in paint, etc Silicon carbide is also made in the electric furnace and is widely used as an abrasive and a refractory, under the trade names carborundum, crystolon, etc. Others made in a similar manner are artificial emery or alundum, aloxite, siloxicon, etc. The production of aluminum and zinc in electric furnaces is an important branch of the industry. Calcium carbide production is also one of the largest and most important of electric furnace processes; calcium carbide is used chiefly for producing acetylene gas for welding and lighting; it is also used for making calcium cyanamide.

The more recent developments of the electric furnace processes have related largely to the production of ferro alloys and high-grade steels. Many varieties of such alloys are produced and various steels of high percentage purity and very low in or free from carbon, sulphur and phosphorus, can only be made in electric furnaces. In the steel industry the electric furnace is used largely for three purposes. High-grade steel is cheaply produced in competition with the crucible steel process. Steel refining, such as the refining of molten Bessemer converter metal or molten open-hearth metal, is also very important. The third important application is the use of the electric furnace for melting steel for castings. There are also many special applications of furnaces to this branch of the industry.

In the last class of processes, those involving the discharge through gases, only a few commercial applications have been made. One process is the production of ozone by passing a silent discharge through air. The ozonizers are operated by high-tension alternating current and operate without any spark or arc discharges. Ozone is used principally for bleaching, purifying and sterilizing. The fixation of atmospheric nitrogen which occurs when a spark discharge is passed through air is of great potential importance, as the nitrogen in the air is inert and useless, while nitrogen compounds are of great industrial value in the manufacture of explosives, fertilizers and other compounds. The principle of electrostatic processes is also used somewhat for ore separators and for dust precipitation and smoke prevention. Dust and fume precipitation, by the Cottrell process, is successfully used in smelters, cement plants, chemical plants, etc.

ELECTROCHEMICAL PROCESSES.—Those in which chemical actions or reactions are facilitated or caused (I) by the electrolytic action of the current or (II) by the temperature generated by the use of the current. Examples (1): decomposing compounds into their elements, refining metals by using the impure metal as anode, plating articles with precious or durable metals, transforming salts into more valuable or desirable ones; (II) melting and refining metals, converting carbon into graphite, producing pig iron from iron ore and charcoal, producing calcium carbide from lime and coke.

ELECTROCHEMISTRY.—The science of applying electrical energy to assist in chemical operations. Since it is impracticable to differentiate between such so-called physical operations as heating, melting, boiling, vaporizing and evaporating, and strictly chemical operations, the use of electrical energy in these operations is included under the general title of electrochemistry and electrochemical industry.

Electrochemistry deals broadly with the production of chemical effects by the use of electrical energy to assist the reaction, and its exact reverse, namely, the production of electrical energy from chemical energy. The first branch of electrochemistry in its relation to industry consists of several processes which may be divided into three general classes: electric furnace processes, using the heat generated by the current; electrolytic processes where the action is caused by the electrolytic action of the current flowing in a liquid; processes involving electric discharges through gases. The second branch of electrochemistry is now confined principally to primary and storage-battery work.

ELECTROCUTION EQUIPMENT FOR ANIMALS.—A cage or box containing a solid or strip metal floor forming one electrode. A second contact or electrode in the form of a collar or other band is attached to the body of the animal. Closing the door or a special switch connects the primary of a transformer and the high-voltage secondary current passes to the electrodes through the animal's body. This method has been applied at several city dog and cat pounds and declared to be far more humane than execution of these animals by drowning or asphyxiation.

Manufacturers:

Ward Leonard Electric Co., Mt. Vernon, N. Y.

ELECTROCUTION EQUIPMENT FOR CRIMINALS.—An "electric chair" provided with the necessary electrodes for attaching to the body of the convicted prisoner is used in states where this form of capital punishment is enforced. The prisoner is strapped in the chair and an electrode applied on a dampened spot on the flesh of the head. Another is secured to the ankle. The prisoner is blindfolded and at a signal the switch is thrown in. By means of transformers the current applied in various instances is stepped up to about 1700 to 2400 volts. Prisoners have been pronounced dead by physicians after current had been applied for as short a time as 87 seconds, while in one instance death did not occur from the application of 2400 volts until 15 minutes. It is firmly believed that this method of execution is the most humane of any because the prisoner is rendered unconscious at the instant the current is applied.

Manufacturers:

Ward Leonard Electric Co., Mt. Vernon, N. Y.

ELECTRODE.—The terminal rod, plate, wire, etc., which is in contact with an electrolyte and by which the current enters or leaves. Also extended in common usage to the terminals of any electric circuit which convey the electric current into an apparatus and to the point where it is usefully employed as an arc, as the electrodes of an arc lamp, the electrodes of an electric arc furnace.

ELECTRODEPOSITED ANODES.—Plates or bars used as anodes, which have been previously formed or deposited as cathodes in another operation. The object of doing this is to obtain very pure metal by the first process, and to then use it as anode without recasting or reforming it by any intermediate operation. This insures highest attainable purity in the anodes, since the intermediate operations referred to often introduce some objectionable impurities.

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ELECTRODEPOSITION.—The precipitation of a substance at the anode or cathode by electrolytic action. Ordinarily, metals are precipitated as such on the cathode, while metallic oxides are sometimes, under special conditions, deposited upon the anode.

ELECTRODES, CAUTERY.—Small loops of platinum wire mounted into a handle, which platinum wire may be heated to a very high temperature by current passing through it. They are used for removing morbid human tissue by cauterizing (burning), or to cauterize it to prevent toxic changes taking place in it. They are also used to open an abscess or other abnormal formation, and are largely used by dentists and surgeons.

Manufacturers:

Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

ELECTRODES, ELECTROLYTIC CELL.—See Anodes, electrolysis and electroplating, and Cathodes, miscellaneous.

ELECTRODES, FURNACE.—Furnace electrodes are usually made of nongraphitic carbon or of artificial or natural graphite. The electrodes are usually provided with some means of end-jointing, either by threading or by a dowel or other joint held by an electrode paste. The purpose of end-jointing is to allow the electrode to be fed in continuously. Since the advent of the electric furnace the use of carbon and graphite for electrodes has become one of the chief uses of these substances. They are used in arc and arc-resistance type furnaces and in some resistance types where the bath or substance melted forms a part of the resistor material the electrode being immersed in the molten material.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Champion Carbon Mfg. Co., The, 305 1st National Bank Bldg., Cincinnati, Ohio. (Carbon.) "Champion."
Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa.
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "National."
Speer Carbon Co., St. Marys, Pa.
Stackpole Carbon Co., St. Marys, Pa.

ELECTRODES, METALLIC FLAME MAGNETITE OR LUMINOUS ARC.—The tips between which the current jumps to form the arc in an arc lamp of what is variously known as the metallic flame, magnetite or luminous type. This is the only type of arc lamp now still in extensive use for street lighting. The positive electrode in such arc lamps consists of a heavy piece of metal, often copper, which is renewed infrequently. The negative electrode lasts from 100 to 350 hours, depending on the electrode efficiency and the current through the lamp. It must be renewed in the regular operation of trimming, and consists of a steel tube filled with metallic oxides, principally the black magnetic oxide of iron known as magnetite. This metallic oxide gives the flame of the arc its luminous qualities, resulting in higher efficiency than in the arc lamps using pure carbon electrodes.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. (Metallic.)

ELECTRODES, THERAPEUTIC.—Dental electrodes used in ionization treatment are made in two general types, the metallic contact where a metal electrode is held in a solution and may or may not enter chemically into that solution, and electrodes for solutions which are glass tubes bent and drawn to suitable forms and provided with a contact clip which fastens to the tube and dips into the solution within the tube. For the so-called "battery outfits" electrodes in their simplest form are metal hand grips which are connected to the high-frequency source. Other electrodes used are designed for contact at some point on the body, as foot plates and wrist electrodes, or for a particular method of application, as the massage roller, hand sponge, hair brush, or various needles. Electrodes for the high-frequency or violet ray outfits are made of glass blown to shapes suitable to direct application on the surfaces of the body, as double-pronged or rake-like electrodes for application to the spine, curved tube electrodes for application to the neck, etc.

Manufacturers:

Kesselring X-Ray Tube Co., 652 W. Lake St., Chicago, Ill.
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Vacuum Glass Co., Lynn, Mass.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

ELECTRODES, WELDING.—The composition of metallic arc electrodes was long a trade secret of those companies performing special work in arc welding. It is still an important factor from the investigator's standpoint. In practice, the desire is for an electrode of relatively pure steel, that will run smoothly and not give a sputtering arc. The chemical constituents are usually based on the results to be desired and much controversy exists as to the best all-around composition. For mild steel plates as used in shipbuilding a composition as follows was considered satisfactory: carbon not over 0.18 per cent, manganese not over 0.55 per cent, phosphorus 0.05 per cent, sulphur, 0.05 per cent, silicon 0.05 per cent. For the joining of special steel compositions, the character of the electrode had best be in some accord with these compositions. Welding rods or melt rods is a term applied to the metal rods used when carbon electrodes are employed in arc welding of cracks, blow holes or other faults, the rod being held in the arc so as to melt and supply the metal needed to fill the crack or fault. They may be included under metal electrodes as auxiliaries thereto. If the rods are as thin as wire, they are often called welding wire. Carbon welding electrodes are commonly called welding carbons or carbon pencils. (See Carbons, welding; Wire, welding.)

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
American Rolling Mill Co., The, Middletown, Ohio. "Armco."
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Electric Arc Cutting & Welding Co., 152-58 Jeliff Ave., Newark, N. J. "Newarc."
Electric Railway Improvement Co., The 2070 E. 61st Place, Cleveland, Ohio.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich.
Indianapolis Switch & Frog Co., Springfield, Ohio.
Page Steel & Wire Co., 30 Church St., New York, N. Y.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y. "Weldtrode."
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Roebling's Sons Co., John A., Trenton, N. J.
Sani Products Co., 209 W. Randolph St., Chicago, Ill.
Siemund Wenzel Electric Welding Co., 30 Church St., New York, N. Y. "Siemund-Wenzel."
Stackpole Carbon Co., St. Marys, Pa.
Standard Carbon Co., 488 Mills Bldg., San Francisco, Cal. "Standard."
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.
Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y.

ELECTRODUCT.—Trade name for rigid steel conduit manufactured by the American Circular Loom Co., 90 West St., New York, N. Y.

ELECTRODYNAMICS.—The science which treats of electric charges in motion, that is, electric currents. It is contrasted with electrostatics, which deals with charges at rest.

ELECTRODYNAMOMETERS.—These are devices for measuring the force between current-carrying conductors. The best known form is that invented by Siemens and known by his name. Since unit current is defined in terms of the force it exerts, electrodynamometers are used for measuring current intensities.

Electrodynamometers may be either absolute or secondary. One form of absolute electrodynamometer consists of a large cylinder of plaster of paris carefully turned and measured. On the outer surface is wound a single-layer coil. The movable coil is wound on a porcelain cylinder, likewise of known dimensions, suspended at the center of the large one by a phosphor-bronze suspension. A torsion head is used to counteract the deflecting force of the current on the movable coil. From the known constants of the instrument the current may be calculated in absolute units.

The secondary electrodynamometer of Siemens' form consists of a movable coil of one or two turns suspended from a torsion head by means of a fiber or helical spring, and a fixed coil of many turns. The planes of the two coils are at right angles to each other, and the coils are connected in series, connection being made through mercury cups. The interaction between the currents in the movable and fixed coils tends to deflect the movable coil, but this tendency is counteracted by the torsion of the suspension. This electrodynamometer principle has wide application and is used in ammeters, voltmeters, wattmeters and watt-hour meters.

Another form of secondary standard electrodynamometer is that known as Kelvin's balance. This consists of six coils, the planes of all being horizontal. Two fixed coils are mounted on opposite ends of a beam which is suspended by a large number of filaments in place of a knife edge. On opposite sides and parallel to the movable coils are the four fixed coils. The coils are connected in series in such a manner that the force of a current on the movable coils is in opposite directions, thus tending to turn them about a horizontal axis. The deflection is prevented by known weights placed in a pan at one end of the beam and a rider. The force between the coils is thus balanced by gravity. From the known weights and the reading on the beam the current is calculated. By the addition of series resistances, Kelvin's balance may also be used as a voltmeter.

The main advantages of the electro-dynamometer type of instrument are sensitivity, accuracy, and adaptability to both a-c. and d-c. measurements. It may be calibrated on direct current and used on a-c. circuits. The limitations of the Siemens' dynamometer and Kelvin's balance are that they are neither direct reading nor do they have a uniform scale.

Manufacturers:

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)

ELECTRO-FLEXO.—Trade name for electric heating pads manufactured by the Ingersoll Electric Appliance Co., 746 S. Wabash Ave., Chicago, Ill.

ELECTROGALVANIZING.—The process of covering an article with an adherent layer of zinc by causing a unidirectional electric current to flow through an electrolyte of zinc salt into which the object is immersed and connected as the cathode, the anode being of pure cast zinc. The object of electrogalvanizing is to protect iron and steel from rust. A general statement of the process of electrogalvanizing is given under the heading of Electroplating.

"Galvanizing" as commonly but erroneously known in the trade is obtained by the immersion of iron or steel objects into a bath of molten zinc to coat them with zinc; in this process there is no control of the amount of zinc taken up, nor its distribution over the surface so treated; this process is not galvanic in any sense of the word. When the obtaining of a zinc coating by electrolysis became commercial,

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the operation was called "electrogalvanizing"; it would more properly be called zinc electroplating.

ELECTROGALVANIZING EQUIPMENT.—Electrogalvanizing equipment is essentially the same in principle as the equipment discussed under Electroplating equipment, which see. The commercial importance of zinc plating or electrogalvanizing has led to the development of special apparatus particularly suited to this work as regards size of the tanks, electrode holders, etc.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Eager Electric Co., The, Watertown, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Meaker Galvanizing Co., 1249 Fulton St., Chicago, Ill.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
U. S. Electro Galvanizing Co., 32-34 Stockton St., Brooklyn, N. Y.

ELECTROHOVER.—Trade name for electric hover manufactured by the Cyphers Incubator Co., Buffalo, N. Y.

ELECTROKINETICS.—Another name for electrodynamics, which see.

ELECTROLABS CO., THE.—Pittsburgh, Pa. Manufacturer of oxygen and hydrogen generating apparatus. President, E. G. Mueller; vice-president, I. H. Levin; secretary, treasurer and general manager, D. J. Tonkonogy. Main office and factory, 2635 Penn Ave., Pittsburgh, Pa. Branch offices, 30 Church St., New York, N. Y.; Morris Bldg., Philadelphia, Pa.; Merchants Exchange Bldg., San Francisco, Cal.

ELECTROLET.—Trade name for conduit fittings manufactured by the Killark Electric Mfg. Co., 3940-46 Easton Ave., St. Louis, Mo.

ELECTROLIER.—This is a contraction of the words electro and chandelier, and is strictly a chandelier having only electric lamps on it. The term electrolier has been used to a limited extent by some fixture manufacturers. See Chandeliers, electric.

ELECTROLON.—Trade name for electrically produced abrasive manufactured by the Abrasive Co., James & Fraley Sts., Philadelphia, Pa.

ELECTROLYSIS.—The chemical decomposition produced by a direct flowing electric current in a liquid electrolyte, resulting in two chemical constituents being liberated at the electrodes. The seat of the electrochemical action is the surface of contact of the electrolyte with the electrodes. It can also be produced by an alternating current when the electrolytic cell itself rectifies the current (aluminum rectifier); the direct current produced causes electrolysis. The facts of electrolysis have only been under investigation about 150 years, and the laws of electrolysis were first made clear by Faraday, less than 100 years ago.

ELECTROLYSIS APPARATUS, DENTAL AND THERAPEUTIC.—Electrolysis apparatus, or ionization apparatus, as it is often called, is used in dental work for introducing medicaments in any pathological condition. It has been found that by using medicaments which go into ionic solution they may be caused by an electric current to penetrate to deep or otherwise inaccessible tissues. Contact is made through a contact button or clamp fastened to the cheek or wrist of the patient and at the tooth by electrodes. These electrodes are described under Electrodes, therapeutic, which see. The apparatus usually consists of a very small synchronous converter, a milliammeter, generally having a range of one-half milliampere and a switch, the outfit being mounted on a small panel.

Manufacturers:

WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

ELECTROLYSIS NEEDLES.—Needles used in the removal of hair by electricity. They are also used by dentists in the treatment of dental abscesses. Very often a strip of pure zinc is cut to the proper size and used, being inserted in the diseased root and surrounded with cotton saturated with a normal salt solution which is the electrolyte. In other cases pure platinum electrolysis needles mounted in a glass tube are used.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

ELECTROLYTE.—The fluid material between two electrodes which is being decomposed by the action of an electrolyzing current. In the case of the electrolyte being a solution, the dissolved salt is sometimes erroneously called the electrolyte; even the solvent is sometimes mistakenly so-called. In such case, it is only the solution itself which should be called the electrolyte; the solution as a whole carries the current and is decomposed by it.

ELECTROLYTE, MISCELLANEOUS.—This classification includes all electrolytes not listed under a separate item; such as various electrolytes employed for the less commonly used batteries and prepared electrolytes used in various electrochemical processes.

Manufacturers:

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Munning & Co., A. P., Church St., Matawan, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

ELECTROLYTE, STORAGE BATTERY.—Since most storage batteries are of the lead-sulphuric acid type most of the electrolyte for storage batteries is diluted sulphuric acid. Manufacturers of storage batteries commonly purchase the acid in concentrated form and dilute it to the proper point for their needs. Battery service stations, garages and others dealing with the maintenance of storage batteries do not find it so convenient to dilute the acid themselves, because this requires a great deal of care and adequate facilities. Therefore, they purchase the diluted acid which is ready to be used as electrolyte in filling the new or freshly reassembled cell.

For the alkaline type of storage battery, represented by the Edison battery, the electrolyte is a solution of caustic potash of about 21 per cent concentration. This is usually furnished by the manufacturer.

In any case whether the electrolyte is sulphuric acid or caustic potash, and whether purchased from the manufacturer of the batteries or from a chemical works it must be of highest possible purity and diluted with distilled water only if it is found too concentrated.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
COOPER & CO., CHARLES, 194 Worth St., New York, N. Y.
EDISON STORAGE BATTERY CO., Orange, N. J. See adv. page 1313.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Grasselli Chemical Co., The, Cleveland, Ohio.
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
Merrimac Chemical Co., 148 State St., Boston, Mass.
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.

ELECTROLYTIC CELL.—The combination of an anode, a cathode and an electrolyte between them, through which an impressed current is passed. A battery cell is essentially the same combination of parts but will generate its own current, needing no impressed outside current to operate it. There is no essential electrochemical difference between the two. The storage cell is an electrolytic cell while being charged and a battery or primary cell while discharging.

ELECTROLYTIC ENGINEERING CORP.—501 5th Ave., New York, N. Y. Manufacturer of electrolytic cells. Branch offices, Toronto, Ont., Can.; Chicago, Ill.

ELECTROLYTIC REFINING OF COPPER.—See Copper.

ELECTROLYZERS.—A general term used by physicians, surgeons, and dentists, applied to electrolysis equipment especially adapted for their use.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Electro Chemical Co., The, 111 W. Court St., Dayton, Ohio.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

ELECTROMAGNET.—This is a temporary magnet the magnetism of which is developed by an electric current passing through coils of insulated wire around the iron core. Practically every electrical machine or apparatus, except heating devices and incandescent lamps, makes use of either permanent magnets, or electromagnets, or both, in its operation.

ELECTROMAGNETIC INDUCTION.—This is the general term applied to processes of developing an e. m. f. in a conductor by relative motion of a magnetic field and the conductor. This may be accomplished in several ways: Magnet stationary and the conductor moving, or the reverse; both conductor and magnet stationary but a variation in the magnetic flux; a conductor carrying a constant current in motion with respect to another conductor; by changing the intensity of the current in a conductor. Electromotive forces produced in a conductor by any of these methods are said to be induced.

ELECTROMAGNETISM.—Faraday and Henry independently discovered that when an electric current flows through an insulated wire the space surrounding the wire has magnetic properties. When the wire is wound into a coil around an iron core, the current in the wire makes a magnet out of the iron. Electromagnetism is the name applied to phenomena associated with magnetism and the electric current jointly.

ELECTROMAGNETS, MISCELLANEOUS.—Many electrical instruments, appliances or machines with electrical control or electrically actuated parts use electromagnets in some form. By electromagnet is meant a coil of wire through which an electric current is passed, the coil having an iron or steel core which may have a bar or horseshoe shape forming an incomplete magnetic path, or it may have a ring or rectangular core forming a complete magnetic path of iron. These magnets are often made by manufacturers of coils, solonoids, etc., and furnished to the appliance maker who may not have the equipment for their manufacture or the expert help needed in their design to provide a certain tractive force by means of a current within definite limits.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. (See display adv. page 1248.)
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Dings Magnetic Separator Co., 800 Smith St., Milwaukee, Wis. "Dings."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Koehler Mfg. Co., Marlboro, Mass.
Liberty Electric Corp., Port Chester, N. Y.
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Mueller & Co., V., 1779 Ogden Ave., Chicago, Ill. (Surgical.)
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

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THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

ELECTROMATIC.—Trade name for electric garage door openers manufactured by the Allith-Prouty Co., Danville, Ill.

ELECTROMECHANICAL CO., THE.—432-434 N. Calvert St., Baltimore, Md. Manufacturer of switchboards. Business established 1908. President, W. D. Young; vice-president, treasurer and sales manager, L. M. Brooks; secretary, Enos S. Stockbridge.

ELECTROMETALLURGY.—A term referring to that branch of industry in which electricity is used in the electrolytic separation and deposition of metals from solutions of their ores. It also consists of smelting and refining where electricity is used as a source of heat, or any other electrical process for the production of the raw material. One branch of it also employs electricity largely in the assay of ores. The industry is, therefore, a part of the electrochemical industry.

ELECTROMETERS.—These are electrostatic instruments and, as with electrostatic voltmeters, their deflecting force is due to the attraction of unlike charges. Electrometers are essentially the same as electrostatic voltmeters but are laboratory instruments. They are of two forms, (a) attracted-disk and (b) quadrant.

The attracted-disk electrometer in its simplest form consists of two parallel circular plates, one fixed and the other attached to one end of a balance beam. When the balanced plate is connected to a source of potential and the fixed plate is grounded, the force of attraction between the plates tends to draw them together. This force is counterbalanced by weights in a scale pan at the other end of the beam. The difference of potential between the two plates is then calculated by the relation

$$V_1 - V_2 = 1504 d\sqrt{(F/A)} \text{ volts,}$$

where d is the distance between the plates in centimeters, F is the attracting force in dynes, and A is the area of the movable plate in square centimeters. In order that the electrostatic field between the plates may be uniform, the movable plate is surrounded by a ring of metal known as a guard ring.

The quadrant electrometer, as its name implies, consists of a shallow circular metal box cut along two diameters into four quadrants. The quadrants are supported on an insulated base and are cross-connected by two wires so that when in use diametrically opposite quadrants are of the same potential. Between the top and bottom of these sectors is suspended an aluminum needle in the form of the figure 8. The controlling force is due to the torsion of the suspending wire. When in use the needle is first charged to a known potential, and the adjacent quadrants are connected to the difference of potential to be measured. The resulting deflection is read by the mirror and scale method and is proportional to a function of the difference of potential.

Manufacturers:

Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J. "Compton."
Radium Ltd., U. S. A., 2 W. 45th St., New York, N. Y.
Roller-Smith Co., 233 Broadway, New York, N. Y.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)

ELECTROMOBILE.—Trade name for storage battery trucks and tractors manufactured by the Koppel Industrial Car & Equipment Co., Koppel, Pa.

ELECTROMOTIVE FORCE.—Water flowing through a system of pipes does so on account of the difference of pressure between any two points along the pipes. This difference of pressure might be called "water motive force," for it causes the water to move. By analogy, when electricity is moved from one point to another point in an electric circuit it is due to an electric pressure called electromotive force (abbreviated e. m. f.). Electromotive force is thus the cause of an electric current. Also see Difference of electric potential.

Electromotive force is produced in several ways: Chemically as in primary cells or in the discharge of storage cells; thermally as when the junction of dissimilar metals is heated, and by electromagnetic induction, which see. The practical unit of electromotive force is the volt.

ELECTROMOTOGRAPH.—A device used at one time as a form of telephone receiver. It is an apparatus consisting of a cylinder of chalk moistened with a solution of an electrolyte and pressed upon by an arm which is connected at the other end to a diaphragm. If while the cylinder rotates a variation occurs in the current passing between the cylinder and the arm, there is a corresponding variation in the friction of the arm, and the diaphragm vibrates to produce the variation in sound.

ELECTROMOTOR CO.—32-40 S. Clinton St., Chicago, Ill. Manufacturer of motors, generators and synchronous converters. Copartnership, J. F. Kadic and H. A. Porter.

ELECTRON.—An electron is the ultimate unit particle, or charge, of negative electricity. Cathode rays and beta rays from radioactive substances consist of electrons traveling with a velocity approaching that of light. When electrons are removed from a body it becomes positively charged. These particles were first called "corpuscles" by J. J. Thomson. All electrons have the same mass or inertia, and they all have the same electric charge. Their velocity depends upon the conditions under which they were produced. Their mass is about 1/1800 of the mass of a hydrogen atom and the charge of each is 1.6×10^{-19} coulomb.

The only kind of electrons definitely known are those upon elements liberated at the anode, and are therefore called negative electrons because they travel through an electrolyte to the positive pole (anode); positive electrons have been spoken of, but their existence is not definitely established. It seems as if electricity were unitary, and that negative electrons constituted electrical quantity; their presence on an atom gives it a negative charge, and deficit of electrons constitutes positive charge. (Also see Electricity, Electron theory.)

ELECTRON RELAY.—See Electron tubes.

ELECTRON THEORY.—The electron theory was developed during the closing years of the 19th century by J. J. Thomson and other physicists. This theory seems to explain and correlate in a remarkable manner numerous widely diversified phenomena, such as electric charge and discharge, electric current, magnetism, cathode rays, X-rays, radioactivity, light and heat radiation, action of a magnetic field on light, the relation between electrical and heat conductivities, valence, thermoelectricity and others referred to below. Many details of the theory yet remain to be worked out.

This theory originated from observations on the discharge of electricity through tubes containing gases at very low pressures. The discharge in all gases was proved to consist of minute particles, negatively charged, moving with a velocity about one-tenth that of light and having a mass about 1/1800 the mass of a hydrogen atom. The charge of each particle is about 1.6×10^{-19} coulomb. These particles were at first called "corpuscles" by J. J. Thomson, but the term "electron" is now generally used.

Radioactive substances were found to give off similar negatively charged particles, the beta rays, having the same mass and the same charge, but their velocity is greater, approaching that of light.

To charge a body positively it is only necessary to remove negative electrons from the body. A negatively charged body has an excess of electrons. This resembles Franklin's single-fluid theory.

In an insulator, or dielectric, the electrons are attached to the atoms but can change their positions with respect to the atoms when subjected to electric forces. In a conductor the electrons are more or less free to move about between the atoms, in fact, they are constantly in motion in all directions. When a difference of potential exists in the conductor, the electrons move in the direction of the higher potential, that is, from negative to positive or just opposite to the direction in which the current is ordinarily considered to flow. The positively charged atoms are not free to move about and play no part in metallic conduction. The conductor is heated by the impact of the electrons against the atoms.

The average velocity of the electrons is increased by heating the body; the tendency then is for the electrons to flow from points of high to points of low temperature, carrying energy by the process that we call heat conductivity.

Ordinarily, the electrons do not pass through the surface layer of the metal, but when two metals are placed in contact there is a transfer from one to the other and, when again separated, they are found to be charged oppositely. The same thing occurs when sealing wax and various other substances are rubbed with flannel. Electrons pass from the flannel to the wax. The wax is found to be charged negatively and the flannel positively.

Under the influence of ultra-violet light some metals are found to give off electrons. Freshly polished zinc negatively charged loses its charge when exposed to the light from an electric arc. If the zinc is positively charged, it will retain its charge.

A wire heated to incandescence permits electrons to escape. If a filament heated electrically is placed in a vacuum tube near a metal plate and a battery has its positive terminal connected to the plate and its negative to the filament, a current will pass from plate to filament through the vacuum. A stream of electrons is actually passing in the opposite direction. If the plate is negative, no current will pass. This electron stream is utilized in the electron or vacuum tubes used as radio detectors or amplifiers and electron relays, also for generating oscillating currents of high frequency, for producing X-rays, and for electron tube rectifiers.

It has been demonstrated experimentally that a charge in motion has a magnetic field and is equivalent to an electric current in its action. Moving electrons, therefore, have a magnetic field and are acted upon by a magnetic field, being deflected in a direction perpendicular to the field. In an electric field the electrons will be deflected in a direction opposite to the field. J. J. Thomson utilized the electric and magnetic deflections in determining the velocity and the ratio of the charge to the mass of the electrons.

The phenomena of magnetization are explained on the assumption that one or more electrons are revolving about each atom and producing magnetic fields which neutralize each other when the planes of rotation are turned in various directions, but when a considerable number are turned the same way the body shows magnetization in that direction.

The rapid motion of electrons in solids and liquids at high temperature, or in gases under the action of large electric forces, sets up magnetic and electric oscillations in the surrounding ether. These are transmitted through the ether and are known as heat, light, or electric waves, according to their frequency. The splitting up of the lines of the spectrum when the source is in a strong magnetic field, which was discovered by Zeeman, is explained by means of this theory.

If two metals in contact are heated at the junction, the energy of the electrons in one may be greater than in the other and there is a flow from one to the other, which will continue if the circuit is complete. This is the thermocouple often used for measuring temperatures.

In an electrolyte the molecules in solution are dissociated into positively and negatively charged ions. The electrons removed from the positive ions are on the negative ions. Since both ions are free to move, there is a transfer of negative ions to the positive electrode and of positive ions to the negative electrode. The negative electrons are liberated at the positive electrode and pass through the conductor to the negative electrodes. The valence is determined by the number of free electrons present on each ion.

When an electron changes its velocity, the electromagnetic field around it changes and energy is radiated into space. The sudden stoppage of cathode rays, consisting of electrons moving with high velocity, causes pulses to be produced in the surrounding ether which are known as X-rays. In the beta rays, produced by radioactive substances, negatively charged particles are projected at high velocity, and the accompanying ether pulses are the gamma rays.

ELECTRON TUBES.—A device consisting of an evacuated vessel containing a heated filament surrounded by a porous grid, which in turn is partly or wholly surrounded by a metal plate. If the plate is made positive with respect to the heated filament, a stream of electrons will flow from filament to plate, i. e., there will be a current of electricity from plate to filament. The value of the device is due to the fact that a small variation of voltage of the grid with respect to the filament will control a comparatively large amount of energy in the plate circuit. Thus the device may be used as an amplifier of any form of electrical energy, such as weak telephone currents or radio signals absorbed at a radio receiving station.

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By coupling the plate circuit to the grid circuit an electron tube can be made to produce varying frequencies from 0.5 cycle to 200 million cycles per second, depending upon the electrical constants of the circuit. As an oscillator the electron tube is extensively used for transmission of radio telephone speech or undamped telegraph signals. Over 25 kw. of high-frequency energy has been generated by a single tube. (For the action of the electron tube as a detector see Detectors, radio.) Electron tubes have frequently been called by other names, such as electron relay, vacuum tube, thermonic valve, etc.; also by special names, such as Audion, Pliotron, Triode, Auditron, Oscillion, etc., to designate the particular types of certain inventors or producers.

Manufacturers:

American Radio & Research Corp, 21 Park Row, New York, N. Y.
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
De Forest, Inc., Lee, 451 Third St., San Francisco, Cal. "Oscillion," "Singer."
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y. "Audion."
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Radio Corp. of America, 233 Broadway, New York, N. Y. "Radiotrons."
Vacuum Glass Co., Lynn, Mass.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass. "Triode."

ELECTROPHITE.—Trade name for electrically refined graphite manufactured by the Huff Electrostatic Separator Co., Box 66, Arlington, Mass.

ELECTROPHITE. — Trade name for graphite manufactured by the International Carbon Products Co., Inc., 230 W. 13th St., New York, N. Y.

ELECTROPHONE. — Trade name for electrically operated phonographs made by the Lakeside Supply Co., 416 S. Dearborn St., Chicago, Ill.

ELECTROPHOROUS.—An instrument devised by Volta for the purpose of illustrating electrostatic induction. It is used only for experimental and demonstration purposes and consists of a plate of insulating material and a metal disk with a glass handle.

ELECTROPHYSICS.—That branch of the science of physics that deals with electricity. Originally physics was a science dealing with anything in the material world but it now comprises the closely related sciences of mechanics, heat, electricity, light and sound and only deals with the phenomena of inanimate matter, not involving any chemical changes. Electrophysics is therefore clearly distinguished from the science of electrochemistry.

ELECTROPISM.—The influencing of the growth and direction of growth of vegetable organisms by electricity.

ELECTROPLATING. — The process of covering an object with a layer of adherent metal by causing a unidirectional electric current to flow through an electrolyte containing a salt of the metal to be plated, into which the object is immersed and connected as the cathode, while the anode is usually made of the metal to be plated so as to keep the composition of the bath nearly constant. Electroplating is used for three principal purposes: First, artistic effect; second, protection of the base metal; third, as a manufacturing adjunct, for example the correction of a defect of manufacturing, or in lieu of an additional process of manufacturing as for example that of case hardening.

The principal metals deposited electrolytically are gold, silver, nickel, copper, brass, zinc, tin, and lead. Electroplating solutions are of two general classes, acid type, in which sulphuric acid usually forms the principal acid content, and the alkaline type, in which cyanide of sodium forms the alkaline content. Of the metals given above gold, silver, brass, and tin are deposited only from alkaline solutions, nickel and lead from acid solutions only, while copper and zinc may be deposited from either acid or alkaline solutions. The elements of any plating solution are: First, a salt of the metal to be plated; second, a conducting salt which may or may not be a salt of the metal; and third, a catalytic reagent, mostly inorganic nonmetallic materials, added to improve the brightness or fineness of the deposit.

Objects to be electroplated are generally classed into two groups, ferrous and nonferrous, due to the difference in preliminary cleaning required for objects made of iron and steel as compared with objects made of a softer metal base. An important item of the process of electroplating is that of cleaning, wherein all traces of grease, dirt, scale, or oxides of the metal are carefully removed for the reason that electrodeposits do not adhere properly and permanently unless the deposit itself is laid down on a chemically clean surface of the base metal.

Electroplated articles when removed from the plating process are carefully washed and dried, then buffed to produce a final finish, the luster of which is determined, however, by the quality of initial polishing. Many plated articles are then protected by a coating of a suitable lacquer.

ELECTROPLATING EQUIPMENT.—The electrical circuit of an electroplating system is one of very low resistance. The operating condition is, therefore, one of high current and low voltage. The direct-current generators are consequently of special design, generating at 5, 6, 10 or 12 volts and having current capacities ranging from about 100 to 7,000 amperes. For further details see Generators, electroplating and electrolytic. For the ammeters used see Ammeters, d-c., switchboard or panel; also Ammeters, d-c., portable; these are often of high current rating requiring shunts. The equipment includes two types of rheostats, a field rheostat for regulation of the generator voltage and a tank rheostat usually allowing very fine control for the tank current. As the source of purchased power is often alternating current, motor-generator sets are often used and commonly driven by an a-c. motor, though d-c. motors are sometimes used where the power supply makes them applicable; also see Motor-generators, miscellaneous. The bath equipment includes the stone, wood, metal or metal-lined tanks for general work, and for special work, various mechanical plating tanks. Some of the mechanically operated tanks include the following features: for small parts, a sieve-like tumbler placed within a bath; for pipe, tubing or conduit, a cylindrical tank which will carry a number of sections of the pipe in each run; for wire cloth, a series of tanks through which the cloth is drawn continuously, being first cleaned, then plated, then given a lacquer or varnish coat if it is desired, and finally dried and rolled; for chain, a tank with a set of rollers which feed the chain continuously through the bath. The plating anodes are discussed under Anodes, electrolysis and electroplating, which see. Operators' protective clothing and equipment, which might be included under this heading is listed separately as gloves, rubber; aprons, acidproof; respirators.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Burns Supply Co., E. Reed, 21-27 Jackson St., Brooklyn, N. Y.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J. "Rotoplater."
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Ely, C. Upham; 50 Vesey St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
National Galvanizing & Plating Equipment Corp., 52 Broadway, New York, N. Y. ("National" barrel.)
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
U. S. Electro Galvanizing Co., 28-34 Stockton St., Brooklyn, N. Y. "National," "U. S. Junior" barrel.

ELECTROPLATING GENERATORS.—See Generators, electroplating and electrolytic.

ELECTROPURE CO., THE.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric milk sterilizers and pasteurizers. Business established 1918. President, J. F. Rudd; vice-president, W. L. Harding; secretary, treasurer and general manager, W. A. Gordon. Factory, Washington, D. C.

ELECTROPURIFIER.—Trade name for electric milk pasteurizers manufactured by the Electropure Co., 53 W. Jackson Blvd., Chicago, Ill.

ELECTROSCOPE.—A device for showing the presence of an electric charge. The simplest form of electroscope consists of a pith ball covered with gold leaf and suspended from a support by a silk thread. A more sensitive form consists of two pieces of gold leaf hung beside each other from the lower end of an insulated metal rod. The upper end of the rod terminates in a ball or plate. The gold leaves are protected from air currents by a bell glass through the top of which the metal rod projects. Strips of tinfoil are often pasted on the inside of the glass. These strips are grounded and thus screen the electroscope from external electric effects. The electroscope is an important instrument of research in radioactivity. The electrometer and electrostatic voltmeter are commercial instruments operating on the principle of the electroscope.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Radium Ltd., U. S. A., 2 W. 45th St., New York, N. Y.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."

ELECTROSE MFG. CO.—Brooklyn, N. Y. Manufacturer of high-tension bushings, insulators, insulating compounds and materials. Louis Steinberger, president.

ELECTROSHINE, INC.—253 W. 34th St., New York, N. Y. Manufacturer of electric shoe shining machines. F. Kingsley, president.

ELECTROSTATIC INDUCTION. — See Electric displacement.

ELECTROSTATIC LAWS. — (1) Like charges of electricity repel and unlike charges attract each other. (2) The force exerted between two charges is directly proportional to the product of the charges, all other things being kept constant. (3) The force between two given point charges varies inversely as the square of the distance between them. Point charges are such as can be considered to be concentrated at a point. (4) The force between two given charges depends upon the property of the medium through which the electric influence is manifest. This property of the medium is called the dielectric constant. (5) The foregoing laws may all be symbolized by an algebraic equation thus,

$$F = q_1 q_2 / kd^2$$

which holds for point charges or charges which are small in size as compared with the distance between them. This expression is known as Coulomb's law for electrostatic charges.

ELECTROSTATIC MACHINES. — Commonly types of generator for converting mechanical energy into electrical energy in the form of electric charges at high potential differences. Electrostatic motors have been built as an experiment but are not used commercially. The electrostatic machine as a generator produces the electric charges through friction or by electrostatic induction. In the friction machines, a glass cylinder or plate is rotated between suitable stationary pads or rubbers and the electric charge produced on the glass is removed by metal brushes or combs. This type of machine is now seldom used. In the electrostatic induction, or influence, machines, disks of glass or other insulating material and metal conductors are so arranged that small electric charges, originally produced by friction, induce other charges which are carried by rotation and successively built up into larger and larger charges at higher and higher potential differences. A limit to the potential difference obtainable is set by the insulation of the machine.

The Toepler-Holtz and the Wimshurst machines are common forms of the electrostatic induction machines. In the former, part of the disks are stationary; in the latter, all disks rotate, a part in one direction, the remainder in the opposite direction. There are also other differences in the arrangement of the metal parts.

Electrostatic machines are occasionally used in laboratory and experimental work and to a limited extent in electrotherapeutics. Their energy capacity is very low in comparison with electromagnetic machines or the modern types of generators. Their efficiency is also dependent on the weather, being low when the humidity is high, as in summer. Consequently electro-

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static machines are chiefly of historical interest as having been, with primary batteries, the only practical sources of electrical energy until the perfection of the direct-current generator and later of the alternating-current generator. Also see Machines, dynamoelectric.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Huff Electrostatic Separator Co., Box 66, Arlington, Mass. (For precipitation.)
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

ELECTROSTATICS.—The science which treats of electric charges at rest. It is contrasted with electrodynamics, which deals with electric charges in motion, that is, electric currents.

ELECTROTHERAPEUTIC APPARATUS, MISCELLANEOUS.—Under separate classifications there are listed some fifty items covering electrotherapeutic equipment. However, even these classifications will not cover all types of such therapeutic apparatus some of which are too limited in their application or of too little importance for other reasons to merit a separate item and for such miscellaneous apparatus this classification is entered.

Manufacturers:

Adon Products, Inc., 516 5th Ave., New York, N. Y. "Physical Vitalizer" exerciser, "Home Battery" massage roller, "Self Vitalizer" exerciser.
Bachelet Medical Appliance Co., Inc., 32 E. Strand St., Kingston, N. Y.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
BURDICK CABINET CO., Milton, Wis. "Radio-Vitant."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Chloride of Silver Dry Cell Battery Co., 407-409 N. Paca St., Baltimore, Md. "Chlorsil."
Empire Electric Co., Inc., 2227 S. San Pedro St., Los Angeles, Cal. "Rose."
Hanovia Chemical & Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y. "Unistat."
Mueller & Co., V., 1779 Ogden Ave., Chicago, Ill. (Ether apparatus.)
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Rogers Electric Laboratories Co., 2015 E. 65th St., Cleveland, Ohio.
Sanitarium Equipment Co., Battle Creek, Mich. "Sanequo."
Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.
Thompson-Plaster X-Ray Co., Leesburg, Va.
Ultima Physical Appliance Co., 136 W. Lake St., Chicago, Ill. "Sinustat."
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

When writing to manufacturers please mention the
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ELECTROTHERMAL.—Applied to any apparatus or operation involving the utilization of the electrical energy supplied for heating purposes only. If the current is used primarily for electrolysis and only secondarily or incidentally for heating purposes, as to keep the electrolyte warm or hot, the operation is classed as electrolytic and not as electrothermal. Examples: electric furnaces for melting steel, reducing iron ore, making calcium carbide, etc.

ELECTRO-STYLOGRAPH.—Trade name for electric engravers manufactured by the Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich.

ELECTRO-THERMO.—Trade name for electric washing machines manufactured by the Folsom-Miller Co., 130 Sycamore St., Milwaukee, Wis.

ELECTROTYPERS' MACHINERY AND TOOLS.—This equipment differs from the more general electroplaters' outfits in that it is designed for electrotyping only. Beside the plating machinery there are various electrotypers' tools, such as motor-driven drills, planers, etc., and heaters designed for the specific purposes of electrotyping work. For the plating equipment see Electroplating equipment.

Manufacturers:

Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Ostrander-Seymour Co., 7 S. Dearborn St., Chicago, Ill.
Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y. (Building Tool.)

ELECTROTYPING.—The process of producing, for use in printing, duplicates of any type composition, engraving or other printing surface, by electroplating copper into the impression left by the type or engraving in a wax mold, after rendering the surface of the wax conducting by coating with a thin layer of powdered graphite.

The object of electrotyping is to produce in a single printing plate what would otherwise have to be handled as individual type or type lines or so-called slugs. Engravings or "cuts" are electrotyped along with the type after being inserted where the illustrations belong. Most commonly the electrotype plate is an assembly of the entire page as it is to be printed. Engravings are often electrotyped separately to preserve or make numerous duplicates of the originals.

In the electrotyping process the type is first set in the customary manner, then a wax impression is made of this type, using a special wax called ozokerite. This wax mold or case is removed from the type, covered with a film of finely divided graphite and connected into an electric circuit in an electrolyte made of a solution of copper sulphate, a copper plate being used as anode. The plates or shells thus produced are stripped from the wax, filled or backed up with type metal, shaved and mounted on blocks of wood. If nickel is used in place of copper, the plate is called a nickeltype; see Nickeltyping.

ELECTRO-WELD CO.—70 Munroe St., Lynn, Mass. Manufacturer of electric toasters and oxyacetylene welding and cutting outfits. Business established 1908. President and general manager, F. W. Collier; secretary, G. W. Collier; treasurer, John H. Madden.

ELECTROZONE WATER STERILIZER CO.—431 S. Dearborn St., Chicago, Ill. Manufacturer of electric sterilizers and ozone generators. President and manager, E. H. Dangremond.

ELEKTRA TOY & NOVELTY CO.—400 Lafayette St., New York, N. Y. Manufacturer of electrical toys and novelties.

ELEKTRO MFG. CO., THE.—4642-4644 Ravenswood Ave., Chicago, Ill. Manufacturer of transformers, electric cooking devices and toys. Business established 1912. President and general manager, Dexter Fairbank; vice-presidents, Ernest W. J. Hughes, William Sickinger; secretary, Irwin Mendels; treasurer, Harold Scott; sales manager, Ernest W. J. Hughes.

ELEMENT.—One of the essential constituent parts of anything, that is, one of the relatively simple forms of units which enter into a complex substance. In electrical apparatus various partial or nearly complete assemblies of units are spoken of as elements. In a transformer, for instance, the completely assembled core with the coils and connections in place and the whole ready to be placed in the transformer case is called the transformer element. In storage batteries, the completely assembled positive and negative plates with separators and connecting straps in place ready to be placed in the jar is called the battery element. In electrical heating and cooking utensils and various other heating appliances, the resistance unit in which the heat is produced is known as the heating element. In a voltaic (primary) cell or couple, an element is either of the pieces of metal that form the couple.

In chemistry, an element is one of a limited number of distinct varieties of matter, which singly or in combination compose every material substance. More specifically, it is a substance which cannot be separated into substances differing from itself, at least by ordinary chemical processes. All elements are divided into two general groups, metals and nonmetals or metalloids. Among the metals are sodium, calcium, gold, copper, iron, etc., and the nonmetals oxygen, hydrogen, nitrogen, sulphur, chlorine, etc. There are about 85 principal elements, with a few others discovered that have not yet been definitely and generally recognized as elements.

ELESCO.—Trade name for steam superheaters and pipe coils manufactured by the Locomotive Superheater Co., 30 Church St., New York, N. Y.

ELESCO.—Trade name for superheaters manufactured by the Superheater Co., 17 E. 42nd St., New York, N. Y.

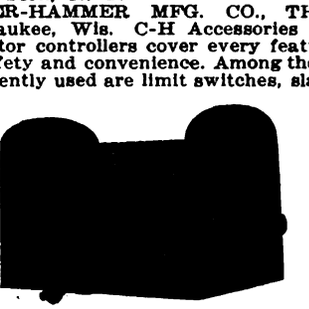
ELEVATOR CO. OF AMERICA.—State & Lake Bldg., Chicago, Ill. Manufacturer of electric elevators. President, Joseph M. Finn; treasurer, Joseph Rice.

ELEVATOR CONTROL.—See Controllers, elevator.

ELEVATOR SAFETY DEVICES, ELECTRIC.—Electrical control is so largely used in elevator operation that most of the elevator safety devices now also operate through electrical means. To prevent the car coming within a set distance of the top or bottom of the hatchway, limit switches are employed which operate to stop the car when either limit is passed by the car; also see Switches, limit. Doors if accidentally left open offer a considerable hazard and consequently many elevators are equipped with control switches which prevent operation of the car if any door or gate is open and which may also prevent operation of the door or gate except when the car is within a few inches of the floor; also see Switches, door, elevator. Reverse-phase relays are frequently placed in the motor circuits to prevent the operation of the motor in the reverse of the normal direction which would occur if a phase became reversed accidentally or through a mistake in making connections after repairing the elevator equipment; also see Relays, reverse phase. The flyball safty governor, which is operated by the speed of the car and used to control the mechanical brakes in case of failure of the hoisting cable, is sometimes also connected in the electrical circuit and made to operate in case the power or control circuits are opened; also see Brakes, electric elevator. If the car is not stopped on a level with the floor there is danger of passengers tripping when leaving or entering. To decrease this danger the car threshold may be illuminated when the car is stopped, either by lights studded in the threshold grating or by a lamp and reflector placed at either end of the threshold with its light directed to illuminate the threshold.

Manufacturers:

Automatic Switch Co., 154 Grand St., New York, N. Y.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Accessories for elevator controllers cover every feature of safety and convenience. Among those frequently used are limit switches, slack

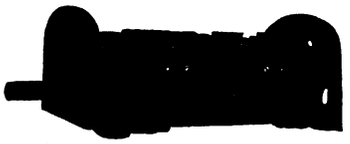


Bulletin 10310 (Cover Removed)

cable switches, door safety switches and car safety switches. C-H Limit Switches include the rotating cam type, the trav-

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eling nut type, the hoistway type and the machine type. C-H Bulletin 10310 (Type A) is a rotating cam limit switch, used with a winding-drum type elevator, operated by a full magnetic controller. Connected to the traveling nut mechanism of the winding drum, it automat-



Bulletin 10312 (Cover Removed)

ically slows down and stops the car at the terminal landings, provided, of course, that the controller is one that has the slowdown feature. C-H Bulletin 10310 (Type B) is used with either traction or drum type elevators, controlled by full magnetic contactors. It is operated by inclined cams in the hoistway. If the controller is provided with slowdown feature, this limit switch automatically slows the car before stopping. C-H Bulletin 10312 is a traveling nut elevator limit switch, used with a full magnetic elevator controller on winding-drum type elevators. It combines the function of the ordinary traveling-nut device and machine limit switch. Two double-pole snap switches are provided for each direction of travel; one of these may be used for slowdown if the controller includes that feature. C-H Bulletin 10315 can be used on either winding-drum or traction type elevators. It is of the double-pole enclosed type and is especially recommended for passenger service because it insures the stopping of the elevator even though one control line may be grounded. C-H Bulletin 10320 is a slack-cable switch, which opens the main contactor on semi-magnetic or full-magnetic elevators, should the car or counterweight become stuck in the guides. C-H Bulletin 10325 is a car safety switch that is installed in the car itself. C-H Bulletin 10327 is an elevator door safety switch. Its design is simple and the construction is such that it is practically unbreakable in service. See display adv. pages 1225-1230.—Adv.



Bulletin 10315



Bulletin 10320 Cover Removed



Type A Bulletin 10327



Type B Covers Removed

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.

Elevator Signal Co., 166 West St., New York, N. Y.

Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J. ("Ricketts" and "Moore" illuminated thresholds).

Grote Mfg. Co., F., 123 3rd Ave., Evansville, Ind.

Heller Elevator Co., S., 250 Milwaukee St., Milwaukee, Wis.

Kaestner & Hecht Co., 500 S. Throop St., Chicago, Ill.

Knickerbocker Annunciator Co., 116 West St., New York, N. Y.

PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.

Quincy Elevator Gate Co., Quincy, Ill. "Quincy."

Reliance Elevator Co., 2122 W. Austin Ave., Chicago, Ill.

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."

SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

Warner Elevator Mfg. Co., The, 2600 Spring Grove Ave., Cincinnati, Ohio.

Warsaw Elevator Co., P. O. Box 889, Warsaw, N. Y.

ELEVATOR SIGNAL CO.—116 West St., New York, N. Y. Manufacturer of electric elevator safety devices and signals. Sole owner, W. A. Hoeneman.

ELEVATOR SIGNALS, ELECTRIC, EXCEPT ANNUNCIATORS.—Signaling systems for elevators, some of which are operated by "up" and "down" push buttons located on each floor to notify the car operator to stop at the floors on which passengers are waiting. In many systems lamps are installed on each floor, and as the car approaches, if traveling up, a white lamp is lighted and, if down, a red lamp. One system has a vertical row of lamps in each car which light up to indicate the stops in a similar manner to annunciators. In another very common system the wiring is arranged to light a single lamp on the car one or two floors before the floor at which the car should stop. The "up" and "down" buttons for these systems require about 10 volts and operate relays which close the 110-volt lamp circuits by means of needles and mercury cups. A sliding contactor at the top of each shaft, controlled by a chain and a worm gear, is sometimes used to close the circuit to lamps on the various floors, thus indicating the location of the car. Other signaling systems are used for automatically dispatching the cars according to definite schedules; instead of having a starter indicate the time to start, a sign is given to the operator at definite intervals, at the proper time to start up and also to come down; the intervals at which these signals are given may be varied according to the traffic. Another system indicates to the starter by an arrangement of lamps in a panel, the exact location of each car at all times and whether it is ascending or descending; for each car there is a vertical row containing as many lamps as there are floors.

Manufacturers:

Elevator Signal Co., 116 West St., New York, N. Y.

Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.

Heller Elevator Co., S., 250 Milwaukee St., Milwaukee, Wis.

PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.

Popper & Sons, Leo, 143 Franklin St., New York, N. Y. (Glass jewels for.)

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

ELEVATOR SUPPLIES CO., INC.—Hoboken, N. J. Manufacturer of elevator annunciators, dumbwaiters, door openers and other electric elevator supplies. Vice-president, J. M. Graham; secretary and treasurer, Albert Martin. Main office and factory, 1515 Willow Ave., Hoboken, N. J. Branch offices, 1039 Walnut Ave., Cleveland, Ohio; 111 S. Jefferson St., Chicago, Ill.; Railway Exchange Bldg., St. Louis, Mo.; 186 5th St., San Francisco, Cal.; 1716 Ludlow St., Philadelphia, Pa.

ELEVATORS, ELECTRIC, AUTOMATIC OR PUSH BUTTON.—Electrically operated elevators in which the control is directed by push buttons on the various floors and in the car. Such cars are equipped with safety appliances to prevent doors being opened and cars being started when passengers on any floor are getting on or off. They are generally used where elevator traffic is light and the services of an elevator operator would be uneconomical, particularly in apartment hotels and commercial establishments. They are sometimes used on freight elevators employed to carry trucks or other unstable loads as they allow the elevator operator to devote his attention entirely to the load, thus eliminating the service of an extra man to ride with the load.

In most of these automatic elevators there is one push button on each floor, pressing of which starts the motor and brings the car automatically to that floor, provided the car is not in use and no other door to the shaft is open; when the car has stopped the door may be opened and the car entered. In the car there is a bank of buttons, one for each floor; after closing the door, the passenger pushes the button for the floor he wishes to be carried to, which automatically starts the motor and brings the car exactly to that floor level. After the car has stopped the door may be opened to leave the car, when it should be again closed to permit others to use the car in the same manner. The control is very ingenious and is provided with interlocks to guard against improper operation. These elevators operate at lower speed than those in charge of regular operators, which adds to the confidence of the passenger who is entirely safe under all possible contingencies. Although there is no theoretical limit to the range and capacity of automatic elevators, they are practically limited to operation between about five floors and to carry not over six passengers at one time.

Manufacturers:

American Elevator & Machine Co., 500 E. Main St., Louisville, Ky. "American."

Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.

Elevator Co. of America, State & Lake Bldg., Chicago, Ill.

Heller Elevator Co., S. 250 Milwaukee St., Milwaukee, Wis.

Kaestner & Hecht Co., 500 S. Throop St., Chicago, Ill.

Kimball Bros. Co., 9th St. & 11th Ave., Council Bluffs, Iowa. "Kimball."

Leitelt Iron Works, 315 Mill Ave., Grand Rapids, Mich.

Nock & Garside Elevator Co., The, 1850 Wazee St., Denver, Colo.

PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.

Reliance Elevator Co., 2122 W. Austin Ave., Chicago, Ill.

Rosenberg Elevator Co., F., 170-174 Reed St., Milwaukee, Wis.

Warner Elevator Mfg. Co., The, 2600 Spring Grove Ave., Cincinnati, Ohio.

Warsaw Elevator Co., P. O. Box 889, Warsaw, N. Y.

ELEVATORS, ELECTRIC, MISCELLANEOUS (FOR PASSENGER AND FREIGHT SERVICE).—Elevators, the mechanisms of which are operated by electric motors, are rapidly gaining favor because of their inherent advantages for most classes of service. Their ease of control, freedom from operating troubles, adaptability to all types of buildings and hoisting conditions has resulted in their use in many of the most prominent and largest buildings in the world. They are particularly adapted for high-speed service. Electric elevators are available for control by an operator, or conductor, and for automatic operation, the latter control being by means of push buttons which are operated by passengers, either within the elevator, or from any station; see preceding classification for this type.

Electric operation can be applied to elevators for any type of service, and is particularly desirable for locations where conservation of space for driving mechanism is essential. The compactness of the electric elevator has led to its replacing the hydraulic type to a very large extent. The average range of capacities is from 1,000 lbs. for the automatic type of passenger elevator to 20,000 lbs. for freight types. Specially designed freight elevators for carrying capacities as high as 35,000 lbs. have been successfully employed. The speed range of electric elevators is from 50 ft. to 600 ft. per minute. The speed of the average express passenger elevator is 400 ft. per min.

There are two broad types of elevator machines adapted for electric operation, the drum type and the traction type. In the drum type, the hoisting rope is fastened to the drum and is wound up on it as the car rises. A geared limit switch can be used with this type of machine so as to cause the motor to slow down and stop at the upper and lower limits of travel.

In the traction type the ropes are fastened to the top of the car and then passed over a set of sheaves, and attached to a counterweight. Hatchway limit switches are used in place of geared limit switches

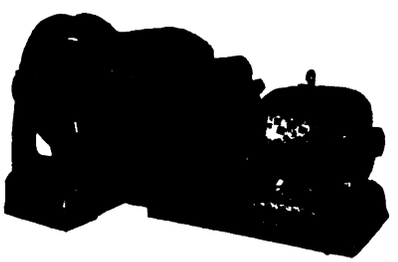
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to guard against slipping of cables on the sheaves.

High-torque squirrel-cage induction motors are widely used for elevator service where the energy supplied is alternating current. Where slip-ring motors are employed, a controller for cutting the resistance out of the secondary circuit must be provided in addition to the main contactor and reverse switch. A two-speed motor is used where slow speed for making landings is required. On direct-current circuits both shunt and compound-wound motors are used. For control systems and equipment for electric elevators see Controllers, elevator.

Manufacturers:

Albro-Clem Elevator Co., Erie Ave. & D St., Philadelphia, Pa. "Albro-Clem."
American Elevator & Machine Co., 500 E. Main St., Louisville, Ky. "American."
Brown Portable Conveying Machinery Co., 10 S. LaSalle St., Chicago, Ill. (Freight) "Brown-Portable."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Edmonds Elevator Co., The, Cleveland, Ohio.
Elevator Co. of America, State & Lake Bldg., Chicago, Ill.
General Elevator Co., 400-402 S. Charles St., Baltimore, Md.
Grote Mfg. Co., F., 123 3rd Ave., Evansville, Ind.
Heller Elevator Co., S., 250 Milwaukee St., Milwaukee, Wis.
Kaestner & Hecht Co., 500 S. Throop St., Chicago, Ill.
Kimball Bros. Co., 9th St. & 11th Ave., Council Bluffs, Iowa. "Kimball."
Leitelt Iron Works, 315 Mill Ave., Grand Rapids, Mich.
Nock & Garside Elevator Co., The, 1850 Wazee St., Denver, Colo.
Ohio Elevator & Machine Co., The, Curtis & Jefferson Aves., Columbus, Ohio. "Ohio."
Otis Elevator Co., 260 11th Ave., New York, N. Y.
PITT ENGINEERING CO., 120 West Kinzie St., Chicago, Ill. Manufacturers of direct-current and alternating-current elevators for all kinds of passenger and freight service, any speed and any



Pitt Elevator Equipment

duty. Also manufacture hydraulic elevators. For over 12 years have given special attention to the design, construction and installation of elevator equipment to meet exceptional engineering requirements. Old installations also repaired or completely rehabilitated to modern standards of efficiency and service.—Adv.

Reliance Elevator Co., 2122 W. Austin Ave., Chicago, Ill.
Rosenberg Elevator Co., F., 170-174 Reed St., Milwaukee, Wis.
Storm Mfg. Co., The, 40-50 Vesey St., Newark, N. J. "Storm."
Warner Elevator Mfg. Co., The, 2600 Spring Grove Ave., Cincinnati, Ohio.
Warsaw Elevator Co., P. O. Box 389, Warsaw, N. Y.

ELEVATORS, ELECTRIC, PORTABLE.—These may consist of a platform raised and lowered along metal posts or guides by a motor located on a platform on wheels. This type of elevator is sometimes drawn about by hand but may be equipped with motor drive controlled from the operator's seat. It is used in piling heavy bales and boxes in warehouses and for stocking platform loads where the lift truck and platform storage system are used. Another type employed in piling sacks, barrels and boxes at shipping points consists of a conveyor mounted on a portable platform and motor-operated. The conveyor types are sometimes used for floor-to-floor elevation where a permanent elevator would be uneconomical. Also see Stackers, lumber, motor-driven.

Manufacturers:

Alvey-Ferguson Co., The, Cincinnati, Ohio.
Brown Portable Conveying Machinery Co., 10 S. LaSalle St., Chicago, Ill. "Brown-Portable."
Economy Engineering Co., 2635-53 W. Van Buren St., Chicago, Ill.
Haughton Elevator & Machine Co., The, Toledo, Ohio.
K & B Co., 495-497 N. 3rd St., Philadelphia, Pa.
Revolvator Co., 336-352 Garfield Ave., Jersey City, N. J. "Revolvator."

1100.—Trade name for lighting fixtures and fixture fittings and parts manufactured by the Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.

ELEXIT.—Trade name for fixture receptacles manufactured by the Electric Outlet Co., Inc., 119 W. 40th St., New York, N. Y.

ELGIN MFG. & PLATING CO., THE.—58 Peter St., Uniontown, Pa. Manufacturer of flashlights. President, Edward W. Haydon; vice-president, Albert A. Ross; secretary and treasurer, Emma K. Ross.

ELI BRIDGE CO.—Jacksonville, Ill. Manufacturer of portable lighting and power plants. President, W. E. Sullivan.

E-LITE.—Trade name for decorative semi-indirect lighting fixture manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

ELITE.—Trade name for automobile wrench kits manufactured by Paul G. Niehoff & Co., Inc., 232-242 E. Ohio St., Chicago, Ill.

ELITE.—Trade name for battery ammeters and voltammeters manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

ELITE ELECTRIC.—Trade name for electric washing machines manufactured by the Minier Mfg. Co., Inc., Minier, Ill.

ELKHART RUBBER WORKS.—Elkhart, Ind. Manufacturers of rubber tape and other rubber products.

ELLIOTT CO.—Pittsburgh, Pa. Manufacturer of condensers, oil filters and purifiers, ejectors and other power plant accessories. President, W. S. Elliott; vice-president and general manager, J. E. Watson; treasurer, A. K. Riley; secretary, W. T. Hamilton; sales manager, C. L. Brown. Main office, Frick Bldg., Pittsburgh, Pa. Factory, Jeannette, Pa. Branch offices, New York, N. Y.; Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; St. Louis, Mo.; Kansas City, Mo.; Detroit, Mich.; Cleveland, Ohio; Cincinnati, Ohio; Syracuse, N. Y.

ELLIOTT-EHRHART.—Trade name for exhaust steam condensers manufactured by the Elliott Co., Frick Bldg., Pittsburgh, Pa.

ELLIOTT-FISHER CO.—Harrisburg, Pa. Manufacturer of electrically operated typewriting, computing and bookkeeping machines. President, Kenneth B. Schley; vice-president and general manager, H. A. Foothorap; vice-president and sales manager, M. S. Eylar; secretary, C. L. E. deGauge; treasurer, C. H. Miller. Main office and factory, Harrisburg, Pa. Branch offices, Albany, N. Y.; Boston, Mass.; Hartford, Conn.; New Haven, Conn.; Springfield, Mass.; Montreal, Que., Can.; Portland, Me.; Providence, R. I.; Worcester, Mass.; 404 Astor House Bldg., New York, N. Y.; Newark, N. J.; Paterson, N. J.; Allentown, Pa.; Baltimore, Md.; Buffalo, N. Y.; Erie, Pa.; Harrisburg, Pa.; Philadelphia, Pa.; Richmond, Va.; Norfolk, Va.; Rochester, N. Y.; Scranton, Pa.; Binghamton, N. Y.; Syracuse, N. Y.; Toronto, Ont., Can.; Washington, D. C.; Cincinnati, Ohio; Dayton, Ohio; Cleveland, Ohio; Akron, Ohio; Youngstown, Ohio; Columbus, Ohio; Detroit, Mich.; Grand Rapids, Mich.; Huntington, W. Va.; Pittsburgh, Pa.; Toledo, Ohio; Wheeling, W. Va.; Peoples Gas Bldg., Chicago, Ill.; Ft. Wayne, Ind.; Indianapolis, Ind.; Louisville, K.; Evansville, Ind.; Minneapolis, Minn.; St. Paul, Minn.; Milwaukee, Wis.; Duluth, Minn.; Oshkosh, Wis.; Rockford, Ill.; Peoria, Ill.; Rock Island, Ill.; South Bend, Ind.; Winnipeg, Man., Can.; Dallas, Tex.; Des Moines, Iowa; Houston, Tex.; Kansas City, Mo.; Wichita, Kans.; Oklahoma City, Okla.; Omaha, Neb.; St. Louis, Mo.; Sioux Falls, S. D.; Denver, Colo.; El Paso, Tex.; Los Angeles, Cal.; Portland, Ore.; Salt Lake City, Utah; San Francisco, Cal.; Sacramento, Cal.; Seattle, Wash.; Spokane, Wash.; Vancouver, B. C., Can.; Atlanta, Ga.; Birmingham, Ala.; Chattanooga, Tenn.; Jacksonville, Fla.; Little Rock, Ark.; Memphis, Tenn.; Nashville, Tenn.; New Orleans, La.; Savannah, Ga.

ELLIOTT-THOMPSON ELECTRIC CO., THE.—203-205 St. Clair Ave., E. Cleveland, Ohio. Manufacturer of armature and field coils and commutators. President and treasurer, J. N. Elliott; vice-president, J. P. Elliott.

ELLISON, LEWIS M.—214 W. Kinzie St., Chicago, Ill. Manufacturer of draft gages. L. M. Ellison, sole owner.

ELM CITY.—Trade name for automatic counters manufactured by the C. J. Root Co., Bristol, Conn.

ELMCO LIBERTY.—Trade name for testing machine for automobile generator and starting motor manufactured by the Electric Machine Co., 329 W. Ohio St., Indianapolis, Ind.

ELMES ENGINEERING WORKS, CHARLES F.—230 N. Morgan St., Chicago, Ill. Manufacturers of motor-driven hydraulic pumps and presses. President, Charles F. Elmes; secretary and treasurer, C. L. Elmes.

ELMIRA.—Trade name for insulated screw driver manufactured by the Cronk & Carrier Mfg. Co., 109 W. Water St., Elmira, N. Y.

ELMIRA MACHINERY & TRANSMISSION CO., LTD.—Elmira, Ont., Can. Manufacturer of power transmission machinery.

ELMORE PROCESS.—An electrolytic process for the production of seamless copper tubes, by the deposition of the copper on a rotating cylindrical mandrel, the resulting cylinder, after removal, being drawn out into a tube.

ELPECO.—Trade name for control switches, switchboard fittings, disconnecting switches, bus supports, choke coils and other high-tension equipment, manufactured by the Electric Power Equipment Co., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa.

ELRECO.—Trade name for combination railway and lighting poles manufactured by the Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.

ELSTAT.—Trade name for electric water heaters made by the Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind.

ELWELL.—Trade name for storage battery trucks and tractors manufactured by the Elwell-Parker Electric Co., Cleveland, Ohio.

ELWELL.—Trade name for radio transmitters manufactured by Emil J. Simon, 217 Broadway, New York, N. Y.

ELWELL-PARKER ELECTRIC CO.—Cleveland, Ohio. Manufacturer of storage battery trucks and tractors. President, M. S. Powson. Main office, Cleveland, Ohio. Branch offices, 72 E. South Water St., Chicago, Ill.; 50 Church St., New York, N. Y.; Boston, Mass.; Worcester, Mass.; Philadelphia, Pa.; Washington, D. C.; Atlanta, Ga.; Richmond, Va.; New Orleans, La.; Newark, N. J.; Buffalo, N. Y.; Pittsburgh, Pa.; Youngstown, Ohio.; Detroit, Mich.; Indianapolis, Ind.; Milwaukee, Wis.; St. Paul, Minn.; St. Louis, Mo.; Kansas City, Mo.; Denver, Colo.; Seattle, Wash.; Portland, Ore.; San Francisco, Cal.; Montreal, Que., Can.

ELY, C. UPHAM.—50 Vesey St., New York, N. Y. Manufacturer of nickel anodes, generators and other electroplating equipment, rheostats and voltmeters. Business established as Yates & Ely in 1877.

EMCO.—Trade name for cotton belting manufactured by the Empire Mfg. Co., Lockport, N. Y.

EMCO.—Trade name for punch presses manufactured by the Enterprise Machinery Co., 30 S. Clinton St., Chicago, Ill.

EMELECTRIC.—Trade name for wires and cables manufactured by the American Electrical Works, Phillipsdale, R. I.

EMERALITE.—Trade name for portable lamps manufactured by H. G. McFaddin & Co., 38 Warren St., New York, N. Y.

EMERGENCY.—Trade name for oil and grease cups manufactured by the American Injector Co., 175 14th Ave., Detroit, Mich.

EMERSON, E. L.—Boston, Mass. Trading as S.U.E. Co. which see.

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EMERSON APPARATUS CO.—Boston, Mass. Manufacturer of electric conditioning ovens.

EMERSON ELECTRIC MFG. CO., THE.—St. Louis, Mo. Manufacturer of motors, generators, farm utility power stands, fans and grinders. Business established 1890. President, T. M. Meston; 1st vice-president, H. I. Finch; 2nd vice-president, E. L. Barkhouse; 3rd vice-president, C. C. Connor; treasurer, H. S. Gilliam; secretary, L. L. Whittemore. Main office and factory, 2012-2032 Washington Ave., St. Louis, Mo. Branch office, 50 Church St., New York, N. Y.

EMERY.—Trade name for lubricating oils manufactured by the Emery Mfg. Co., Bradford, Pa.

EMERY MFG. CO.—Bradford, Pa. Manufacturer of lubricating oils. Proprietor, Lewis Emery, Jr.; general manager, Lewis Emery; sales manager, W. A. McCafferty.

EMERY THOMPSON.—Trade name for motor-driven ice-cream freezers made by the Emery Thompson Machine & Supply Co., 271-75 Rider Ave., New York, N. Y.

E.M.F.—Abbreviation for electromotive force.

E.M.F., TERMINAL AND IMPRESSED—The difference of potential at the terminals of a generator, transformer, battery or other source of e.m.f. when the circuit is closed is called the terminal e.m.f. Impressed e.m.f. is the total e.m.f. applied to and causing current in a circuit. It is the sum of the terminal e.m.f.'s of all sources acting to produce a current in the same direction. If there are also counter e.m.f.'s present, the actual current will be determined by the difference between the impressed and total counter e.m.f.'s.

EMISSIVITY.—The rate of emission of heat from a body per unit of surface area and per degree centigrade elevation of temperature above its surroundings. The C.G.S. dynamical unit is the erg per second, per square centimeter and per degree centigrade.

EMKA.—Trade name for bells, buzzers and circuit testers manufactured by the Electric Signal Mfg. Co., Inc., 31 Tremont Ave., Orange, N. J.

EMLENTON REFINING CO.—Emlenton, Pa. Manufacturer of transformer oil, lubricating oil, paraffin and other lubricants. Business established 1895. President, P. J. Bayer; vice-president, H. J. Crawford; secretary, T. B. Gregory; treasurer, S. Messer; manager, G. B. Hunter.

EMMET, WILLIAM LE ROY.—An American electrical and mechanical engineer, born at New Rochelle, N. Y., 1859. He graduated from the United States Naval Academy in 1881. He left the navy in 1883 and in 1887 began his electrical work with the Sprague Electric Railway & Motor Co. He next served as electrical engineer for the Buffalo Railway Co., and later as district engineer for the Chicago district of the Edison General Electric Co. Since 1892 he has been with the General Electric Co., except for a time in 1898 when he served as navigator on the U. S. S. Justin during the Spanish-American War. His most important work has been in steam-turbine inventions and developments. For the success of the Curtis turbine, Mr. Emmet is largely responsible. He planned and promoted the use of electricity for ship propulsion and invented many features and designed equipment now being applied for propulsion to many large ships of the United States Navy. In the electrical field, Mr. Emmet was the first to develop insulation with varnished fabric. He developed some methods of distribution by alternating currents, actively promoted the introduction of large uses of alternating currents and designed many of the first large installations. He also designed many switching and control devices for early large uses of alternating currents, including the first invention and application of oil switches. In 1919 the American Institute of Electrical Engineers awarded Mr. Emmet the Edison medal for inventions and developments of electrical apparatus and prime movers.

EMPIRE.—Trade name for duct rods manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

EMPIRE.—Trade name for transformers and electric disk stoves manufactured by the Elektro Mfg. Co., 4642-4644 Ravenswood Ave., Chicago, Ill.

EMPIRE.—Trade name for portable electric lamps manufactured by the Empire Lamp & Brass Mfg. Co., 663 W. Washington St., Chicago, Ill.

EMPIRE.—Trade name for lighting fixture manufactured by the Empire Lighting Fixture Co., 224-226 Centre St., New York, N. Y.

EMPIRE.—Trade name for cotton belting manufactured by the Empire Mfg. Co., Lockport, N. Y.

EMPIRE.—Trade name for oiled cloth, paper, cambric, tubing, tape, etc., manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

EMPIRE BRASS MFG. CO., LTD.—London, Ont., Can. Manufacturer of brass castings for electric fixtures.

EMPIRE ELECTRIC CO., INC.—2227 S. San Pedro St., Los Angeles, Cal. Manufacturer of x-ray and high-frequency treatment apparatus. Business established 1911. President and treasurer, D. F. Hill; secretary and general manager, R. C. Hill; sales manager, K. C. Dewey. Sales representatives, Walter's Surgical Supply Co., San Francisco, Cal.; Shaw Supply Co., Portland, Ore., and Spokane, Wash.; Durbin-Muckle Co., Denver, Colo.; Professional Supply Co., Los Angeles, Cal.

EMPIRE ENGINEERING & SUPPLY CO.—1 Dominick St., New York, N. Y. Manufacturer of panelboards, switchboards and fixture hangers. Norman P. Findley, owner and manager.

EMPIRE LAMP & BRASS MFG. CO.—663 W. Washington St., Chicago, Ill. Manufacturer of portable electric lamps. President, Max Herskovitz; vice-president, William Herskovitz; secretary and treasurer, Abraham Herskovitz.

EMPIRE LIGHTING FIXTURE CO.—224 Centre St., New York., N. Y. Manufacturer of lighting fixtures and portable lamps. Business established 1907. President, Percy I. Ansorge; secretary and treasurer, Louis Schaffer. Sales representative, Central Chandelier Co., 121 W. 42nd St., New York, N. Y.

EMPIRE MFG. CO.—Lockport, N. Y. Manufacturer of cotton belting, tape and flexible fabric tubing. Business established 1882. Partnership, T. A. Hall and E. W. Cary.

EMPIRE STAMPING & METAL SPINNING CO., INC.—88-90 Walker St., New York, N. Y. Manufacturer of fixture parts, metal spinnings and stampings. Charles Richter, president.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. — President, Henry W. Peck, Schenectady, N. Y. Secretary, Charles H. B. Chapin, Grand Central Terminal Bldg., New York, N. Y.

EMPIRE TIRE & RUBBER CORP.—N Clinton Ave. & Mulberry St., Trenton, N. J. Manufacturer of rubber tires, tubing, packing, belting and other rubber products. Business established 1892. President, W. M. Pepper; vice-presidents, F. I. Reynolds, C. E. Murray, Jr.; secretary, H. R. Nason; treasurer, C. E. Murray, Jr.; sales manager, F. I. Reynolds. Sales representative, Rubber Corp. of America, 240 W. 55th St., New York, N. Y.

EMPLOYEES.—The total number of employees engaged in the electrical industry in the United States is estimated at 1,500,000. The principal divisions are as follows: Utilities, 900,000; manufacturing, 200,000; mercantile, including construction, 400,000.

EMPRESS.—Trade name for oil and grease cups manufactured by the Bowen Products Corp., Auburn, N. Y.

EMPRESS.—Trade name for electric iron manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

ENAMELAC.—Trade name for insulating paint manufactured by the Robertson Chemical Co., Cleveland, Ohio.

ENAMELDUCT.—Trade name for rigid metallic interior conduit manufactured by the National Enameling & Mfg. Co., Renshaw Blvd., Pittsburgh, Pa.

ENAMELED METALS CO.—61 Bridge St., (Etna), Pittsburgh, Pa. Manufacturer of rigid metallic conduit. Business established 1905. President and treasurer, John S. Patterson; vice-president and general manager, P. McIlroy; vice-president and secretary, F. W. Howard. Sales representatives, W. P. Ambos Co., 985 The Arcade, Cleveland, Ohio; William S. Brown Electric Co., 3 W. 29th St., New York, N. Y.; Guy V. Carpenter, 901 Mutual Life Bldg., Buffalo, N. Y.; William P. Crockett Co., 411 S. Jefferson St., Chicago, Ill.; Electrical Sales Co., 2 E. Redwood St., Baltimore, Md.; Robertson Supply Co., 2317 First Ave., Birmingham, Ala.; William P. Crockett Co., 1413 Pine St., St. Louis, Mo.

ENAMELED STEEL SIGN CO.—190 N. State St., Chicago, Ill. Manufacturer of metal sign letters and frames. President and treasurer, N. H. Simmons; vice-president, L. Simmons; secretary, R. M. Miller.

ENAMELED WIRE.—See Wire, enameled, miscellaneous; also Wire, magnet, enameled.

ENAMELIGHT.—Trade name for lighting unit manufactured by the Wardell Lighting Co., Detroit, Mich.

ENAMELING OVENS.—See Ovens, electric, enameling and japanning.

ENAMELITE.—Trade name for magnet wire manufactured by the Acme Wire Co., New Haven, Conn.

ENAMELS, LUMINOUS. — See Compounds, luminous.

ENAMELS, METAL, AIR-DRYING AND BAKING.—These enamels are largely used to give an attractive and protective finish to metals. The enamel is usually applied by a spray and baked dry in an oven. Metal enamels have a very wide field of application in the electrical industry, particularly in the manufacture of appliances, motors, and motor-driven tools. They are also very extensively used in the manufacture of conduit, which is either galvanized or enameled. Air-drying enamels are also used on metal products as a protective and insulating finish. They are often applied to busbars, framework of switchboards, etc., installed in battery rooms. Lacquer enamels are used on a number of electrical products, such as lighting fixtures, portable lamps, flush switch plates, etc., where a highly decorative finish is required. Perhaps one of the most important uses of metal enamels is in insulating wire. (See Wires, enameled, miscellaneous; also see Lacquers, metal.)

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York, N. Y.
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio.
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Condensite Co. of America, Grove St., & Erie R. R., Bloomfield, N. J.
Celluloid Zapon Co., 200 5th Ave., New York, N. Y. (Air drying) "Zapon."
Dielectric Mfg. Co., St. Louis, Mo.
Du Pont de Nemours & Co., E. I., Wilmington, Del. "Pyroxylin."
Egyptian Lacquer Mfg. Co., The, 5 E. 40th St., New York, N. Y.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa.
General Bakelite Co., 2 Rector St., New York, N. Y.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo." (See display adv. page 1318.)
Impervious Metal Corp., 421 Wood St., Pittsburgh, Pa.
Murphy Varnish Co., Chestnut & McWhorter Sts., Newark, N. J.
Nikolas & Co., G. J., 1227-35 Van Buren St., Chicago, Ill. (Metal, air drying.)
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Standard Varnish Works, 90 West St., New York, N. Y.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.
Toch Bros., 320 5th Ave., New York, N. Y.

ENAMELS, PORCELAIN.—Porcelain enamels, due to their reflecting and protective properties, have come into extensive use for metal reflectors for industrial and outdoor lighting units. If properly prepared and applied they give a durable surface possessing the most desirable characteristics for that purpose. The surface

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that is left after the treatment is completed is really a form of glass, very hard and somewhat brittle, but a good reflector. One method of applying the enamel to the cleaned metal surface is to make a paste of the powdered enamel and spread it on the reflector that has been pressed into final shape. It is then placed in a baking oven where the powder melts and as it fuses spreads over the surface evenly to give the desired result. White enamel is used for the interior, and white, blue, green, black or other colors for the exterior.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. A complete modern porcelain enameling plant is operated by this company, which supplies many other manufacturers with all classes of porcelain enameled materials.—Adv.
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Murphy Varnish Co., Chestnut & McWhorter Sts., Newark, N. J.
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.

ENAMELS, STORAGE-BATTERY.—Enamels for storage batteries must be acid-resisting. The enamels used are sometimes of a special acid-resisting character or are ordinary enamels to which has been added a special mixture to give them these properties. They are used mostly to enamel portable battery boxes and trays, and often also the trays, shelving and supports in battery rooms.

Manufacturers:

Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Peerless."
Dielectric Mfg. Co., St. Louis, Mo.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa.
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Standard Varnish Works, 90 West St., New York, N. Y.
Toch Bros., 320 5th Ave., New York, N. Y.

ENAMELS, WIRE.—Wire enamels are used as insulation on small wires, generally for magnet wire, this form of insulation effecting an economy in space. The enamel is baked on and when dry is very tough so that it will not crack or chip off when the wire is wound or sharply bent. For the properties and uses of these enamels see Wire, enameled; also Wire, magnet, enameled.

Manufacturers:

HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo" a tough-drying, baking enamel suitable for the manufacture of armature and field coils for automobile starting devices, etc. Successive coats baked at high heat for a short time permit of quick production. Finished wire shows no loss of elasticity after standing six months. Also see display adv. page 1318.—Adv.

EN-AR-CO.—Trade name for transformer oil manufactured by the National Refining Co., Cleveland, Ohio.

ENCO.—Trade name for flashlights manufactured by the Enterprise Electric Novelty Co., Inc., 603 W. 130th St., New York, N. Y.

END BELL.—A cup-shaped metal covering for the end connections of armature coils of high-speed rotating armatures, for the purpose of reducing windage and holding the end connections in place. Also a type of protection for the joint between an underground cable and an indoor open conductor; see Cable end bells.

END SLOPES, THIRD RAIL.—A steel or iron casting having the same section as the third rail at one end, tapering to a blunt knife edge at the other. It is used at track and road crossings, and similar points where a break is necessary in a third rail so that the shoe will glide on to and off of the third rail as it passes the break. Sometimes the end slopes are prepared by cutting a V-slot in the web of the rail and bending the head down to touch the base.

Manufacturers:

OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."

ENDLESS GRAPH MFG. CO., THE.—4200 W. Adams St., Chicago, Ill. Manufacturer of electrically operated phonograph combined with lamp. President, Paul B. Rudyk; secretary, John Iwaskewitz; treasurer, Phillip Rudyk.

ENDOSMOSE.—Passage of a liquid by osmosis from an outer vessel through a diaphragm into an inner vessel. Electrically, the passage of a solution through a porous diaphragm in the direction from anode to cathode.

ENDOTHERMIC REACTION.—A reaction which, proceeding by itself, absorbs heat. Such is the vaporization of a liquid, the melting of a solid, the expansion of a gas when doing work. More strictly, a chemical reaction is meant, such as the combination of carbon and hydrogen to form acetylene, the combination of carbon and sulphur to form carbon bisulphide, the dissociation of limestone into lime and carbon dioxide, the decomposition of steam by red-hot carbon. A small part of simple chemical combinations are of this nature, but a larger part of chemical dissociations or decompositions, mostly such as take place at high temperatures.

ENDOULETS.—Trade name for conduit bodies manufactured by S. R. Fralick & Co., 15 S. Clinton St., Chicago, Ill.

ENDURANCE.—Trade name for storage batteries manufactured by the Endurance Battery Corp., 580 Hudson St., New York, N. Y.

ENDURANCE BATTERY CORP.—580 Hudson St., New York, N. Y. Manufacturer of storage batteries. Business established 1919.

ENDURITE.—Trade name for automobile ignition wire manufactured by the Branford Electric Co., Inc., 9 Church St., New York, N. Y.

ENERGY.—Energy is the ability to do work. Mechanical energy, heat, chemical energy, electrical energy and radiant energy are the principal forms. It is customary to divide mechanical energy into kinetic and potential energy. Kinetic energy is energy of motion and is expressed by the formula $mv^2/2$. Potential energy is energy of position of a body with respect to other bodies, or with respect to other parts of the same body, as, for example, a weight lifted above the ground, or a bent spring.

Energy is measured in work units, foot-pounds, ergs, or joules.

Heat is energy of motion of the molecules, atoms or electrons of a body.

The energy of an electric current is energy of the moving electrons. An electric charge at rest has potential energy.

Our great source of energy is the sun, from which we receive energy by radiation. The principal terrestrial source of energy is coal, from which energy is obtained by chemical reaction. Water power, the wind and the tides are also important sources of energy.

The recognition of the principle of conservation of energy has contributed largely to recent scientific progress. This principle is that no energy can be created or destroyed by any known agency. It follows that no device can continue to do work unless supplied with energy in some form, in other words, the aim of many would-be inventors—"perpetual motion"—is only a dream.

One of the greatest engineering problems is the conservation of fuel, which cannot be replaced, and the utilization of other forms of energy now largely allowed to go to waste.

ENERGY OF CHARGED CONDENSER.—By definition, the quantity of electricity that a condenser will hold is equal to the product of its capacitance by the difference of potential between its terminals. Symbolically $Q=EC$. The energy of a charged condenser is $QE/2=CE^2/2$ joules, when E is in volts and C in farads.

ENERGY OF DIELECTRIC FIELD.—When a transmission line or any system of conductors is charged the dielectric is stressed and energy is stored in it. The algebraic expression for this energy is the same as for a condenser, viz., $CE^2/2$. This energy fluctuates with the voltage, and hence in an a-c. circuit it is a maximum at the maximum or crest value of the voltage wave. It is delivered back to the circuit with decreasing voltage. The dielectric energy is of great importance at high voltages, especially in radio communication.

ENERGY OF MAGNETIC FIELD.—The magnetic field around a magnet is a seat of energy. The energy stored in a unit volume can be calculated at any point where the flux density is B and permeability is μ. When the magnetic field is due to a current of I amperes flowing in a circuit whose inductance is L henrys, the total energy stored in the magnetic field is $LI^2/2$ joules. The magnetic energy stored in a ferromagnetic substance is probably less owing to hysteresis.

ENERGY, WAVE PROPAGATION OF.—See Wave propagation of energy.

ENGBERG'S ELECTRIC & MECHANICAL WORKS.—St. Joseph, Mich. Manufacture of portable lighting and power plants and generators. President, Carl Engberg; vice-president, John Erickson; secretary, treasurer and sales manager, D. D. Merrill.

ENGELN ELECTRIC CO., THE.—4601 Euclid Ave., Cleveland, Ohio. Manufacturer of X-ray apparatus.

ENGINEER CO., THE.—New York, N. Y. Manufacturer of boiler furnace draft regulators, boiler settings, etc. Business established 1900. President, K. L. Martin; vice-president, A. W. Patterson, Jr.; treasurer, Embury McLean. Main office, 17 Battery Pl., New York, N. Y. Branch offices, 1414 S. Michigan Ave., Chicago, Ill.; 515 National City Bldg., Cleveland, Ohio; Builders Exchange Bldg., Minneapolis, Minn.; 10 High St., Boston, Mass.; 847 Baronne St., New Orleans, La.; 316 Indiana Trust Bldg., Indianapolis, Ind.; 314 Coristine Bldg., Montreal, Que., Can.; Railway Exchange Bldg., St. Louis, Mo.; Trust Co. of Georgia Bldg., Atlanta, Ga.; 1010 Harrison Bldg., Philadelphia, Pa.; 870 Woodward Ave., Detroit, Mich.; 614 Security Bldg., Milwaukee, Wis.; Jenkins Arcade Bldg., Pittsburgh, Pa.; Bennett Bldg., Wilkes Barre, Pa.

ENGINEERING, ELECTRICAL.—See Electrical engineering.

ENGINES, FIRE, ELECTRIC—See Fire engines, electrically operated.

ENGINES, INTERNAL-COMBUSTION, GAS, GASOLINE OR OIL.—Gas, gasoline and oil engines find many applications where steam engines are not feasible, as where water is scarce or of objectionable properties; where the initial investment must be kept down to the minimum (internal-combustion engines eliminate the need for boilers, steam pipes, etc.); and where oil or gas are cheap and plentiful forms of fuel.

Small power plants having a period in which the load is very light, or the total load is of short duration can often use the oil or gas engine advantageously during such periods. The initial investment is low, operating economy high and the space required small compared with the steam power plant.

The gasoline engine is often the best solution where small amounts of power is to be produced as for farm lighting and portable lighting plants. Gasoline-engine sets are usually built as self-contained units, compact and portable. They may be designed for direct connection to an electric generator or may be designed for belt drive. Gasoline tank, generator, control switchboard, cooling-water pump, etc., are generally mounted together upon the frame, which in turn may be mounted upon wheels. The gasoline-engine outfit may be of from 1 to 60 hp.; it may be designed to use gasoline or kerosene.

Gas engines are used for driving generators chiefly where there is considerable natural or industrial by-product gas available at low cost. They have been used as the prime movers in the electric power plants of large steel mills, using blast-furnace and coke-oven gas. Where low-grade coals are the only fuel available, gas-producer plants are sometimes installed to convert this fuel to gas, which is used in gas engines driving generators or sometimes other machinery direct.

For engines using heavier oils as fuel see the next classification.

Manufacturers:

Akerlund & Semmes, Inc., 17 Battery Pl., New York, N. Y.
Alamo Engine Co., The, Hillsdale, Mich. "Alamo."
American Engine & Foundry Co., Charles City, Iowa. "Armstrong."
Anderson Foundry & Machine Co., Anderson, Ind.

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Baltimore Oil Engine Co., Baltimore, Md. "Boec."
Benninghofen & Sons, C., Hamilton, Ohio. "Big Ben."
Bessemer Gas Engine Co., Grove City, Pa.
Bruce-Macbeth Engine Co., 2111 Center St., N. W., Cleveland, Ohio.
Buda Co., The, Harvey, Ill.
Cady Co., Inc., C. N., Canastota, N. Y. "Cady of Canastota."
Callahan Co., The W. P., Dayton, Ohio.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Challenge Co., Batavia, Ill.
Charter Gas Engine Co., 9 Wallace St., Sterling, Ill. "Charter."
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Giant."
Clark Engine & Boiler Co., Kalamazoo, Mich.
Combination Engine & Compressor Co., Inc., The, 15 Leon St., Bradford, Pa.
Construction Machinery Co., Waterloo, Iowa. "Wonder."
Continental Motors Corp., 2951 Jefferson Ave., E., Detroit, Mich. "Red Seal."
Cooper Co., The C. & G., Mt. Vernon, Ohio.
Cushman Motor Works, 932 N. 21st St., Lincoln, Neb.
Davenport Mfg. Co., Davenport, Iowa.
De La Vergne Machine Co., East 138th St., New York, N. Y.
Dodge Mfg. Co., Mishawaka, Ind. (Exclusive distributor, Oil Engine Division, Dodge Sales & Engineering Co., Mishawaka, Ind.)
Dubois Iron Works, 805 N. Brady St., Du Bois, Pa.
Dunn Mfg. Co., W. E., Holland, Mich. "Dunn."
Eagle Mfg. Co., The, 624 Winnebago St., Appleton, Wis. "Eagle."
Evinrude Motor Co., 279 Walker St., Milwaukee, Wis.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Y," "Z."
Frisbie Motor Co., The, Middletown, Conn. (gasoline)
Fuller & Johnson Mfg. Co., 1350 E. Washington Ave., Madison, Wis.
Gaffga & Co., J. S., Greenport, N. Y. "Greenport."
Grand Rapids Gas Engine Co., Grand Rapids, Mich. "Monarch."
Hassell Iron Works Co., Colorado Springs, Colo.
Hercules Corp., The, Evansville, Ind.
Hope Forge & Machine Co., The, Mount Vernon, Ohio. "Recves."
Howden Co. of America, Inc., James, Wellsville, N. Y. "Howden."
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Johnson Machine Co., The Carlyle, 52 Main St., Manchester, Conn. (gasoline) "Bud-E."
Jones Oil Engine Corp., 805-17 Free St., Syracuse, N. Y. (oil) "Jones."
King Bros., 439 E. Water St., Syracuse, N. Y. (gasoline) "Barber."
Knowlson & Kelley Co., Inc., Troy, N. Y.
Lauson-Lawton Co., De Pere, Wis. "Wisconsin."
LeRoi Co., Mitchell St. & 60th Ave., Milwaukee, Wis.
Lister & Co. (Canada) Ltd., R. A., 58 Stewart St., Toronto, Ont., Can.
Maytag Co., The, Newton, Iowa.
McIntosh & Seymour Corp., Auburn, N. Y.
Mesta Machine Co., West Homestead, Pa. (gas)
Missouri Engine Co., 2806 N. 11th St., St. Louis, Mo.
National Transit Pump & Machine Co., Oil City, Pa. "Transit."
Nordberg Mfg. Co., Milwaukee, Wis.
Oil City Boiler Works, Box 137, Oil City, Pa. (gas)
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. (gas) "Simplex."
Otto Engine Mfg. Co., 33rd & Walnut Sts., Philadelphia, Pa. "Otto."
Petroleum Engine & Mfg. Co., 120 Broadway, New York, N. Y. (oil) "Penmac."
Piersen Mfg. Co., The, 700 E. 8th St., Topeka, Kans. "Superior Piersen."
RADIANT MFG. CO., Water & Perry Sts., Sandusky, Ohio. "Radiant."
Rapid Tool & Machine Co., Ltd., 174 St. Joseph St., Lachine, Que., Can.
Regal Gasoline Engine Co., Coldwater, Mich.
Reliable Tractor & Engine Co., The, Portsmouth, Ohio. "Reliable Heer."
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Rural Electric Equipment Co., Canton, Pa. "Reeco."
St. Marys Oil Engine Co., St. Charles, Mo. (gas)
Sandwich Mfg. Co., Sandwich, Ill.
Spang & Co., Butler, Pa.
Stearns Motor Mfg. Co., Box 252, Ludington, Mich.
Sterling Engine Co., 1252-1274 Niagara St., Buffalo, N. Y. ("Sterling" gasoline for standby service).
Stover Mfg. & Engine Co., Freeport, Ill. "Stover."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Termaat-Monahan Mfg. Co., Oshkosh, Wis. "Wiscona."
Turner Mfg. Co., The, Port Washington, Wis.
Union Gas Engine Co., Kennedy & Boehmer Sts., Oakland, Cal. "Union."
UNIVERSAL MOTOR CO., 39 Ceape St., Oshkosh, Wis. (marine type, stationary' "Universal." (See display adv. page 1328.)
Venn-Severin Machine Co., 1327 W. North Ave., Chicago, Ill.
Western Machinery Co., 900 N. Main St., Los Angeles, Cal.
Wisconsin Motor Mfg. Co., 44th Ave. & Burnham St., Milwaukee, Wis. "Wisconsin" gas.
Woodin & Little, 33-41 Fremont St., San Francisco, Cal. "Hercules."
Wright Machine Co., The, 321-408 E. 2nd St., Owensboro, Ky.

ENGINES, INTERNAL-COMBUSTION SEMI-DIESEL AND DIESEL TYPE.—These engines use crude oil for fuel although they may use more or less refined distillates also. The Diesel type engine is the highest type of internal-combustion engine. It is usually of the vertical type and makes use of rather high compression which involves a number of auxiliaries and quite a complex machine. Its original cost is the highest per horsepower rating of any of the internal-combustion engines; its efficiency, however, is the highest of any of these types. For this reason it has been used in many electric light and power stations where fuel oil was readily available, as in the states of Oklahoma, Texas and California. It requires rather skilled attendants.

On account of this latter fact as well as the high initial cost of the Diesel engine, what is known as the semi-diesel type has come into considerable use especially in lighting plants, factories and mills, where it is difficult to secure specially skilled attendants. This type of engine is much simpler than the diesel and uses a lower compression. These engines are built in capacities ranging from 10 to 800 hp. in standard sizes although units as large as 2000 hp. are used.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Anderson Foundry & Machine Co., Anderson, Ind.
Bauer Machine Co., The, 113 W. 18th St., Kansas City, Mo. "Bauer, K.C."
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can. "Robey."
Busch-Sulzer Bros.-Diesel Engine Co., 2nd & Utah Sts., St. Louis, Mo. "Busch-Sulzer Diesel."
Hassell Iron Works Co., Colorado Springs, Colo.
Hooven, Owens, Rentschler Co., The, Hamilton, Ohio.
Knowlson & Kelley Co., Inc., Troy, N. Y.
National Transit Pump & Machine Co., Oil City, Pa. "Transit."
Nordberg Mfg. Co., Milwaukee, Wis.
Otto Engine Mfg. Co., 33rd & Walnut Sts., Philadelphia, Pa.
St. Marys Oil Engine Co., St. Charles, Mo.
Western Machinery Co., 900 N. Main St., Los Angeles, Cal.

ENGINES, MINE HOISTING, ELECTRIC.—See Hoists, electric, mine.

ENGINES, STEAM, COMPOUND AND TRIPLE EXPANSION.—Steam engines using two or three expansions in separate cylinders have been in much use in electric power plants, but have been rapidly replaced within the past ten years especially by the much more compact and lower cost steam turbines. The compound steam engines have a high pressure and a low pressure which may be arranged side by side with separate cranks and connecting rods, giving what is called the cross-compound type. In this type a single flywheel is placed between the two cranks and often, as the engine drives a generator, the latter is placed alongside a flywheel; in case of very large revolving field a-c. generators a flywheel has been dispensed with. Where space was available the tandem compound engine has been used. This has the two cylinders in the same line, both pistons operating on a single connecting rod and crank. Compound engines have been made with ratings up to 3000 hp. quite commonly and occasionally as high as 5000.

In the triple-expansion engine there are three cylinders, high, intermediate and low. The cylinders may be arranged horizontally or vertically but in either case are almost invariably side by side instead of in tandem as the latter arrangement would make an extremely long union. These engines were used to only a limited extent in electric power plants because the additional cylinder and its appurtenances increased the compression of the unit. The vertical or marine type was the one most used although combinations of vertical and horizontal have also been employed in a few cases. The largest of these units had a combined rating of about 5000 kw. but occupied a very large floor space, in comparison with the very compact arrangement and much lower cost of the 5000 kw. turbogenerator unit at the present time.

Both compound and triple-expansion engines as a rule have been operated condensing, the condensers being of any of the types now used with turbines but having as a rule more engine-driven auxiliaries than are now employed. In some cases noncondensing units were employed where the exhaust steam was used either for heating or for industrial purposes in other departments of the plant.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Beggs & Co., James, 36 Warren St., New York, N. Y.
Buckeye Engine Co., Salem, Ohio.
Cooper Co., The C. & G., Mt. Vernon, Ohio.
Enterprise Co., The, Columbiana, Ohio. "Enterprise."
Erie Ball Engine Co., 2 Ross St., Pittsburgh, Pa.
Evans & Co., Inc., C. H., 187 Fremont St., San Francisco, Cal. "Evans."
Fitchburg Steam Engine Co., Box 443, Fitchburg, Mass.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
High-Speed Engine Corp., 9-11 Clinton St., Newark, N. J.
Hooven, Owens, Rentschler Co., The, Hamilton, Ohio. "Hamilton."
Houston, Stanwood & Gamble Co., The, Cincinnati, Ohio.
Howden & Co. of America, Inc., James, Wellsville, N. Y. "Howden."
Knowlson & Kelley Co., Inc., Troy, N. Y.
Mesta Machine Co., West Homestead, Pa.
Murray Iron Works Co., Burlington, Iowa.
Nordberg Mfg. Co., Milwaukee, Wis.
Providence Engineering Corp., 521 S. Main St., Providence, R. I. (Corliss type) "Rice & Sargent."
Vilter Mfg. Co., The, Milwaukee, Wis. "Vilter."

ENGINES, STEAM, SIMPLE.—Simple steam engines are those in which the complete expansion is carried out in a single cylinder. They formerly occupied an important place in the electrical industry, but have since been displaced by compound engines and more recently by steam turbines. However, simple reciprocating steam engines are still used for slow speeds, high starting torque and for variable-speed drive. In a central-station boiler room they are used largely for variable-speed work, such as driving stokers and forced-draft blowers. They permit much easier speed adjustment than do a-c. motor-driven auxiliaries and in the low and variable speeds cannot be competed with by the steam turbines. In some small power plants where the load is not large simple steam engines have often been used to drive a slow or medium-speed generator. They are also used in private industrial plants where the initial outlay must be kept as small as possible and give satisfactory operation for the service for which they were built, al-

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though they are not very efficient. Both the horizontal and vertical type engines are used.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich. "ABC."
Automatic Furnace Co., The, 1st & Harshman Sts., Dayton, Ohio. "Acme."
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can. "Hindley."
Beggs & Co., James, 36 Warren St., New York, N. Y.
Brownell Co., The, N. Findlay St., Dayton, Ohio.
Buckeye Engine Co., Salem, Ohio.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Giant."
Clark Engine & Boiler Co., Kalamazoo, Mich.
Cooper Co., The C. & G., Mt. Vernon, Ohio.
Enterprise Co., The, Columbiana, Ohio. "Enterprise."
Erie Ball Engine Co., 2 Ross St., Pittsburgh, Pa.
Erie City Iron Works, Erie, Pa.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fitchburg Steam Engine Co., Box 443, Fitchburg, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. Furnished direct-connected to a-c. or d-c. generators up to 60-kw. capacity. See Generators, Lighting and power, d-c., engine, also adv. pages 1203-1223.—Adv.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
High-Speed Engine Corp., 9-11 Clinton St., Newark, N. J.
Hooven, Owens, Rentschler Co., The, Hamilton, Ohio. "Hamilton."
Houston, Stanwood & Gamble Co., The, Cincinnati, Ohio.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Knowlson & Kelley Co., Inc., Troy, N. Y.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Mesta Machine Co., West Homestead, Pa.
Murray Iron Works Co., Burlington, Iowa.
Nagle Engine & Boiler Works, Erie, Pa.
Nordberg Mfg. Co., Milwaukee, Wis.
Oil City Boiler Works, Box 137, Oil City, Pa.
Orr & Sembower, Inc., Reading, Pa.
Providence Engineering Corp., 521 S. Main St., Providence, R. I. "Rice & Sargent."
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Troy Engine & Machine Co., Troy, Pa.
Vilter Mfg. Co., The, Milwaukee, Wis. "Vilter."

ENGINES, TOY ELECTRIC.—Electric toy engines are usually built in imitation of a horizontal steam engine. The cylinder is in reality a solenoid and the piston a plunger. The solenoid is controlled by a make-and-break contact on the flywheel. They are usually operated by means of dry batteries.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Martalex Mfg. Co., Inc., 450 E. 148th St., New York, N. Y.
Russell Electric Co., Danbury, Conn.

ENGLISH MICA CO.—Spruce Pine, N. C. Manufacturer of ground mica.

ENGRAVERS, ELECTRIC, PORTABLE.—Machines provided with motor-driven flexible shafts attached to rapidly rotating cutting heads which are caused to pass over the work by the operator, or machines having motor-driven cutting heads under which the work to be engraved is passed by the operator. Also hand tools of an electric needle type used for engraving names or other data on tools and parts.

Manufacturers:

Brewster Co., Inc., The William, 30 Church St., New York, N. Y. "Etchograph."
Capital Novelty Co., 138 N. 12th St., Lincoln, Neb.
Electro-Stylograph Co., 17 Madison Ave., New York, N. Y.
Federal Products Corp., 393 Harris Ave., Providence, R. I. "Federal."
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "Electro-Stylograph."

ENGRAVING MACHINES, AUTOMATIC.—These motor-driven machines are used to make reproductions, enlarging or reducing the engraving as may be desired, the copy being made from an original set on the machine. The cutting tool slides back and forth over the plate to be engraved, the sliding block being mounted on the machine bed. The tool is mounted at one end of a set of levers, the tracing point at the other. The tracing point sliding over the original communicates its motion accurately to the copy through the levers, so that the cutting tool will produce an exact copy of the original.

Manufacturers:

Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Production Equipment Co., Inc., 5 Union Sq., New York, N. Y. "Federal."

ENSIGN.—Trade name for electric calculating machines manufactured by the Ensign Co., Brighton District, Boston, Mass.

ENSIGN CO.—Brighton District, Boston, Mass. Manufacturer of electric calculating machines. Sole owner, M. Burke; managers, C. T. Daley and M. J. Daley. Branch offices, New York, N. Y.; Chicago, Ill.; Philadelphia, Pa.; Pittsburgh, Pa.; Cleveland, Ohio; Toledo, Ohio; Indianapolis, Ind.; Baltimore, Md.; Newark, N. J.

ENTERPRISE.—Trade name for packings for piston, valves, etc., manufactured by Randolph Brandt, 70 Cortlandt St., New York, N. Y.

ENTERPRISE.—Trade name for electric coffee grinders and meat choppers manufactured by the Enterprise Mfg. Co. of Pa., 3rd & Dauphin Sts., Philadelphia, Pa.

ENTERPRISE CO., THE.—Columbiana, Ohio. Manufacturer of steam engines. President, Jacob Detwiler; vice-president and general manager, H. H. Detwiler; secretary and treasurer, Elmer Detwiler. Main office and factory, Columbiana, Ohio. Branch offices, 136 Liberty St., New York, N. Y.; 120 3rd Ave., N., Minneapolis, Minn.

ENTERPRISE ELECTRIC CO., THE.—Warren, Ohio. Manufacturer of transformers. Business established 1898. President, R. A. Cobb; vice-president, F. B. McBerty; secretary and treasurer, Charles B. McCurdy. Sales representatives, National Electrical Supply Co., Washington, D. C.; Charles A. Cotton, Boston, Mass.; Walter P. Amos & Co., Cleveland, Ohio; Moore-Handley Hardware Co., Birmingham, Ala.

ENTERPRISE ELECTRIC NOVELTY CO., INC.—603 W. 130th St., New York, N. Y. Manufacturer of flashlights, flashlight batteries and Christmas tree lighting outfits. Business established 1916. President, William Samuel; vice-president, Sanford Samuel; secretary, A. Rahauser; treasurer and general manager, B. C. Samuel; sales manager, T. N. Pinkerton.

ENTERPRISE MACHINERY CO., THE.—30 S. Clinton St., Chicago, Ill. Manufacturer of mica and transformer coil presses. Business established 1912. President, W. S. Gooding; secretary, S. F. Gooding.

ENTERPRISE MFG. CO.—North West St., Easton, Pa. Manufacturer of lamp changers. C. D. Buss, manager.

ENTERPRISE MFG. CO. OF PA.—Philadelphia, Pa. Manufacturer of electric coffee grinders and meat choppers. President, H. E. Asbury; secretary, J. W. Gates; treasurer, C. W. Asbury. Main office and factory, 3rd & Dauphin Sts., Philadelphia, Pa. Branch offices, 29 Murray St., New York, N. Y.; 9 Main St., San Francisco, Cal.

ENTERPRISE OPTICAL MFG. CO.—564 W. Randolph St., Chicago, Ill. Manufacturer of motor-driven motion-picture machines. President and treasurer, A. C. Roebuck; vice-president and general manager, O. F. Spahr.

ENTORF FILTER CO.—Amboy, Ill. Manufacturer of filters for gasoline and other light oils. Business established 1913. President and general manager, C. A. Entorf; secretary and treasurer, Dwight Bristol.

ENTRANCE FITTINGS, SERVICE.—See Service entrance fittings.

ENTRANCE TUBES OR BUSHINGS.—See Bushings, service entrance.

EPCO.—Trade name for lamp coloring and frosting compound manufactured by the Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.

EPOCH.—Trade name for storage batteries manufactured by the Calumet Storage Battery Co., 10113 Indianapolis Ave., Chicago, Ill.

EQUALITE.—Trade name for illuminating glassware manufactured by Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.

EQUALIZER.—A heavy electrical connection between the armature ends of the series windings of compound direct-current generators running in parallel. The equalizer tends to maintain the proper division of the load among the generators by taking current, when necessary, from the more heavily loaded machines and sending it through the series winding of the more lightly loaded. In this way the series excitation of one is reduced and that of the others increased with a corresponding change in the loads. The equalizer connection is often called the equalizer bus. For three-wire d-c. generators there is usually a positive equalizer and a separate negative equalizer to give proper equalization when the positive and negative sides of the systems are unbalanced.

EQUALIZING RING.—One of several rings of copper connected to points on the windings of parallel wound d-c. armatures which should be at the same potential. If they are not, due to eccentricity of the field structure or other causes, the rings have currents in them which tend to equalize the currents through the brushes and reduce the loss in the armature circuit.

EQUATOR.—Trade name for electric heating appliances manufactured by the Equator Mfg. Co., 144 York St., Hamilton, Ont., Can.

EQUATOR MFG. CO.—144 York St., Hamilton, Ont., Can. Manufacturer of electric heating appliances. Business established 1910. President, W. W. Gabbott; vice-president and general manager, B. M. Fudge; sales manager, H. R. Hannah.

EQUILIBRIUM, CHEMICAL.—The balancing of chemical affinities against each other, as modified by the active mass of the bodies present. It is disturbed or displaced by changes in the temperature or concentration of the substances in equilibrium.

EQUIPOISE.—Trade name for desk telephone bracket manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

EQUIPOTENTIAL CONNECTIONS.—Another name for equalizer rings. See Equalizing rings.

EQUITHERM CONTROL CORP.—13 Tillary St., Brooklyn, N. Y. Manufacturer of temperature controls. Business established 1907. President, W. A. S. Smith; vice-president and secretary, H. W. Threse; treasurer, W. Carlile Wallace; general manager, E. B. Lane.

EQUIVALENT CONDUCTIVITY.—The conductivity of a solution divided by 0.001 of its concentration. Since concentration is expressed as the fraction of a chemical equivalent of a salt present in a liter of solution, 0.001 of its concentration is the chemical amount present in 1 cubic centimeter, and the quotient indicated is the conductivity expressed per chemical equivalent of salt in the solution. It is found to increase with increase in dilution, until it reaches a maximum which is nearly constant, and which is taken as representing the maximum electrical carrying power of one chemical equivalent of the dissolved substance when it is "completely dissociated" (in terms of the ionization theory), or when its constituents are completely combined with the solvent (solvate theory).

EQUIVALENT SINE WAVE.—See Sine wave, equivalent.

ERADIUM LUMINOUS.—Trade name for luminous switch plates, attachments, etc., manufactured by the Pioneer Corp., 1255 W. 63rd St., Chicago, Ill.

ERASERS, DRAFTSMEN'S, MOTOR-DRIVEN.—A very small motor to the extended shaft of which is attached a circular rubber or eraser. A flexible cord and plug provide for connections to an electric

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circuit. They are used chiefly in large drafting rooms. Here the device may be hung from a trolley so as to serve conveniently a number of tables. For alterations in tracings, where there may be a considerable amount of erasing to be done, the work done by hand is slow and fatiguing, particularly to the women tracers often employed in the larger drafting rooms, and the motor-driven eraser is then a valuable convenience and time saver.

Manufacturers:

Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

ERECTORS, POLE.—The work of raising poles and setting them into the holes is greatly facilitated by an erector. These machines are made with a derrick and equipped to lift the pole bodily by chains attached at its center of gravity, swinging it to the hole prepared for it and lowering it into position. They are often mounted on a truck or other movable carriage.

Manufacturer:

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

ERFMANN.—Trade name for feed water regulators manufactured by the Neptunus Ship Supply Co., Inc., 73 Front St., New York, N. Y.

ERG.—The absolute or C. G. S. unit of work is the erg. It is defined as the work done by a force of one dyne acting through a distance of one centimeter. This is a small unit and 10^7 ergs, called the joule, is the practical scientific unit; the common work unit, the foot-pound, equals 13,562,600 ergs.

ERICKSON.—Trade name for conduit couplings manufactured by the Thomas & Betts Co., 63 Vesey St., New York, N. Y.

ERICSSON MFG. CO.—Buffalo, N. Y. Manufacturer of lightning arresters.

ERIE.—Trade name for switchboard fittings manufactured by the Erie Electrical Equipment Co., Johnstown, Pa.

ERIE.—Trade name for electric hoists manufactured by the Erie Hoist Co., 1908 Holland St., Erie, Pa.

ERIE.—Trade name for electric pumps and steam engines manufactured by the Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y.

ERIE.—Trade name for electric traveling cranes manufactured by the Erie Steel Construction Co., 615 Haybarger Lane, Erie, Pa.

ERIE BALL ENGINE CO.—Pittsburgh, Pa. Manufacturer of steam engines. President, H. D. Wilson; vice-president, F. B. McBrier; secretary, R. J. Wilson; treasurer, B. F. Harris; sales manager, W. T. Greenleaf. Main office, 2 Ross St., Pittsburgh, Pa. Branch offices, 621 Commercial Trust Bldg., Philadelphia, Pa.; 132 Nassau St., New York, N. Y.; 476 Kirby Bldg., Cleveland, Ohio; 1540 Monadnock Block, Chicago, Ill.

ERIE CITY IRON WORKS.—Erie, Pa. Manufacturer of boilers, tanks and engines. Business established 1840. President, George D. Selden; vice-president, E. P. Selden; secretary, George T. Bliss; treasurer, Edward C. Moore; sales manager, F. C. Burton.

ERIE ELECTRICAL EQUIPMENT CO.—Johnstown, Pa. Manufacturer of switchboard fittings. H. A. Selah, treasurer and general manager. Main office and factory, Johnstown, Pa. Branch offices, New York, N. Y.; Chicago, Ill.; Boston, Mass.; San Francisco, Cal.; Minneapolis, Minn.; Cleveland, Ohio; Los Angeles, Cal.; Philadelphia, Pa.; Buffalo, N. Y.; St. Louis, Mo.; Seattle, Wash.; Terre Haute, Ind.

ERIE FORGE & STEEL CO.—Erie, Pa. Manufacturer of steel forgings and castings.

ERIE HOIST CO., THE.—1908 Holland St., Erie, Pa. Manufacturer of electric hoists and winches. Business established 1874. President, H. Hagenlacher.

ERIE PUMP & ENGINE WORKS.—139 Glenwood Ave., Medina, N. Y. Manufacturers of electric pumps and steam engines. Business established 1889. President, A. L. Swett; vice-president, C. S. Swett; secretary, F. M. Poler; treasurer and general manager, R. F. Swett. Sales representatives, American Hardware & Equipment Co., Charlotte, N. C.; Davant Machinery & Equipment Co., Roanoke, Va.; Joseph H. Hewetson, Cincinnati, Ohio; William Hale & Co., Minneapolis, Minn.; Leighton Supply Co., Fort Dodge, Iowa; Northern Equipment Co., Erie, Pa.; M. L. O'Fallon Supply Co., Denver, Colo; Otto C. Reymann, Philadelphia, Pa.; Standard Sanitary Mfg. Co., Cleveland, Ohio; Royal C. Wise, 53 W. Jackson Blvd., Chicago, Ill.

ERIE STEEL CONSTRUCTION CO.—615 Haybarger Lane, Erie, Pa. Manufacturer of electric traveling cranes and structural steel. President, G. H. Strayer; vice-president, George R. Metcalf; secretary, treasurer and general manager, William C. Hoffman; sales manager, Macdonald S. Reed. Sales representatives, A. D. Granger Co., 15 Park Row, New York, N. Y.; Fairbanks Co., Pittsburgh, Pa.; 701 W. Washington Blvd., Chicago, Ill.

ERIE TOOL WORKS, THE.—11th & French Sts., Erie, Pa. Manufacturer of electricians', steamfitters', plumbers' and machinists' tools. Business established 1902. President, Frank W. Bacon; vice-president, E. Warner Bacon; secretary, DeWitt Bull; treasurer, A. M. Kite; sales manager, H. F. Milne.

ERIKSON ELECTRIC CO., L.—6 Portland St., Boston, Mass. Manufacturer of lighting reflectors and fixtures. Business established 1895. Leonard Erikson, owner.

ERMET MFG. CO.—Indianapolis, Ind. Manufacturer of storage batteries. Business established 1920. President, Norman Metzger; vice-president and treasurer, Joseph Erpelding; secretary, Alex Metzger. Main office and factory, 16th St. & Sherman Drive, Indianapolis, Ind. Branch office, 521 Stevens Bldg., Detroit, Mich.

ERNST, CHARLES K.—999-1007 E. Ferry St., Buffalo, N. Y. Manufacturer of motor-driven ash hoists and elevators.

ERUSA.—Trade name for belt dressing manufactured by the Cling-Surface Co., 1032-48 Niagara St., Buffalo, N. Y.

ESCALATORS.—See Stairways or escalators, moving, motor-driven.

ESCO.—Trade name for electric bottle washer manufactured by the Electric Specialty Co., Stanford, Conn.

ESLER ELECTRIC MFG. CO.—Delphi & Western Aves., Marion, Ind. Manufacturer of switches and current taps. Samuel M. Esler, sole owner.

ESROBERT.—Trade name for portable electric lamps and conduit fittings manufactured by S. Robert Schwartz & Bro., 729-31 Broadway, New York, N. Y.

ESSCO.—Trade name for lamp guards manufactured by the Electric Service Supplies Co., 17th & Cambrai Sts., Philadelphia, Pa.

ESSENTIALITE.—Trade name for welder's lenses manufactured by the Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

ESSEX.—Trade name for cartridge fuses manufactured by the Essex Mfg. Co., 117 Mulberry St., Newark, N. J.

ESSEX MFG. CO.—117 Mulberry St., Newark, N. J. Manufacturer of cartridge fuses, automobile and metal specialties. Business established 1917. President, treasurer and general manager, William H. Neefus; vice-president and secretary, John D. Neefus.

ESSEX RUBBER CO.—Trenton, N. J. Manufacturer of molded soft rubber products. President and general manager, C. H. Oakley; vice-president, F. N. Hamerstrom; secretary, A. E. Moon; treasurer, Owen Moon, Jr. Main office and factory, Trenton, N. J. Branch offices, 258 Broadway, New York, N. Y.; 58 Lincoln St., Boston, Mass.; 179 N. Wells St., Chicago, Ill.

ESSEX STORAGE BATTERY & SUPPLY CO., INC.—279-81 Halsey St., Newark, N. J. Manufacturer of magnetizers, testing sets and battery connectors. President, Geoffrey Simon; vice-president, treasurer and general manager, H. H. Lippe; secretary, M. T. Lippe; sales manager, L. R. Korn.

ESTATE.—Trade name for electric ranges, heaters and hot plates manufactured by the Estate Stove Co., Hamilton, Ohio.

ESTATE STOVE CO., THE.—Hamilton Ohio. Manufacturer of electric ranges, hot plates and radiators. Business established 1845. President, Felix Kahn; vice-president, Lazard Kahn; secretary and general manager, David F. Kahn; treasurer, Samuel Kahn; sales manager, Albert M. Kahn.

ESTES & SON, E. B.—362-364 5th Ave., New York, N. Y. Manufacturer of wood handles, boxes, cabinets and other wood specialties for electrical purposes. Business established 1867. President, Joseph B. Estes; vice-president and general manager, Elwood W. Hannas; secretary, George C. Wing; treasurer, Webster C. Estes; sales manager, Thomas A. Bradley. Factories, Hancock, Mass.; Farmington, Me.; Gorham, N. H.

ESTERLINE-ANGUS CO., THE.—Indianapolis, Ind. Manuufacturer of curve-drawing instruments. President, J. W. Esterline; secretary, treasurer and general manager, D. J. Angus. Main office, 227 E. South St., Indianapolis, Ind. Branch offices, 15 Park Row, New York, N. Y.; 929 Chestnut St., Philadelphia, Pa.; 950 Ellicott Sq., Buffalo, N. Y.; 1st National Bank Bldg., Pittsburgh, Pa.; 323 Ohio Bldg., Akron, Ohio; 19 S. Wells St., Chicago, Ill.; Broad & Hunter Sts., Atlanta, Ga. District offices, 307 1st National Bank Bldg., Cincinnati, Ohio; 1202 Illuminating Bldg., Cleveland, Ohio; 805 Ford Bldg., Detroit, Mich.; Brown-Marx Bldg., Birmingham, Ala.; 2046 Railway Exchange Bldg., St. Louis, Mo.; 141 Milk St., Boston, Mass.; 643 Wells Bldg., Milwaukee, Wis.; Gas & Electric Bldg., Denver, Colo.; Walker Bank Bldg., Salt Lake City, Utah; 325 Yesler Way, Seattle, Wash.; 536 Call Bldg., San Francisco, Cal.; 305 Metropolitan Bank Bldg., Minneapolis, Minn. Sales representative, J. W. Murphy Co., 108 S. LaSalle St., Chicago, Ill.

ETCHOGRAPH.—Trade name for electric engravers manufactured by the William Brewster Co., Inc., 30 Church St., New York, N. Y.

ETHER.—Light, heat waves and electric waves are found to be transmitted through space which is free from matter. All three phenomena are found to be periodic in character and to travel through space with the astonishing velocity of 186,000 miles per second. The wave length and the frequency of vibration has been determined for each experimentally.

It is obvious that waves cannot travel without a medium to transmit them. Since ordinary matter is not necessary for their propagation, a medium is assumed to exist which cannot be removed from any portion of space, which pervades matter as water fills a sponge and which has the properties necessary to enable electromagnetic waves to travel through it at high velocity. This medium has been called the ether.

This medium apparently offers no resistance to the passage of matter through it. Many ingenious experiments have been made to find out whether the ether is at rest, or is carried along by moving matter. The results of these experiments lead to the conclusion that the ether is not fixed in space with bodies moving through it, but travels more or less rapidly with moving bodies.

The ether is also believed to serve as a medium for the action of electric forces between charged bodies and for magnetic forces in the vicinity of magnets and electric currents. While we have no direct evidence, it seems reasonable that the same ether may serve to transmit the force of gravitation.

ETNA ELECTRIC WORKS.—410 E. 15th St., New York, N. Y. Manufacturer of electrical measuring instruments. Business established 1902. Theodore Reyman, proprietor.

ETRURIAN.—Trade name for boudoir lamps manufactured by the Highlands Mfg. Co., Muncie, Ind.

ETTCO.—Trade name for armored cable and flexible nonmetallic conduit manufactured by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y.

ETTE.—Trade name for pole-line hardware manufactured by the St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

EUCLID CRANE & HOIST CO., THE.—Euclid, Ohio. Manufacturer of electric cranes and hoists. Business established 1907. President, treasurer and general

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manager, G. A. Armington; vice-president, H. C. Hutchinson; secretary and sales manager, W. White. Sales representatives, F. E. Tyng, 50 Church St., New York, N. Y.; Factory Products Co., 203 Oliver Bldg., Pittsburgh, Pa.; C. E. Stamp Co., Citizens Bldg., Cleveland, Ohio; Dyer & Young, 421 Harris Trust Bldg., Chicago, Ill.; A. E. Kendall, 502 Bearinger Bldg., Saginaw, Mich.; American Transmarine Co., Rialto Bldg., San Francisco, Cal.; Western Engineering Sales Co., 407 E. 3rd St., Los Angeles, Cal.

EUPHONA.—Trade name for electrically operated piano manufactured by the Cable Co., 301 S. Wabash Ave., Chicago, Ill.

EUREKA.—Trade name for bells and buzzers manufactured by the Ansonia Electrical Co., Ansonia, Conn.

EUREKA.—Trade name for packing for steam engines, pumps, compressors, etc., made by the Eureka Packing Co., 78 Murray St., New York, N. Y.

EUREKA.—Trade name for fiber insulators and insulated nails made by the Eureka Supply Co., Sewell, N. J.

EUREKA.—Trade name for electric vacuum cleaners made by the Eureka Vacuum Cleaner Co., Greenwood & Dewey Aves., Detroit, Mich.

EUREKA.—Trade name for soldering flux manufactured by the Grasselli Chemical Co., Cleveland, Ohio.

EUREKA.—Trade name for lamp guard manufactured by the Hamblin & Russell Mfg. Co., Worcester, Mass.

EUREKA.—Trade name for telegraph sets manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

EUREKA.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

EUREKA.—Trade name for motor-driven ice cream freezers manufactured by Thomas Mills & Brother, 1301 N. 8th St., Philadelphia, Pa.

EUREKA.—Trade name for switch and terminals manufactured by Frank W. Morse, 291 Congress St., Boston, Mass.

EUREKA.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

EUREKA.—Trade name for storage batteries manufactured by the Storage Battery & Appliance Corp., Philadelphia, Pa.

EUREKA BATTERY CO.—1254 Addison St., Chicago, Ill. Manufacturer of storage batteries.

EUREKA CO.—North East, Pa. Manufacturer of commutator bars, rings and segments, trolley wheels, trolley ears, line material, controller fingers, etc.

EUREKA PACKING CO.—78 Murray St., New York, N. Y. Manufacturer of packing for steam engines, flanges, cylinders, compressors, etc. Business established 1878 President, secretary and general manager, James L. Robertson, Jr.; treasurer and sales manager, Frank Robertson.

EUREKA STONE & MARBLE CO.—179 W. Maple St., Columbus, Ohio. Manufacturer of moisture-proof switchboards.

EUREKA SUPPLY CO.—Sewell, N. J Manufacturer of battery boxes, cable hangers, fiber insulators and insulated nails. Business established 1909. Thomas E. Burrough, proprietor; H. B. Simpson, general manager.

EUREKA VACUUM CLEANER CO.—Detroit, Mich. Manufacturer of electric vacuum cleaners. Business established 1908. Vice-president and general manager of manufacturing division, E. R. Field; secretary and treasurer, P. A. Barnard; vice-president and general manager of sales, A. L. McCarthy; vice-president and general manager, V. W. Young. Main office, Greenwood & Dewey Aves., Detroit, Mich. Factories, Detroit, Mich., and Kitchener, Ont. Branch offices and warehouses, 62 E. Monroe St., Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; 12 E. 42nd St., New York, N. Y.; San Francisco, Cal.; Kitchener, Ont., Can.

EVANS, F. H.—31 Hewes St., Brooklyn, N. Y. Manufacturer of expansion bolts and pitch kettles.

EVANS & CO., INC., C. H.—187 Fremont St., San Francisco, Cal. Manufacturer of steam engines and electric and turbine driven pumps. Business established 1875. President, C. H. Evans; vice-president, W. W. Fairchild; secretary and general manager, C. W. Evans.

EVAPORATORS, LABORATORY TYPE ELECTRICALLY HEATED.—Evaporators for laboratory use are very often electrically heated as this method provides an easy and accurate control of the temperature. They are used for driving off excess moisture in various substances and for evaporating many different solutions. Such articles as sugar, glue, gelatine, potash, and many acids and extracts, etc., are evaporated in laboratory tests. The evaporators consist of a heating element placed within or under a metal container, the character of which depends on the solutions to be used. The solution is often agitated or circulated while being evaporated.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

EVAPORATORS, POWER PLANT.—Evaporators are used in power plants where the water supply is acid or contains salt and other impurities that would be very injurious to the boiler if such water was evaporated in it. Evaporators usually are built so that steam, either from the exhaust or direct from the boilers, is passed through a coil of pipe or around a large number of tubes. The impure water surrounding the coil or in the tubes is evaporated and must be condensed later, at which time it will be free from its impurities and may safely be used in the boiler.

Evaporators are used where it is found more economical to distill the water than to use so-called boiler compounds or install what are called water-softening plants. Evaporators require considerable condensing water and are used only where there is abundant water available for this purpose, even though it is impure. Since the water fed to the boilers is all distilled, whether it comes from the evaporator or from the surface condenser that has condensed the exhaust steam from the turbines or engines, the boilers can operate under the best conditions. The water is used over and over again, so that the evaporator has to supply only enough distilled water to make up for leakage or other losses as a rule.

Manufacturers:

Griscom-Russell Co., The, 2141 West Street Bldg., New York, N. Y.
Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y.
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa. "S & K."
Swenson Evaporator Co., 945 Monadnock Block, Chicago, Ill. "Swenson."
Wheeler Condenser & Engineering Co., Carteret, N. J. "Lillie."

EVELAND ELECTRIC RIVETER CO.—509 West End Trust Bldg., Philadelphia, Pa. Manufacturer of electric riveting and rivet heating machines, spot welders and welding transformers. President, S. S. Eveland.

EVER-HOT.—Trade name for soldering iron manufactured by the Products Corp., Maywood, Ill.

EVEREADY.—Trade name for storage batteries, flashlights and electrical measuring instruments manufactured by the American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y.

EVER READY.—Trade name for cable bender manufactured by B. S. Barnard & Co., 31 Union Sq., New York, N. Y.

EVER READY.—Trade name for porcelain knobs manufactured by the Davidson Porcelain Co., East Liverpool, Ohio.

EVER-READY.—Trade name for heating pads manufactured by the Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn.

EVER SO NEW.—Trade name for lighting fixtures manufactured by C. G. Everson & Co., 70 W. Lake St., Chicago, Ill.

EVERETT.—Trade name for chains manufactured by the Clinton E. Hobbs Co., 30-35 Pearl St., Boston, Mass.

EVERLAST STANLICO.—Trade name for commercial lighting unit manufactured by the Standard Light Co., 448 E. Water St., Milwaukee, Wis.

EVERLASTING.—Trade name for power transmission belting manufactured by N. Palmer & Co., Bridgeport, Conn.

EVERLASTING VALVE CO.—New York, N. Y. Manufacturer of valves. Business established 1907. President, John H. Allen; vice-president and secretary, William F. Madill; treasurer, Conrad H. Koellhoffer. Main office, 2 Rector St., New York, N. Y. Factory, Jersey City, N. J. Branch offices, 1414 Continental Trust Bldg., Baltimore, Md.; 804 Kanawha St., Charleston, W. Va.; Easton, Pa.; 421 Wood St., Pittsburgh, Pa. Sales representatives, Scully Steel & Iron Co., 24th St. & Ashland Ave., Chicago, Ill.

EVERLITE.—Trade name for lighting plants manufactured by the Everlite Co., 928 S. 3rd St., Minneapolis, Minn.

EVERLITE CO.—Minneapolis, Minn. Manufacturer of farm lighting plants. President and general manager, F. D. Peabody; vice-president and sales manager, W. G. Shaw; secretary and treasurer, Fred Barts. Main office, 928 S. 3rd St., Minneapolis, Minn. Branch office, 44 Whitehall St., New York, N. Y.

EVERSON & CO., C. G.—70 W. Lake St., Chicago, Ill. Manufacturers of lighting fixtures. Business established 1904. President and general manager, C. G. Everson; vice-president and treasurer, R. B. Everson; secretary, J. B. Skully; sales manager, J. P. Cade.

EVERSTICK ANCHOR CO.—St. Louis, Mo. Manufacturer of guy anchors.

EVERTITE.—Trade name for boiler covering manufactured by the Excello Mfg. Co., Cleveland, Ohio.

EVINRUDE MOTOR CO.—279 Walker St., Milwaukee, Wis. Manufacturer of oil engines and magneto generators.

EVOLUTION PHONE CO., INC., THE.—48 Greenwich Ave., New York, N. Y. Manufacturer of hearing devices for the deaf, telephones and parts. Business established 1914. President, secretary and general manager, Herman G. Pape; treasurer, Ida B. Pape.

EWART.—Trade name for friction clutches and link-belt manufactured by the Link-Belt Co., 329 W. 39th St., Chicago, Ill.

EXCAVATORS OR SHOVELS, ELECTRIC.—Electric shovels are generally used where there is some convenient source of power, as for electric railway rehabilitation or extensions, or when laying an additional track for which the trolley is installed before the track; also for the construction of canals, ditches, etc., along or near transmission lines. They are built very much in the same way as the common steam shovel except that the steam engine, boiler and related machinery are replaced by the more compact electric motors and controlling devices. Three motors are generally used; two to hoist and to swing the boom, and a thrust motor which holds the dipper against the bank during the digging operation. The swing and hoist motors are located in the cab. The thrust motor is mounted on the boom. Through reducing gears it communicates its motion to a pinion which engages a rack on the staff. Magnetic contactor control is generally provided for the motors, though the thrust motor is sometimes operated with an ordinary drum controller. To prevent injury to the hoist and thrust motors when stalled by digging too deeply, or striking an obstruction, a notching-back arrangement is provided which automatically cuts resistance into the circuit when the current exceeds a certain limiting value.

Manufacturers:

Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Bucyrus Co., South Milwaukee, Wis. "Bucyrus."
Keystone Driller Co., Beaver Falls, Pa. "Keystone."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P & H."
Sauermann Bros., 53 W. Jackson Blvd., Chicago, Ill.
Thew Automatic Shovel Co., Lorain, Ohio (shovels).

EX-CEL BATTERY WORKS, INC.—1502 S. Wabash Ave., Chicago, Ill. Manufacturer of storage batteries. President and general manager, Stephen Keller; vice-president and treasurer, M. Keller; secretary, P. H. Hahm.

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EXCELITE.—Trade name for lighting fixtures manufactured by the Commercial Excelite Co., Inc., 312 N. Eutaw St., Baltimore, Md.

EXCELITE.—Trade name for lighting unit for commercial use manufactured by the Lightolier Co., 569-71 Broadway, New York, N. Y.

EXCELLO MFG. CO., THE.—Cleveland, Ohio. Manufacturer of boiler coverings and protective paints. President, treasurer and general manager, J. M. Aarons; vice-president, B. M. Wise; secretary, A. B. Aarons.

EXCELSIOR.—Trade name for motor-driven polishing machines, presses, punches, etc., manufactured by the Excelsior Tool & Machine Co., East St. Louis, Ill.

EXCELSIOR.—Trade name for nickel anodes manufactured by the General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

EXCELSIOR.—Trade name for telegraph sets and accessories manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

EXCELSIOR.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

EXCELSIOR.—Trade name for motor-driven ice cream freezers manufactured by Thomas Mills & Brother, 1301 N. 8th St., Philadelphia, Pa.

EXCELSIOR.—Trade name for electric disc stoves manufactured by the Perfection Electric Products Co., New Washington, Ohio.

EXCELSIOR LEATHER WASHER MFG. CO., INC.—921 W. State St., Rockford, Ill. Manufacturer of spark plugs, fiber and leather washers, felt cushions, gaskets, etc. President, J. A. Johnson.

EXCELSIOR TOOL & MACHINE CO.—East St. Louis, Ill. Manufacturer of motor-driven grinding and polishing machines, presses, punches, etc. President, T. F. Philipp; vice-president, Frank Geppert; secretary, Paul Schlafly.

EXCESS INDICATORS.—See Indicators, excess demand.

EXCHANGE, TELEPHONE.—A telephone exchange is a switchboard with lines, telephones and related apparatus for the purpose of enabling any subscriber to talk with any other subscriber. It may have one office (single-office exchange) or several offices (multioffice exchange). There are several kinds of telephone exchanges, as follows:

Public Exchange. A telephone exchange which serves the telephone needs of the public in general.

Private Exchange. A telephone exchange which serves the telephone needs of one business concern, factory, residence, apartment house, institution, etc., and has no outside connection.

Private Automatic Exchange. (Abbreviated P. A. X.) An automatic exchange which serves one business concern, etc., and has no connection to a public exchange.

Private Branch Automatic Exchange. An automatic exchange for the use of one concern but which has trunks to the public exchange. It is a private branch exchange which is automatic instead of manual.

Private Branch Exchange. (Abbreviated P. B. X.) This is a private telephone exchange, serving one subscriber, business house, factory, apartment house, public building, etc., but which has also trunk lines connecting it to the public exchange.

EXCITATION.—The act of producing and maintaining the magnetic field of dynamo-electric machines, or the state of having such a field. Also see Excite.

EXCITE.—To produce and maintain the magnetic field of dynamoelectric machines and static transformers. Generators may be (1) self-excited by taking a part or all of their current through the shunt or series field windings, respectively, or (2) separately excited by current from more or less independent sources, commonly other generators called exciters. Direct-current generators are usually self-excited, exceptions being very low or very high-voltage machines; while alternating-current generators are practically always separately excited, induction generators excepted. Motors are generally excited from the same source as that from which they receive the electric power which is converted into mechanical power. An exception exists in the case of the synchronous motor in which separate d-c. excitation is employed. Also see Generators, excitation, or exciters.

EXCITERS.—See Generators, excitation, or exciters.

EXCITING CURRENT, TRANSFORMER.—This is the no-load current of a transformer; it is the current needed to maintain the magnetic flux when no secondary current is flowing. This is also considered as a practically constant component of the primary current for all loads.

EXHAUST.—Trade name for car ventilators manufactured by the J. G. Brill Co., 62nd St. & Woodland Ave., Philadelphia, Pa.

EXHAUSTERS.—See Fans, exhaust or ventilating.

EXIDE.—Trade name for storage batteries manufactured by the Electric Storage Battery Co., 19th St. & Allegheny Ave., Philadelphia, Pa.

EXIT SIGNS.—See Signs, electric, exit and entrance.

EXOLON CO.—Blasdell, N. Y. Manufacturer of electrically produced abrasives, refractories and cements. Business established 1914. President, Dr. H. T. Kalmus; vice-president, secretary, treasurer and general manager, W. A. Harty; sales manager, C. R. Fletcher. Factories, Thorold, Ont., Can., and Blasdell, N. Y. Branch office, Thorold, Ont., Can.

EXOTHERMIC REACTION.—An operation which, proceeding by itself, evolves heat. Such is the condensation of a vapor, or the freezing of a liquid which always evolve heat. More strictly, a chemical reaction is meant, such as the combustion of carbon, oxidation of a metal, burning of gun-powder, and the majority of chemical combinations. It is contrasted with endothermic reaction (which see) that consumes heat.

EXPANSION JOINTS, COPPER BUS.—Under overload conditions busbars are subject to considerable heating with a resultant linear expansion. This expansion, unless some means of equalizing it is provided, may result in displacing the bar or seriously damaging the supporting insulators or other equipment rigidly fastened to the bar. To equalize this expansion and prevent such damage a bus expansion joint is used. This joint is made up of laminations of copper strip bent into an open loop shape to allow free linear movement to the busbars, the joint being bolted to the ends of the two stacks of bars, sufficient space having been allowed for the joint.

Manufacturers:

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

EXPANSION JOINTS FOR STEAM, WATER, ETC., PIPE LINES.—The wide changes in temperature to which pipe lines are sometimes subjected causes material variation in the length of the line which may result in breaking fittings or causing leaks in the line. To prevent this damage expansion joints capable of absorbing this change in length are placed in the line. These joints are often made of corrugated seamless copper tube. If the variation in length which the joint must equalize is great, the tube must have several corrugations. This may result in an uneven distribution of stress in the tube and break it, so this type of joint is sometimes provided with rings which fit over the troughs in the corrugations and equalize the stress over the joint.

Manufacturers:

Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y. "Wainwright."

American District Steam Co., N. Tonawanda, N. Y. "Adsco."

Badger & Sons Co., E. B., 75 Pitts St., Boston, Mass. "Badger."

Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

Griscom-Russell Co., 2141 West St., Bldg., New York, N. Y.

Lunkenheimer Co., The, Cincinnati, Ohio.

Walworth Mfg. Co., Boston, Mass. "Walmanco."

Waterbury Mfg. Co., Waterbury, Conn.

Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa.

Williams Valve Co., D. T., Cincinnati, Ohio.

EXPANSION OR ANCHOR BOLTS, SCREWS, SHELLS, SHIELDS AND SLEEVES.—Expansion or anchor bolts are a special form of bolt or screw for fastening in concrete, stone, brick or other hard or brittle substance. A hole is drilled in the material and the bolt inserted; the hole is often made of larger diameter in the interior than at the mouth. This bolt consists of two parts, an ordinary screw or bolt and one or two expanding sleeves. When the bolt or screw is tightened the sleeve is forced to expand, usually by wedge action, and firmly grips the sides of the hole. These devices are sometimes encased in a lead shield to increase their power to grip irregular surfaces. The screw type commonly has one sleeve, the bolt type two. Both are made in a great variety of forms, many patented, and marketed under various names, as shells, shields, sleeves, etc. Their uses are very numerous and include the fastening of cable and trolley-wire hangers and span anchors in mines, mounting of insulators, conduit and pipe hangers and other supports in solid masonry and concrete walls and ceilings, etc.

Manufacturers:

Ackerman-Johnson Co., 625 W. Jackson Blvd., Chicago, Ill.

American Expansion Bolt Co., 4077 Park Ave., New York, N. Y.

Barnard & Co., B. S., 31 Union Sq., New York, N. Y. "Hercules."

Barrett Sales Co., 568 W. Washington Blvd., Chicago, Ill. "Duplex."

Brohard Co., Philadelphia, Pa. "Climax."

Brush Nail Expansion Bolt Co., Greenwich, Conn.

Chicago Expansion Bolt Co., 324 W. Washington St., Chicago, Ill.

Chicago Nut Co., 2513 W. 20th St., Chicago, Ill. "Ajax."

Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Diamond N-Y," "Keystone," "Di-En-Key."

Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.

Evans, F. H., 31 Hewes St., Brooklyn, N. Y. "Crescent."

Fee & Mason, 81 Beekman St., New York, N. Y.

Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."

HUBBARD & CO., Pittsburgh, Pa. Peirce lead sleeve expansion bolts, galvanized. The Peirce expansion bolt is one with which any article may be economically and securely fastened to brick, stone or concrete surfaces. It is unsurpassed for holding power and the ease with which it can be set. It consists of a steel bolt with a wedge-shaped head tapering toward the shank and provided with a soft lead sleeve. To install it, a hole is drilled in the masonry, the bolt inserted head first, and the lead sleeve driven or swaged back upon the wedge-shaped head. The



Peirce Expansion Bolt

lead sleeve is thus compressed into every crevice of the masonry; and the greater the outward load put upon the bolt, the greater becomes the compression upon the lead and the tighter it grips the surrounding wall. That this is not theory, but a proven fact, was demonstrated by the Electrical Department of the City of Chicago when tests were made of all expansion bolts on the market. The Peirce bolt held six times the load of its nearest competitor, the testing apparatus registering an outward pull of 3,015 lbs., when the shank of the ¼-in. bolt broke, leaving the head still imbedded. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

Lanz & Sons, Mathew, Pittsburgh, Pa.

McCabe Hanger Mfg. Co., 426-428 W. 25th St., New York, N. Y.

National Lead Co., 111 Broadway, New York, N. Y. "Cinch."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

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Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Paine Co., The, 1742 W. Van Buren St., Chicago, Ill. "Never-Give-Up."
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
Savage Expansion Bolt Corp., 10 Desbrosses St., New York, N. Y. "Savage."
Stannard Mfg. Co., 379 Allen St., Springfield, Mass. "Little Giant."
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."
U. S. Expansion Bolt Co., 139 Franklin St., New York, N. Y. "USE."
Van Expansion Bolt Mfg. Co., 53 W. Jackson Blvd., Chicago, Ill. "Van."

EXPLORING COILS.—Exploring coils are testing instruments used to determine the location of faults in cables installed in underground conduit systems and occasionally for overhead suspended telephone cables. It consists merely of a flat coil of a great many turns having no magnetic material in its core. It is arranged to connect to a pair of telephone receivers. When a current of rather high frequency is passed through the cable, the coil, if carried along over the conduit line, will have a current induced in it and will give a sound in the receivers. The sound will stop when the fault is reached. For an overhead cable the coil may be carried on a pole so as to bring it near to the cable. These coils with their auxiliaries are sometimes called fault finders.

Manufacturers:

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Simon, Emil J., 217 Broadway, New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

EXPERT.—Trade name for hacksaws manufactured by the Napier Saw Works, Inc., Springfield, Mass.

EXPORTS, ELECTRICAL.—Exports of electrical machinery, appliances and supplies from the United States to foreign countries have, with but comparatively few exceptions, made gradual advances year by year for the past 20 years. Soon after the outbreak of the World War electrical exports received a tremendous impetus which has continued unabated until the first few months of 1921. Whereas previously electrical exports in any considerable quantities were concentrated on a comparatively few products for which American manufacturers were especially noted, beginning with the latter part of 1914 all electrical products were in demand, a marked increase being shown for all classifications recorded by the Department of Commerce.

Electrical exports for 1913 were $28,197,368. For 1918 exports of American electrical products reached the imposing figure of $59,983,606. During the 12 months of 1919 these exports amounted to $89,089,711, and for 1920, $101,990,075, the latter being the highest in the history of the country. It will be seen that even since the close of the war the demand has steadily continued and it is expected that as soon as the exchange situation improves exports will make additional increases. While there will undoubtedly be a lessening in demand on the part of the countries with whom we were associated in the war, and to whom the largest percentage of products were shipped during the past few years, the re-establishment of trade relations with central Europe and especially Russia will tend to maintain the volume far above prewar figures.

The following figures give the value of electrical exports for the years 1919 and 1920, divided as to products.

	1920	1919
Batteries	$ 6,633,542	$ 5,998,337
Carbons	1,477,831	1,391,765
Dynamos and generators	7,952,935	5,799,885
Fans	1,364,742	1,421,160
Heating and cooking apparatus	1,801,127	1,579,757
Insulated wire and cables	8,208,539	8,815,212
Interior wiring supplies, including fixtures	3,386,068	2,319,498
Lamps—		
Arc	26,717	16,836
Incandescent—		
Carbon filament	114,542	202,590
Metal filament	4,050,549	4,674,317
Magnetos, spark plugs, etc.	3,601,419	3,034,775
Meters and measuring instruments	2,676,538	2,891,807
Motors	13,265,181	10,635,476
Rheostats and controllers	707,719	514,760
Switches and accessories	4,438,773	3,564,772
Telegraph apparatus, including wireless	713,798	830,887
Telephones	3,898,987	3,783,398
Transformers	4,803,158	3,787,851
All other	32,867,910	27,827,128
Total	$101,990,075	$89,089,711

The value of electrical exports for the first four months of 1921 is shown in the following figures:

January	$15,332,955
February	13,632,478
March	9,787,160
April	9,085,598

The total for these months is $47,838,191. If this average should be maintained during the remaining 8 months of the year, the total for 1921 would be about $143,515,000. It is interesting to compare this estimate and the values for 1919 and 1920 with the exports of preceding years. The totals for the calendar years from 1912 to 1921 are given below.

1912	$23,212,813
1913	28,197,368
1914	19,963,115
1915	24,308,510
1916	40,244,075
1917	55,478,079
1918	59,983,606
1919	89,089,711
1920	101,990,075
1921 (estimated)	143,515,000

The explanation of the tremendous increase in electrical exports to the Allies was due to two principal causes. First, every available manufacturing plant in those countries was devoted to the manufacture of munitions, hence the local supplies of electrical products were soon exhausted. Secondly, the urgent need for the conservation of fuel and labor resulted in a widespread adoption of electricity in all walks of life, resulting in an abnormal local demand entirely aside from war needs.

The Department of Commerce, through its Bureau of Foreign and Domestic Commerce, is giving a great deal of study to the expanding of export trade and is prepared to furnish interested manufacturers with such information as has thus far been collected. Through the American Counsular Service, a great deal of information is secured regarding markets and sales possibilities in foreign countries. The Daily Commerce Reports published by the Bureau of Foreign and Domestic Commerce contains adequate summaries of the trade activities of the consular agents. The Bureau has also published many special reports covering special industries, including the electrical. There are also numerous foreign-trade associations and a number of American publications devoted especially to the export field.

EXPRESS.—Trade name for spark plugs manufactured by the Express Spark Plug Co. of America, Westory Bldg., Washington, D. C.

EXPRESS.—Trade name for electric blueprinting machines manufactured by Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

EXPRESS SPARK PLUG CO. OF AMERICA.—Westory Bldg., Washington, D. C. Manufacturer of spark plugs. Business established 1911. President, E. J. Quinn; vice-president, John Loughran; secretary, W. C. Prentiss; treasurer, F. C. Plugge; general manager, C. H. Neely; sales manager, James North. Factory, Alexandria, Va. Sales representatives, Graham & Berwin, New York, N. Y.; General Sales Co., Philadelphia, Pa.; Automatic Specialty Co., Chicago, Ill.; Express Spark Plug Co. of Iowa, Des Moines, Ia.; W. A. Wallace & Co., Seattle, Wash.; Spokane Battery & Ignition Co., Spokane, Wash.; Littlefield Rubber Co., Denver, Colo.

EXPULSION FUSES.—See Fuses, high-tension expulsion.

EXTENSION BELLS.—See Bells, extension telephone.

EXTENSION SOCKETS OR SOCKET EXTENSIONS.—See Adapters, reducers and extensions, socket.

EXTENSIONS, SOCKET.—See Adapters, reducers or extensions, socket.

EXTINGUISHERS, FIRE.—See Fire extinguishers.

EXTRA BEST BEST IRON WIRE.—A commonly used trade name for the highest quality iron telegraph and telephone line wire. Usually abbreviated EBB. It is superior to what are called Best and Best Best wires. For manufacturers, see Wire, iron line.

EXTRACTORS, MOTOR-DRIVEN.—Motor-driven extractors are often used in commercial and laboratory processes for separating substances or extracting the solid or suspended material in a solution by means of centrifugal force. The material is usually placed in a perforated container, which is rotated at a high speed. Any liquid material will be allowed to pass through the perforations while solid material is retained. Extractors can also be used to separate substances of different weight. In laundries it is found more economical to remove the bulk of the water from clothes that have been washed by means of extractors than by wringers. The latter require much handling of each piece and are destructive to buttons, whereas extractors drive off the water as effectively with practically no handling or damage. In the chemical industry extractors are widely used, often being called centrifugals. Special laboratory types are called centrifuges. See Centrifuges, electric; also Centrifugals, sugar, motor-driven.

Manufacturers:

Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.
Curtis, Estate of Albert B., Worcester, Mass. ("Curtis." oil extractor.)
GILLESPIE EDEN CORP., 7 Dey St., New York, N. Y. (See display adv. page 1296.)
Hepworth Co., S. S., 2 Rector St., New York, N. Y. "Mackintosh."
International Equipment Co., 352 Western Ave., Boston, Mass.
Munning & Co., A. P., Church St., Matawan, N. J.
Oakes Co., The Roland T., Holyoke, Mass.
Raymond Co., The, Saugatuck, Conn.
Standard Supply & Equipment Co., Cherry & 13th Sts., Philadelphia, Pa.
Willey Co., Inc., The, 1222 Race St., Philadelphia, Pa.

EXTRUDED BRASS, BRONZE, ETC.—The term "extruded" is applied to metals which, in a semi-plastic state, have been forced through steel dies by the use of hydraulic power at high pressure. In this way rods or bars of odd and irregular forms, but constant in cross section, are produced. The cross-sectional dimensions and the length limit the parts which may be thus extruded. Copper may also be extruded in sizeable compact sections.

Manufacturers:

American Brass Co., The, 414 Meadow St., Waterbury, Conn.

EYE COMFORT.—Trade name for indirect lighting fixtures manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

EYE MAGNETS.—In shops or factories where machine work on iron and steel is done, very often employees get flying iron and steel in their eyes. To remove these particles of steel a powerful electromagnet with a smoothly finished and polished pole piece is used. This eye magnet is brought

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up to the eye and the piece of iron or steel is quickly and safely removed by the magnet attracting it.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Watters."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

EYE SHIELD DIFFUSER.—Trade name for commercial lighting units manufactured by the Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind.

EYE SHIELDS, LAMP.—These are diffusing shields to protect the eyes from the glare of brilliant lamp filaments. Usually made of opal glass in the form of a dish or shallow cup (sometimes a ring) suspended a little below the incandescent lamp and supported either from the lamp bulb or the reflector. If closely fitting on the hemispherical tip part of the lamp, they are usually called lamp caps (see Caps, lamp).

Manufacturers:

Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

EYE TESTING LANTERNS.—See Opthalometers, also Optical test charts, electrically illuminated.

EYELETS FOR ELECTRICAL USE.—Metal eyelets are used in electrical apparatus to provide holes in insulating material through which wires may be drawn or to which terminals may be secured. Examples of this are on relays and electro-magnets, where the ends of the bobbin are perforated and fitted with eyelets or with an eyelet and soldering terminal combined, so that the terminals of the coil may be led out and secured to the metal material. Eyelets are also used on canvas and other fabric covers for electrical machinery.

Manufacturers:

WATERBURY BUTTON CO., THE, 935 So. Main St., Waterbury, Conn. Established 1812. This company makes eyelets for electrical use by automatic machinery, and is prepared to contract for as high as 100,000 per day per machine. They can be furnished in practically any metal, color or finish. Many products of a similar nature, for electrical use, such as terminals, ferrules, and such small metal parts can be made in any number, design, metal, color or finish. (See entry also under "Insulation, molded, miscel." and display adv. page 1328.)—Adv.

EYNON-EVANS CORP.—15th & Clearfield Sts., Philadelphia, Pa. Manufacturer of injectors, ejectors and other power plant specialties.

E-Z.—Trade name for telephone bracket manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

E-Z.—Trade name for welding compound manufactured by the Anti-Borax Compound Co., Fort Wayne, Ind.

E Z.—Trade name for electric hair cutters and vibrators manufactured by the Earl Mfg. Co., Inc., 4332 N. Gratz St., Philadelphia, Pa.

E.Z.—Trade name for combination hand and stationary and stationary conduit benders manufactured by the Henderson Electric Co., Ampere, N. J.

E-Z.—Trade name for electric scrubbing and polishing machines manufactured by the John Herr Mfg. Co., 44 N. 4th St., Philadelphia, Pa.

EZ-WAY.—Trade name for electric dishwashers, vegetable parers and other kitchen equipment manufactured by Redmon, Edgar & Redmon, 218 S. 1st St., W., Cedar Rapids, Iowa.

E-Z WIRE.—Trade name for wiring devices manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

F

F.—Symbol for frequency (f); also for electrostatic field intensity (F); also for magnetomotive force, but in this case usually the old English form F is used. —F. is the common abbreviation for Fahrenheit when giving any temperature on the Fahrenheit scale; sometimes the form Fahr. is used.—F is also the chemical symbol for the element fluorine.

FA.—Trade name for knife switches, switchboards, panelboards, steel cabinets and switchboard fittings manufactured by the Frank Adam Electric Co., 3650 Windsor Pl., St. Louis, Mo.

FABER.—Trade name for blowoff valves manufactured by the Elliott Co., Frick Bldg., Pittsburgh, Pa.

FABRICATED STEEL PRODUCTS CORP.—Leetonia, Ohio. Manufacturer of transformers, tanks and structural steel. Business established 1917. President and general manager, H. Lindemann; secretary, A. S. Keller; treasurer, V. C. Lambrecht. Main office and factory, Leetonia, Ohio. Branch office, 1102 Park Row Bldg., New York, N. Y.

FABRICS, OILED, INSULATING.—Thin white cotton, silk or linen fabrics are frequently coated with two or more applications of pure linseed oil which oxidizes and forms a smooth surface. Occasionally heavier fabrics, such as duck, etc., are treated in the same way. The insulating properties are dependent upon the impregnating oil or compound used, and the dielectric strengths vary from 23,600 to 30,000 volts per mm. for duck, 29,500 to 47,000 for cotton, 49,000 to 54,000 for linen, and 43,300 to 57,000 for silk. (Also see Cloth insulating, miscellaneous).

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Good Mfg. Co., 160 N. Wells St., Chicago, Ill.
Mica Insulator Co., 68 Church St., New York, N. Y. "Empire."
Mica Insulator Co., Victoriaville, Que., Can.
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Standard Insulation Co., Rutherford, N. J. "Sico."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FABRIKOID.—Trade name for leather substitute for car curtains and upholstery material manufactured by the E. I. du Pont de Nemours & Co., Inc., Fabrikoid Division, Wilmington, Del.

FABROIL.—Trade name for gears and pinions manufactured by the General Electric Co., Schenectady, N. Y.

FACILE.—Trade name for electric milk testers manufactured by D. H. Burrell & Co., Inc., Little Falls, N. Y.

FACTOR OF ASSURANCE.—See Assurance, factor of.

FACTOR OF SAFETY.—A term expressing the safety limit to which materials or machines may be subjected. It is widely used in all construction work and is the ratio of the theoretical maximum allowable stress to the maximum calculated stress that will be present in the member under normal loads. It is often a number somewhere between 2 and 6 for beams, girders, etc., in construction work. In wiring and transmission and distribution systems it is the ratio between the maximum breaking stress of the wire and the maximum tension to which it is subjected in any particular span.

FACTORY MUTUAL CODE.—The electrical rules of the Associated Factory Mutual Fire Insurance Companies are substantially the same as the National Electrical Code, but a few additional requirements have been applied to factory work. In publishing the rules, however, they have been supplemented by illustrations and explanatory notes, which aid in their application by the installer and the inspector. A general analysis of the requirements of the rules is also given. These rules retain in Class D the detailed construction and test requirements for electrical fittings, devices, etc. The twelfth edition of these rules was published in 1915 by the Inspection Department of the Associated Factory Mutual Fire Insurance Companies, 31 Milk St., Boston, Mass., the changes of 1918 being issued as a supplement. The 1920 edition will appear early in 1921.

FACTORY SPECIAL.—Trade name for tungsten lamps manufactured by the Betalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.

FACTRYLITE.—Trade name for commercial lighting fixture manufactured by the Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.

FAFNIR BEARING CO., THE.—New Britain, Conn. Manufacturer of ball bearings. President, Howard S. Hart; vice-president, E. C. Goodwin; secretary, Maurice Stanley; treasurer, Elisha H. Cooper. Branch offices, 1301 S. Michigan Ave., Chicago, Ill.; 752 Whitney Bldg., Detroit, Mich.; 916 Swetland Bldg., Cleveland, Ohio.

FAHNESTOCK ELECTRIC CO.—East Ave. & 8th St., Long Island City, N. Y. Manufacturer of binding posts, battery connectors, ignition switches and push buttons. A. A. Danda, general manager.

FAHRENHEIT THERMOMETER.—Abbreviated F. or Fahr. A scale of temperatures in general use in this country and in England. On this scale the boiling point of water is arbitrarily taken as 212° and the melting point of ice at 32°. For conversion to the centigrade scale, see Centigrade thermometer. For practically all scientific work the centigrade scale is used.

FAIRBANKS, MORSE & CO.—Chicago Ill. Manufacturer of generators, motors, oil engines, lighting plants, air compressors, pumps, etc. President, C. H. Morse, Jr.; vice-presidents, H. J. Fuller, R. H. Morse, M. H. Hovey; vice-president and treasurer, W. E. Miller; vice-president and sales manager, C. W. Pank; secretary, F. M. Boughey. Main office, 900 S. Wabash Ave., Chicago, Ill. Factories, Beloit, Wis.; Three Rivers, Mich.; Indianapolis, Ind.; St. Johnsbury, Vt.; Moline, Ill. Branch offices, Atlanta, Ga.; Baltimore, Md.; Boston, Mass.; Cincinnati, Ohio; Cleveland, Ohio; Dallas, Tex.; Denver, Col.; Des Moines, Ia.; Detroit, Mich.; Indianapolis, Ind.; Jacksonville, Fla.; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Milwaukee, Wis.; Minneapolis, Minn.; New Orleans, La.; New York, N. Y.; Omaha, Neb.; Philadelphia, Pa.; Portland, Ore.; Salt Lake City, Utah; San Francisco, Cal.; Seattle, Wash.; Spokane, Wash.; St. Louis, Mo.; Stuttgart, Ark.; St. Paul, Minn.

FAIRFACTS CO.—234 W. 14th St., New York, N. Y. Manufacturer of electric radiators.

FAIRFIELD.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

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FAIRY.—Trade name for electrically operated phonograph combined with lamp manufactured by the Endless Graph Mfg. Co., 4200 W. Adams St., Chicago, Ill.

FAIR HAVEN MARBLE & MARBLEIZED SLATE CO.—Fair Haven, Vt. Manufacturer of electrical slate. Business established 1859. President and secretary Frank E. Allen; treasurer and general manager, G. H. Shinville.

FAIRMONT.—Trade name for electric coal mining machinery manufactured by the Fairmont Mining Machinery Co., 10th St. & Belt Line, Fairmont, W. Va.

FAIRMONT MINING MACHINERY CO.—10th St. & Belt Line, Fairmont, W. Va. Manufacturer of electric coal mining machinery. Business established 1906. President and general manager, W. D. Stockley; vice-president, F. R. Lyon; secretary, John Rock; treasurer, Walton Miller; sales manager, J. C. Evans. Sales representatives, Keiser-Geismer Engineering Co., Birmingham, Ala.; O. H. Davidson Equipment Co., Denver, Colo.; Huntington Supply & Equipment Co., 1633 Tremont St., Huntington, W. Va.; Sterling Hardware Co., Hazard, Ky.; S. M. Casterline, Starret Place, Pittsburgh, Pa.; O. H. Davidson Equipment Co., Salt Lake City, Utah; Power Supply Co., Terre Haute, Ind.; McCombs Supply Co., Harlan, Ky.; Jellico, Tenn.

FAIRMOUNT.—Trade name for wrenches manufactured by the Fairmount Tool & Forging Co., 10611 Quincy Ave., Cleveland, Ohio.

FAIRMOUNT ELECTRIC & MFG. CO.—59th & Woodland Ave., Philadelphia, Pa. Manufacturer of conduit fittings, grounding devices, cable stringing cars, etc. Business established 1906. President and general manager, J. C. Vogel; secretary, E. D. Saint; treasurer, M. Patterson; sales manager, J. T. Doris. Sales representatives, Wetmore-Savage Co., 76 Pearl St., Boston, Mass.; Wm. S. Brown Electric Co., 3 W. 29th St., New York, N. Y.; Union Electric Co., 933 Liberty Ave., Pittsburgh, Pa.; Guy V. Carpenter, 310 Pearl St., Buffalo, N. Y.; I. A. Bennett Co., 112 W. Adams St., Chicago, Ill.; Bittmann & Battee, Inc., 84 2nd St., San Francisco, Cal.; McNair Electric Sales Co., 28 Woodbridge St., E., Detroit, Mich.

FAIRMOUNT TOOL & FORGING CO. THE.—10611 Quincy Ave., Cleveland, Ohio. Manufacturer of wrenches.

FALCON.—Trade name for pipe and spanner wrenches manufactured by J. H. Williams & Co., 187 Vulcan St., Buffalo, N. Y.

FALK CO., THE.—Milwaukee, Wis. Manufacturer of steel castings. President, Herman W. Falk; vice-presidents, Otto H. Falk, Clarence R. Falk; secretary and treasurer; Emanuel A. Wurster; general manager, Harold S. Falk.

FALKENBACH MFG. CO., INC.—New York, N. Y. Manufacturer of electric lighting fixtures and portable electric lamps. Business established 1905. President and treasurer, Edward Falkenbach; secretary, M. C. Boggis. Main office and factory, 159 E. 54th St., New York, N. Y. Branch offices, 164 Federal St., Boston, Mass.; 126 Post St., San Francisco, Cal.; 4th & Broadway, Los Angeles, Cal. Sales representative, P. K. Douglas & Co., St. Nicholas Bldg., Montreal, Que., Can.

FAMOUS.—Trade name for oil filters manufactured by the Famous Filter Co., 116 Pine St., St. Louis, Mo.

FAMOUS FILTER CO.—116 Pine St., St. Louis, Mo. Manufacturer of filters for purifying used or waste lubricating oils. Business established 1897. President, Edward G. Franke; secretary, M. A. Franke; general manager, A. H. Franke.

FAN BLADES.—See Blades, electric fan.

FAN FLAME SPARK PLUG CO., INC.—30-32 Nepperhan St., Yonkers, N. Y. Manufacturer of spark plugs. Business established 1917. President and general manager, John H. Gill; vice-president, E. C. Rhodes; secretary, B. B. Tottingham; treasurer, F. W. Dyer; sales manager, John J. Gill.

FANCLEVE SPECIALTY CO.—Jamaica Plain, Boston, Mass. Manufacturer of conduit fittings, switch and outlet boxes. President and treasurer, J. Leonard Gleason.

FANS, BATTERY.—These fans are made in small sizes, seldom over 8 ins. They are intended for use where no electric service is available except from portable batteries, either dry cells or storage cells being used. The motors are d-c. series, usually of 6 or 8 volts. A 6-volt fan may be operated from a standard automobile ignition, lighting or starting battery. These fans are called for mostly in the sickroom where a cool breeze must be provided even though standard electric lighting service is not in use. In such and similar cases the comfort supplied by the fan often leads to wiring the premises.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y. "Limo-Sedan."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco Jr." "Ideal."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."

FANS, CAR.—Car fans are nearly always bracket fans, mostly in 12-in. sizes. They are usually d-c. fans rated 30, 60 or 550 volts, as they are used chiefly on dining, sleeping, parlor and private cars and occasionally the better classes of day coaches of steam railroads; some interurban electric railways also use them for similar service and urban railways for exhaust chiefly. Both nonoscillating and oscillating fans are used, the latter chiefly in private, dining and parlor cars, in which they often have a special finish. In sleepers and day coaches they are usually placed at the ends of the long central section of the car, also in smoking and lavoratory rooms. When provision is made for adjusting the angle at which the fans blow there is usually included a method of locking the adjustment to prevent loosening and possible dangerous tilting due to motion of the car. Some of the fans have a special base arranged for both horizontal and vertical adjustment of the fan breeze; it may or may not include a switch, as in many cases the control switches are placed near the porter's cupboard. In some fans the speed-regulating resistors are mounted below the motor shell instead of in the base. Exhaust fans are used in the kitchens of diners and also in many large city and interurban electric cars; they are usually arranged for vertical exhaust delivery through the ceiling. Fans for electric cars are frequently wound for 300 volts, but connected two in series across the 500 to 600-volt line; each fan motor is insulated for 600 volts, however.

Manufacturers:

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E railroad type electric fans, designed especially for railroad service, have been perfected in every detail essential to efficiency, accessibility for inspection, and satisfactory operation. A special feature is the double voltage winding, which prevents the necessity of changing fans in transcontinental service. Other important features are: universal adjustments, dust-proof body and separable base and bracket. The inevitable dust and soil of summer railroad travel is guarded against effectively by the totally enclosed frame. The ceiling type, like the bracket fan, is especially designed to withstand the jolts peculiar to railroad service. These have been found especially applicable in subways, as well as passenger coaches of steam roads. See adv. pages 1203-1223.—Adv.
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

FANS, CEILING.—Ceiling fans are large slow-speed fans suspended from the ceiling by an insulated hanger. They are usually supplied with four wooden blades with a sweep of 52 to 60 ins., and are used extensively in large rooms, such as hotel lobbies, theaters, banks, restaurants and stores, especially in southern cities. A-c. motors of the single-phase series or the self-starting induction types are used and in the d-c. fans the motors are usually series wound. Many of the higher-priced types have three speeds, generally within the limits of 100 to 225 r.p.m. Adjustable blades which make it possible to blow the air either up or down are sometimes provided. Electrolier attachments are often used which permit placing lamps immediately below the blades, thus obviating the flicker which is annoying if the lights are above the blades.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Made in 52-inch size, for use on either alternating or direct current. The motors are unexcelled for efficiency, air delivery and freedom from noise. See adv. pages 1203-1223. —Adv.
Hunter Fan & Motor Co., Fulton, N. Y.
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FANS, COLUMN.—Column fans are usually of the same design and construction as ceiling fans, but are made to mount on the top of a short column or floor pedestal. They are not so frequently used and consequently are nearly always made special. Counter fans used in some stores are a slight modification of this class, the column being mounted on top of the counter. Gyrating fans are also mounted on columns occasionally.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Hunter Fan & Motor Co., Fulton, N. Y.
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. ("De Luxe" decorative.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FANS, DESK AND BRACKET.—Electric desk and bracket fans consist of a small, rather high-speed motor with a set of metal blades, properly shaped to force the air, attached to the rotor shaft. The

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blades are usually made to measure 6, 8, 9, 10, 12, or 16 ins. across. These fans derive their name from the fact that they are adaptable for portable use, where they may be set on a desk or table, or mounted on a wall, in which case the base is turned so as to become a mounting bracket. They are made for a-c. and d-c. circuits, also universal for both, and for all standard voltages from 32 to 250 volts. In small (6 and 8-in.) fans there often is but one speed, but usually the speed may be adjusted to any one of three or even more values on the higher-priced fans; a large variation in the speeds is afforded by the different manufacturers, the general limits being about 650 r.p.m. minimum and 2300 maximum. A hinge or trunnion joint just above the base usually permits the fan to be turned or tilted vertically through any angle up to about 110° and makes possible the wall mounting. On some of the larger fans an oscillating mechanism produces a slow and even oscillation of the entire fan body through an arc of about 90°; this mechanism is usually of the worm-gear type driven from the rotor shaft; vanes and other devices to secure oscillation through reaction are now seldom used, although formerly much in vogue. Oscillating fans stir the air in a much wider zone than nonoscillating fans. Commutator type series motors, some of which may be operated on either a-c. or d-c. circuits, are common, although many of the larger fans for a-c. circuits use an induction motor.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."

Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."

Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."

Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.

Dilg Mfg. & Trading Co., The, 27 E. 125th St., New York, N. Y. "Acme."

Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "Hurricane."

EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo. "Northwind."

Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.

Fitzgerald Mfg. Co., Torrington, Conn. "Star."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E standard a-c. and d-c. fans are made with four blades, oscillating or non-oscillating, in 9-inch, 12-inch and 16-inch sizes. These fans are furnished to operate on either 110 or 220 volts alternating current with frequencies within the range of 25 to 60 cycles. Marine service requires that an electric fan must be absolutely immune to the effects of salt air, dampness and chemical action. The distinctive features of marine fans are, therefore, a totally enclosed motor with an armature winding especially prepared to resist these atmospheric conditions. G-E fans for marine service are quiet in operation, light in weight, very efficient, and durable. The motors are enclosed, the iron base and motor cage are heavily enameled, and the fan blades and cage are of brass, thoroughly lacquered. These fans may be readily converted from desk to bracket type. They are arranged for three operating speeds, with "off" position, and are built with six blades in nonoscillating types. They can be furnished for any popular voltage, direct current. See adv. pages 1203-1223.—Adv.



G. E. Standard Fan

Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."

Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "Cyclone."

Hunter Fan & Motor Co., Fulton, N. Y.

Kendrick & Davis Co., Lebanon, N. H. "K. & D."

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross," "Breezer."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

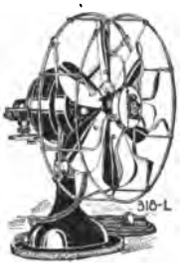
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)

Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y. "Pittsburgh."

Plaut & Co., L., 434 E. 23rd St., New York, N. Y. ("De Luxe" decorative)

Racine Electric Co., Bridge & Ontario St., Racine, Wis.

ROBBINS & MYERS CO., THE, Springfield, Ohio. Robbins & Myers fans are made in oscillating, non-oscillating, ceiling and ventilating types for alternating and direct current circuits. The oscillating and non-oscillating fans are made in the light weight drawn steel construction. All sizes are furnished from 8-in. to 16-in. inclusive. All direct current fans can be supplied in low voltage types for service on farm lighting plant circuits.—Adv.



R & M Oscillating Fan

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Aerofan."

Star Electric Motor Co., Miller St., & N. J. R. R. Ave., Newark, N. J.

Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

Tecla Co., Inc., Detroit, Mich. "Venti-Lite."

Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. "Triplex." (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Whirlwind." (See display adv. pages 1395-1402.)

FANS, ELECTRIC.—The term is used to designate a fan whose blades are permanently attached to the rotor shaft of an electric motor. There are two general divisions of fans, namely portable and stationary. Portable fans are made in a variety of types and sizes and are intended for connection to the ordinary lighting circuit. They are made in both oscillating and nonoscillating types and with blade sizes ranging from 5 to 16 ins. Stationary fans may also be divided into two general groups, namely ceiling and column fans, made in a variety of styles and sizes, and exhaust and ventilating fans for both light and heavy-duty service. The latter are commonly used for drawing out foul or vitiated air or for furnishing a supply of fresh air in schools, theaters or other auditoriums, and in factories, mines, etc.

The production of electric fans is increasing at a rapid rate each year, due not only to a growing appreciation of their comfort and health value in warm weather but also because new uses are being found for fans during all seasons of the year. During 1920 a total of 1,700,000 portable fans were produced, their retail value being $25,000,000. Exports of fans for 1920 were valued at $1,364,742.

Early Development and Uses. The employment of a small motor for rotating fan blades was one of the earliest applications of electric power. Electric-fan development has extended over a period of nearly 30 years, during which time there has been noteworthy development. The perfection of the fractional-horsepower fan motor, permitting of any desired speed regulation, and absolute quiet operation has resulted in the widespread adoption of the fan in the home. The perfection of a quiet oscillating mechanism for diverting the direction of the breeze also greatly extended the usefulness of the fan.

The first use of fans was in offices, which accounts for the term "desk fan," which designates the portable type designed for standing on its own upright base. Coincidently the ceiling or column type fan was developed and extensively employed in restaurants, hotel lobbies and other similar places, it being found to provide not only relief from heat but an effectual means for dispersing flies and other insects.

With the perfection in design, the use of fans in homes, hotel sleeping rooms, etc., increased very rapidly until today electric fans are the most extensively used motor-driven portable devices in use.

In recent years a large number of new uses have been found for the portable fan and they are now extensively used in winter as well as summer and in factories as well as in homes and offices. Among the important new uses may be mentioned: clothes drying, facilitating circulation of heat in rooms in extremely cold weather, preventing accumulation of frost on glass show windows, furnishing draft for household furnaces, drying fruit, etc., and for drying purposes in numerous industrial operations.

The cooling action of a fan may be accomplished in either of two ways: by the impact of cooler air on the skin directly lowering its temperature; by the blowing of relatively dry but not cool air over the perspiration on the skin which causes the moisture to be evaporated, thereby extracting from the skin the heat necessary to effect this. This latter principle is also used in drying clothes, vegetables, fruit, paper, leather, wool, etc., by merely directing the artificial breeze upon the articles. To facilitate drying, fans sometimes have special electric heating coils to permit blowing a warmed breeze. (See Driers.)

A very interesting experiment showing that air quality is actually improved by the action of a fan without the introduction of additional air was performed 8 or 9 years ago by Dr. Leonard Hill in England. Some men were placed in a sealed enclosure and after a time became drowsy and languid, but when an electric fan was operated to stir the air in the room these ill effects were observed to disappear.

With the development of heating and ventilating practice the use of electric ventilating and exhaust fans gained impetus. Especially has there been development in the use of fan equipment in motion-picture theaters, schools and other locations where people assemble in large numbers. Elaborate ventilating systems are now available, permitting of securing any predetermined number of complete air changes, and in connection with artificial heating and cooling equipment any predetermined degree of temperature can be secured.

FANS, EXHAUST OR VENTILATING, FACTORY, KITCHEN, ETC.—Exhaust or ventilating fans, as the name implies, are used to exhaust dust, hot or foul air, gases, acid, dye and paint fumes, etc., from a room or enclosure. They are usually arranged for mounting in a wall opening, transom or upper half of a window and exhaust directly into the open air. Sizes varying from 10 to 72 ins. in diameter are made, the larger sizes being used for exhausting large rooms and in various industrial processes, such as drying leather, wool, cotton, paper, etc. Six blades are generally used on the 12 and 16-in. sizes, which are by far the most common. The motor is usually supported by a bracket extension of the fan-enclosing ring. A-c. motors of the induction type and d-c. series motors, with adjustable-speed regulators, provide quite a range in the volume of air exhausted per minute. If there is much dust, moisture, or corrosive fume in the air being exhausted, the motor may be entirely enclosed or put into a separate compartment.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco," "ABC," "Ventura."

Barney Ventilating Fan Works, 25-27 Haverhill St., Boston, Mass.

Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill. "Autovent."

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Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Berry Fan Co., A. Hun, 28 Binford St., Boston, Mass. "Berry."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Centrifugal Fan Co., 9-15 17th Ave., Newark, N. J. "Four Leaf Clover."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "Hurricane."
Eclipse Air Brush Co., 79 Orange St., Newark, N. J. "Eclipse."
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale", "Garden City."
GENERAL ELECTRIC CO., Schenectady, N. Y. Davidson and Ventura fan outfits made in self-contained units for both alternating and direct current standard voltages, ranging in sizes from 12½ to 48 in. with capacities from 750 to 25,900 cu. ft. of air per minute. (Bulletin 41801.) See adv. pages 1203-1223.—Adv.



Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Hersh Bros. Co., Allentown, Pa. "Lehigh."
Hunter Fan & Motor Co., Fulton, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Indiana Fan Co., 40 E. South St., Indianapolis, Ind.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J. "Four Leaf Clover."
New England Ventilating & Heating Co., 926 Manton Ave., Providence, R. I.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
Perkins & Son, Inc., B. F., 2 Crescent St., Holyoke, Mass.
Pullman Ventilator & Mfg. Co., York, Pa. "Pullman."
Pyle-National Co., The, 1334 N. Kostner Av., Chicago, Ill.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Aerofan."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Star Electric Motor Co., Miller St. & N. J. R. R. Ave., Newark, N. J. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y. "Wing-Scruplex."

FANS, EXHAUST OR VENTILATING, SCHOOL, THEATER AND OTHER AUDITORIUM.—Auditorium ventilation usually requires a larger and more powerful fan, though one of similar type as for factory and kitchen use described above. These fans are often installed in pent houses on the roof and connected by exhaust ducts with the auditorium or other large room being ventilated. The term ventilating fan is also applied to motor-driven fans of large size that are used to force air through steam heating coils and sometimes also through air washers so as to supply ventilating air at the proper temperature and humidity.

Manufacturers:

Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill. "Autovent."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Berry Fan Co., A. Hun, 28 Binford St., Boston, Mass. "Berry."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass. "Marvel."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale", "Garden City."
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Hersh Bros. Co., Allentown, Pa. "Lehigh."
Hunter Fan & Motor Co., Fulton, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Johnson Fan & Blower Co., 115 S. Clinton St., Chicago, Ill.
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
New England Ventilating & Heating Co., 926 Manton Ave., Providence, R. I.
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J. "Four Leaf Clover."
PEERLESS ELECTRIC CO., Warren Ohio. "Peerless." (See display adv. page 1308.)
Perkins & Son, Inc., B. F., 2 Crescent St., Holyoke, Mass.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y. "Wing-Scruplex."

FANS, GYRATING.—Gyrating fans, which may be either for ceiling or column mounting, produce a continuous flow of air outward, the direction of the flow continually gyrating about the central axis. When properly placed, they produce a periodic movement of the air in nearly all parts of a room of medium size. They consist of two self-contained fans, diametrically opposite, the motor of one being geared to a central mechanical drive, which causes a slow steady revolution of the entire unit about the vertical axis of support. The fans may often be adjusted to blow in a horizontal direction or at an angle below horizontal.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio. "Gyrofan."
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FANS, MINE AND OTHER HEAVY-DUTY VENTILATING.—These are very large, substantial fans used for ventilating purposes for mines, large buildings, shops, etc., where noxious odors or gases are present and should be removed. They are usually of heavy construction, cast iron frames being used in some cases and the blades being made of heavy steel. In many cases the blades are of large number and they are arranged close together to form a multivane drum or cylinder. Other types of fans have a smaller number of blades and are made in disk form with the blades nearly overlapping. In practically all these large fans the blades are secured to a ring on the outer edge.

Large fans of this type are usually arranged for direct motor drive, although they may also be driven by a belt. In addition to their use as ventilating fans they are sometimes used in connection with heated air; in this case they are placed near the heating coils. Mine fans are generally mounted on the surface in a compact weatherproof housing leading directly to a special ventilating shaft.

Manufacturers:

American Blower Co., Detroit, Mich. "Sirocco."
Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill. "Autovent."
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Sirocco Co., Ltd., Windsor, Ont., Can. "Sirocco."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill. "Cycloidale", "Garden City."
Green Fuel Economizer Co., Beacon, N. Y.
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio. "Straitflo."
Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J. "Four Leaf Clover."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

FANSTEEL PRODUCTS CO., INC.—North Chicago, Ill. Manufacturer of ignition coils and molybdenum sheet and wire, contact points and other electrical, steel and chemical products. President, Lawrence R. Wilder; vice-president, James M. Troxell; secretary, John C. Baker; treasurer, Emory H. Wilder; sales manager, J. M. Troxell. Main office and factory, North Chicago, Ill. Branch offices, Detroit, Mich., and 15 Park Row, New York, N. Y.

FARAD.—The practical unit of capacitance is called farad, which is a contraction of the name Faraday. A farad is the capacitance of a condenser which is charged by one coulomb to a difference of potential of one volt. This is a rather large unit and the microfarad, which is 0.000001 of a farad, is the more commonly used unit. In radio work a much smaller unit, a micromicrofarad, is often used. A farad is equal to 10^{-9} absolute electromagnetic units (abfarads).

FARADAY.—A unit named after the real founder of the quantitative science of electrolysis, being the number of ampere-seconds or coulombs which liberates one gram-equivalent weight of an element, on the basis of the chemical equivalent of oxygen=8. According to the most accurate determinations this is 96,494 coulombs, with a possible error of + or — 10 coulombs, so it is usually rounded out to 96,500. This means that 96,500 coulombs

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sets free 8 grams of oxygen, or a chemically equivalent amount of any other element.

FARADAY.—Trade name for electric signaling apparatus manufactured by Stanley & Patterson, 34 Hubert St., New York. N. Y.

FARADAY CO., THE.—746 Chapel St., New Haven, Conn. Manufacturer of electric ovens, heaters and signaling systems. President, Fred C. Boyd; secretary, C. F. Littlejohn; treasurer, S. C. Morehouse.

FARADAY, MICHAEL. — An English chemist and physicist noted for his investigations in electricity, magnetism and electrochemistry. He was born at Newington, Surrey, in 1791, and died at Hampton Court in 1867. Receiving but little school education, he was early apprenticed to a bookbinder, in whose establishment some scientific books fell into his hands. These he read with such interest that it led him to forthwith devote himself to the study of chemistry and physics. He attended the lectures of Sir Humphrey Davy, at the Royal Institution, London, in 1812, and in the following year was appointed assistant to Davy. He then took up extended experimental work in various subjects. In 1820 he discovered the chlorides of carbon and in 1821 the mutual interaction of the magnetic pole and an electric current. This had been preceded by the experiments of Oersted, who found that a current would deflect a magnetic needle. Faraday showed that a magnet could continuously move a conductor carrying a current, which led to the invention of the electric motor. In 1831, he published a series of papers on his researches in electricity where his discovery of electromagnetic induction was described. This is the fundamental principle employed in electric generators and transformers. He also made extended investigations in electrolysis and formulated the quantitative laws of electrolytic action. He discovered the deflection of light by a magnet and also the magnetic effect of a field upon flames. In 1833, he was appointed professor of chemistry at the Royal Institution, London, which chair he held until his death. In his honor the unit of capacitance is called the farad, and a unit of electrolytic action the faraday.

FARADAY'S CUBE.—A cube made by Faraday for experimental purposes to prove that there is not a field of electrostatic force inside of a hollow conductor. The cube was a very large one and covered all over its surface with tin foil. The foil was heavily charged with electricity, but it was impossible to detect any electrical field on the inside by very sensitive instruments.

FARADAY'S LAWS.—The quantitative laws of electrolysis. (1) The amount of an element or compound produced by electrolysis depends only on the amount of electricity flowing, and is not primarily dependent upon the size of the electrodes, their distance apart, the concentration of the electrolyte or its temperature. (2) The amounts of different elements or compounds produced or decomposed by the same amount of electricity are proportional to their chemical equivalent weights. The first law corrected previous errors which ascribed the amount of electrolysis to variations in the four factors mentioned. The second law showed that chemically equivalent weights of elements or compounds were electrically equivalent, in that they required equal quantities of electricity to produce or to decompose them. This amount (measured in coulombs per gram weight of chemical equivalent) is now called the Faraday, which see.

FARADIC.—A term used largely by manufacturers of medical batteries and other electrotherapeutic apparatus in speaking of induced electric currents obtained from their machines. It merely refers to the current obtained from an induction coil, and such terms as faradic current, machine, battery, coil, adapter, etc., refer to the various apparatus used in its production.

FARADMETERS AND MICROFARADMETERS.—Instruments used to measure the value of unknown capacitances. As the capacitance (or electrostatic capacity) is always of such value as to be expressed in microfarads, the term faradmeter is simply one of convenience, and all of these instruments are really microfaradmeters. They are used principally for determining the capacitance of telephone, telegraph and power lines and cables, and for calibrating or checking the capacitance of condensers. One form of meter is a direct-reading instrument which indicates the unknown capacitance directly on a scale similar to a voltmeter or ammeter. It consists of a method of balancing the current through the unknown capacitance against that through a standard condenser connected in parallel with it. A moving-coil element similar to a wattmeter element takes up a position with respect to the field coils so as to indicate the value of the capacitance which determines the current flow. Other instruments for the same purpose utilize the bridge method of determining capacitance. They consist of a Wheatstone bridge with two resistance arms and two condenser arms, one being the unknown. The bridge must be balanced to determine the unknown value, and this is accomplished by using either a galvanometer or a telephone receiver to tell when the current is zero. These instruments are not as conveniently used as the direct-reading instruments, but may be used for more accurate determinations, especially in radio work.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. The "capaciometer" is a portable instrument for measuring capacitance ranging from 0.000,001 mfd. to 1 mfd. It has a scale about 14 in. in length marked from 1 to 10 and divided into 100 divisions. A switch having 5 points is provided which multiplies the scale reading by 0.00001, 0.0001, 0.001, 0.01, 0.1. A small rheostat is also provided for adjusting the resistance of the circuit. The interrupted current for measuring purposes is produced by a high tone buzzer and 2 dry cells. The frequency can be varied by an adjusting screw from about 600 to 1,500 cycles. A pair of low resistance head telephones is supplied with the capaciometer. The overall dimensions of this instrument are approximately 12x 11½x9½ ins. and all apparatus except the telephones is contained in it. See adv. pages 1203-1223.—Adv.

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

FARADOID.—Trade name for porcelain insulators manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FARADON.—Trade name for condensers manufactured by the Wireless Specialty Co., C & Fargo Sts., Boston, Mass.

FARIES MFG. CO.—Decatur, Ill. Manufacturer of portable electric lamps, lighting fixtures, shades, etc. Business established 1880. President and treasurer, E. P. Irving; vice-president, W. E. Surface; secretary and sales manager, W. J. Grady. Main office and factory, Decatur, Ill. Branch office, 740 State-Lake Bldg., Chicago, Ill. Sales representative, Harry Pickhardt, 98 Park Pl., New York, N. Y.

FARM LIGHTING AND POWER PLANTS.—These are self-contained generating plants for installation on farms, in country residences, schools, churches and other buildings located in rural districts remote from the lines of electric light and power companies. The demand of farmers for the convenience and safety of electric lighting and small motor-driven machines has been met by these plants that are especially designed to supply direct current for lamps and in some cases also for electrical appliances, pumps and other small farm or dairy machinery. It is estimated that there are now in use in the United States about 350,000 of these farm electrical plants, practically all of which have been installed within the last ten years.

The essential parts of such a plant are: an engine, a generator and a small switchboard or control panel; a storage battery is also provided in most plants, but is not absolutely essential. The engine is almost invariably of the internal-combustion type so as to dispense with need for a boiler; either gasoline or kerosene is used for fuel. Simplicity and ruggedness are usually aimed at in the engine, sometimes self-starting is arranged for by having the generator act as a starting motor supplied with current from the battery. The engine is either directly connected or belted to the generator, in the latter case sometimes mounted on a separate base, or even on skids if it is intended to move it to the vicinity of other belt-driven machinery when the generator is not in service. Occasionally stationary engines have two pulleys, one for the generator and the other for driving other farm machinery nearby. The engine size usually ranges from 1½ to 3 hp., but in larger plants may be 5, 7½ or even 10 hp.

Generators are invariably d-c. machines, usually shunt wound, as these are simple, require no exciter and, when a load battery is used, must be direct current. When a battery is used it is very desirable that its capacity be obtained by a rather small number of cells of fair size than by a large number of small size. To use a standard circuit pressure of 110, 115 or 120 volts would require a storage battery of 60 to 67 cells of the ordinary lead type whose discharge voltage ranges from 2.0 to 1.8 volts. A battery of so many cells would very probably not receive as good care as one of, say, 15 to 18. For this reason 16 cells (of lead type) is the most common battery group used; the nominal circuit voltage is practically standardized at 32 volts for battery-using plants, each cell being roughly rated at 2 volts. The generator voltage must be capable of adjustment from 32 to at least 42 volts to permit of overcharging the battery to about 2.6 volts per cell. Where a load battery is not used there is no reason why standard voltage should not be used, therefore, the generator is of standard 110 to 120-volt rating. There are marked advantages in using this voltage in that the wiring of the circuits need not be as large as for 32 volts; power can be supplied to outlying buildings with much less line loss; motor-driven appliances, flatirons and other labor-saving electrical devices and machines can be more readily and satisfactorily used; all lamps, motors and other devices are of standard voltage and need not be changed if power is later bought from an electric light and power supply system. On the other hand, unless an auxiliary battery is provided, the plant must be run whenever current is wanted for even a single lamp. In load rating the generators range from 0.75 to 4 kw., or over, depending on the number of lamps and other appliances to be supplied, and whenever the battery is likely to be charged while the generator is also supplying the maximum load.

When a load-carrying storage battery forms part of the outfit it is most commonly a 16-cell lead battery and it may be either of the stationary type with glass jar and sand-filled tray for each individual cell, or of the electric vehicle type with rubber jars and group trays holding 4 to 8 cells; the latter gives a more compact arrangement. The capacity of the battery depends on the load it is expected to carry while the generator is not running. In some cases this is merely the lighting load during a single evening or night; in others the battery has to be capable of carrying the entire load for 2 or 3 full days, so that the generator need not be run more than 4, 3 or 2 times a week. Some reserve capacity is always desirable for cases when the engine is out of order. During charge the generator voltage must rise to overcome the increasing counter e.m.f. of the battery. To prevent excessive voltage from burning out any lamps that may be turned on at this time an automatic load-voltage regulator is sometimes provided. This may include a group of 4 or 5 special counter e.m.f. cells gradually added in the load circuit so that the load voltage remains fairly constant; these latter cells are usually skeleton cells without active material on their grids.

The switchboard equipment depends on the extent to which the entire plant is automatic, on which question there is considerable difference of opinion among the many manufacturers of these plants. The board is simplest if the plant includes no automatic features, but must be started, stopped and regulated by hand. If there is a load battery, the board should have a zero-center battery ammeter, voltmeter, field rheostat, knife switches, fuses and a reverse-current circuit breaker to protect the battery from discharging back through the generator in case the latter's voltage falls during charge due to engine stoppage or other cause. In full automatic

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plants, an ampere-hour meter of the contact-closing type is often provided to terminate the charge and shut down the engine when the battery is fully recharged, and to restart the engine and charge when the battery reaches a certain point on discharge. The engine is started by the generator acting as a starting motor drawing its current momentarily from the battery. Plants that have no load battery are usually automatic in that they shut down when there is no load and restart as soon as any load circuit is closed; in such plants a 6-volt automobile type ignition and starting battery serves for starting and ignition, being charged by the generator in the same way as on any gasoline automobile.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St. U. B. Bldg., Dayton, Ohio. "Dayton."

Acme Engineering Co., Louisville, Ky. "Farm-O-Lite."

Alamo Farm Light Co., 703 Tower Bldg., Chicago, Ill. "Silent Alamo."

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Battery Co., 1134 Fulton St., Chicago, Ill.

American Engine & Foundry Co., Charles City, Iowa. "Americo," "Americo Junior."

American Farm Equipment Co., Williamsport, Pa.

Andrae & Sons Co., Julius, Broadway & Michigan Sts., Milwaukee, Wis. "Jasco."

Auto Farm-Light Co., Inc., The, 1002 Kentucky Ave., Indianapolis, Ind.

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio. "All Purpose."

Beaudette & Graham Co., Boston, Mass. "Beacon Light," "Syco-Light."

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can. "Fairbanks-Morse."

Canadian Linderman Co., Ltd., Woodstock, Ont., Can. "Electrion."

Carlton, Young & Catlin, Inc., Grand Central Palace, New York, N. Y. "C-Y-C."

Chambers Mfg. Co., Etna St., Butler, Pa. "Chambers."

Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."

Cushman Motor Works, 932 N. 21st St., Lincoln, Neb. "Does More."

Delco-Light Co., Dayton, Ohio. "Delco-Light."

Drury Engineering Co., 1713 1st Ave., Evansville, Ind. "Drualite."

Duplex Storage Battery Co., Beaver Dam, Wis.

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

Engberg's Electric & Mechanical Works, St. Joseph, Mich.

EVERLITE CO., 928 S. 3rd St., Minneapolis, Minn. The Everlite unit embodies the L-type motor with which the farmer has been familiar for years; a switchboard that is simple and foolproof; no parts to get out of adjustment. (See display adv. page 1321.)

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."

Faries Mfg. Co., Decatur, Ill.

Fort Dearborn Mfg. Co., Sterling, Ill "Fort Dearborn."

Friday Machinery & Supply Co., Sigourney, Iowa.

Fritchle Electric Co., The, 1544 Clarkson St., Denver, Colo.

GENERAL ELECTRIC CO., Schenectady, N. Y. A generator equipped with switchboard, sliding base and pulley making a neat, compact and absolutely reliable generating outfit for use in connection with the ordinary farm gasoline engine and 32-volt, 16-cell, lead plate storage battery. Furnished in capacities of 175 watts and above, all rated at 35 volts. Equipment makes generator voltage adjustable from any value from 32 to 42 volts. When desired, panels and generators can be furnished separately, the former equipment with brackets for wall mounting. (Bulletin 60012A.) Generators for direct connection are also furnished, the mechanical and electrical layouts being such as to suit the plant for which the generators are intended. See adv. pages 1203-1223.—Adv.

General Gas-Electric Co., Hanover, Pa. "Genco Light."

Globe Electric Co., 368 Broadway, Milwaukee, Wis. "Globe."

Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.

Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."

Holt Farm Light Co., Toledo, Ohio. "Holt."

Kewanee Private Utilities Co., Kewanee, Ill. "Kewanee."

Kohler Co., Kohler, Wis. "Kohler Automatic."

Lalley Light Corp., Detroit, Mich. "Lalley Light."

Langstadt-Meyer Co., Appleton, Wis.

Lauson-Lawton Co., De Pere, Wis. "Wisconsin."

Lister & Co. (Canada), Ltd., R. A., 58 Stewart St., Toronto, Ont., Can. "Lister-Bruston."

Litscher Lite Corp., 1138-40 Monroe Ave., Grand Rapids, Mich. "Litscher Lite."

Main Electric Co., Cleveland, Ohio "Main-Power-Light."

Marco Power & Light Corp., 2230 Michigan Ave., Chicago, Ill.

Matthews Co., The, Port Clinton, Ohio. "Ker-O-El."

Matthews Engineering Co., Sandusky, Ohio. "Matthews Full Automatic."

Mayhew Co., 867 Meinecke Ave., Milwaukee, Wis. "Mayhew."

Merrell Co., Toledo, Ohio.

Northlite Mfg. Co., Chippewa Falls, Wis. "Northlite."

Owen & Co., R. M., 1825 S. Michigan Ave., Chicago, Ill. "Owen."

Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection," "Jupiter."

Perkins Corp., Mishawaka, Ind. (windmill-driven) "Perkins."

Petroleum Engine & Mfg. Co., 120 Broadway, New York, N. Y. "Penmac."

Phelps Light & Power Co., Rock Island, Ill. "Phelps."

Piersen Mfg. Co., The, 700 E. 8th St., Topeka, Kans.

Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Premier."

Pyke Motor & Yacht Co., Ltd., 374 Notre Dame St., W., Montreal, Que., Can.

RADIANT MFG. CO., Water & Perry Sts., Sandusky, Ohio. Radiant electric light and power plant, 300 watts, (15 lamps, carries 9 extra without difficulty); also 1½ Kw., and 3 Kw., sizes—all 32 volts: Clear light, no flicker. Lights direct or from batteries. Extremely well built, attractive and simple to operate. Lowest priced direct-connected, water-cooled plant made.—Adv.

Regal Gasoline Engine Co., Coldwater, Mich. "Regalite."

Roberts-Hamilton Co., 413 S. 4th St., Minneapolis, Minn. "Rohaco."

Rural Electric Equipment Co., Canton, Pa. "Reeco."

Simms Magneto Co., The, East Orange, N. J. "Homelite."

Simplex Utilities Corp., 360 Madison Ave., New York, N. Y. "Simplex."

Star Dynamo Co., Jefferson City, Mo. "Star."

Stearns Motor Mfg. Co., Box 252, Ludington, Mich. "De Luxe," "Simplex."

Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

Sunbeam Electric Mfg. Co., Evansville, Ind. "Sunbeam Farm-Lite."

Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.

Swartz Electric Co., Indianapolis, Ind. "Swartz-Light."

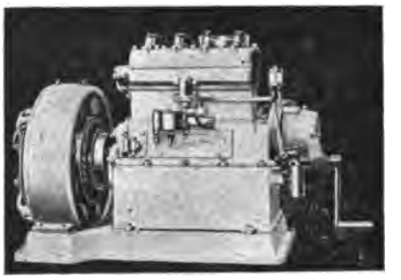
Tilley, J. B., Pen Yan, N. Y. "Perfect."

Unilectric Corp., Detroit, Mich.

United Engine Co., St. Joseph & Hosmer Sts., Lansing, Mich.

Universal Battery Co., 3410-3424 S. La-Salle St., Chicago, Ill. "Universal."

UNIVERSAL MOTOR CO., Oshkosh, Wisc., manufacturers of The Universal 4 K. W. Electric Generating Set. Noted for its simplicity, reliability and smoothness of operation. Every phase of the field of requirements of a substantial generating set was fully considered in the design of the Universal, the engineers who gave much special time and study before deciding on a design have evolved a set which has proven out in practice to cover all that could be desired and it can be fully expected that this same design without any change whatever will be standard for many years to come. The sets give such excellent and satisfactory service everywhere that the manufacturers naturally feel a certain pride in offering them, knowing fully that the results will be gratifying. Large numbers are daily operating on gasoline, kerosene, distillate and natural gas. Aside from the advantages of the special type of generator which was developed with a view to provide a simple and at the same time reliable product, one of the recommending features of the Universal outfit lies in the fact that the generator is connected to the Universal 4 cycle 4 cylinder engine. This engine operates with a turbine light smoothness which insures a steady and flickerless light. The size 4 K. W. (meaning 4,000 watts) has been arrived at as the most useful in the average of sizes and admirably adapts it to the following service: Town, store, house



Universal 4 K. W. Generating Set

and farm lighting; boat lighting; searchlights for boats, contractors or wreckers, etc.; wireless telegraphy, moving picture machines, battery charging, etc. It is supplied in both stationary and portable combination, in a voltage to suit the work and equipped for gasoline, kerosene or gas. A high grade construction throughout is one of our "safety first" points, every detail being properly designed and constructed. Adjustments are provided for the parts requiring occasional adjustment to take up the wear. Smaller parts hardened to prevent wear and large wearing surfaces mark the distinction of the Universal engine. The generating sets can be supplied in either 60 or 110 volts. Bulletin No. 30 describing and illustrating the above product will be furnished on request without charge. Adapted to any installation that comes within the range of its capacity. See display adv. page 1328.—Adv.

Universal Products Co., Oshkosh, Wis. "Upco."

Western Cable & Light Co., Baldwin, Wis. "Wesco."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Willys Light Division of the Electric Auto-Lite Corp., Toledo, Ohio. "Willys Light."

FARM-O-LITE.—Trade name for farm lighting plants manufactured by the Acme Engineering Co., Louisville, Ky.

FARM SERVICE UNITS, PROTECTIVE.—Where service is taken from a high-tension line for farms or other consumers, the transformer and accessories may be mounted on a single pole or structure placed at a suitable point. The protective equipment is often arranged as a unit and includes primary fuses, lighting arrestor, choke coil, disconnecting switch, and perhaps a meter box. The fuses and arrester must be of a type which will be serviceable without a disproportionate cost. The arrester is usually of the horn-gap type with resistance in circuit to ground, and the fuse is of the expulsion or chemical tube type. A meter housing is provided where there is no suitable building available for the meter.

Such sets are made for all line voltages from 5,000 to 33,000 volts, inclusive, though it is not usual to find farm service lines operated at voltages above 13,200.

Manufacturers:

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.

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DELTA-STAR ELECTRIC CO., 2433-2439 Fulton St., Chicago, Ill. The Delta-Star "Unit Type" single phase, high tension, farm power and lighting equipment, is intended for the use of farmers and those situated in places where city circuits cannot conveniently be tapped. It is designed for use in connection with cross-country transmission lines, and consists of a double pole switching, lightning arrester, choke coil and primary fusing element, complete with two steel cross-arms and operating mechanism, shown in cut below. These are designed for mounting on



Delta-Star Unit Type Farm Service Equipment

a standard wooden pole to be furnished by the user, or on an expanded steel pole that can be furnished by this company as a part of the equipment. Single phase switching and protective equipment consists of two single pole elements with a mechanically interlocked operating mechanism. Both blades are simultaneously operated by a handle located for convenient use from the ground level. Fuses, choke coils, switch blades and line side horn of lightning arresters are mounted on one shaft, and rotate 90°. Operating handle near ground can be locked in "on" or "off" position. Connections from operating handle to switch are galvanized steel wires of the same type as used for operating railway interlocking signals, and are strong and positive in action. Three phase equipment can be had if desired. Primary fuses are of the carbontetrachloride type, so rated in relation to transformer that they will only blow in case of actual trouble. On short circuit conditions, fuses open in 0.013 sec. When switch is open, entire switching, arrester, choke coil and fusing element are fully disconnected from supply circuit. Current taken from high tension transmission lines for farm use can be used for house and barn lighting, kitchen and stock barn pumps, cooking and housecleaning apparatus, irrigation, operating milking machines and cream separators, refrigeration, churns and butter workers, etc.—Adv.

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

HI-VOLTAGE EQUIPMENT CO., Cleveland, Ohio. Manufacturers of air break switches, lightning arresters, choke coils, high voltage fuses, disconnecting switches, outdoor bus supports, steel sub-station structures, crossarms. Hi-Voltage sub-station equipment for farm units. These sub-station equipments for farm installations include Hi-Voltage switch, lightning arrester and fuse together with the complete mounting. The switch is designed to break any load and is of the same general construction as the standard Hi-Voltage switch. In the design of these farm equipments special care has been taken to produce apparatus which is absolutely safe in the hands of inexperienced operators. —Adv.

ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."

Ward Leonard Electric Co., Mt. Vernon, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FARM UTILITY POWER STANDS AND ATTACHMENTS.—The machinery used on the farm frequently cannot be grouped together, to be driven by a single motor through a countershaft. Where such machines as grinders, separators, churns, saws and grindstones are scattered among the farm buildings or yard a single portable motor or two may be used to drive any of them. A popular power stand is a motor base mounted on an adjustable tripod. Ropes or rods for anchoring are supplied with the stand or truck. The motor usually has a pulley for belt drive, although a flexible shaft and coupling is occasionally used for direct drive.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. B'dg., Dayton, Ohio.

Alamo Farm Light Co., 703 Tower Bldg., Chicago, Ill.

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.

Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."

Delco-Light Co., Dayton, Ohio. "Delco-Light."

EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

Litscher Lite Corp., 1138-40 Monroe Ave., Grand Rapids, Mich.

MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."

Mayhew Co., 867 Meinecke Ave., Milwaukee, Wis.

ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio.

Ward Leonard Electric Co., Mt. Vernon, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FAR-OPERATIVE VALVE CO.—2 Rector St., New York, N. Y. Manufacturer of electrically operated and other valves. Business established 1920. President, John H. Allen; vice-president and general manager, E. P. Pennebaker; secretary, W. F. Madill; treasurer, Conrad H. Koellhoffer. Factory, Jersey City, N. J.

FARREL FOUNDRY & MACHINE CO.—Ansonia, Conn. Manufacturer of bearings, clutches, gears and pinions and other power transmission equipment. Business established 1848. President, Charles F. Bliss; vice-presidents, Franklin Farrel, Jr., Walter Perrp; secretary, George C. Bryant; treasurer, Alton Farrel; sales manager, Harry D. Temporal. Main office, 25 Main St., Ansonia, Conn. Factories, Ansonia, Conn., Buffalo, N. Y. Branch office, 802 Swetland Bldg., Cleveland, Ohio.

FARRINGTON & CO., INC.—28-30 Grand St., Mount Vernon, N. Y. Manufacturer of springs. President, H. L. Farrington; secretary, A. W. Jones; treasurer, G. P. Harrington.

FASTENERS, FLEXIBLE TUBING.—A metal collar with a saw-tooth edge on one end that is slipped over the end of flexible nonmetallic conduit or tubing (or "loom") that projects into switch boxes or switch and cutout cabinets and holds the tubing from pulling out of the box or cabinet by having the teeth bite into the fabric of the tubing. These fasteners are very easily applied and provide a firm hold on the tubing. They are sometimes called "loom clips."

Manufacturers:

E. & B. Mfg. Co., The, 965 Woodward Ave., Detroit, Mich. "Neco."

EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)

Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

FASTFEED DRILL & TOOL CORP.—Toledo, Ohio. Manufacturer of twist drills, reamers, etc. President, M. W. Mix; vice-president, J. D. McGrath; secretary and treasurer, H. D. Robbins. Main office and factory, Toledo, Ohio. Branch office, 21 Murray St., New York, N. Y.

FAUCETS, ELECTRIC WATER HEATING.—See Heaters, electric, water, instantaneous or faucet type.

FAULT FINDERS.—These are instruments for locating faults in telephone, telegraph and power circuits. They are usually special forms of portable testing sets. See Testing sets, portable (battery, bridge and galvanometer type); also Testing sets, portable (exploring coil, interrupter and telephone type).

FAULT SEARCHER.—A variety of a fault finder or testing outfit used in connection with submarine cable work. When a cable is being pulled up to locate the fault and repair it, the fault searcher, which is located on the ship, indicates the point in the cable at which the fault is located as it passes aboard ship.

FAULTLESS.—Trade name for guy anchors manufactured by the Faultless Anchor & Mfg. Co., Centerburg, Ohio.

FAULTLESS.—Trade name for adjustable lighting fixtures manufactured by the Sterling Stamping Co., Sterling, Ill.

FAULTLESS.—Trade name for electric washing machines and air compressors manufactured by the Vulcan Mfg. Co., 1511 Cypress St., Kansas City, Mo.

FAULTLESS ANCHOR & MFG. CO., THE.—Centerburg, Ohio. Manufacturer of guy anchors. President, C. Bowen; vice-president and general manager, H. T. Blosser; secretary and treasurer, F. C. Bishop.

FAULTLESS RUBBER CO., THE.—Ashland, Ohio. Manufacturer of rubber sundries and specialties. President and treasurer, T. W. Miller; vice-president, P. A. Myers; secretary, I. L. Miller; general manager, C. E. Campbell; sales manager, W. H. Balch.

FAUNT LE ROY ELEVATOR CO.—Baltimore, Md. Manufacturer of electric elevators.

FAURE PLATES.—A type of lead storage-battery plates in which the lead grid of the plate is used as a holder and conductor for active material applied to the plate as a paste, hence often called the "pasted plate." This has practically supplanted the original Planté, or "formed," plate. The various manufacturers of storage batteries have adopted numerous characteristic designs of grid for holding the paste. Also see Planté plates; Batteries, storage.

FAVORITE.—Trade name for die stocks manufactured by the S. W. Card Mfg. Co., Mansfield, Mass.

FAVORITE.—Trade name for boiler tube cleaners and soot blowers manufactured by the Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y.

FAWCUS MACHINE CO.—2820 Smallman St., Pittsburgh, Pa. Manufacturer of gears and shaft couplings. Business established 1900. President, Eliot A. Kebler; vice-president, George E. Shaw; secretary, A. A. Alees, Jr.; treasurer, T. J. Haley; manager, A. F. Cooke; sales manager, E. P. Cooke. Factories, Pittsburgh and Ford City, Pa.

FAY & EGAN CO., J. A.—Cincinnati, Ohio. Manufacturer of motor-driven woodworking machines. Business established 1830. President, L. R. Egan; vice-president, S. P. Egan; secretary, W. S. Green; treasurer, A. A. Faber; general manager, C. P. Egan; sales manager, F. L. Egan. Main office, 705-755 W. Front St., Cincinnati, Ohio. Branch offices, 714 Lexington Bldg., Baltimore, Md.; 313 Oliver Bldg., Boston, Mass.; 887 Ellicott Square Bldg., Buffalo, N. Y.; Chattanooga, Tenn.; 635 Continental & Commercial Bank Bldg., Chicago, Ill.;

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Denver, Colo.; Detroit, Mich.; Fayetteville, N. C.; Jacksonville, Fla.; Los Angeles, Cal.; Louisville, Ky.; Minneapolis, Minn.; New Orleans, La.; 13-21 Park Row, New York, N. Y.; 327 Water St., Pittsburgh, Pa.; 46-48 S. Front St., Portland, Ore.; 139 Townsend St., San Francisco, Cal.; 3204 1st Ave., Seattle, Wash.; 9 Amherst Ave., St. Louis, Mo.; 2025 N. 9th St., Sheboygan, Wis.

F. B. ELECTRIC & MFG. CO.—Detroit, Mich. Manufacturer of automobile testers, battery-charging panels, etc. President, J. W. Fitzgerald; vice-president, D. J. Burns; secretary and treasurer, W. M. Chamberlin. Main office, 119 E. Atwater St., Detroit, Mich. Branch offices, 90 West St., New York, N. Y.; Bourse Bldg., Philadelphia, Pa.

F. C. M.—Trade name for plug fuse cut-out bases manufactured by the Fernando C. Mesa Co., Coit St. & Chancellor Ave., Irvington, N. J.

F. D. W.—Trade name for fire alarm systems manufactured by the Fire Detecting Wire Corp., 2 W. 45th St., New York, N. Y.

FE.—The form Fe is the chemical symbol for the metallic element iron. It is a contraction of ferrum, the Latin name for iron.

FEARLESS.—Trade name for electric dishwashers manufactured by the Fearless Dishwasher Co., Inc., 175-179 Colvin St., Rochester, N. Y.

FEARLESS DISHWASHER CO., INC.—175-179 Colvin St., Rochester, N. Y. Manufacturer of motor-driven dishwashers. Business established 1901. President, Albert N. Beal; vice-president and treasurer, Elizabeth M. Beal; secretary and general manager, William B. Barley. Sales representatives, Harvey Brett, 239 W. 35th St., New York, N. Y.; Fred S. Campbell, 173 Jessie St., San Francico, Cal.

FEASTER FILM FEED CO.—New York, N. Y. Manufacturer of film feed machines.

FEATHERWEIGHT.—Trade name for soldering irons manufactured by the Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.

FEATHERWEIGHT.—Trade name for motor-generators manufactured by J. H. Hallberg, 25 W. 45th St., New York, N. Y.

FEDCO.—Trade name for electrical porcelain products manufactured by the Federal Porcelain Co., Carey, Ohio.

FEDERAL.—Trade name for armored cable and flexible steel conduit manufactured by the Federal Armored Cable Co., 609 W. 48th St., New York, N. Y.

FEDERAL.—Trade name for storage batteries manufactured by the Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C.

FEDERAL.—Trade name for electric signs, wiring devices, labor-saving devices, alarm systems, etc., manufactured by the Federal Electric Co., 8700 S. State St., Chicago, Ill.

FEDERAL.—Trade name for electric spot and butt welders manufactured by the Federal Machine & Welder Co., Dana Ave., Warren, Ohio.

FEDERAL.—Trade name for miniature incandescent lamps manufactured by the Federal Miniature Lamp Division, National Lamp Works of General Electric Co., 920 S. Michigan Ave., Chicago, Ill., and 6 E. 39th St., New York, N. Y.

FEDERAL.—Trade name for electric engravers manufactured by the Federal Products Corp., 393 Harris Ave., Providence, R. I.

FEDERAL.—Trade name for radio transmitters manufactured by the Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.

FEDERAL.—Trade name for telephone, telegraph and radio apparatus manufactured by the Federal Telephone & Telegraph Co., Buffalo, N. Y.

FEDERAL.—Trade name for electrical engraving machine manufactured by the Production Equipment Co., Inc., 5 Union Sq., New York, N. Y.

FEDERAL ARMORED CABLE CO.—609 W. 48th St., New York, N. Y. Manufacturer of armored cable and flexible steel conduit. Business established 1919. General manager, Harry B. Mulliken; sales manager, William H. Toop.

FEDERAL BATTERY MFG. CORP.—Owen Bldg., Washington, D. C. Manufacturer of storage batteries. Business established 1920. President and general manager, Richard B. Owen; secretary, B. F. Garvey; treasurer, William H. Benjamin. Main office, Owen Bldg., Washington, D. C. Branch office and warehouse, Federal Battery Service, Inc., 1314 Ninth St., N. W., Washington, D. C. District office, Federal Battery Service, Inc., 1624 Venango St., Philadelphia, Pa.

FEDERAL BEARINGS CO.—Poughkeepsie, N. Y. Manufacturer of ball bearings. President, J. W. Schatz; vice-president, treasurer and general manager, H. A. Schatz; secretary, G. H. Schatz; sales manager, H. T. Petersen. Exclusive distributor, F. M. Cobbledeck Co., 693 Mission St., San Francisco, Cal.

FEDERAL ELECTRIC CO.—Chicago, Ill. Manufacturer of electric wiring devices, signs, labor-saving devices and alarm systems. Business established 1901. President, John F. Gilchrist; secretary and treasurer, J. M. Gilchrist; general manager, H. I. Markham; sales manager, C. B. Graves. Main office, 8700 S. State St., Chicago, Ill. Factories, Chicago, Ill., and New York, N. Y. Branch offices, 507 N. Eutaw St., Baltimore, Md.; 2113 3rd Ave., Birmingham, Ala.; 80 Boylston St., Boston, Mass.; Electric Bldg., Buffalo, N. Y.; 240 N. High St., Columbus, Ohio; 415 17th St., Denver, Colo.; 199 Jefferson Ave., E., Detroit, Mich.; 224 N. Meridian St., Indianapolis, Ind.; 1417 Grand Ave., Kansas City, Mo.; 134 W. Short St., Lexington, Ky.; 126 S. 3rd St., Louisville, Ky.; 436 Public Service Bldg., Milwaukee, Wis.; 1215 Nicollet Ave., Minneapolis, Minn.; 204 Charles St., New Orleans, La.; 627 W. 43rd St., New York, N. Y.; 208 Weaver Bldg., Oklahoma City, Okla.; 534 Paxton Block, Omaha, Neb.; 331 Oak St., Portland, Ore.; 1627 Sansom St., Philadelphia, Pa.; 203 Stanwix St., Pittsburgh, Pa.; 91 New Montgomery St., San Francisco, Cal.; 1200 Pine St., St. Louis, Mo.; 147 E. 6th St., St. Paul, Minn.; 2715 Elliott Ave., Seattle, Wash.

FEDERAL HARDWARE & ELECTRIC CO.—Everett, Mass. Manufacturer of pull-chain sockets. S. S. Grady, secretary.

FEDERAL LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Manufacturer of miniature incandescent lamps. Two separately organized divisions as follows: Chicago, 920 S. Michigan Ave., H. D. Laidley, general manager; New York, N. Y., 6 E. 39th St., H. K. Annin, general manager.

FEDERAL MACHINE & WELDER CO.—Dana Ave., Warren, Ohio. Manufacturer of electric spot and butt welders. President, T. H. Kane; vice-president, H. C. Milligan; secretary and treasurer, Z. A. McBerty; general manager, F. P. McBerty. Main office and factory, Warren, Ohio. Branch offices, 401 New Garfield Bank Bldg., Cleveland, Ohio; 1724 Dime Bank Bldg., Detroit, Mich.; 15 S. Clinton St., Chicago, Ill.; Board of Trade Bldg., Indianapolis, Ind.; 613 Lincoln Bldg., Philadelphia, Pa.; 932 Oliver Bldg., Pittsburgh, Pa.; 17 Battery Pl., New York, N. Y.; 311 Falls St., Niagara Falls, N. Y.; 92 Pearl St., Boston, Mass.; Builders Exchange Bldg., Minneapolis, Minn.; 406 San Fernando Bldg., Los Angeles, Cal.; 817 Mission St., San Francisco, Cal.; 1021 N. Broadway, St. Louis, Mo.

FEDERAL MFG. CO., INC.—Boston, Mass. Manufacturer of aluminum solder and blow torches. President, Lester L. Lasher; secretary and treasurer, D. Allen Lenk. Main office, 27 Haymarket Sq., Boston, Mass. Factory, Lynn, Mass. Branch offices, Grand Central Palace, New York, N. Y.; 30 W. Walton Pl., Chicago, Ill.; 1337 Schofield Bldg., Cleveland, Ohio; 1037 Monadnock Bldg., San Francisco, Cal.

FEDERAL PORCELAIN CO., THE.—Carey, Ohio. Manufacturer of electrical and special porcelain products. Business established 1917. President, E. C. Edwards; treasurer, C. G. Spencer; general manager, R. G. Spencer. Sales representative, Fedco Sales Co., 1170 Broadway, New York, N. Y.

FEDERAL POWER COMMISSION.—The Federal Power Commission, created by the Federal Water Power Act (which see) is composed of Secretary of War John W. Weeks, chairman, Secretary of Agriculture Henry C. Wallace and Secretary of the Interior Albert B. Fall. Oscar C. Merrill has been appointed executive secretary of the Commission, Lieut.-Col. William Kelly, engineer officer, and Maj. L. W. Call, chief counsel. The Commission has established offices in the new Interior Department Building in Washington, D. C. The country has been divided into five districts with headquarters and branch offices to be maintained as follows: No. 1, Washington, D. C.; No. 2, St. Paul, Minn.; No. 3, St. Louis, Mo.; No. 4, Denver, Colo.; No. 5, San Francisco, Cal.

The Commission has an appropriation of $100,000 for 1920-21, but a recent ruling by the comptroller of the treasury holds that none of this may be used for the employment of clerical, technical or other personnel, so the Commission has to depend upon such help as may be loaned by the War, Agriculture and Interior Departments. Within two weeks of the signing of the bill, applications for permits totaling almost half a million hp. of water power development had been made. Applications filed with the Commission prior to Jan. 1, 1921, numbered 137 involving a net total of 12,901,131 hp. These projects are nearly all by public service companies and only a small part (about 2%) industrial companies. By April 1, 1921, this number had increased to 200 projects, involving a total of 13,536,431 hp. The work of the Commission had at that time reached the stage of granting preliminary permits and licenses, 16 of which have been granted, 10 of which were for hydroelectric plants and 6 for transmission lines.

FEDERAL PRODUCTS CORP.—393 Harris Ave., Providence, R. I. Manufacturer of electric engravers. President, Paul E. Aldrich; vice-president and sales manager, Everett S. Hartwell; secretary, H. B. Cross; treasurer and general manager, L. C. Tingley. Sales representative, Manufacturers Sales Co., Detroit, Mich.

FEDERAL SIGNAL CO.—Albany, N. Y. Manufacturer of railway and mine signaling systems. Business established 1904. President, A. H. Renshaw; vice-presidents, F. Pruyn, E. Seitz; secretary, F. Pruyn; treasurer, W. C. Vanderpoel. Main office and factory, Albany, N. Y. Branch offices, 1129 Monadnock Block, Chicago, Ill.; 52 Vanderbilt Ave., New York, N. Y. Sales representative, Consolidated Equipment Co., Ltd., 263 St. James St., Montreal, Que., Can.

FEDERAL TELEGRAPH CO.—San Francisco, Cal. Manufacturer of radio equipment. Business established 1910. President, R. P. Schwerin; vice-president, Leon Bocquerez; secretary, Augustus Taylor; treasurer, J. E. Godcharles. Main office, 812 Hobart Bldg., San Francisco, Cal. Factory, Palo Alto, Cal. Branch office, 400 Homer Bldg., Washington, D. C.

FEDERAL TELEPHONE & TELEGRAPH CO.—Buffalo, N. Y. Manufacturer of telephone, telegraph and radio apparatus. President, B. G. Hubbell; vice-presidents, C. L. Ingham, Byron L. Moore; secretary, H. M. Dixon; treasurer, G. H. Raymond; sales manager, M. A. Kelly.

FEDERAL WATER-POWER ACT.—After an eight-year struggle in which Congress had been seeking to enact legislation to safeguard the public interest and also to encourage private enterprise in water-power development under United States Government jurisdiction, the Federal Water Power Act was passed by the House of Representatives on May 4, the Senate on May 28, and signed by President Wilson on June 11, 1920. It is expected that this act will stimulate water-power development, as it assures permission under reasonable restrictions to develop and operate water-power projects for at least 50 years, with provision for repayment of the net investment at that time if continued operation is not granted. The many uncertainties and almost lack of definite policy regarding power development on navigable streams and on public lands are terminated by the clear policy laid down in the act.

The act provides for a Federal Power Commission, to be composed of the Secretaries of War, the Interior and Agriculture, and to have authority over all matters pertaining to the water-power development along, from or in navigable waters of the United States or upon any part of the public lands and reservations of the United States (including the territories) or for the utilization of the surplus water from any Government dam. The Commission is authorized to appoint an executive secretary at a salary of $5,000 a year and may request the President to detail an officer of

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the Engineer Corps as engineer officer. The duties of both are to be prescribed by the Commission.

The Commission is also authorized to collect, record and publish data concerning the water resources of any region to be developed. It may issue preliminary permits allowing applicants three years in which to make examination of water-power projects, to prepare plans and to make financial arrangements. The Commission may also issue licenses for a period of 50 years from the expiration of the preliminary permits and may reserve projects which in its opinion should be developed by the United States itself. Preference must be given to states and municipalities over private companies or individuals as developers of water powers. Provisions are made to aid irrigation, for the construction of locks and for the building of headwater storage reservoirs to prevent floods.

At the expiration of the 50-year license the Federal Government has the option of purchasing the plant, by paying the licensee his net investment, or issuing a new license to the original licensee or to a new licensee, who shall pay the original owner his net investment. The licensee shall pay the Government reasonable annual charges fixed by the Commission, for the cost of the administration. Regulation of the rates and service by the state public service commissions is provided for, and excess profits not reached in this way will be controlled by the Commission. Severe penalties are provided for the infraction of this law. Also see Federal Power Commission.

FEE & MASON.—81 Beekman St., New York, N. Y. Manufacturer of conduit fittings. Business established 1891. Partnership, Thomas Fee and Thomas Mason.

FEED CUTTERS AND GRINDERS MOTOR-DRIVEN.—In this type of machine the motor is usually mounted on and is a part of the frame of the cutter or grinder and the motor shaft is geared or direct-connected to the shaft carrying the cutting or grinding knives. These machines are much used on the farm for preparing feed for live stock and poultry. They are also called ensilage or silage cutters and grinders. Fibrous materials, like hay, are cut, while grains are ground, a different shaped rending member being used for grinding that may be interchanged for the cutting knives.

Manufacturers:

Bauer Bros. Co., The, Springfield, Ohio. "Scientific."
Gump Co., B. F., 431-437 S. Clinton St., Chicago, Ill. "Bar-Nun."
Sprout, Waldron & Co., Muncy, Pa.

FEED WATER, BOILER.—Boiler feed water is that water supplied to a boiler in which it is to be evaporated into steam. It is essential from the standpoint of efficiency and wear and tear on the boiler that the feed water be as free from impurities as is possible. Very often there is no pure water supply near a power plant and it is then necessary to treat the water in some manner before it is introduced into the boilers.

Water is known as hard or soft water, according to the amount and character of the minerals it contains. The hardness of water is known as temporary and permanent hardness, respectively. Temporary hardness can be removed by boiling when the dissolved carbon dioxide is expelled, breaking up the bicarbonates held in solution and finally throwing into suspension or depositing the carbonates of lime and magnesia in excess of their solubility for the particular water. Permanently hard water requires further treatment before it can be used in the boilers.

In general, there are three ways in which the water may be treated, depending largely on the size of the plant and the expenditure warranted. For rather small plants there are numerous boiler compounds for treating the water while in the boiler. See Compounds, water treating. If the water is very hard or if the plant is a large one, feed-water purifiers may be used. These are an auxiliary apparatus that treats the water before it reaches the boiler. See Feed-water purifiers. Very bad water that contains injurious matter such as acid, salt, etc., that would act on the boiler or feed-water heater to cause rapid deterioration may be treated in an evaporator. This is merely a distilling apparatus, that evaporates all of the water and then condenses the steam so that it may be used in the boiler. The construction of the evaporator is such that the impurities do not injure it as much as they would in a boiler where the temperature is higher, and it may also be cleaned easily. See Evaporators, power plant. In some plants where very large quantities of water have to be treated it is found desirable to have a separate treating plant adjacent to the boiler room. This is a special and more elaborate form of purifier, but is more frequently called a water-softening plant. It may consist of several large tanks in which the water is subjected to the action of chemicals, the precipitate settling slowly and the purified and filtered water passing on. See Water-softening apparatus.

FEED-WATER HEATERS.—Feed-water heaters, as their name implies, are used for heating the boiler feed water before it passes to the boiler. They also act as feed-water purifiers to a certain extent because certain minerals contained in water are deposited or thrown down on heating.

There are three general classes of feed-water heaters, known as exhaust steam, live steam and flue-gas heaters, respectively. The first operates on exhaust steam, the feed water and steam being separated from each other at all times and are able to heat the water up to about 212° F. They are similar in principle to a surface condenser but have boiler feed water substituted for circulating water. Live-steam heaters, if of the open type, permit the steam and the feed water to mix together as in a jet condenser; if of the closed type, steam and water are separated. The water is heated up to the temperature of the boiler contents. In the flue-gas heaters the feed water is heated by part of the heat remaining in the gases and smoke after passing the boiler before entering the chimney: since this heat would otherwise be wasted, these heaters are usually called economizers, which see.

All types of heaters consist of a number of tubes or trays or equivalent surface by which the feed water is brought into intimate contact with the exhaust or live steam or flue gases. The open type of heater is much like a jet condenser in general arrangement, being a large rectangular box or cylindrical tank large enough to provide a little storage capacity for feed water, as the boiler-feed pumps usually draw direct from the heater. Closed heaters are built like surface condensers, usually having straight tubes. In some makes the tubes are corrugated, in others coiled, or with a single U-bend. The tubes are always carefully expended fast in the tube sheets.

By heating the water as it comes in contact with the steam or hot coils or tubes some of the impurities are driven off or precipitated. All feed-water heaters act, therefore, as water purifiers to some extent. However, the precipitation of scale-forming elements interferes with the transfer of heat from the steam to the feed water so that the efficiency of the heater may be leopardized unless the trays or heater surfaces are kept clean. This also means that it may be more profitable to treat the water for impurities before it passes to the feed-water heater. In economizers the outsides of the tubes are almost continually scraped by motor-driven scrapers to prevent accumulation of soot, which is a heat insulator.

Manufacturers:

Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y. "Wainwright."
American District Steam Co., N. Tonawanda, N. Y. "Adsco."
Beggs & Co., James, 36 Warren St., New York, N. Y.
Berry Engineering Co., The 610-32 Crosby St., Chester, Pa.
Brennan & Co., John, 24th St. & M. C. R. R., Detroit, Mich. "Detroit."
Brownell Co., The, N. Findlay St., Dayton, Ohio.
General Ventilating Co., 162 N. Clinton St., Chicago, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Graver Corp., East Chicago, Ind.
Griscom-Russell Co., The, 2119 West St. Bldg., New York, N. Y. "Massillon," "G-R."
Harris & Co., Arthur, 212 Curtis St., Chicago, Ill.
Heine Safety Boiler Co., 5316 Marcus Ave., St. Louis, Mo.
Hoppes Mfg. Co., The, Belmont & Larch Sts., Springfield, Ohio.
Houston, Stanwood & Gamble Co., The, Cincinnati, Ohio. "Easy-Cleaned," "Simplex."
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
National Pipe Bending Co., The, River & Lloyd Sts., New Haven, Conn. "National."
Nordberg Mfg. Co., Milwaukee, Wis.
Ohio Body & Blower Co., Swartwout Specialty Division, Cleveland, Ohio.
Patterson-Kelley Co., Inc., The, 28 Cortlandt St., New York, N. Y. "Patterson-Berryman."
Platt Iron Works, Dayton, Ohio.
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y.
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa. "S & K."
Superheater Co., The, 17 E. 42nd St., New York, N. Y. "Elesco."
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Webster & Co., Warren, Camden, N. J.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa.
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

FEED-WATER PURIFIERS.—Water softeners and purifiers treat the boiler water before it enters the boiler. The boiler is an evaporator and is most efficient only when used as such. Scale interferes with the transfer of heat from furnace gases to boiler contents, thus lowering the efficiency and encouraging injury to heating surfaces.

There are many compounds for treating the boiler water while in the boiler, likewise materials which are placed in the boiler to lessen the amount of scale that adheres to the boiler surfaces; see Compounds, water treating. Water purifiers, however, are pieces of apparatus external and separate from the boiler. All feed water passes through them. They filter the water and usually heat it also, with live or exhaust steam or both, while chemicals are added, to counteract and throw down in precipitation the scale-forming constituents in the water. The chemical treatment is effected by time and temperature. The chemicals added and the quantity are determined by chemical analysis. The feed-water purifiers are usually cylindrical tanks containing a series of trays. When the water is heated or in some cases filtered, the suspended materials and impurities are deposited on the trays or in a separate compartment.

Scientific water treatment pays. The removal of scale-forming substances results in fuel saving, maintenance of higher boiler capacity, safer conditions and allows a boiler to remain in service longer without having to be taken out of service for scale removal. Also see Evaporators, power plant; Water-softening apparatus.

Manufacturers:

Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Harris & Co., Arthur, 212 Curtis St., Chicago, Ill.
Hoppes Mfg. Co., The, Belmont & Larch Sts., Springfield, Ohio.
International Filter Co., 1st National Bank Bldg., Chicago, Ill. "Hot-Flow."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
National Pipe Bending Co., The, River & Lloyd Sts., New Haven, Conn. "National."
Patterson-Kelley Co., Inc., The, 28 Cortlandt St., New York, N. Y. "Patterson-Berryman."
Permutit Co., The, 440 4th Ave., New York, N. Y.
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Scaife & Sons Co., William B., Pittsburgh, Pa. "We-Fu-Go", "Scaife."
Webster & Co., Warren, Camden, N. J.

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FEED-WATER REGULATORS. — Automatic feed-water regulators do with precision what can be only done haphazard and erratically by hand. A man cannot see through the steel of a pipe or boiler so he guesses how wide to open the valve in the feed-water pipe. The automatic feed-water regulator controls the supply scientifically.

By controlling feed-water supply automatically, just the right amount of water is fed to the boiler at the right time. A sudden demand for steam is not met by flooding the boiler with too much water and so creating a still further drop in steam pressure. Instead the regulator aims to utilize the heat-storage capacity of the boiler.

By using automatic feed-water regulators a fuel saving around 4% is obtained because of the higher average feed-water temperature. Every 11° F. increase in feed-water temperature is equivalent to about 1% saving of fuel. The boiler is subjected to less wear and tear as the temperature changes due to the incoming water are less than when the feed is hand-controlled. The steaming capacity of boilers is increased, while the steam pressure tends to be steadier. With fuel prices as high as they are now, an automatic feed-water regulator should pay for itself in less than six months.

The regulator usually acts to control the stroke or speed of the feed-water pumps. It operates to maintain a constant level, and as the level of water decreases due to steaming when the boiler is loaded a balanced weight or float operates the valve to increase the pump speed the required amount. When the water gets too high the pump steam valve is closed and no more water is delivered until the level has again dropped.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Berry Engineering Co., The, 610-32 Crosby St., Chester, Pa.
Burrows Mfg. Co., York, Pa. "Burrows."
Chaplin Fulton Mfg. Co., The, 28-34 Penn Ave., Pittsburgh, Pa. "Vigilant."
Crosby Steam Gage & Valve Co., Boston, Mass. "Bosworth."
Ford Regular Corp, 405 Broome St., New York, N. Y.
Foster Engineering Co., 109-117 Monroe St., Newark, N. J.
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Neptunus Supply Co., 73 Front St., New York, N. Y. "Erfmann."
Northern Equipment Co., 110 W. 11th St., Erie, Pa. "Copes."
S-C Regulator Mfg. Co., The, Fostoria, Ohio. "S-C."
Squires Co., The C. E., E. 40th St. & Kelley Ave., Cleveland, Ohio.
Thermoid Rubber Co., Trenton, N. J. "Thermoid."
Watts Regulator Co., 252 Lowell St., Lawrence, Mass. "Lawrence."

FEEDER, ELECTRIC.—A cable, wire or circuit in a distribution system, by means of which energy is supplied to or fed to a certain point of the system. In interior wiring where it relates to a circuit, it is a circuit that supplies one section of the building or one floor, running from the main switchboard to the distributing board on the floor.

FEEDER REGULATORS.—See Regulators, feeder voltage.

FEEDER WIRE OR CABLE.—See Wire or cable, feeder.

FELT CUSHIONS, GASKETS AND WICKS.—To prevent abrasion of polished surfaces felt cushions or pads are commonly placed on the bottom of table, piano and desk lamps, desk fans, desk telephones, desk clamp push buttons, etc. As extraneous sound absorbers and ear cushions felt is sometimes applied to telephone receivers. To exclude dust it is used as a gasket under the edges of instrument covers or for packing at bearing ends. Small motors are commonly lubricated by means of an oil or grease cup fastened below the bearing; the lubricant is drawn to the bearing surface by a wick which is often of felt.

Manufacturers:

Advance Felt & Cutting Co., 322 S. Jefferson St., Chicago, Ill. "Advance."
Auburn Leather Goods Co., Auburn, N. Y.
Bacon Felt Co., Winchester, Mass. "Bacon."
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
BOOTH FELT CO., INC., 463-467 19th St., Brooklyn, N. Y. Felt for electrical purposes is cut by this company into any size or form, and in any quantities, from a few to millions. Absolute accuracy is one of the vital factors in this class of work. As a result of years of experience and constant improvement, the proper equipment and dies have been developed which insure the fine, accurate work required in making felt parts for electrical work. A careful study has also been made of the different grades of felts best suited for various purposes, from heavy duty motors to electric light bulbs. These felts are bought from different mills that specialize, thus securing the necessary qualities, weights and thicknesses. See display pages 1309 and 1325.—Adv.
Chicago Leather & Mercantile Co., 1848-50 W. 14th St., Chicago, Ill.
Continental Felt Co., 64-66 E. 11th St., New York, N. Y.
Eastern Felt Co., Winchester, Mass.
Excelsior Leather Washer Mfg. Co., Inc., 921 W. State St., Rockford, Ill. "X-L."
Gasket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hoffeld & Co., R., 61-69 Carroll St., Buffalo, N. Y.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Paige & Co., Frank E., 68 Essex St., Boston, Mass.
Phoenix Specialty Mfg. Co., 48-50 Duane St., New York, N. Y.
Star Felt Cutting Co., The, 260 69th St., Brooklyn, N. Y.

FENDERS, ELECTRIC RAILWAY CAR—Fenders are very necessary equipment of all street railway cars and are frequently required on interurban cars where the latter operate for considerable distances over city streets. It is a device attached to the car or truck to either pick up or push aside a person, object or obstruction in the path of the car, and is of two general types, protruding and nonprotruding. They are also classified into automatic, i. e., dropping down to the track when a projecting guard or gate is struck, to pick up the object struck, or nonautomatic, which type is permanently carried in a fixed position as close to the rails as possible to catch or push aside an object struck by the car.

Manufacturers:

Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.
Root Spring Scraper Co., The, Kalamazoo, Mich.

FENIX.—Trade name for resistance wire manufactured by the General Electric Co., Schenectady, N. Y.

FENNER.—Trade name for dental lamp and inspection lamp manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

FERALUN.—Trade name for safety stair treads manufactured by the American Abrasive Metals Co., Hudson Terminal Bldg., New York, N. Y.

FERONIC.—Trade name for resistance wire manufactured by the Branford Electric Co., Inc., 9 Church St., New York, N. Y.

FERRANTI METER & TRANSFORMER MFG. CO., LTD. — Toronto, Ont., Can. Manufacturer of electrical indicating instruments and transformers. Business established 1909. President, A. W. Tait; vice-president, treasurer and general manager, George C. Royce; secretary, Fred W. Rountree. Main office, 26 Noble St., Toronto, Ont., Can. Branch offices and warehouses, Halifax, N. S., Langside & Notre Dame Sts., Winnipeg, Man., Can. District offices, 128 Bleury St., Montreal, Que., Can.; Timmins, Ont., Can.; Galgary, Alta., Can.; 358 Water St., Vancouver, B. C., Can.

FERRENEWO.—Trade name for valves manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

FERRIC OXIDE.—The most common oxide of iron found in nature. Its chemical formula is Fe_2O_3, and it contains (when quite pure) 70% of iron. Called mineralogically red hematite or simply hematite. Brown hematite is the same combined with water, $2\,Fe_2O_3\,3\,H_2O$; also called limonite.

FERRO.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

FERRO-ALLOYS.—Crude alloys of iron with other elements. They are used chiefly in making steel, either as deoxidizing agents or to incorporate an alloying element in the steel, a small amount of the ferro-alloy being added to the molten steel just before casting. Ferromanganese and ferrosilicon deoxidize steel by reason of the greater affinity of manganese and silicon for oxygen than of iron for oxygen. The oxides of manganese and silicon thus formed rise to the top of the bath in the form of slag. Other important ferro-alloys are ferrochromium, ferrotungsten, ferromolybdenum, ferrovanadium, ferro-urnaium, ferrophosphorus, ferrotitanium and ferrocerium. Most of the ferro-alloys are manufactured in the electric furnace, reducing the elements from their oxides, along with a large proportion of iron. A large part of the ferromanganese, however, is made by smelting in the blast furnace. The ferro-alloys usually contain a considerable percentage of carbon in addition to the iron and the alloying element, part of the carbon used for reducing being absorbed by the alloy. Some of the ferro-alloys must be partially refined to remove excess of carbon.

FERROCASE.—Trade name for bell-ringing transformers manufactured by the Kilark Electric Mfg. Co., 3940-46 Easton Ave., St. Louis, Mo.

FERROMAGNETIC BODIES. — Those whose permeability is large, of the same order as iron. Iron and most of its alloys belong to this group. Also see Permeability.

FERRULES, FUSE.—Ferrules are the cylindrical metal caps on the ends of any cartridge type fuse rated up to 60 amperes. They serve as the terminals through which contact is made with the fuse element inside the cartridge when the fuse is in place in the clips of the fuse block or cutout base. In the nonrenewable type cartridge fuse the ferrules are securely fastened to the fiber enclosing tube; in the renewable type the ferrules, or at least one of them, can be unscrewed from the tube to give access to the fuse element. Above 60 amperes cartridge fuses have knife-blade terminal contacts instead of ferrule contacts.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CRESCENT ELECTRIC CO., Mountain Grove, Mo.
Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
PATTON-MACGUYER CO., 31 Mathewson St., Providence, R. I.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

FERRULES, MISCELLANEOUS, BRASS AND COPPER.—These ferrules are widely used for various electrical purposes where they form a part of conducting equipment and also for use on tools, switch sticks, etc., where they are used for mechanical purposes, usually between the handle and the tool proper. Such ferrules are made in various diameters, thicknesses and lengths to suit the dimensions required. When they form a part of conducting equipment copper is usually employed, but when used only for mechanical purposes brass is more commonly used.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bay State Stamping Co., 380 Chandler St., Worcester, Mass.
Chicago Ferrule & Nut Co., 878-880 Lill Ave., Chicago, Ill.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

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FERRY MFG. CO.—2113 S. 4th St., St. Louis, Mo. Manufacturer of battery separators, plates and battery supplies.

FEWPART.—Trade name for push button switches manufactured by the Trumbull Electric Mfg. Co., Plainville, Conn.

F-F.—Trade name for battery charging equipment, remagnetizers, insulated wire strippers, electric arc soldering irons and transformers manufactured by the France Mfg. Co., 10325 Berea Rd., Cleveland, Ohio.

FIBER.—Fiber is a hard, dense material made of vegetable fiber, cotton rag stock or cotton cellulose, by treating with zinc chloride and other chemical reagents. When rags are used they are cut into shreds, cooked in rotating boilers, and beaten into a pulp. The pulp is then treated with chemicals and manipulated in heavy presses and rolls to give the final forms. The coloring is obtained by using mineral pigments or aniline colors. While in the pulp stage, fiber is often treated with Bakelite and other compounds, and a great many grades of fiber are thus produced. The chemical and water used are not always completely removed by the rolling process or even when the finished material is compressed into slabs or tubes under great pressure. It absorbs water quite freely, taking up nearly 50% of its weight in 24 hours, and for this reason is confined to moderate voltages as an insulating material. The resistivity is on the order of 10^7 to 10^{10} ohm-cm. Its dielectric strength given by different observers has quite a variation, depending largely on the dryness and manufacture, and ranges all the way from 3540 to 15,000 volts per mm. Fiber is attacked by strong acids, but is not soluble in oil or water. When it soaks up water it swells and upon drying it warps badly and even cracks. It has a tensile strength of from 10,000 to 20,000 lbs. per sq. in. and compressive strength of 35,000 to 60,000 lbs. per sq. in. It can be sawed, sheared, turned, threaded, bent, punched, etc. It is made into various shapes, such as rods, tubes, and sheets at the time of manufacture, and other special forms used in the electrical industry, like conduit and pipe, bushings, cleats, handles, gears, blocks, rings, etc., are also made.

FIBER CONDUIT.—See Conduit, underground, fiber.

FIBER CONDUIT FITTINGS.—See Bends, elbows and other fittings, fiber conduit.

FIBER OLITIC.—Trade name for lighting fixtures manufactured by the National Plastic Relief Co., 330 Main St., Cincinnati, Ohio.

FIBER SHEET, RODS, TUBES AND TUBING.—There are three principal forms into which fiber is made at the time of manufacture, and from these all other forms of the finished product are made. These are sheets, rods, and tubes or tubing. In the process of manufacture the cotton cellulose, which is the pulp rolled into a form similar to blotting paper, is passed through an acid bath, which acts as a parchmentizing agent, and transforms it into fiber. A leaching process is required to remove this acid, and this frequently requires a very long time. The material is pressed into the desired shapes and sizes and, after drying, is rolled and put away for seasoning.

Fiber is made in several grades and degrees of hardness and flexibility to meet the various requirements. Fiber in the form of sheets, rods and tubes is machined, bent and pressed into hundreds of articles, many of which are very important in the electrical field. Some of the principal forms which are described elsewhere are: Insulating parts for ignition systems, motors and generators; switch handles and bases, socket bushing and insulating linings; cartridge-fuse shells, underground conduits, bushings, cleats, push buttons, gears, etc.

Manufacturers:

American Vulcanized Fibre Co., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
BRANDYWINE FIBRE PRODUCTS CO., P. O. Box 122, Wilmington, Del.
Campbell Fibre Co., Stanton, Del.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Continental Fibre Co., Newark, Del. "Bakelite-Dilecto," "Continental-Bakelite," "Conite."
Delaware Hard Fibre Co., Wilmington, Del. "Egyptian."
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Elastoid Fibre Co., The, Waltham, Mass.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hard Fibre & Insulation Corp., 96-104 Spring St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Keystone Fibre Co., Yorklyn, Del.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned," "S-S."
Rogers Fibre Co., 121 Beach St., Boston, Mass. "Leatheroid."
Rogers Paper Mfg. Co., Inc., The, 219 Hartford Rd., South Manchester, Conn. "Nux."
St. Louis Paper Can & Tube Co., 4400 Union Blvd., St. Louis, Mo.
Spaulding & Sons Co., Inc., J., 300 Wheeler St., Tonawanda, N. Y. "Cocheco."
Spiro Mfg. Co., The C., 68 E. 131st St., New York, N. Y. "Uniq."
Standard Fibre Co., 11 Miller St., Somerville, Mass.
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Wilmington Fibre Specialty Co., Wilmington, Del. "Wilmington Fibre."

FIBRE CLAD.—Trade name for weatherproof wire manufactured by the Peerless Insulated Wire & Cable Co., 90 West St., New York, N. Y.

FIBRE CONDUIT CO., THE.—Orangeburg, N. Y. Manufacturer of underground fiber conduit. Business established 1893. President, S. R. Bradley; vice-president and general manager, A. M. Cregier; secretary and treasurer, F. J. Frost; eastern sales manager, E. F. Norton; western sales manager, W. W. Smythe. Main office and factory, Orangeburg, N. Y. Branch offices, 101 Park Ave., New York, N. Y.; Monadnock Block, Chicago, Ill. Sales representatives, S. B. Condit, Jr., & Co., Boston, Mass.; Pacific States Electric Co., San Francisco, Cal.; Los Angeles, Cal.; Portland, Ore.; Seattle, Wash.; Southern Jobbers Supply Co., New Orleans, La.; E. G. DeWald, Salt Lake City, Utah.

FIBREDURO, INC.—396 Broadway, New York, N. Y. Manufacturer of lighting fixtures and portable lamps. President, A. Levy; vice-president, S. Meyerson; secretary, treasurer and sales manager, Joseph A. Lichterman. Factory, Brooklyn, N. Y.

FIBREX.—Trade name for tree wire manufactured by the Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.

FIBRO-METALLIC.—Trade name for high-pressure piston packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

FIDELITY ELECTRIC CO.—331 N. Arch St., Lancaster, Pa. Manufacturer of motors, motor-generators, generators and fans. Business established 1895. President, Charles F. Stauffer; treasurer and general manager, B. Grant Stauffer.

FIELD.—A name given to the space occupied by electric or magnetic lines of force. It may be specified as the field of a dynamoelectric machine, solenoid or electromagnet, and is then often spoken of as the magnetic field. Field magnets, yokes, cores and poles and field coils and spools all refer to the parts of the magnetic circuit and the exciting winding by which the field is produced when current passes. Electric fields are regions of electrostatic stress, as in the insulation of a high-tension cable, the dielectric of a condenser, the space between charged sparking points or terminals, the line wires of a current, etc.

FIELD & CO., R. B.—10 Clarence St., Worcester, Mass. Manufacturers of leather and fiber specialties. R. B. Field, president.

FIELD COILS.—See Coils, armature and field.

FIELD, CYRUS WEST.—An American financier (born at Stockbridge, Mass., 1819, and died at New York, 1892), who was the indefatigable promoter of the first submarine telegraph cable between Europe and America. At the age of 33 he retired from the paper business. Having secured all the practicable landing rights on the American side of the ocean, he organized the New York, Newfoundland & London Telegraph Co. for the purpose of laying telegraph cables across the ocean. Unsuccessful attempts to lay the cable were made in August, 1857, and in June, 1858, but a complete cable was laid between July 7 and Aug. 5, 1858; for a time messages were transmitted, but in October the cable became useless, owing to the failure of its electrical insulation. Mr. Field reorganized the enterprise under the name of the Anglo-American Telegraph Co., and in 1866, after a futile attempt in the previous year, a cable was laid and brought successfully into use. Mr. Field spent his succeeding years in railroad development.

FIELD DISCHARGE SWITCHES.—See Switches, field discharge.

FIELD, DYNAMO.—The magnetic flux in the air gap of generators and motors. The term is also used broadly to denote the iron structure which completes the magnetic circuits of a dynamoelectric machine outside of the armature core and air gaps together with the windings thereon and all of the necessary supporting material.

FIELDCO.—Trade name for leather and fiber specialties manufactured by R. B. Field & Co., 10 Clarence St., Worcester, Mass.

FIFTY-FIFTY.—Trade name for lighting bracket manufactured by the Lightolier Co., 569 Broadway, New York, N. Y.

FILAMENT SUPPLY CO.—1317 Willow Ave., Hoboken, N. J. Manufacturer of filaments for carbon lamps. Business established 1908. President and treasurer, F. J. Rooney; vice-president, J. Rooney; secretary, Jerome C. Jackson.

FILAMENTS, INCANDESCENT LAMP.—The small conductor in the incandescent lamp bulb which becomes heated to incandescence and is the source of light. The first commercially successful incandescent lamp filaments were of carbon, and for about 25 years carbon remained the principal incandescent lamp-filament material, although the processes of manufacture were greatly improved and cheapened. With the discovery of methods of making filaments of the metals tantalum and then tungsten, incandescent lamps of much higher efficiency became possible. Tantalum was used for only a few years. Methods of drawing tungsten wire have been perfected within recent years which render the tungsten filament, which was formerly very fragile, as tough as the carbon filament and as a result the tungsten lamp is now used almost exclusively.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Filament Supply Co., 1317 Willow Ave., Hoboken, N. J.
Hofmann, Alfred, 150-152 Hudson Ave., Union Hill, N. J.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
McJunkin, Paul, 15 E. 40th St., New York, N. Y.
Pick Mfg. Co., Richard, 224 N. Wells St., Chicago, Ill. "Wolfram."
Rooney Lamp Co., F. J., Hoboken, N. J.

FILES ENGINEERING CO., INC., THE.—Providence, R. I. Manufacturer of hand-operated and mechanical stokers. Business established 1912. President and treasurer, William Rolfe Files; general manager, Roland T. Hungerford. Main office, 75 Westminster St., Providence, R. I. Branch offices, 543 W. Washington St., Chicago, Ill.; 105 W. 40th St., New York, N. Y.; 838 Real Estate Trust Bldg., Philadelphia, Pa.; 416 Equitable Bldg., Baltimore, Md.; 141 Milk St., Boston, Mass.; 429 Newfield Bldg., Bridgeport, Conn.

FILES, SLOTTING.—See Commutator slotting files and devices.

FILLION, INC., S. O.—New York, N. Y. Manufacturer of mica and mica products. Business established 1908. President, S. O. Fillion; treasurer, C. J. Busick. Main office, 68 Murray St., New York, N. Y. Branch office, 86 Duke St., Ottawa, Ont., Can.

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FILM CUTOUTS.—See Cutouts, film, incandescent street lamp.

FILMS, CUTOUT.—Thin disks of specially prepared paper or cloth, such as silk, that are placed in series cutouts of series incandescent street lamps. For their use and action, see Cutouts, film, incandescent street lamp. The films are of carefully selected stock and are made to have as uniform a disruptive or puncture voltage as possible. This is usually rated somewhere between 200 and 300 volts. The film is placed in a special film cutout device that usually forms part of the lamp socket. Each film is used once only, as it is worthless after being punctured.

Manufacturers:

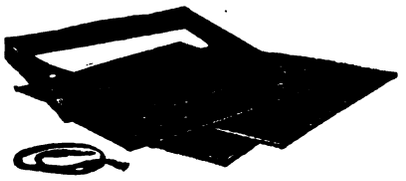
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Standard Insulation Co., Rutherford, N. J. "Sico."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FILTERS, ELECTRICAL.—Certain electrical circuits containing inductance and capacitance have the property of suppressing certain electrical frequencies and are called filters. A shunt circuit containing inductance and capacitance in series will eliminate the frequency for which such a circuit is resonant. A shunt circuit in which the inductance and capacitance are in parallel will eliminate all frequencies excepting that for which the shunt circuit is resonant. Various other combinations may be used for the elimination of all frequencies or certain bands of frequencies.

FILTERS, LIGHT.—A term used to designate a transparent medium through which light is passed for the purpose of filtering out some of the colors of which the light is composed, so as to change the color of the light passing through the filter. Such light filters may be of glass, gelatin, transparent solution, or other transparent medium. The color of the glass or other medium of which the filter is composed is due to the fact that the filter absorbs light of certain colors and the resultant light color which is seen is only that made up of the colors which pass through the filter. In fact, every piece of colored glass, gelatin color screen, or other transparent colored substance is a light filter in the broad sense.

Manufacturers:

HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. The "Color-Ray" unit, provides practical colored lighting in show windows,



"X-Ray" Color-Ray

etc. Used with X-Ray Jove or Jupiter reflectors, easily installed, without removing lamps or disturbing reflectors, provides any combination of colors. See Adv. page 1405.—Adv.

FINCH MFG. CO.—9th Ave. & W. Linden St., Scranton, Pa. Manufacturer of electric hoists. Business established 1855.

FINDLAY.—Trade name for porcelain knobs manufactured by the Trenton Porcelain Co., 803 E. State St., Trenton, N. J.

FINDLAY ELECTRIC PORCELAIN CO. THE.—Findlay, Ohio. Manufacturer of porcelain bushings, cleats, knobs, etc. Business established 1910. President, J. E. Bickwell; secretary, F. E. Owen.

FINDLAY MFG. CO., INC., ROBERT.—224 5th Ave., New York, N. Y. Manufacturer of lighting fixtures. President, Herman M. Schwartz; secretary and treasurer, Frederick Schwartz.

FINDLAYLITE.—Trade name for lighting fixtures manufactured by the Robert Findlay Mfg. Co., Inc., 224 5th Ave., New York, N. Y.

FINE ARTS LAMP & SHADE CO.—2301 Wabansia Ave., Chicago, Ill. Manufacturer of portable electric lamps and lamp shades. Business established 1920. President and sales manager, Fred M. Lawrence; vice-presidents, William Abrams, John Carlson; secretary and treasurer, William P. Maeder; general manager, William Abrams.

FINE ARTS PRODUCT CO.—4311 Grand Blvd., Chicago, Ill. Manufacturer of portable electric lamps. E. G. Henig, sole owner.

FINGERS, CONTROLLER.—See Controller fingers and segments.

FINLAY CELL.—A cell designed for the electrolysis of brine solution, making alkali and chlorine.

FINNELL.—Trade name for motor-driven scrubbing machines manufactured by the American Scrubbing Equipment Co., Inc., 180 N. Wabash Ave., Chicago, Ill.

FINUCANE CO., THE BERNARD E.—296 Franklin St., Rochester, N. Y. Manufacturer of electric washing machines. Business established 1920. President, Bernard E. Finucane; general manager, E. H. Gilman, Jr.; sales manager, J. F. O'Donnell.

FIRE-ALARM BOXES.—See Boxes, fire-alarm.

FIRE ALARMS.—See Alarms, fire; Alarm systems, fire.

FIRE BOXES AND REGISTERS.—See Boxes, fire, electric railway car or station; Registers, car fare.

FIRE DETECTING WIRE CORP.—2 W 45th St., New York, N. Y. Manufacturer of fire alarm systems. President and general manager, William H. Garrison; vice-president, Henry D. Reed; secretary and treasurer, John S. Roberts.

FIRE ENGINES, ELECTRICALLY OPERATED.—This term, although usually restricted to the pumping appliance, is often used broadly to cover fire hose wagons, chemical extinguisher outfits and other fire-fighting equipment mounted on vehicles, with the exception of large ladder trucks. In this broad sense electrically operated fire engines are such as are driven by electric motor for driving over the streets and also by either the same or another motor for operating the water pump. Power is derived from the storage battery in either case. In general principle they are built like other electrically propelled trucks except that the storage batteries, motor, control and other driving elements are much more rugged and serviceable than for ordinary commercial use. They are also built for higher speeds. All these requirements call for a much larger battery than is customarily used. The batteries may be disposed in several compartments arranged in various places on the chassis of the truck where they are not in the way. Electrically operated fire equipment has been found to give good results in city service where the runs are not very long and, although not widely used, has been found to meet all requirements fully as satisfactorily as the gasoline type equipment.

Manufacturers:

Couple-Gear Freight-Wheel Co., 1450 Buchanan Ave., S. W., Grand Rapids, Mich.

FIRE EXTINGUISHERS.—This term is applied to all appliances, whether using a special liquid, water or powder, employed to put out a fire. They are made in various sizes and types according to the service for which they are intended. Aside from violent explosions all fires start from small and readily controllable origins, such as lighted matches, cigaret stumps, oily rags, etc. If the fire can be put out before it has gained headway a serious fire and loss will be prevented. This is the object of all fire extinguishers. They prove of value for not only miscellaneous fires but in case of short-circuits on electrical machinery and switchboards. For this purpose extinguishers with nonconducting liquids, such as carbon tetrachloride, should be kept handy around electrical generating rooms where there is hazard of spread of fire from the burning of insulation on cables or other conductors.

Manufacturers:

American-La France Fire Engine Co., Elmira, N. Y. "La France."
Boyce-Veeder Corp., 68 Hunters Point Ave., Long Island City, N. Y. "Boyce."
Carbona Products Co., 302 W. 26th St., New York, N. Y.
Castle, Inc., James M., 1210-12 Arch St., Philadelphia, Pa. "Castle," "Fire Guard," "Liberty," "Mohawk."
Diener Mfg. Co., G. W., 400 Monticello Ave., Chicago, Ill. "Automatic."
Foamite Firefoam Co., 200 5th Ave., New York, N. Y.
Hall-Thompson Co., The, Hartford, Conn. "Wonder Worker."
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y. "Success."
Northern Fire Apparatus Co., 2422 University Ave., S. E., Minneapolis, Minn. "Northern."
Pyrene Mfg. Co., 17 E. 49th St., New York, N. Y. "Pyrene."
Relc Equipment Corp., 5 Beekman St., New York, N. Y.
Western Fire Appliance Co., 703 Market St., San Francisco, Cal. "Pyrocide."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

FIRE-FELT.—Trade name for insulating material manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

FIRE FLY.—Trade name for tungsten incandescent lamps manufactured by the Turnbull Electric Mfg. Co., Inc., 1237 Atlantic Ave., Brooklyn, N. Y.

FIRE-FLY.—Trade name for electric egg tester manufactured by Frank W. Gaylor, 30 Barclay St., New York, N. Y.

FIRE GUARD.—Trade name for fire extinguishers manufactured by James M. Castle, Inc., 1210-12 Arch St., Philadelphia, Pa.

FIRE POINT OF OILS.—Oils used for fuel and for insulating and cooling purposes in transformers, oil switches, oil circuit breakers, etc., need to be tested to determine the fire and flash points, as these are an indication of their value for the various purposes. The fire point is that temperature at which the vapors given off, if ignited, will continue to burn.

FIRE POTS, ELECTRIC.—These are electrically heated fire pots, which are very similar in their general construction and applications to electricians' and plumbers' fuel-heated fire pots. They are used especially in places where the other types would involve too great a fire hazard because of the open flame in the neighborhood of inflammable materials. They are also advantageous where work is done with electric power always available, as in a power house, telephone exchange, factory, etc., where their convenience, safety and compactness is of special value.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. An electrically-heated, two-compartment furnace for heating moderate and heavy-duty soldering irons. Consists of two special steel alloy muffles wound with nickel chromium wire on insulators made of a compound which retains its electrical resistance at high temperatures. Made for 220 volts, single heat, and for 110 volts providing three heats. 1,500-watt furnaces suitable for irons up to 2½ lbs. in weight per muffle, 2,000-watt furnaces for heavier irons. (Bulletin 69702.) See adv. pages 1203-1223.—Adv.

FIRE POTS, ELECTRICIANS'. — Oil-burning heating devices used by electricians, cable splicers and plumbers in heating solder and lead pots; it is usually provided with a large tank (about 5 quarts) for gasoline, a holder for the metal pots, irons or other tools to be heated, and an air pump for supplying air pressure for forcing the gasoline into the burner. Fire pots are used for heavier work than gasoline torches as a rule. They are especially adapted for melting lead or solder for splicing lead-covered cables and soldering cable lugs; they are aso used for heating splicing and filling compounds.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen."
Ashton Mfg. Co., 184 Emmet St., Newark, N. J. "Red-Hot."
Beach-Russ Co., 220 Broadway, New York, N. Y. "Beach-Russ."
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Bernz Co., Otto, 17-37 Ashland St., Newark, N. J. "Always Reliable."
Burgess Soldering Furnace Co., Columbus, Ohio. "Gem," "Star."
Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.

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HERBST, PAUL W., Chicago, Ill. We are exclusive distributors of the Davidson fire pot or soldering furnace. Destined to be the standard furnace. See display adv. page 1258.—Adv.
Kress Co., George R., 1900-1902 Brighton Rd., Pittsburgh, Pa.
Malleable Iron Fittings Co., Branford, Conn.
TURNER BRASS WORKS, THE, Sycamore, Ill. (See display adv. page 1326.)

FIRE PUMPS, ELECTRIC.—See Pumps, fire, electric.

FIRELESS COOKERS, ELECTRIC.—See Cookers, electric, fireless.

FIREPLACES, ELECTRIC.—These are made in many types, from those having large heating elements and arranged permanently in the wall so as to serve effectively as clean and sanitary fireplaces, to those constructed chiefly for ornamental purposes and provided with colored lamps to simulate the appearance of a burning coal or log fire. Also see Logs, electrically illuminated and heated.

Manufacturers:

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
STRAIT & RICHARDS, INC., Fabyan Place, Newark, N. J. The electric "Gliolog." See Logs, Electrically illuminated or Heated.—Adv.
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

FIREFLY.—Trade name for electric egg testers manufactured by Frank W. Gaylor, 30 Barclay St., New York, N. Y.

FIRING OF GUNS.—See Gun firing on battleships.

F-I-R-O-L.—Trade name for spark plugs manufactured by the Firol Spark Plug Co., 1526 Manhattan Bldg., Chicago, Ill.

FIROL SPARK PLUG CO.—1526 Manhattan Bldg., Chicago, Ill. Manufacturer of spark plugs.

FIRST.—Trade name for nitrogen lamps manufactured by the B. First Co., 170-172 W. Broadway, New York, N. Y.

FIRST AID EQUIPMENT.—Most industrial accidents occur when no physician is present and yet immediate care of the injury is essential. If proper treatment is not given infections frequently set in and increase the seriousness of the injury, sometimes resulting in the loss of fingers, hands, arms, legs, and occasionally causing death. To supply the proper materials for immediate treatment is the purpose of "first aid equipment." Since the accidents which may occur are various, first aid equipment is a varied but adequate assortment of the most essential materials, including as a rule: Antiseptics, stimulants, emetics, salts, bandages, absorbent cotton, plain gauze, knife, scissors, pins, tongue depressors, splints, wire, and in some cases stretchers. Where danger from gas or electric shock make it necessary, resuscitation apparatus is also included as a part of the first aid equipment. For this see Respirators and resuscitation equipment.

First aid equipment should always be kept in a sanitary cabinet. The foreman or some bright workman in each shift or working crew should be instructed in its use, so that relief may be given to the injured person at the earliest possible moment after the accident.

Manufacturers:

Ambrine Laboratories, 347 Madison Ave., New York, N. Y. "Ambrine."
American-LaFrance Fire Engine Co., Inc., Elmira, N. Y. "LaFrance."
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."
Lungmotor Co., 711 Boylston St., Boston, Mass. "Lungmotor."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."

FIRST CO., B.—170-172 W. Broadway, New York, N. Y. Manufacturer of nitrogen lamps.

FIRST NATIONAL LIGHTING CORP.—2030 E. 22nd St., Cleveland, Ohio. Licensed manufacturer and distributor of "Perfeclite" lighting fixtures and "Aladolamp" portable lamps for territory east of the Mississippi River. President, J. L. Jaffe; vice-president, W. S. Kiesel; secretary, treasurer and general manager, C. H. Heide.

FISCHER & CO., INC., H. G.—2341 Wabansia Ave., Chicago, Ill. Manufacturers of X-ray and other electrotherapeutic apparatus. Business established 1913. President, treasurer and general manager, H. G. Fischer; vice-president, P. P. Musket; secretary and sales manager, H. T. Fischer. Sales representatives, Seattle Supply Co., Seattle, Wash.; J. A. Wilferth, Los Angeles, Cal.; Electric Mfg. Co., San Francisco, Cal.; Magnuson X-ray Co., Omaha, Neb.; William Painter Co., Minneapolis, Minn.; A. S. Harris Co., New York, N. Y.; Thompson-Plaster Co., Lessburg, Va.

FISCHER & HAYES ROPE & STEEL CO.—741-745 W. Van Buren St., Chicago, Ill. Manufacturer of galvanized copper and steel strand, clamps, lag bolts and screws, etc. Business established 1916. President, A. C. Fischer; treasurer, T. S. Hayes.

FISHER & VINAL JEWEL WORKS.—15 Crescent St., Waltham, Mass. Manufacturer of jewel bearings for instruments. Business established 1910. Sole owner, Herbert C. Vinal.

FISCHER-SWEENY BRONZE CO., INC.—1301 Grand St., Hoboken, N. J. Manufacturer of metal castings and electroplating anodes. Business established 1911. President, C. J. G. Fischer; vice-president and treasurer, L. A. J. Fischer; secretary, A. Helmke.

FISHER ELECTRICAL WORKS.—1014 Lynn St., Detroit, Mich. Manufacturer of automobile lighting and starting systems. Frank E. Fisher, sole owner.

FISHER GOVERNOR CO., THE.—Marshalltown, Iowa. Manufacturer of power plant specialties.

FISHING, ELECTRICAL.—The processes preparatory to drawing wires and cables through underground ducts and interior conduit systems, and preparatory to drawing armored cable, flexible fabric tubing and flexible steel conduit through walls, floors, partitions, etc., are known as fishing. Two and sometimes three steps are usually involved before the conductors are in place.

In underground conduit work rats and ferrets were formerly used to draw a string through the duct and a heavy wire or pulling cable was then drawn through to which the lead-covered cable was finally attached. Present methods employ conduit rods, which may be joined together in short sections and pushed through; the pulling cable is attached to the last rod and drawn through by the rods; then the lead-covered cable is pulled in from the manhole at the other end. See Rods, duct or conduit cleaning and fishing.

Interior conduit systems generally require the use of a fish tape. A steel wire or tape, known as a fish wire or fish tape or "snake" (see Tape or wire, steel, fish) is run through the conduit. This may be pushed through from one outlet, junction or pull box to another. Bends or irregularities in the conduit, especially places where two lengths are coupled together, sometimes catch the tape but by twisting and shaking it may be worked loose and fished through. Where a great deal of fishing is to be done, or long lengths of conduit fished, pneumatic devices have been used in which a small wad or plug acts as a piston and is forced through the conduit by air pressure from a bellows, foot pump or compressed-air tank; a cord attached to the wad then is pulled in in this way and permits a light conductor or pulling-in wire to be drawn through, by which the heavy wires are pulled in.

Fishing of armored cable or flexible conduit in completed buildings is more difficult, but follows the same general methods. Fish tape is commonly used to draw the flexible conduit or tubing or armored cable into place. In the case of flexible steel conduit a fish plug is often used to connect the fish tape to the end of the conduit; see Plugs, fish, flexible steel conduit. After this conduit or the flexible fabric tubing (or "loom") is in place and secured to the outlet fittings, the fish tape is fished through it and used to draw in the conductors.

FISH PAPER.—See Paper, fish and rope.

FISH PLATE.—The metal plate which is used to join one rail to another in electric and other railway track construction.

FISHWAYS.—Fishways are required by law in nearly every state as an appendage to water-power, irrigation or other dams constructed on natural waterways. Their purpose is to afford a gradual incline through which a continuous stream of water of low velocity shall flow and against which the fish may readily swim, thus permitting the free passage of fish upstream. Both the inlet and outlet are below water.

FISKE BROS. REFINING CO.—24 State St., New York, N. Y. Manufacturer of lubricating oils. President, F. J. Snyder; vice-president and treasurer, William M. Teetsel; vce-presidents, C. W. McDaniel, C. Rodriguez; secretary, E. T. Johnson. Factories, Newark, N. J.; Toledo, Ohio.

FITCHBURG STEAM ENGINE CO.—Box 443, Fitchburg, Mass. Manufacturer of steam engines. Business established 1876. President and general manager, F. Fosdick; secretary, William J. Clifford; treasurer, Charles Fosdick. Sales representatives, Rowland & Burns, New York, N. Y.; George H. Conner, Philadelphia, Pa.; W. C. Teal, Chattanooga, Tenn.; H. J. Gebhardt, 343 S. Dearborn St., Chicago, Ill.

FITRITE.—Trade name for heating device plug manufactured by the Union Electric Corp., 103 Mott St., New York, N. Y.

FITSWELL.—Trade name for welder's goggles manufactured by the Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

FITTINGS, CONDUIT.—Conduit fittings is a broad term covering practically all the accessories used with conduit to form a complete conduit wiring system. It applies particularly to interior conduit, rigid or flexible, and includes hangers, straps, couplings, nipples, unions, locknuts, bushings, caps, conduit boxes of all kinds (such as outlet, switch, junction and pull), also box covers, outlet plates, etc. (Some details and the lists of the makers of the fittings will be found under the name of each fitting.)

FITTINGS, FIBER CONDUIT.—See Bends, elbows and other fittings, fiber conduit.

FITTINGS, PIPE, FOR AIR, STEAM, WATER, ETC.—Pipe fittings for use in power plants on air, steam and water lines are made in hundreds of forms and sizes for the various conditions that are to be met. While a few of the common and important fittings, such as valves and expansion joints are described elsewhere, the miscellaneous fittings include a very large number. In power plants the steam lines that are of large size generally contain pipe bends. These bends are merely standard sections made in the various pipe sizes and with a rather large radius so as to prevent friction losses and to allow for a certain amount of expansion. Pipe lines of smaller sizes and more complicated layout frequently require the use of elbows to make short turns, tees for making a tap from a line, couplings to join two lengths together, crosses to connect four lines, unions, reducers, etc. These are the most common fittings and are made of wrought, cast and malleable iron and also of brass quite commonly. In addition to these there are reducing elbows, couplings and unions, three-way elbows, 45° and other angle elbows, Y-branches at various angles, return bends, traps, offsets, offset couplings, branch tees, plugs, crossovers, crossover tees, etc., and various other flanges, gaskets, etc., and special fittings.

Manufacturers:

A. & J. Mfg. Co., The, 559 W. Lake St., Chicago, Ill.
Bashlin Co., The, Warren, Pa.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill.
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Keystone Iron & Steel Works, 2931 Santa Fe Ave., Los Angeles, Cal.
Lunkenheimer Co., The, Cincinnati, Ohio.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity."

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Malleable Iron Fittings Co., Branford, Conn.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Newbury & Son, Jay H., Goshen, N. Y.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

FITTINGS, SHRINK, FOR TUBULAR COPPER BUSES.—These are generally cast copper fittings with a carefully machined projection of such size as to make a shrink fit between copper tubing used for busbars and the fitting. Several forms of fittings are used, the most common being elbows, tees and straight connectors. In addition to these there are various special angle connectors, separable fittings, lug connections, tap connections and fittings for connecting to flat rectangular busbars.

Manufacturers:

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

FITTITE.—Trade name for lamp adapters manufactured by L. D. Bloch & Co., 37-41 E. 18th St., New York, N. Y.

FITZALL.—Trade name for plug manufactured by the Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y.

FITZ E-Z.—Trade name for attachment plugs manufactured by the Fitzgerald Mfg. Co., Torrington, Conn.

FITZGERALD.—Trade name for shaft hangers manufactured by the Challenge Co., Batavia, Ill.

FITZGERALD MFG. CO., THE.—Torrington, Conn. Manufacturer of electric vibrators, dishwashers and other electrical household specialties. Business established 1906. President and general manager, P. J. Fitzgerald; vice-president, M. D. Fitzgerald; secretary and sales manager, B. G. Peck; treasurer, M. F. Fitzgerald. Factories, Torrington, Conn., Winsted, Conn.

FITZGIBBONS BOILER CO.—Oswego, N. Y. Manufacturer of fire-tube boilers. Established 1886. Main office and factory, Oswego, N. Y. Branch office, 1181 Broadway, New York, N. Y. Sales representatives, Wallace Stebbins & Sons, Baltimore, Md.; M. B. Spooner, 141 Milk St., Boston, Mass.

FIVE HUNDRED.—Trade name for porcelain sockets and receptacles manufactured by the E. H. Freeman Electric Co., 803 E. State St., Trenton, N. J.

5 IN 1.—Trade name for draft gages manufactured by the Precision Instrument Co., 21 Halsey St., Newark, N. J.

5-MINUTE.—Trade name for electric vulcanizer manufactured by the C. A. Shaler Co., 22 Jefferson St., Waupun, Wis.

FIXATION OF ATMOSPHERIC NITROGEN.—Combination of the nitrogen of the air with other elements to form useful chemical compounds. The processes used are electrical, and are discussed under Nitric acid, which see.

FIXTURE CASING, CANOPIES, HANGERS, JOINTS, STEMS, STUDS, SWITCHES AND WIRE.—See Casing, fixture; Canopies, fixture; Hangers, fixture; Joints, fixture insulating; Stems, fixture; Studs, fixture; Switches, fixture (candelabra, canopy, keyarm, etc.), and Wire, fixture.

FIXTURE FITTINGS AND PARTS.—Many fixture fittings and parts such as canopies, casing, crowfeet, hickeys, joints, plates, rings, stems, studs, sockets, switches, are separately listed elsewhere; however, these listings include only standard and more commonly used parts. Parts of special design or uncommon use, such as fixture crossbars, and other special metal strips, various bowl clamps, hangers and buttons, loops and a wide variety of brass, copper, and iron stampings and spinnings are included under this more general classification. There are many manufacturers that specialize on the production of these parts, which are purchased by many manufacturers of fixtures for further manufacture and assembling into the countless designs of lighting fixtures they produce.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
American Art Metal Works, 348 N. 3rd St., Philadelphia, Pa.
American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
American Pin Co., The, Waterbury, Conn. "Ampinco."
Andresen Co., Jacob, 258 Third Ave., S., Minneapolis, Minn.
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin fixture fittings are practically all N. E. C. standard, expertly constructed and made of the best materials obtainable. Write for catalog.—Adv.
Best Electric Corp., 476 Broadway, New York, N. Y.
Brass Fixtures Co., The, Plantsville, Conn.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Butler Electric Co., 3531 Cottage Grove Ave., Chicago, Ill. "Beco."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass.
Champion Brass Works, Coldwater, Mich. (brass cast arms and loops).
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Day Co., Thomas, 725 Mission St., San Francisco, Cal.
Duplan Co., John, Carnegie, Pa. "J-D."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Empire Stamping & Metal Spinning Co., Inc., 88-90 Walker St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Faries Mfg. Co., Decatur, Ill.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio.
Frankford Brass Mfg. Co., 207-9 Quarry St., Philadelphia, Pa.
Friedley-Voshardt Co., 733-737 S. Halsted St., Chicago, Ill.
Frost, Samuel, 41-43 W. 14th St., New York, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Hudson Brass Works, 16 Nassau St., Brooklyn, N. Y.
Hyman & Co., Inc., Henry, 476 Broadway, New York, N. Y. "Hylite."

INTERIOR LAMP & FIXTURE CO., THE, 4888 N. Clark St., Chicago, Ill. A most unique line of cast metal fixture parts is manufactured by this company. A No. 704 Tassel size six by three ins. is shown at the left. Among the other more important products are arms, arm plates, bodies, canopies of various designs, brackets and backs, flanges, fixture loops, socket covers, both key and keyless, also some very novel designs in one-piece cast lamp bases. Write for catalog information and prices covering the entire Interior line of fixture fittings.—Adv.



No. 704 Tassel or 2¼" Shade Holder

Johnsen & Co., Arthur, 4802 Fullerton Ave., Chicago, Ill. "Ajco."
Liberty Machine Co., Wauwatosa, Wis.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
Lincoln Mfg. Co., 716 Erskine St., Detroit, Mich. "Lincoln."
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv. page 1275.)
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Matchless Brass Mfg. Co., 57 Jay St., Brooklyn, N. Y.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. (adjustable joint).
Metallic Mfg. Co., 544 W. 35th St., Chicago, Ill.
Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.
M. S. W. Mfg. Co., Inc., 1527 Niagara St., Buffalo, N. Y.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
National Metal Spinning & Stamping Co., 176-180 Grand St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y.
Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Phoenix Light Co., 525 Market St., Milwaukee, Wis. "Non-Kor."
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Polacheck & Bro. Co., Charles, 217 3rd St., Milwaukee, Wis.
Reading Brass Works, Reading Pa.
Reliance Lighting Fixture Corp., 275 Canal St., New York, N. Y. "Relifco."
Rome Mfg. Co., Rome, N. Y. "Rome."
Rome Metal Products Co., Inc., 23-31 W. 43rd St., New York, N. Y. (loops)
SCOVILL MFG. CO., 99 Mill St. Waterbury, Conn. (See display adv. page 1327.)
Simplex Metal Spinning & Stamping Co., Inc., The, 24-34 New Chambers St., New York, N. Y.
Sprecher Mfg. Co., Inc., P. W., Milwaukee, Wis. (suspension and joint)
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco," bowl hanger.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Twin City Die Castings Co., Talmage & 33rd Aves., S. E., Minneapolis, Minn. (loops).
United Metal Mfg. Co., Inc., 27 Shipping St., Norwich, Conn.
Universal Bearing Bronze Co., Winsted, Conn.
Universal Chain Co., The, Stroudsburg, Pa. (loops)
Universal Metal Spinning & Stamping Co., Inc., 718 Atlantic Ave., Brooklyn, N. Y.
Vester Sons, Inc., Alfred, 5 Mason St., Providence, R. I.
Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. (white metal).
Walworth Mfg. Co., Boston, Mass.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

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FIXTURE WIRE.—See Wire, fixture.

FIXTURES, LIGHTING.—A lighting fixture is generally understood to be a device for holding a lamp or lamps in a fixed position, the device being fixed or permanently attached to some supporting surface. An exception to this specific definition is the adjustable fixture which is permanently attached to some surface, but in which the position of the lamp is adjustable; another more recent exception is a class of fixtures that are designed to be removed or replaced occasionally, special receptacles being provided for supporting the fixture and connecting it to the circuit without difficult rewiring. The "fixed" feature in fixtures is becoming less an essential than formerly. Fixtures are to some extent classified in the trade according to the uses to which they are put, especially when it is a question of selecting fixtures for a particular service. A more general classification commonly in use, based on the design of the fixtures itself, is as follows:

(1) Pendent fixtures are those designed to hang from the ceiling. In the fixture trade a "pendant" means usually a tubular stem or chain with a single lamp on the end. However, in its broader sense pendent fixtures include all fixtures hung from the ceiling, in which the lamps are some distance from the ceiling, without regard to the number of lamps.

(2) Ceiling fixtures are those which carry a lamp or lamps close to the ceiling without the intervention of any stem or chain.

(3) Bracket fixtures are those attached to walls and projecting from the walls. A simple lamp screwed into a receptacle attached to the wall would not be a fixture in the ordinary understanding of the word.

(4) Floor and newel post standards are fixtures designed for attachment to a permanent outlet on a floor or on top of a newel post. A floor lamp which can be moved from place to place and is not attached to the floor is not considered to be a fixture.

The term fixture is also sometimes used for the brackets and other means used for the support of street lamps on posts.

Pendent fixtures are usually supported by tubes or chains. If the fixture is of the indirect or semi-indirect type, the bowl is supported by several tubes, rods and chains. In the multiple-arm fixture the lamps are placed on the ends of arms, following old gas-jet and candle practice. The shower fixture, which is a modification of the pendent type, has a central fitting or body from which a number of lamps are suspended by chains or rods. The main body of the shower may be either against the ceiling or hung some distance from it.

Fixtures are sometimes also classified according to the nature of the lighting into the following three classes:

Direct lighting fixtures, in which the light is distributed directly from the fixture downward or obliquely into the room.

Indirect lighting fixtures, in which all the light is first transmitted to the ceiling and then distributed throughout the room by reflection from the ceiling.

Semi-indirect lighting fixtures, in which most (or at least a very large part) of the light is first directed to the ceiling, and the rest is allowed to pass into the room directly through diffusing glassware.

In the following descriptions of some of the principal classes of lighting fixtures as to service, are included some remarks on the development of the electrical fixture production art, especially as to residence lighting fixtures, which constitute the largest single class. The art, in general, has progressed slowly, but in the last few years it has given promise of incorporating the principles of good illumination as well as the canons of artistic effect in fixture design. The organization of the fixture manufacturers and of fixture dealers has already led to important developments in advancing this branch of the lighting business.

Some idea of the magnitude of this business is obtained from the annual production of fixtures and accessories. It has been estimated that in the United States there were produced in 1920, fixtures and auxiliary equipment, such as various types of reflectors and shades, to the total value of over $220,000,000.

FIXTURES, LIGHTING, ADJUSTABLE.—Adjustable fixtures are commonly some form of bracket fixture, the bracket being made up of one or two tubes connected by a universal joint, or the tubes are joined through joints which are the equivalent of a universal joint. Sometimes they are attached to the ceiling and include telescopic tubular sections. Adjustability is also obtained by use of a flexible conduit instead of sectional tubes. Such fixtures are particularly adapted to lighting surfaces which are cast in shadow by obstructions to the general overhead lighting, or for furnishing more intense local illumination than is provided by the general lighting for exacting visual work. They are used in machine shops, sewing rooms, sometimes in drafting rooms, and by physicians and dentists. For obtaining adjustability in floodlight or spotlight projectors a fixture which consists of a base for mounting on a supporting surface, and a trunnion attached to the base by a swivel joint is often used, but in most cases it forms part of the projector housing.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.

American Fixture Co., Milwaukee, Wis. "American."

AMERICAN FIXTURE CO., 232 W. Water St., Milwaukee, Wis. "American" adjustable fixtures combine grace and strength with light weight. They are made of light gauge sheet steel, rectangular in section, and have welded joints of the new "Universal" joint which allows lamp to be placed securely in any position. The lamp cord is inclosed in fixture and passes through joint, so that it is practically impossible to chafe or injure insulation. Thumb nut and dished washers also give joint great holding power. Illustration shows fixture fitted with base plate for wall or ceiling installation. These fixtures are equally adapted to floor, bench, machine installation, or as portables. The design eliminates the use of drop cords and makes the fixture of especial value in drafting rooms, sewing rooms, shoe factories, machine shops, etc. The "American" fixture is made in lengths and sizes to fill every requirement. Standard finish is olive green, baked enamel, which presents a neat, very pleasing appearance. The company also furnishes cone, pear and parabola-shaped shades with frosted aluminum inside finish, if desired.—Adv.



"American" Adjustable Fixture

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. (See display adv. page 1294.)

Andresen Co., Jacob, 258 Third Ave., S. Minneapolis, Minn.

Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.

Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)

Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.

Black & Boyd Mfg. Co. 17 E. 47th St., New York, N. Y.

Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."

Canadian Duplexalite Co., Ltd., 745 St. Catharine St., W., Montreal, Que., Can. "Duplexalite."

Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio. "Ray."

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.

Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."

Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."

Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.

Eclipse Light Co., 583-87 Broadway, New York, N. Y.

Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.

Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.

Everson & Co., C G., 70 W. Lake St., Chicago, Ill. "Ever So New."

Faries Mfg. Co., Decatur, Ill.

First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."

Frankford Lighting Fixture Manufacturers, 4273-75 Frankford Ave., Philadelphia, Pa.

Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.

Granden Electric Co., 1511 Howard St., Omaha, Neb.

Great Western Electric Fixture Co., 292 Church St., New York, N. Y.

GREEN EQUIPMENT CORP., 53 W. Jackson Blvd., Chicago, Ill.

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill "Monolite."

Henkel & Best Co., 122 S. Michigan Ave., Chicago. Ill.

Herwig Art Shade & Lamp Co., 2140 N. Halsted St., Chicago, Ill.

Highlands Mfg. Co., Muncie, Ind.

Hinsdill Electric Co., 225 River St., Troy, N. Y. "Hinsdill."

Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.

Keith Mfg. Co., Inc., Clinton, N. Y. "Keith."

Koken Companies, 2528 Texas Ave., St. Louis, Mo. "Koken."

Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.

Lindblad, K. F. M., Boston, Mass. "Adlight."

Lindcraft Studios, Jamaica Ave. & 125th St., Richmond Hill, N. Y.

LINE MATERIALS CO., South Milwaukee, Wis. (See display adv. page 1278.)

LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv. page 1275.)

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)

McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.

McFaddin & Co., H. G., 38 Warren St., New York, N. Y.

Manhattan Brass Co., 332 E. 28th St., New York, N. Y.

Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.

Miller Saw-Trimmer Co., Penn & Water Sts., Pittsburgh, Pa. "Anyangl."

Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.

MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.

Morse, Frank W., 289 Congress St., Boston, Mass. "Harwood."

National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

New York Lighting Fixture Co., 67-69 Spring St., New York, N. Y. "Nylco."

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."

Phoenix Light Co., 525 Market St., Milwaukee, Wis.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

POLACHEK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."

Polly Mfg. Co., Milwaukee, Wis.

Reading Chandelier Works, The., 503 Penn St., Reading, Pa.

Reliance Lighting Fixture Corp., 275 Canal St., New York, N. Y. "Relifco."

Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.

SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."

Simes Co., The, 22-26 W. 15th St., New York, N. Y.

STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."

Sterling Stamping Co., Sterling, Ill. "Faultless."

Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."

Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.

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Wetzler, S., 34 Union Sq., New York, N. Y. "Anywheare."
White Co., The O. C., 17 Hermon St., Worcester, Mass.
Wolf & Davis, 71-73 Spring St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, AUDITORIUM.—In the lighting of theater and church auditoriums, concert or lecture halls, ballrooms, banquet halls and similar large public assembly halls, the decorative effect is generally regarded as of equal importance to the lighting effect. The electrical fixtures used in these rooms have largely followed the accepted designs of the old candle fixtures used for the same purpose a century or more ago. The fairly common practice of making the general plan and decoration of these rooms conform to the design of a particular period has led to the use of lighting fixtures of corresponding period design to be in harmony with the general decorative scheme. One of the most popular styles has been the crystal prism chandelier, which lends itself to many decorative schemes. These fixtures contain hundreds of cut prisms suspended from a metal framework, the sockets and lamps being almost entirely hidden behind the network of cut glass. The prisms are cut in many forms, such as beads, spearheads, stars, and rosettes, from crystal, opal, ruby, green, amber, or irridescent glass. Candle fixtures of elaborate ornamental period designs made of spun or hammered metals, usually brass, bronze, or silver, are also popular, though their application is more limited. The problem of securing ample light without glare has not yet been solved in such candle fixtures. Ornamental iron and composition are also used sometimes, particularly for fixtures which are given a polychrome finish.

Within the last dozen years a new type of auditorium lighting has been developed, the essential feature being that of indirect or semi-indirect lighting, wherein stress is laid on the decorative value of the lighting effect rather than of the fixture itself; in fact, in some installations the fixtures are invisible. The inception of the large motion-picture theater with its steadily increasing elaborate decorative effects and new requirements in auditorium lighting has done much to alter existing practice in this field of lighting. Here the chief requirement of the fixture is to bring out the beauties of the theater interior and the fixtures as a result are designed primarily to furnish adequate and comfortable illumination. Total indirect, semi-indirect and indirect with a separately illuminated bowl are the types of fixtures generally used. In large fixtures many lamps are used to permit securing polychrome lighting effects. Ceiling fixtures for totally indirect or semi-indirect lighting are, of course, artistically designed but, due to their radical difference from candle fixtures, have developed an individual style. Fixtures employed in lighting from entirely concealed sources are usually placed in coves or in side-wall boxes. They are consequently very compact, generally being little more than a socket, shade holder and reflector. The reflectors most commonly used are the silvered-glass types, formed to distribute the light according to the requirements of the installation.

Bracket fixtures when used in the open spaces of the auditorium are usually of low intensity, since they serve mostly for decorative effect. Under balconies, however, the problem of lighting is more difficult and brackets may have to furnish most of the light; the use of half shades often solves the glare problem from such brackets. In some cases where the balcony was both broad and deep, and there was not sufficient headroom for indirect or semi-indirect fixtures, recourse has been made to fixtures recessed in the ceiling or under the side of the balcony; such fixtures have a reflector to direct the light over a considerable area of the floor, and are unobtrusive and effective means of solving a difficult problem of lighting without glare.

Commercial types of office and store lighting units are, to a limited extent, also used for small auditorium lighting, but when so used are generally provided with a more decorative bowl, or a shade of silk or parchment.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Alexalite Co., The, 434 E. 23rd St., New York, N. Y. "Alexalite."
Anodion Metal Co., The, 124 South St., Baltimore, Md.
Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago, Ill. See description of "Denzar" lighting unit under "Fixtures, lighting, office and store."—Adv.
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Black & Boyd Mfg. Co., 17 E. 47th St., New York, N. Y.
Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catharine St., W., Montreal, Que., Can. "Duplexalite."
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Decorators Supply Co., 2547 Archer Ave., Chicago, Ill.
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfoclite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
General Lighting Fixture Co., 28 W. Lake St., Chicago, Ill.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Deluxite."
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Lighting Studios Co., 220 W. 42nd St., New York, N. Y.
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. "Brascolite." (See display adv. pages 1276-1277.)
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.
National Diffused Light Co., 136 W. Lake St., Chicago, Ill.
National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. X-ray ceiling fixtures, floor pedestals, and other special lighting units are supplied for every lighting requirement. All types embody proper principles of lighting. X-ray mirror reflectors have made X-ray lighting equipment famous. See Adv. page 1405.—Adv.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
New York Art Works, 328-330 7th Ave., New York, N. Y.
Panama Lamp & Commercial Co., 595 Mission St., San Francisco, Cal. "Panama-Lite."
Pearlman & Co., Victor S., 533 Wabash Ave., Chicago, Ill.
Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa. "Magian", "Daylight Competitor."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Planetlite Co., Inc., 15 E. 40th St., New York, N. Y. "Planetlite."
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa. "Britasday."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polly Mfg. Co., Milwaukee, Wis.
Reading Chandelier Works, The., 503 Penn St., Reading, Pa.
Reedicon Light Co., The, 7 E. Grant St., Minneapolis, Minn. "Reedicon."
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Standard Light Co., 448 E. Water St., Milwaukee, Wis. "Stanlico."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa. "Compolite."
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."
Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Wyle & Bros., Inc., J. J., 18-20 E. 27th St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, CAR.—Due to the low headroom in railway cars the lighting units are for the most part either mounted directly on the ceiling or supported by very short stems. For steam-railroad day coaches very simple fixtures are generally used, consisting of little more than a canopy, stem, socket, shade holder and glass shade. In the case of parlor, dining, sleeping and private cars a great deal more attention is given to producing a variety of pleasing designs. Brackets are often provided in such cars and these are equipped with decorative shades. In sleepers the berth lamps serve instead of brackets. In diners special attention is given to producing an attractive lighting as well as decorative effect. In some cases the lighting units are partly recessed in the deck of the car, the visible portion being of art glass or other pleasing and diffusing glass; indirect lighting has also been tried out on dining cars. Baggage, express and mail cars are provided with simple ceiling or occasionally bracket fixtures equipped with prismatic, mirrored or opal glass, or with porcelain enameled steel reflectors. Rugged construction characterizes all fixtures used on steam-railway cars.

The fixtures used on interurban electric cars are coming to be of types and designs similar to steam-railroad car-lighting practice. Electric street and other urban cars are in most cases lighted by bare, exposed lamps mounted in ceiling receptacles without any fixture or reflector. On some systems opal or prismatic glass reflectors have been adopted with good results, as they greatly diminish the glare and permit using fewer and larger candlepower lamps.

Manufacturers

Adams & Westlake Co., 319 W. Ontario St., Chicago, Ill. "Adlake."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Black & Boyd Mfg. Co. 17 E. 47th St., New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catharine St., W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Dayton Mfg. Co., The, Dayton, Ohio. "Dayton."
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."

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NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polly Mfg. Co., Milwaukee, Wis.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, DESK, FLOOR AND TABLE.—Articles commonly referred to as desk, floor and table fixtures are more properly called lamps. See Lamps, desk and piano; Lamps, floor and Lamp, table and reading.

FIXTURES, LIGHTING, INDUSTRIAL.—Industrial lighting fixtures use most commonly a reflector of porcelain-enameled steel, aluminumized steel or white painted metal, or opal, mirrored or prismatic glass, and containing a single high-wattage lamp. The reflector and lamp are usually mounted on a rigid stem, generally ordinary conduit. Each fixture may be equipped with a ceiling, stem or pendent switch or pull or key socket for individual control, though the more common method is to have the fixture controlled by a wall switch or at the panelboard.

The reflectors are the distinctive feature of the many industrial lighting fixtures. They are made in a great variety of shapes, sizes and materials suitable to the variety of working conditions found in industrial plants. One of the commonest modern forms is what is known as the R. L. M. standard dome reflector, a wide dome of medium depth, which gives a flux distribution adapted to general illumination under a wide variety of conditions. Where the fixtures are mounted high above the working plane a deep bowl reflector is used. Another type in common use is the skirted cone, resembling a flat pan in shape. As this type exposes the lamp filament to the eye an auxiliary piece, called an eye shield, which surrounds the bowl of the lamp is usually suspended from the pan. The shield may either be enameled metal or dense opal glass. To avoid glare any type of fixture may be equipped with a metal reflecting or opal glass diffusing cap held on the lower half of the lamp so that the filament is not visible to the eye. The majority of industrial lighting fixtures are designed for general lighting of fairly high intensity. Small reflectors of the same material as the larger reflectors are commonly used for illuminating stairways, storage space, or for local lighting over benches, on important machines, etc. A fixture stem is seldom used with smaller ceiling fixtures as they are generally suspended from the rosette or other ceiling outlet by the lamp cord. For lighting around boring machines, special lathes, punch presses, and other machine tools adjustable fixtures are sometimes required; for these see above under Fixtures, lighting, adjustable. Also see Reflectors, industrial lighting, miscellaneous.

Manufacturers:

Abco Mfg. Co., 1633 Walnut St., Chicago, Ill.
Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y. "Acmetal."
Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. "Reelite." (See display adv. page 1294.)
Andresen Co., Jacob, 258 Third Ave., S. Minneapolis, Minn.
Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."
Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill. "Pull-Clean."
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago, Ill. See description of "Denzar" lighting unit under "Fixtures, lighting, office and store."—Adv.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Industrial Lighting fixtures are made in a wide variety of types for every kind of service, and for lamp sizes of 75 to 1000 watts. For general factory lighting, the Reflector Socket is widely used. The R. L. M. Dome type is illustrated at the left. It consists of a porcelain enameled steel reflector formed in one piece and therefore strong and durable, the well known Benjamin two-piece, easy-to-wire porcelain socket and a heavy brass-to-iron separable fitting tapped at the top for conduit support and arranged to bear the weight of the reflector and socket. Variations of this fixture are: the Reflector Unit, with removable reflector, of which the fluted bowl type is illustrated below, and the type RR fixture with a threaded cast hood and threaded neck, removable reflector. Where the work must be done often, cleaning is made easy with removable reflectors. The Benjamin



R. L. M. Dome Type



Fluted Bowl Type

line also comprises high grade protective fixtures with enclosing globes such as acid resisting, gas- and vapor-proof, moisture-proof and watertight types. These are for the industries where acid fumes, corrosive gases or vapors, etc., are encountered or where inflammable materials or explosives are present. A complete line of outdoor fixtures is made by this company for sign-board, street, yard and dock lighting. This company also manufactures a number of lighting fixtures and signs of particular value to railroads. Among them is the type RR fixture with threaded cast hood and threaded neck, porcelain enameled steel reflector. This fixture is unusually strong and durable and the reflector is easily unscrewed for cleaning. Three types of reflectors are furnished—R. L. M. Dome (left, upper figure), Bowl and Symmetrical Angle, left, lower figure (reflector only); sizes for 75 to 1000-watt lamps.—Adv.





Type RR Reflectors

Black & Boyd Mfg. Co. 17 E. 47th St., New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Contreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio. "Crescent."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."
Forg Mfg. Co., Peter, 50 Park St., Somerville, Mass.
Frost, Samuel, 41-43 W. 14th St., New York, N. Y.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Great Western Electric Fixture Co., 292 Church St., New York, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.
Herwig Art Shade & Lamp Co., 2140 N. Halsted St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
Jaehnig Gas Fixture Co., Inc., 221-223 13th Ave., Newark, N. J.
Jefferson Glass Co., The, Follansbee, W. Va.
Kapsa, Rudolph, 2320 S. Kedzie Ave., Chicago, Ill.
LIGHTOLIER CO., 569 Broadway, New York. To get best results from the new Type C Mazda nitrogen lamps, it is not necessary to buy complete new



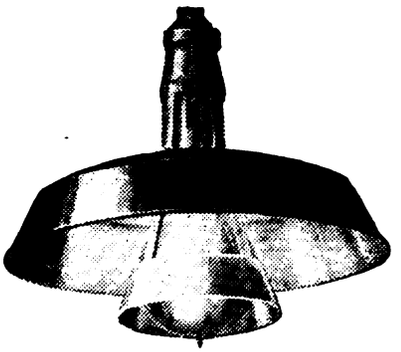
The Lightolier 16-21 Unit

fixtures. The Lightolier 16-21 unit can be screwed onto the old fixtures now hanging in the store or work room. This entirely modernizes the lighting equipment with accompanying betterment of distribution. It consists of a neat, artistic brass holder with ample ventilation for maximum efficiency—dust and bug proof. This supports the glass globe of proper density to insure soft, pleasant light and with curvature correctly designed for maximum diffusion.—Adv.
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv. page 1275.)
Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind. "Day-Glow."

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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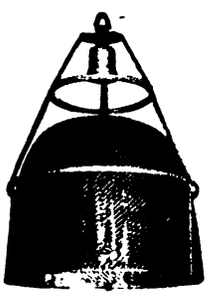
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Industrolite is designed to eliminate the glare from high power lighting units, and to distribute the light evenly over the range of each reflector. It is, therefore, of particular value in factories, eliminating eye-strain and improving working conditions. Industrolite is



The Industrolite

composed of two elements; an upper reflector of white porcelain enameled steel and a white porcelain enameled steel reflecting cone suspended below the upper reflector in such manner that all light above the angle of 40 deg. is intercepted and reflected to the working plane. Made in two sizes, 10 and 13 ins. diameter for use on porcelain sockets, accommodating lamps ranging in size from 75 to 200 watts. See display adv. on pages 1276-7 for other Luminous Unit products.—Adv.

Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.
National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill. "Radiolite."
National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" reflectors are ideal for installation wherever mechanical work is done. Reflectors are installed at the ceiling, eliminate drop cords and save lamp breakage. The "Jumbo"



"Jumbo"

with 1000-watt Mazda "C" lamp, will replace arc lamps. All X-Ray mirror reflectors are made with a silver reflecting surface and are permanently brilliant. See Adv. page 1405.—Adv.

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Pittsburgh Reflector & Illuminating Co., Inc., 3rd & Ross Aves., Pittsburgh, Pa.
Planetlite Co., Inc., 15 E. 40th St., New York, N. Y. "Planetlite."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."
POLACHEK & BRO. CO., CHARLES. 217 3rd St., Milwaukee, Wis. "Light House."
Reading Chandelier Works, The., 503 Penn St., Reading, Pa.
Reedicon Light Co., The, 7 E. Grant St., Minneapolis, Minn. "Reedicon."
REFLECTOLYTE CO., THE. 914 Pine St., St. Louis, Mo. "Reflectolyte."
Rozee Mfg. Co., 10 Ionia Ave., S. W., Grand Rapids, Mich. "Rozee-Lite."
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."
Service Electric Co., Inc., 2337 N. Hoyne Ave., Chicago, Ill.
SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
Solar Illuminating Co., 54 W. Lake St., Chicago, Ill. "Solar."
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Standard Light Co., 448 E. Water St., Milwaukee, Wis. "Stanlico."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sol-Lux." (See display adv. pages 1395-1402.)
White Co., The O. C., 17 Hermon St., Worcester, Mass.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."
Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, MARINE, WATERTIGHT AND VAPORPROOF.—On shipboard the need for minimizing hazards is leading to the location of fixtures overhead and abandoning to a great extent all bulkhead or bracket fixtures, thus reducing the fixture design to narrower standards. The tendency is also to avoid the use of untreated wood as well as metal in fixtures and to use some form of insulating material such as porcelain or molded insulation. This is especially the case in living quarters where the material is subjected to neither salt water and salt air, nor mechanical injury. In exposed locations where subjected to hard usage, such as on deck, in cargo spaces, engine and boiler rooms, etc., steam-tight, guarded fixtures are required. These are of metal, but of such quality and so prepared that they will withstand the effects of alternate exposure to water and air. If key switches are combined with fixtures, they should be so designed that turning them in either direction will extinguish the light. The trend of opinion, on account of fire risk, is to provide separate push switches in crew and passenger quarters designed so that they cannot be taken apart without tools.

The compartments or staterooms in steam vessels are usually of small dimensions and by common usage invariably painted in gloss white. This makes the problem of illumination very simple as the value of light source is returned by good reflection and with little absorption. The 25-watt tungsten lamp is recommended as the standard unit for each compartment. For large spaces, such as cargo holds, where lighting is only needed at and under special conditions, the tendency is to place the large lighting units well overhead so as to keep the light out of the line of vision of the workers. Ocean-going vessels usually have outlets for large portable cargo lights located near the hatchways. Packet steamers using only well known and customary docks are arranged with side openings in the hull for charging and discharging. This type of vessel may be provided with permanent small lighting units carefully protected from mechanical injury.

In many land installations it is necessary to provide water-tight lighting fixtures. This is done on docks and wharves, in tunnels, breweries, refrigerating rooms and other damp locations. Where there is apt to be much steam, explosive or combustible vapor or gas, or corrosive fume, the fixtures are made even more tight, being of the type called vaporproof. This type is required in oil refineries, dry-cleaning establishments, dye houses, laundries, locomotive roundhouses, many chemical works, powder mills, etc. This type of fixture has a heavy outer glass globe surrounding the lamp and fitting tightly against a rubber gasket in a special holder that covers the socket completely. Such fixtures are almost invariably made keyless.

Manufacturers:

Anodion Metal Co., The, 124 South St., Baltimore, Md.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin watertight fixtures



with cast brass or iron fixture bodies, heavy screw globe and brass guard are also gas and vaporproof. Sturdy fixtures for land and sea service in key and keyless types. Illustration shows keyless outlet box ceiling fixture, 75-watt size. Made also in angle wall and drop fixture types.—Adv.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conneaut."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Dayton Mfg. Co., The, Dayton, Ohio. "Dayton."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Electric Appliance Co., 701-709 W. Jackson Blvd., Chicago, Ill. "Watight."
Faries Mfg. Co., Decatur, Ill.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Morse, Frank W., 289 Congress St., Boston, Mass.
National Marine Lamp Co., The, Forestville, Conn.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polly Mfg. Co., Milwaukee, Wis.
Porter Co., The, 241 Water St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.

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Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
Smyser-Royer Co., York, Pa.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sol-Lux." (See display adv. pages 1395-1402.)
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, MISCELLANEOUS.—Lighting fixtures of a special character and for miscellaneous purposes not otherwise referred to elsewhere in this book are included under this classification. Electric lighting has already displaced other methods of lighting in practically every class of lighting installation, almost exclusively in many and to a very large extent in most. The kinds of fixtures and the classes of service for which they are designed are therefore very numerous and the classes listed above and below cannot by any means cover all. A few of these miscellaneous classes are as follows: Fixtures for art museums, libraries, banks, schools, laboratories, gymnasiums, courts of justice, post offices, penal institutions, etc. These involve special types of direct, indirect, or semi-indirect fixtures in many cases, that cannot be discussed in detail for lack of space.

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y. "Acmetal."
Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Alexalite Co., The, 434 E. 23rd St., New York, N. Y. "Alexalite."
Andresen Co., Jacob, 258 Third Ave., S. Minneapolis, Minn.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.
Baehker, F., 2531 Milwaukee Ave., Chicago, Ill.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (Acidproof.) (See display adv. pages 1231-1234.)
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Black & Boyd Mfg. Co., 47 E. 47th St. New York, N. Y.
Bridgeton Chandelier Co., Belmont & Oxford Sts., Bridgeton, N. J.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Clinton Metal Lamp Co., 55 Chrystie St., New York, N. Y.
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.
Crescent Art Metal Co., The, Bridgeton, N. J.
Crescent Brass Products Co., The 8410 Lake Ave., Cleveland, Ohio. "Crescent."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.
Crucet Mfg. Co., 292 5th Ave., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (bank screen and desk.) See adv. page 1308.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Falkenbach Mfg. Co., Inc., 159 E. 54th St., New York, N. Y. "Woodfibre."
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio. (billiard table) "Frankelite."
Frost, Samuel, 41-43 W. 14th St., New York, N. Y.
General Lighting Fixture Co., 28 W. Lake St., Chicago, Ill.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Hovorka, John D., 3509 W. Roosevelt Rd., Chicago, Ill.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Incandescent Supply Co., 638 Liberty Ave., Pittsburgh, Pa. "Isco."
Jaehnig Gas Fixture Co., Inc., 221-223 13th Ave., Newark, N. J.
Kapsa, Rudolph, 2320 S. Kedzie Ave., Chicago Ill.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
LUMINOUS UNIT CO., DIV. ST. LOUIS BRASS MFG. CO., St. Louis, Mo. In addition to a complete line of semi-indirect lighting fixtures (Brascolites, Aglites, E-lites and Industrolites) for use in homes, offices, stores, etc., this company manufactures a special line of fixtures particularly adaptable to churches, banks, public and semi-public institutions, with massive hangings and fittings, candelabra effects, etc., all employing the Brascolite principle of efficient illumination. See display adv. pages 1276-1277.—Adv.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.
National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.
National Plastic Relief Co., 330 Main St., Cincinnati, Ohio. "Fiber Olitic."
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Art lamps, pedestals, wall brackets, candelabra fixtures, cornices, glass bowls, composition bowls, metal bowls—all indirect lighting by X-Ray reflectors. A staff of artists and illuminating engineers is maintained to design and specify distinctive architectural detail. See Adv. page 1405.—Adv.
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y. "Nylco."
Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."
POLACHEK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."
Polly Mfg. Co., Milwaukee, Wis.
Reading Chandelier Works, The, 503 Penn St., Reading, Pa.
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y. "Remssco."
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
St. Charles Fixture Mfg. Co., St. Charles, Ill.
Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Universal Bearing Bronze Co., Winsted, Conn.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, OFFICE AND DRAFTING ROOM.—Offices and drafting rooms nearly always require lighting fixtures which will give a uniform distribution of light over a large area. As work is frequently done upon glazed paper or other polished surfaces these units are often designed with particular attention to the elimination of glare. Offices and drafting rooms usually have a light-colored ceiling so the conditions are such as to make direct and semi-indirect fixtures applicable. In many cases some attention is paid to the decorative effect of the fixture, especially in offices open to the public. The semi-indirect bowls used in these fixtures are sometimes decorated and vertical rod suspensions are used to avoid objectionable shadows on the ceiling. Units producing semi-indirect illumination by supplying their own reflecting surface are also extensively used; they have an enameled reflecting plate that serves as a small false ceiling, from which is suspended a dense opal glass bowl. These units may be suspended from the ceiling or mounted on the ceiling surface, both these mountings being especially suitable when the ceiling is dark or redecorated infrequently. Other types are the one-piece and multipart assembled glass units, generally of opal glass or a combination of opal and clear glass. In some types of these units the dome part or the upper surface of the one-piece bowl is made reflecting, producing a lighting effect somewhat similar to the units employing a reflecting plate.

Direct lighting fixtures are also extensively used in offices. In most cases they consist of dome or bowl-shaped reflectors, either of glass or metal, suspended by a chain or fixture stem or by reinforced lamp cord direct. Such direct lighting fixtures are preferably of the deep dome or bowl-reflector type, unless hung close to the ceiling in a high room. The shallow types of reflectors expose the lamp, causing very annoying glare. Diffusing or reflecting caps are often put on the lamp to diminish or prevent this glare, and in other cases small diffusing rings, bowls or shields are suspended below the lamps for the same purpose.

The tendency in office and drafting room lighting has for many years been away from the use of individual desk lamps and toward the use of general lighting from ceiling fixtures. From the standpoint of visual comfort a well designed indirect or semi-indirect lighting system is conceded to be the ideal. Where there is much dust or smoke more frequent cleaning of fixtures is necessary or it may be advisable to use direct or semi-indirect fixtures that can be cleaned more quickly than the ordinary open-bowl indirect or semi-indirect fixtures. Desk lamps are now provided as a rule, only for special locations or for very exacting visual work that cannot be so well illuminated by the general lighting of the room as a whole.

Also see Lighting units, office, store and other commercial types. For desk lamps, see Lamps, desk.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
Aglow Sales Co., 671 3rd Ave., New York, N. Y.
Alexalite Co., The, 434 E. 23rd St., New York, N. Y. "Alexalite."

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Alt-Le Lighting Fixture Co., 262 Bowery, New York, N. Y. "Altelite."
American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Anodion Metal Co., The, 124 South St., Baltimore, Md.
Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."
Banfield & Sons, Ltd., W. H., 370-386 Pope Ave., Toronto, Ont., Can.
Bauer, Inc., H. A., Lansdowne. Pa. "Pull-A-Lite."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago. Manufacturers of the "Denzar" lighting unit, scientifically designed for use with the powerful Mazda "C" lamp. Carries reflector shaped to give the proper distribution of light and allows sufficient light to filter through to the ceiling so as to avoid shadows or streaks. The upper portion of the bowl



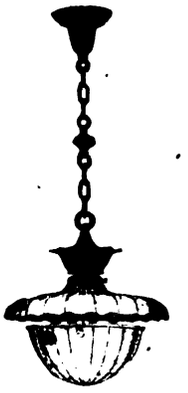
"Denzar" Lighting Unit

is clear glass, permitting the greater portion of the light to be thrown upward to the reflector and be redirected from there to the working plane where it is needed. This portion of clear glass also prevents the accumulation of dust and dirt in the bowl and makes the "Denzar" practically a dust-, dirt- and bug-proof unit. The lower part of the bowl is finished with a hard, smooth, white translucent enamel of good diffusing quality, completely concealing the filament and eliminating all glare. We also manufacture a complete line of direct, indirect and semi-direct lighting units; also a complete line of lighting fixtures, brackets, etc., to meet all conditions.—Adv.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See entry under Fixtures, lighting, store, also industrial.—Adv.
Black & Boyd Mfg. Co., 17 E. 47th St., New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St.. W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y. "Cas-O-Lux."
Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio. "Ray."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Commercial Excelite Co., Inc., 312 N. Eutaw St., Baltimore, Md. "Excelite."
Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.
Conneaut Metal Works Co., The, Conneaut, Ohio.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio. "Crescent."
Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.
Crown Electrical Mfg. Co., Ltd., Brantford, Ont., Can. "Crown-Lite."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W. Toronto, Ont., Can. "Britlite," "Edmundslite."
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill. "Lite Unit."
Egan & Egan, 21 E. 40th St., New York, N. Y. "Ray-O-Day."
Empire Lighting Fixture Co 224 Centre St., New York, N. Y.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Farles Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Findlay Mfg. Co., Inc., Robert, 224 5th Ave., New York, N. Y. "Findlaylite."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."
Forg Mfg. Co., Peter, 50 Park St., Somerville, Mass.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio. "Frankelite."
General Lighting Fixture Co., 28 W. Lake St., Chicago, Ill.
Goetz, Inc., A. Edgar, 55 Barclay St., New York, N. Y.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Granden Electric Co., 1511 Howard St., Omaha, Neb.
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Deluxlite."
Heather Co., The R. C., 19-21 W. 36th St., New York, N. Y. "Heatherlite."
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill. "Factrylite."
Highlands Mfg. Co., Muncie, Ind. "Reth-Lite."
Hobrecht Co., J. H., 1012 6th St., Sacramento, Cal. "Xtralite."
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Ideal Gas & Electric Fixture Co., 433 Broadway, New York, N. Y.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Ace," "Trojan." (See display adv. pages 1266-1269.)
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Lighthouse Corp., 98-100 Bleecker St., New York, N. Y.
Lighting Studios Co., 220 W. 42nd St., New York, N. Y. "Lsco," "Studio Lite," "Doric Lite."
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv. page 1275.)
Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind. "Day-Glow."
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Brascolite fixtures for offices employ the same scientific principles as worked out in other Brascolite fixtures, giving even distribution of light without eyestrain. The arrangement of bowl and



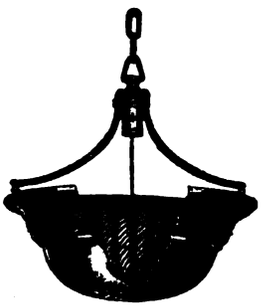
The Brascolite

reflector directs all emitted light to the working plane with a minimum absorption. The mechanical features are simple and substantial. They are manufactured for installation on any standard outlet, for mounting on ceiling or for hanging by chains or pendants. A wide variety of styles and sizes are offered in brass metal finished antique gold, leather bronze, old gold, porcelain white enamel, white lumo-vitro, etc. See display adv. pages 1276-7.—Adv.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles Cal. "Meycolite."
Mitchell Vance Co., Inc., 503-511 W. 24th St., New York, N. Y. "T. R. B."
Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16 and 18 W. Washington St., Chicago. Manufacturers of the "Raymo" patented lighting unit for the office, store or factory. An absolutely shadowless lighting unit. Gives most light with least lamp wattage. Glare is an unknown quantity in "Raymo," and ample ventilation prolongs the life of the lamp. "Raymo" is strong, practical and sightly, and is made in 16 different styles to meet varying conditions. Adaptable for low or high ceilings in plain or ornamental designs; for 100 200 or 300 watt lamps. Has given perfect satisfaction wherever installed, and is used extensively in hundreds of leading banks. department stores, offices, industrial plants, drafting rooms and in other places where perfect illumination is demanded. "Raymo" assures service, quality and workmanship.—Adv.



The "Raymo"

Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
National Diffused Light Co., 136 W. Lake St., Chicago, Ill.
National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill. "Nefcolite."
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" fixtures, utilizing X-Ray mirror reflectors. produce best indirect lighting. X-Ray fixtures embody, with the advantages of a concealed light



1321—Cut Away to Show Reflector

source, an ideal type of illumination for offices and drafting rooms. See Adv. page 1405.—Adv.
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
New England Incandescent Supply Co., 266 Bowery, New York, N. Y. "Neiscolite."
Newman Mfg. Co., 717-21 Sycamore St.. Cincinnati, Ohio.
Panama Lamp & Commercial Co., 595 Mission St., San Francisco, Cal. "Panama-Lite."
Pearlman & Co., Victor S., 533 Wabash Ave., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa. "Maglan," "Daylight Competitor."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."

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Philadelphia Mfg. Co., Howard St. & Montgomery Ave., Philadelphia, Pa.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Planetlite Co., Inc., 15 E. 40th St., New York, N. Y. "Planetlite."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."
Polly Mfg. Co., Milwaukee, Wis.
Reedicon Light Co., The, 7 E. Grant St., Minneapolis, Minn. "Reedicon."
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y. "Remssco."
Rush Bros. Co., 136 W. Lake St., Chicago, Ill. (porcelain and china).
SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."
Shapiro & Aronson, 20 Warren St., New York, N. Y.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
Solar Illuminating Co., 54 W. Lake St., Chicago, Ill. "Solar."
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Tallman Brass & Metal, Lt., Wilson St., Hamilton, Ont., Can.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio. "V. M. C. Brass."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Wardell Lighting Co., Detroit, Mich. "Enamelight."
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."
White Co., The O. C., 17-21 Hermon St., Worcester, Mass.
WHITING CO., INC., H. S., 104 East 41st St., New York, N. Y. The "Economy Light" (licensed under Duplexalite Corporation patents) is designed to combine, scientifically, the advantages of direct, indirect and semi-direct illumination The circulation of air insures the maximum life of the modern lamp operating at high temperature. Illustration shows the principle, which is indirect illumination from an inverted porcelain-enamel steel reflector; redirect illumination reflected upward from the glass bowl, and redirected downward by the cream-enameled under-surface of the steel reflector; direct illumination through a diffusing opal glass bowl.—Adv.



"Economy Light"

Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Wilmarth Co., T. W., 227-229 W. Huron St., Chicago, Ill.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, OPERATING ROOM AND OTHER HOSPITAL.—Operating rooms in hospitals are frequently lighted by indirect lighting fixtures except where the operating room is covered by a skylight in which case one now common practice is to place a battery of high-powered lamps with reflectors above the skylight which will produce artificial lighting similar to the day lighting. The indirect units are made with mirrored glass or porcelain enameled reflectors. Many types are made dustproof, the indirect bowl being completely closed over the top by a clear glass cover. The units are so disposed as to concentrate the light strongly on the operating table and provide somewhat less light around it. If the operating room is arranged like an amphitheater for students to witness the operation and take notes on it, there is provided only enough general lighting in this portion of the room to permit writing.

In some operating rooms elaborate special systems of lighting have been provided, including arc or other high-power lamps with large reflectors or lenses giving a series of searchlight-like beams concentrated on the operating table. This method of lighting is not looked upon as the best practice by many surgeons and also illuminating engineers, as it results in violent direct glare, glaring or specular reflections from the instruments and great contrast between the small brilliantly illuminated area and the surroundings.

All requirements for this special lighting can be met by providing on the operating table high-intensity illumination, at least 25 foot-candles, almost entirely free from glare and deep shadows, and gradually diminishing illumination in the remainder of the room. If direct lighting fixtures are used, they must be equipped with diffusing means to minimize glare.

For the other rooms in the hospital, such as wards, patients' private rooms, laboratories, offices, corridors, etc., the fixtures need be special only to the extent of being easily cleaned and at least not disagreeable in appearance. Indirect and semi-indirect fixtures are much used and usually white enameled.

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y. "Acmetal."
Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
Anodion Metal Co., The, 124 South St., Baltimore, Md.
Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Commercial Lighting Works, Inc., 154 W Lake St., Chicago, Ill.
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Faries Mfg. Co., Decatur, Ill.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn. "Gra-D."
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. (See display adv. page 1275.)

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Aglite is an all-glass fixture particularly designed for use in hospitals, bathrooms, etc., or wherever sanitation or cleanliness are necessary. Finish is pure marble white. A simple arrangement of the working parts secures a perfectly insulated unit, which is manufactured in many types, for wall and



The Aglite

ceiling use, direct and semi-indirect principle, with and without switches, single and double units, with and without bowl, and for 25 to 75-watt lamps. An auxiliary to the Aglite is a unit containing a tiny transformer in the base. One socket is for using 110-115-volt current, and the other for an automobile lamp (6-volt) through the transformer, making a very desirable night light with the added feature of having available from the same unit a powerful light as well. See display adv. pages 1276-7 for other Luminous Unit products.—Adv.

Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Moe-Bridges Co., 236 Broadway, Milwaukee Wis.
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. X-Ray indirect lighting fixtures for hospital work are equipped with powerful silvered mirror X-Ray reflectors. Special forms of installations are provided for operating rooms, whether equipped with or without skylight. X-Ray fixtures for hospital lighting are supported by one center rod, eliminating dust-catching chains, and have white washable finish, inside and out. Special dust covers may be provided. See Adv. page 1405.—Adv.
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."
Polly Mfg. Co., Milwaukee, Wis.
Reedicon Light Co., The, 7 E. Grant St., Minneapolis, Minn. "Reedicon."
REFLECTOLYTE CO, THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
Reliance Lighting Fixture Corp., 275 Canal St., New York, N. Y. "Relifco."
Rush Bros. Co., 136 W. Lake St., Chicago, Ill. (porcelain and china).
Scanlan-Morris Co., Madison, Wis. "Bartlett Noshado Lite."
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WAKEFIELD BRASS CO., THE F. W. Woodland Rd., Vermilion, Ohio.
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."
White Co., The O. C., 17 Hermon St., Worcester, Mass.

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WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."
Wilmarth Co., T. W., 227-229 W. Huron St., Chicago, Ill.
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, ORCHESTRA.—These fixtures are primarily for illuminating the music. They usually consist of a metal reflecting trough containing one or two lamps mounted by a short stem to the stage or on a rod rigidly fastened to the floor or on a portable stand with sloping rack for the music sheets or books. Dense glass reflectors with green or other attractive finish are sometimes used. The entire fixture together with the music rack or stand are often of ornamental design.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catherine Sts., W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Stage Lighting Co., 112 N. La-Salle St., Chicago, Ill.
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
Farles Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McDonald & Willson, Ltd., 347 Younge St., Toronto, Ont., Can.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill.
Pearlman & Co., Victor S., 533 Wabash Ave., Chicago, Ill.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."
Polly Mfg. Co., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
White Co., The O. C., 17-21 Herman St., Worcester, Mass.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, RESIDENCE.—Residence lighting fixtures are usually of different design suitable to the purpose of each room. Perhaps the most important is the living-room fixture. The first electrical fixtures were made in imitation of the multiple-arm gas fixtures then in use and were generally constructed with two outlets on the end of each arm, the upper a gas outlet, the lower an electric outlet. They were usually made of brass, no great attention being paid to the decorative effect of the fixture, though they were generally highly polished or made more ornate by the addition of brass scrolls or spinnings. Electric lighting soon demonstrated its reliability and the gas feature was abandoned. These first purely electric fixtures utilized the rigid arms mounted on a central stem, very similar to the older combination gas and electric fixtures. The rigid arm idea was soon left for the loose suspension used on what is known as the shower type of fixture. This fixture suspends the sockets, generally four, five, or six in number, on chains fastened to a ceiling plate, or a plate or ring is suspended from the ceiling by one or more chains or rods and the sockets hung from this plate by short suspensions or fastened directly to the plate. These and other multiple-socket fixtures were first designed for use with carbon-filament lamps whose low efficiency made so many sockets a necessity. However, the introduction of the tungsten lamp had for a long time no effect on the design or use of this fixture, except that when it is installed (and such installations are in use by a large percentage of all electrically lighted homes) only one or two sockets are in use at the same time, giving a very unbalanced appearance to the fixture.

The next development in residence lighting was the introduction of the semi-indirect fixture. This type of fixture consists of a transluscent bowl suspended from a ceiling canopy by chains, usually three in number, and having two or three sockets within the bowl. The bowls are always easily detachable to facilitate cleaning, as the efficiency of this type of lighting is to a large extent dependent upon the cleanliness of the reflecting surface of the bowl. More recently candle fixtures have become popular, particularly in the better class homes. Wall brackets, though to a very limited extent used for auxiliary lighting with shower and semi-indirect fixtures, in this scheme of lighting are one of the chief features, in fact many living rooms are lighted by wall brackets only. Where ceiling fixtures are employed they are, of course, in harmony with the wall-bracket designs. These brackets are fastened to the wall by a flat or raised plate from which extend short arms, generally curved tubing, which support the candle sockets. These candle fixtures are generally of period design. Unshaded, low-wattage, frosted or white-bulb lamps may be used, or the lamps may be shaded, by small silk or similar shades on every lamp. More recently special types of indirect units, employing the gas-filled tungsten lamps, have come into use. These types utilize on opaque metal reflector which may be open at the bottom, a translucent glass plate covering the opening. The reflector is concealed within a silk shade.

Next in importance is the dining-room fixture. One of the earlier designs in this line was the art-glass dome, a large dome mounted directly over the table, usually on a long rigid stem. In many respects the art-glass dome is the most satisfactory fixture which has been developed for this purpose and it is still in considerable use. Before the advent of semi-indirect lighting, where the dome was not used the ceiling showers described above as a living-room fixture were employed, or a type of fixture made up of a suspended bowl of roughed glass from the rim of which are suspended several sockets equipped with bell shades, was employed. With the introduction of semi-indirect lighting this peculiar and theretofore common fixture was made the basis of the most popular designs utilizing this type of lighting, the semi-indirect design differing only in that opal glass was substituted for the clear roughed glass. One of the reasons advanced for this strange combination of semi-indirect and shower fixture is that appliance outlets are necessary in the dining room and this fixture has an ample supply of sockets otherwise not in use. Dining-room candle fixtures differ little from the living-room types. The indirect and semi-indirect fixtures utilizing the gas-filled lamp are also designed for dining rooms, being modified in size and suspension to satisfy dining-room lighting requirements. Many highly special fixtures have been designed for dining-room lighting. Most of these fixtures employ a lens or reflecting device for producing a circular area of high-intensity light which will fall upon the table without striking the persons seated at the table. However, it is difficult to design a satisfactory fixture which will accommodate a circle of fixed size to a table of varying dimensions. Such fixtures have not yet attained any considerable use.

Outside of living and dining rooms, the single-socket fixture is almost the only type used. The single socket is suspended by a chain or rigid tube in the ceiling types, or mounted on a rigid arm in the wall bracket types. The earlier designs were, of course, combination gas and electric. They had one peculiarity, the socket was almost invariably set at an angle to the stem, a practice long since abandoned in fixture design except in a few types in use in kitchens, where the combination fixture is still quite common.

Residence fixtures are almost exclusively made of brass, a brushed or high polished finish being the most common. Bronze, silver or silver-plate are used in many of the more expensive fixtures, particularly the candle types. Almost all residence fixtures employ a shade of some material which will diffuse the light so as to reduce the glare of the lamp filament. Glass is by far the most common material used for shades. Silk and parchment are used to a limited extent, almost entirely on candle fixtures and widely on portable lamps. Also see Bowls, lighting; Domes, art glass and miscellaneous glass; Glassware, illuminating; and Shades.

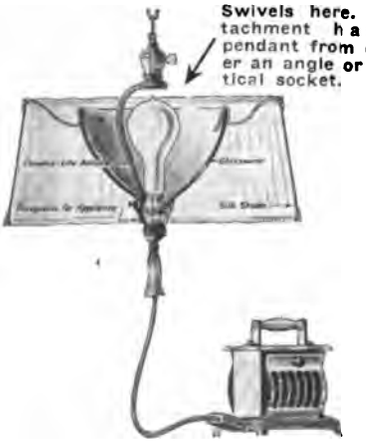
One of the chief difficulties in residence fixture design is that the fixture, which now usually remains in place for years, should be adapted to many schemes of decoration not only varying with the changing whims and tastes of one occupant but with the different furnishings and schemes of many occupants, particularly in apartment buildings. To overcome this difficulty it has been suggested that the occupant own his fixtures. Recently, with a view to making this a practical scheme, some promising steps have been taken to design and introduce readily detachable or interchangeable fixtures which would not require the services of a skilled fixture hanger for installation or removal. Further development of standardized fixture-hanging and connecting receptacles is anticipated so as to make this line fully interchangeable and thus make it possible to remove fixtures during redecoration of the room, move them to other outlets and exchange them entirely if a different scheme of lighting or decoration is to be used. Also see Receptacles, ceiling or wall fixture.

Manufacturers:

Abco Mfg. Co., 1633 Walnut St., Chicago, Ill.
Acme Lighting Fixture Co., Inc., 132-136 W. 14th St., New York, N. Y. "Acmetal."
Adam Co., The E. C., 902 Pine St., St. Louis, Mo.
Aglow Sales Co., 671 3rd Ave., New York, N. Y.
Aladdin Mfg. Co., Muncie, Ind.
Alt-Le Lighting Fixture Co., 262 Bowery, New York, N. Y. "Altelite."
American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Andresen Co., Jacob, 258 Third Ave., S. Minneapolis, Minn.
Anodion Metal Co., The, 124 South St., Baltimore, Md.
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Artistic Lighting Fixture Corp., 21-25 E. Houston St., New York, N. Y. "Alfco."
Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.

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Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B-L."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago. This company has specialized in the manufacture of high class lighting fixtures for over 40 years. We manufacture a complete line of fixtures bearing the famous Beardslee trade mark, suitable for use in the most modest home or the most exclusive residence. We also carry in stock a line of fixtures ready for immediate shipment.—Adv.
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Beyer & Co., L., 2337-39 E. 4th St., Cleveland, Ohio.
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Black & Boyd Mfg. Co., 17 E. 47th St., New York, N. Y.
Brandt-Dent Co., Watertown, Wis. "Bee-Dee."
Bridgeton Chandelier Co., Belmont & Oxford Sts., Bridgeton, N. J.
Buffalo Chandelier Corp., 233 Ellicott St., Buffalo, N. Y.
Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y. "Cas-O-Lux."
Central Chandelier Co., 224 Centre St., New York, N. Y.
Central Lighting Fixture Co., 2110 N. 16th St., Philadelphia, Pa.
Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."
Clinton Metal Lamp Co., 55 Chrystie St., New York, N. Y. "Artistic Beauty."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.
Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.
Conneaut Metal Works Co., The, Conneaut, Ohio.
CONVENOLITE CO., THE, 231 N. Wells St., Chicago, Ill. A revolution in the lighting of the home may be brought about by the use of the "Convenolite" (see view below), which is designed to convert old fixtures into modern ones by a simple attachment. The Convenolite adapter may be fitted to any



The "Convenolite"

wall bracket or ceiling fixture. It permits the use of the modern nitrogen lamp in the home without ghastliness. Candlestick adapters and neat 3-way dining-room table connectors also furnished. Any desired color-lighting effect may be obtained by using opal reflectors, silk shades, tassels, etc., as illustrated. Each Convenolite adapter provides an extra outlet for electric iron, toaster, washing machine, vacuum cleaner, etc. The Convenolite is also sold in the form of complete fixtures for residence use, or wherever soft, pretty, home effects are sought in stores and offices. A third form is sold only to fixture manufacturers, for permanent attachment to new fixtures.—Adv.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Crescent Art Metal Co., The, Bridgeton, N. J.
Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio. "Crescent."
Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.
CROWN ELECTRICAL MFG. CO., St. Charles, Ill.
Crown Electrical Mfg. Co., Ltd., Brantford, Ont., Can. "Crown-Lite."
Crucet Mfg. Co., 292 5th Ave., New York, N. Y.
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "1100," "600."
Day Co., Thomas, 725 Mission St., San Francisco, Cal. "Daylite."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill. "Lite Unit."
Empire Lighting Fixture Co., Inc., 224-226 Centre St., New York., N. Y. "Empire."
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Farics Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y. "Artfibre."
Findlay Mfg. Co., Inc., Robert, 224 5th Ave., New York, N. Y. "Findlaylite."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio. "Frankelite."
Frankford Lighting Fixture Manufacturers, 4273-75 Frankford Ave., Philadelphia, Pa.
Frost, Samuel, 41-43 W. 14th St., New York, N. Y.
Gaites, Peace & Co., Inc., 204 Willoughby St., Brooklyn, N. Y. "Ehrlichtric," "Val-U-Line."
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Granden Electric Co., 1511 Howard St., Omaha, Neb.
Great Western Electric Fixture Co., 292 Church St., New York, N. Y.
Gross Chandelier Co., 21st & Morgan St., St. Louis, Mo.
HANDEL CO., THE, 381 E. Main St., Meriden, Conn. Designs of all kinds for residential purposes, including a complete line of hand-decorated fixture glassware; also etched and cut glass.—Adv.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Hendrickson Chandelier Mfg. Co., 4032 11th Ave., S., Minneapolis, Minn.
Henkel & Best Co., 122 S. Michigan Ave. Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind. "Deka-ro."
Horn & Brannen Mfg. Co., 427-433 N. Broad St., Philadelphia, Pa.
Hovorka, John D., 2509 W. Roosevelt Rd., Chicago, Ill.
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Ideal Gas & Electric Fixture Co., 433 Broadway, New York, N. Y.
Incandescent Supply Co., 638 Liberty Ave., Pittsburgh, Pa. "Isco."
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Ivin Lighting Fixture Co., 159-161 Leonard St., New York, N. Y.
Jaehnig Gas Fixture Co., Inc., 221-223 13th Ave., Newark, N. J.
Kapsa, Rudolph, 2320 S. Kedzie Ave., Chicago, Ill.
Kayline Co., The, 600 Huron Rd., Cleveland, Ohio. "Kayline."
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
Liberty Lamp & Shade Co., 103 Court St., Brooklyn, N. Y. "Lov Lite."
Lighting Appliance Co., 4 White St., New York, N. Y. "Laco."
Lighting Studios Co., 220 W. 42nd St., New York, N. Y.
LIGHTOLIER CO., 569 Broadway, New York. The Corona Lightolier is designed especially for the dining room. It represents seven years of study and experiment to evolve a fixture which should be perfect from both the artistic and practical standpoints. It pro-



The Corona Lightolier

duces a brilliant light directly encircling the table, and a soft, subdued light throughout the rest of the room. This has the effect of hemming the diners in, producing a dinner-party atmosphere for even the simplest meal. In planning the artistic dress of the fixture the same careful and exhaustive study has been made. The Corona designs finally approved for the market are refined, distinctive and in rich taste. There are four of these designs, three following much admired periods of interior decoration—Adam, Chippendale and Louis XV. The fourth is an unique and characteristic Lightolier design (see illustration). Special colors of silk and finish of metal make it possible to harmonize the Corona Lightolier with any decorative scheme.—Adv.
Lincoln Mfg. Co., 716 Erskine St., Detroit, Mich. "Lincoln."
Lindcraft Studios, Jamaica Ave. & 125th St., Richmond Hill, N. Y.
Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. E-lite, Brascolite and Aglite fixtures are all manufactured in types and sizes especially designed for residence use. The E-lite fixture illustrated above is made for mounting directly to brass canopy or for chain hanging. The reflector and bowl are both of white glass, the bowl being suspended in such manner as to insure maximum distribution of light without glare. Can



The E-lite

be furnished with or without switch, one size only—6-in. lower glass shade, 13 inch reflector. Brascolites are manufactured in a diversity of styles and sizes to suit the requirements of beauty and utility for the home, all employing the Brascolite semi-indirect principle.

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The fixture illustrated has an antique gold finished reflector and marble white glass bowl. It can be furnished in three sizes, 17 and 21-in. reflectors with 9 and 11⅝-in. bowls respectively for medium sockets, and 21-in. reflectors with 11⅝-in. bowls for mogul sockets. All sizes are furnished with or without switches and in ceiling or pendant types. The Aglite fixture illustrated below is particularly useful in bath rooms and hospitals where all night lights of small power, and sanitation and cleanliness are particularly desirable. Aglite is all glass of white mar-



The Brascolite

ble-like appearance. The small light shown is an automobile lamp (6-volt) using current from a small transformer concealed in the base of the unit. Many styles of Aglites are manufactured for ceiling and wall mounting with direct and semi-indirect features. All can be furnished with or without



The Aglite

switches. An Aglite for ceiling mounting is made with sockets for two lamps. See display adv. pages 1276-7 for other Luminous Unit products.—Adv.

Mayer Co., Leon, 237 Center St., New York, N. Y.

Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.

McDonald & Willson, Ltd., 347 Young St., Toronto, Ont., Can.

McKenney & Waterbury Co., 181 Franklin St., Boston, Mass.

McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."

Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal. "Meycolite."

Miller & Co., Edward, 99 Center St., Meriden, Conn. "Miller."

Mitchell Vance Co., Inc., 503-511 W. 24th St., New York, N. Y. "T.R.B."

Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.

Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."

When writing to manufacturers please mention the

E M F ELECTRICAL YEAR BOOK

MORAN & HASTINGS MFG. CO., 16 and 18 W. Washington St., Chicago We are one of the oldest fixture manufacturers in the west and devote our entire time and energy in manufacturing a complete line of high-grade and substantial lighting fixtures for residences, banks, schools, etc. We can furnish anything required in our line — from the simplest and least expensive to the most elaborate and highest priced Our corps of designers are qualified to overcome your lighting fixture problems.—Adv.



M & H Lighting Fixture

Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.

Morreau Co., 1303-1307 Oregon Ave., N. E., Cleveland, Ohio. "Qualiti-Lite."

Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.

National Diffused Light Co., 136 W. Lake St., Chicago, Ill.

National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill. "Nefcolite."

National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y. "Six-S."

National Plastic Relief Co., 330 Main St., Cincinnati, Ohio. "Fiber Olitic."

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Art lamps, wall fixtures, ceiling fixtures, electroliers, etc. All types produce perfect indirect lighting by X-Ray mirror reflectors. Designs range from simple to artistically ornate. Special models created to harmonize with any surroundings. See Adv. page 1405.—Adv.

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.

New England Incandescent Supply Co., 266 Bowery, New York, N. Y. "Neiscolite."

New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y. "Nylco."

Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.

Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.

Panama Electric Light Co., Inc., Philip, 1627 Melrose St., Chicago, Ill.

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."

Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa. "Magian," "Daylight Competitor."

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."

Peters Co., H. J., 227-229 W. Huron St., Chicago, Ill.

Philadelphia Mfg. Co., Howard St. & Montgomery Ave., Philadelphia, Pa.

Phoenix Light Co., 525 Market St., Milwaukee, Wis.

Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa. "Britasday."

Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."

Polly Mfg. Co., Milwaukee, Wis.

Progressive Fixture & Brass Co., 2171-3 E. 2nd St., Cleveland, Ohio.

Radiant Lighting Fixture Co., Inc., 33 Bleecker St., New York, N. Y. "Radiant."

Reading Chandelier Works, The, 503 Penn St., Reading, Pa.

REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."

Reliance Lighting Fixture Corp., 275 Canal St., New York, N. Y. "Relifco."

Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y. "Remssco."

Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.

Rogers Silver Plate Co., Danbury, Conn. "Moon-Glow." (Exclusive distributor, Eclipse Light Co., 587 Broadway, New York, N. Y.)

Rozee Mfg. Co., 10 Ionia Ave., S. W., Grand Rapids, Mich. "Rozee-Lite."

Royal Art Glass Co., 243 Canal St., New York, N. Y.

St. Charles Fixture Mfg. Co., 1 E. Main St., St. Charles, Ill.

Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.

Scott-Ullman Co., The, 3311-25 Perkins Ave., N. E., Cleveland, Ohio.

Service Electric Co., Inc., 2337 N. Hoyne Ave., Chicago, Ill.

SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y. Manufacture a complete line of standardized lighting fixtures in standardized finishes for residence and other lighting work. (Catalog No. 22 shows the complete line of standardized fixtures. Sent to interested parties on request.) —Adv.



No. 5335
DESIGN PATENT

Sieffert Electric Co., 210 Main St., Evansville, Ind.

Siegel Light Supply Co., The, 231 Market St., Philadelphia, Pa.

Simes Co., The, 22-26 W. 15th St., New York, N. Y.

Snyder-McFadden Co., 602 Pierce St., Sioux City, Iowa.

STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."

Standard Light Co., 448 E. Water St., Milwaukee, Wis. "Stanlico."

Star Chandelier Co., Inc., 33 Bleecker St., New York, N. Y. "Star."

Sterling Bronze Co., 201 E. 12th St., New York, N. Y.

Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.

Triangle Chandelier Mfg. Co., 4607 Ravenswood Ave., Chicago, Ill.

Universal Bearing Bronze Co., Winsted, Conn.

Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio. "V.M.C.Brass."

VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa. "Compolite."

Wagner-Woodruff Co., 830 S. Olive St., Los Angeles, Cal.

WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.

Walsh Mfg. Co., Owen, 525-531 W. 26th St., New York, N. Y.

Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.

Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.

White Co., The O. C., 17 Hermon St., Worcester, Mass.

WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."

Wilmarth Co., T. W., 227-229 W. Huron St., Chicago, Ill.

Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.

World Lighting Appliance Co., 136 Bowery, New York, N. Y. "World."

Wrought Iron & Art Glass Fixture Co., 195 Canal St., New York, N. Y.

Wyle & Bros., Inc., J. J., 18-20 E. 27th St., New York, N. Y.

Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, STAGE.—It is quite a stretching of the word "fixtures" to refer to stage-lighting equipment as such, because practically none of it, except the foot-lights, is fixed. However, many persons refer to even the portable and suspended outfits as fixtures. For their convenience the manufacturers of stage-lighting equipment of the various generally used and also of special types are listed below. Separate listings and brief descriptions will be found under the following principal classes of stage-lighting outfits: Borders, bunches, clusters, footlights, spotlights, strips; also see Theatrical electrical effects, special (lightning, waterfalls, etc.). All stage-lighting fixtures re-

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quire specially rugged construction and careful attention to insulation and elimination of fire hazard.

Manufacturers:

Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chicago Stage Lighting Co., 112 N. La-Salle St., Chicago, Ill.

Cole Mfg. Co., Kent St., Lindsay, Ont., Can.

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.

Eclipse Light Co., 583-87 Broadway, New York, N. Y.

Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.

Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

Erikson Electric Co., L., 6 Portland St., Boston, Mass.

Faries Mfg. Co., Decatur, Ill.

Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.

Hallberg, J. H., 25 W. 45th St., New York, N. Y.

Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.

Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.

LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)

Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.

National Plastic Relief Co., 330 Main St., Cincinnati, Ohio. "Fiber Olitic."

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Bunches, stage. Borders, stage, Clusters, stage, Footlights, stage, Strips, stage. See Adv. page 1405.—Adv.

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.

Non-Twist Canopy, Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.

Phoenix Light Co., 525 Market St., Milwaukee, Wis.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."

REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill. "Ready-2-Install."

Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.

Service Electric Co., Inc., 2337 N. Hoyne Ave., Chicago, Ill.

STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Olivette."

WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.

Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, STORE.—The requirements of store lighting vary greatly; the types of fixtures used consequently include almost every type of fixture made. However, the great majority of stores have more simple requirements and the direct lighting glass shaded, single lamp type of fixture is commonly used in these stores. They usually employ a high-wattage gas-filled tungsten lamp and therefore, use a dense opal glass shade, generally either an enclosing bowl suspended from the ceiling or a bell-shaped shade mounted on a shade holder on a receptacle fastened directly to the ceiling. Chain-suspended semi-indirect fixtures are to some extent used but more commonly a modified form of the semi-indirect type is used. These fixtures suspend a dense opal bowl from an auxiliary reflecting surface, which may be a porcelain enameled metal plate or a piece of dense opal glass. One-piece glass units similar in principle to the two-piece glass units are now coming into use. This piece of glassware connects the bowl piece to the reflecting plate by a clear glass surface instead of suspending the bowl by hooks as is done with the two-piece units.

Where decorative effect is of some importance, as in furniture, drug, art and specialty stores, display rooms, and automobile salesrooms, modified forms of commercial or residence fixtures of the more expensive types are commonly employed. Some stores, particularly where color matching must be done, use daylight lighting units to a limited extent. In large department stores the fixtures, as a rule, are of the best commercial types with indirect and semi-indirect used almost as frequently as the direct lighting types. For store window and showcase fixtures see the second classification separately listed below.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.

Aglow Sales Co., 671 3rd Ave., New York, N. Y.

Alexalite Co., The, 434 E. 23rd St., New York, N. Y. "Alexalite."

Alt-Le Lighting Fixture Co., 262 Bowery, New York, N. Y. "Altelite."

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.

Anodion Metal Co., The, 124 South St., Baltimore, Md.

Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.

Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."

Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.

Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.

Bauer, Inc., H. A., Lansdowne, Pa. "Pull-A-Lite."

Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.

BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago. Manufacturers of the "Denzar" lighting unit, scientifically designed for use with the powerful Mazda "C" lamp. Carries reflector shaped to give the proper distribution of light and allows sufficient light to filter through to the ceiling so as to avoid shadows or streaks. The upper portion of the bowl is clear



"Denzar" Lighting Unit

glass, permitting the greater portion of the light to be thrown upward to the reflector and be redirected from there to the working plane where it is needed. This portion of clear glass also prevents the accumulation of dust and dirt in the bowl and makes the "Denzar" practically a dust-, dirt- and bug-proof unit. The lower part of the bowl is finished with a hard, smooth, white translucent enamel of good diffusing quality, completely concealing the filament and eliminating all glare. We also manufacture a complete line of direct, indirect and semi-indirect lighting units; also a complete line of lighting fixtures, brackets, etc., to meet all conditions.—Adv.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin store lighting fixtures are characterized by simplicity, neatness and efficiency. The pendent



Benjamin Pendent Types

types for interior lighting, illustrated above are furnished with solid stem or chain suspension. The Ben-ox ceiling units, illustrated below, represent a line of interchangeable lighting fixtures which are built upon a basic element



Ben-Ox Ceiling Units

with a standard thread which permits removal, by unscrewing of the parts, such as reflectors and bowls, for cleaning or replacement with other styles. The right figure has a holder for glassware. For lighting of store fronts the Benjamin line offers a number of types of outdoor fixtures, among which is the style shown at the left. The hood and reflector on this fixture are of porcelain enameled steel and the top is tapped for conduit suspension.—Adv.



Out-door Type

Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.

Black & Boyd Mfg. Co., 17 E. 47th St., New York, N. Y.

Brandt-Dent Co., Watertown, Wis. "Bee-Dee."

Bridgeton Chandelier Co., Belmont & Oxford Sts., Bridgeton, N. J.

Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.

Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Central Lighting Fixture Co., 2110 N. 16th St., Philadelphia, Pa.

Cole Mfg. Co., Kent St., Lindsay, Ont., Can.

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Colonial Chandelier Works, Inc., 122-130 Centre St., New York, N. Y.

Commercial Excelite Co., Inc., 312 N. Eutaw St., Baltimore, Md. "Excelite."

Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.

Conneaut Metal Works Co., The, Conneaut, Ohio.

Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.

Crescent Art Metal Co., The, Bridgeton, N. J.

Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio. "Crescent."

Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.

Crown Electrical Mfg. Co., Ltd., Brantford, Ont., Can. "Crown-Lite."

Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.

Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."

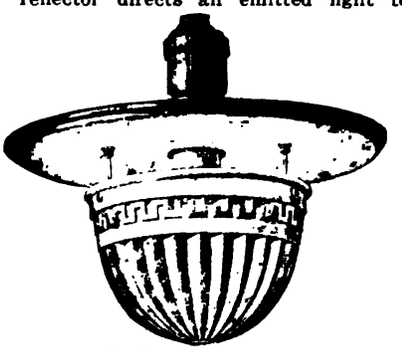
Day Co., Thomas, 725 Mission St., San Francisco, Cal. "Daylite."

Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."

Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.

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Eclipse Light Co., 583-87 Broadway, New York, N. Y.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill. "Lite Unit."
Egan & Egan, 21 E. 40th St., New York, N. Y. "Ray-O-Day."
Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Erikson Electric Co., L., 6 Portland St., Boston, Mass.
Everson & Co., C. G., 70 W. Lake St., Chicago, Ill. "Ever So New."
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Findlay Mfg. Co., Inc., Robert, 224 5th Ave., New York, N. Y. "Findlaylite."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfecelite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Frost, Samuel, 41-43 W. 14th St., New York, N. Y. "Wonderlight."
General Lighting Fixture Co., 28 W. Lake St., Chicago, Ill.
Goetz, Inc., A. Edgar, 55 Barclay St., New York, N. Y.
Grady Fixture Mfg. Co., M. J., 608 1st Ave., N., Minneapolis, Minn.
Granden Electric Co., 1511 Howard St., Omaha, Neb.
Great Western Electric Fixture Co., 292 Church St., New York, N. Y.
Gross Chandelier Co., 21st & Morgan Sts., St. Louis, Mo.
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."
Heather Co., The R. C., 19-21 W. 36th St., New York, N. Y. "Heatherlite."
Hendrickson Chandelier Mfg. Co., 4032 11th Ave., S., Minneapolis, Minn.
Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind. "Reth-Lite."
Hobrecht Co., J. C., 1012 6th St., Sacramento, Cal. "Xtralite."
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.
Ideal Gas & Electric Fixture Co., 433 Broadway, New York, N. Y.
Incandescent Supply Co., 638 Liberty Ave., Pittsburgh, Pa. "Isco."
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Ace," "Trojan." (See display adv. pages 1266-1269.)
Kapsa, Rudolph, 2320 S. Kedzie Ave., Chicago, Ill.
Lighthouse Corp., 98-100 Bleecker St., New York, N. Y.
Lighting Studios Co., 220 W. 42nd St., New York, N. Y. "Lsco," "Studio Lite," "Doric Lite."
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.
Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind. "Day-Glow."
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. The Brascolite arrangement of bowl and reflector directs all emitted light to



The Brascolite, Type GC

the working plane with a minimum absorption and insures uniform distribution, making these fixtures particularly desirable for store and office use. The drop in efficiency is less in Brascolites than with direct reflectors and other semi-indirect units or indirect units, tests showing only a three percent drop in the Brascolite. Type GC Brascolite shown is for attachment to old sockets by means of shade holder. It is manufactured in two sizes for 40 to 75-watts and 100 to 150-watt lighting units; outside diameters, 10 and 14½ ins.; bowl, 6¼ and 8¼ ins., with 2¼ to 4-in. fitters. Type JE, similar to type GC may be fitted to the base of ceiling fans without interfering with operation of fan. See display adv. pages 1276-7 for other Brascolite products.—Adv.

Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Mefcolite."
McKenney & Waterbury Co., 181 Franklin St., Boston, Mass.
McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Mitchell Vance Co., Inc., 503-511 W. 24th St., New York, N. Y. "T.R.B."
Mohrlite Co. of America, The, 901 Harrison St., Nashville, Tenn. "Mohrlite."
MORAN & HASTINGS MFG. CO., 16 and 18 W. Washington St., Chicago. Manufacturers of the "Raymo" patented lighting unit for the office, store or factory. An absolutely shadowless lighting unit. Gives most light with least lamp wattage. Glare is an unknown quantity in "Raymo," and ample ventilation prolongs the life of the lamp. "Raymo" is strong, practical and sightly and is made in 16 different styles to meet varying conditions. Adaptable for low or high ceilings, in plain or ornamental designs; for 100, 200, or 300 watt lamps. Has given perfect satisfaction wherever installed, and is used extensively in hundreds of leading banks, department stores, offices, industrial plants, drafting rooms and in other places where perfect illumination is demanded. "Raymo" assures service, quality and workmanship.—Adv.



The "Raymo"

Morreau Co., 1303-1307 Oregon Ave., N. E., Cleveland, Ohio. "Qualiti-Lite."
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
National Diffused Light Co., 136 W. Lake St., Chicago, Ill.
National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill. "National A."
National Lighting Fixture Mfg. Co., 176-180 Grand St., New York. N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" indirect lighting systems comprise a unit in which each lamp is equipped with X-Ray reflector for insuring perfect indirect illumination. Remarkable results are obtained from X-Ray fixtures because of the X-Ray reflector which conceals the glaring lamp. The company maintains a staff of illumination engineers and designers for the production of special fixtures for any purpose; this service is extended without obligation or charge to prospective patrons. Also see entry under Reflectors, showcase and showwindows. See Adv. page 1405.—Adv.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
New England Incandescent Supply Co., 266 Bowery, New York, N. Y. "Nelsco-lite."
Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.
Panama Electric Light Co., Inc., Philip, 1627 Melrose St., Chicago, Ill.
Panama Lamp & Commercial Co., 595 Mission St., San Francisco, Cal. "Panama-Lite."
Pearlman & Co., Victor S., 533 Wabash Ave., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."
Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa. "Magian," "Daylight Competitor."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."
Peters Co., H. J., 227-229 W. Huron St., Chicago, Ill.
Philadelphia Mfg. Co., Howard St. & Montgomery Ave., Philadelphia, Pa.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa. "Britasday."
Pittsburgh Reflector & Illuminating Co., Inc., 3rd & Ross Aves., Pittsburgh, Pa.
Planetlite Co., Inc., 15 E. 40th St., New York, N. Y. "Planetlite."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."
Polly Mfg. Co., Milwaukee, Wis.
Progressive Fixture & Brass Co., 2171-3 E. 2nd St., Cleveland, Ohio.
Reading Chandelier Works, The, 503 Penn St., Reading, Pa.
Reedicon Light Co., The, 7 E. Grant St., Minneapolis, Minn. "Reedicon."
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y. "Remssco."
Rozee Mfg. Co., 10 Ionia Ave., S. W., Grand Rapids, Mich. "Rozee-Lite."
Rush Bros. Co., 136 W. Lake St., Chivago, Ill. (porcelain and china).
St. Charles Fixture Mfg. Co., 1 E. Main St., St. Charles, Ill.
SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y. The "Salite" fixture is constructed upon scientific principles which reduce waste of light to a minimum, distributing the illumination in a manner to obviate glare and the accompanying eyestrain. It is made in two styles, No. 2734-E (illustrated), and No. 2735-E, ceiling type. The one-piece reflector is sealed against the usual accumulation of dust and insects. Both style fixtures are shipped wired complete. Glassware packed in individual cartons.—Adv.



No. 2734 DESIGN PATENT

Sieffert Electric Co., 210 Main St., Evansville, Ind.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
Smyser-Royer Co., York, Pa.
Solar Illuminating Co., 54 W. Lake St., Chicago, Ill. "Solar."
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Standard Light Co., 448 E. Water St., Milwaukee, Wis. "Stanlico."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Walsh Mfg. Co., Owen, 525-531 W. 26th St., New York, N. Y.
Wardell Lighting Co., Detroit, Mich. "Enamelight."

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Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.

Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.

WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."

Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.

Wilmarth Co., T. W., 227-229 W. Huron St., Chicago, Ill.

Wyle & Bros., Inc., J. J., 18-20 E. 27th St., New York, N. Y.

Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FIXTURES, LIGHTING, STREET.—Street lighting fixtures are of many kinds, because of the varied methods of mounting street lamps on posts at the curb or suspended over and near the middle of the street. Nearly all these fixtures are listed separately as follows: Lighting units, ornamental street; Pendants, street lighting; Streethoods; Brackets, street lighting; Hangers, arc lamp; Hangers, incandescent lamp; Mastarms, street lighting; Posts, ornamental and plain, street lamp, concrete, iron and steel. Some manufacturers are in position to furnish several kinds of these fixtures, thus supplying all the equipment needed for the various classes of streets in the average city or town. There are also special fixtures required in certain cases, such as brackets that may be mounted on the walls of abutting buildings, especially on very narrow streets; combination trolley and lighting posts, usually equipped with special brackets; special fixtures used on bridges, viaducts, in traffic subways, etc.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto.

Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.

BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Colonial Chandelier Works, Inc., 122-130 Center St., New York, N. Y.

Eclipse Light Co., 583-87 Broadway, New York, N. Y.

Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.

Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

GENERAL ELECTRIC CO., Schenectady, N. Y. "Novalux" units, both ornamental and pendent types. See these items for brief description, also adv. pages 1203-1223.—Adv.

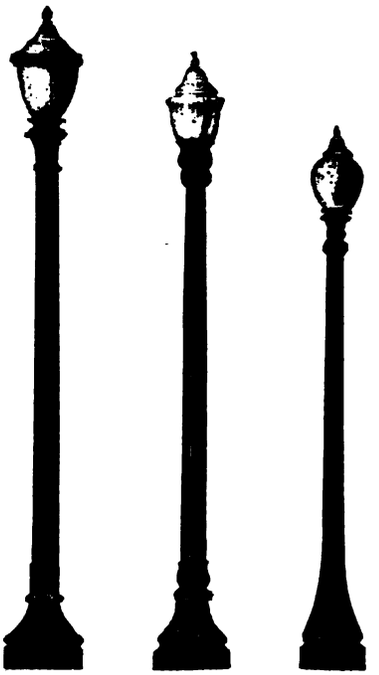
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."

Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.

Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.

Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.

KING MANUFACTURING CO., Monadnock Bldg., Chicago, Ill. King lighting equipment is created and designed by artists and engineers who have made a thorough study of outdoor lighting conditions. In purchasing King equipment with the aid and recommendation of our engineers, one has the satisfaction of knowing that they have procured that which is best suited to their requirements and which will give to the street, boulevard, or building to be illuminated an artistic appearance of stability, permanence and grace. Lighting equipment, like jewels, bear a value commensurate with the reputation of the firm selling them. Satisfaction results only when you are absolutely certain you have secured the full value of your purchase price in quality, in expert workmanship, in design



King Lighting Standards

and in efficiency. The name King appearing on all lighting equipment is your guarantee. See display adv. page 1257.—Adv.

LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."

LINE MATERIAL CO., South Milwaukee, Wis. "Light Light," "Ventolight." (See display adv. page 1278.)

McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis. "Light House."

Smyser-Royer Co., York, Pa.

Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Luxsolite." (See display adv. pages 1395-1402.)

WHEELER REFLECTOR CO., 156 Pearl St., Boston, Mass.

FIXTURES, LIGHTING, WINDOW AND SHOWCASE.—Due to the wide variety of window displays and shapes and dimensions of store windows, there are numerous types of fixtures adapted to window lighting. However, to protect the eye of the observer and at the same time give a high illumination upon the objects displayed is a requirement common to almost all window lighting. This is usually met by the use of fairly high-wattage lamps with special reflectors mounted as close to the ceiling as possible so that the light source may be hid by a screen, valance or fringe. The fixture is therefore almost no fixture at all, the shade holder and receptacle used being fastened directly to the outlet box. For showcases, wallcases and some forms of window lighting, the fixture and light source must be hidden in a corner or other small space in the case or window. To meet this requirement special fixtures are made which are generally long trough-shaped reflectors equipped with fittings designed to hold standard or candelabra-base tubular lamps.

Manufacturers:

Adam Co., The E. C., 902 Pine St., St. Louis, Mo.

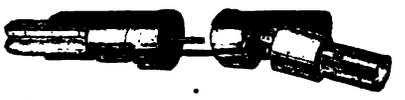
Anodion Metal Co., The, 124 South St., Baltimore, Md.

Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin sectional show case



fixtures embody a number of desirable features, some of which are: even light distribution; inconspicuous because of uniform narrow shape; easy to change lamps, the lamp and socket are slipped out together as illustrated below; easy to install, the sections are joined electrically and mechanically by turning home the two screws illustrated. The Benjamin line comprises other types



Method of Assembly (above fixture)

of fixtures for all kinds of display cases and stands.—Adv.

Burtschaell, J. W., 357 Ellis St., San Francisco, Cal.

Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Cole Mfg. Co., Kent St., Lindsay, Ont., Can.

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Commercial Lighting Works, Inc., 154 W. Lake St., Chicago, Ill.

Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."

Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.

Eclipse Light Co., 583-87 Broadway, New York, N. Y.

Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.

Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)

Faries Mfg. Co., Decatur, Ill.

First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."

Frink, Inc., I. P. 239-43 10th Ave., New York, N. Y.

HANDEL CO., THE, 381 E. Main St., Meriden, Conn.

Henkel & Best Co., 122 S. Michigan Ave., Chicago, Ill.

Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y. "L. & L."

LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)

McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can.

McPhilben Lighting Fixture Co., Inc., Queens, N. Y. "Queens Quality."

Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.

Moe-Bridges Co., 236 Broadway, Milwaukee, Wis.

MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Reflectors, showcase and show window. See Adv. page 1405.—Adv.

Non-Twist Canopy Ring, Ltd., 58 Temperance St., Toronto, Ont., Can.

Pearlman & Co., Victor S., 533 Wabash Ave., Chicago, Ill.

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerlite."

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."

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Pittsburgh Reflector & Illuminating Co., Inc., 3rd & Ross Aves., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo. "Reflectolyte."
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago. "Ready-2-Install." A 2 in. square tubing fix-



ture with two-piece "easy to wire" sockets for installing reflectors in show windows and coves, strip lighting and other places where a number of lamp outlets are spaced on close centers.—Adv.
Simes Co., The, 22-26 W. 15th St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y. "Foco-Light."
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y. "Economy Light."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

FL.—Trade name for street-lighting bracket manufactured by the J. P. Hebendahl Co., 228-232 Broadway, Elizabethport, N. J.

FLAGLITE.—Trade name for electric lapel button manufactured by the M. Propp Co., 108 Bowery, New York, N. Y.

FLAGS, ELECTRICALLY LIGHTED.—These devices consist of colored lamps of either the miniature candelabra or ordinary size grouped so as to give the proper colors. The lamps may or may not be arranged in circuits connected to automatic motor-driven flashers to cause the lamps to flash "on" and "off" or in some sequence to imitate the waving of the flag. During the recent war these flags proved a popular feature by themselves and in connection with other patriotic displays.

Manufacturers:

Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

FLAME ARC LAMPS.—See Lamps, arc, carbon flame; Lamps, arc, metallic flame, magnetite or luminous.

FLAMEBLAST.—Trade name for gas-electric blowers and blow torches manufactured by the North American Mfg. Co., 5902 Carnegie Ave., Cleveland, Ohio.

FLAMEPROOF WIRE.—See Wire, flameproof.

FLAMING ARC.—An arc lamp into which are systematically and regularly introduced some salts with high boiling points, whose vapors intensify and color the arc. The usual method is to use the salts as a core in hollow carbon electrodes. The colors and effects produced are highly characteristic of the various salts used, and have even been proposed as valuable tests for identifying the elements. For further details see Lamps, arc, carbon flame.

FLANGETITE.—Trade name for sheet packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

FLARAY.—Trade name for automobile signal manufactured by the Arthur J. Dunkle Co., 50 Church St., New York, N. Y.

FLASH AN OPERATOR.—If a telephone subscriber desires the attention of the operator during a connection, he slowly presses the receiver hook down and up several times. This causes the supervisory lamp to flash intermittently. Rapid moving of the hook does not attract the operator's attention.

FLASH-O-LIGHT SALES CO.—New York, N. Y. Manufacturer of spark plug testers. Business established 1920. President, Aaron Engel; vice-president and sales manager, William H. Gough; secretary, Richard J. Davies; treasurer, Irving Laikin. Main office, 507 5th Ave., New York, N. Y. Factory, Weehawken, N. J.

FLASH OVER.—An arc around the commutator of a d-c. machine causing a short-circuit. Flashing over may occasionally be caused by a dirty commutator but more frequently by sudden large changes in load, such as a short-circuit, which induces a high voltage between adjacent commutator segments and starts the arc. In some high-voltage d-c. generators, barriers have been placed between the brush sets in order to reduce the intensity of the flash over.

FLASH POINT OF OILS.—The flash point of an insulating or fuel oil is that temperature at which the vapor given off by the oil will ignite, but will not continue to burn. Also see Fire point of oils.

FLASHBOARDS.—Simple devices used in connection with a water-power or irrigation dam for providing control of limited variations in head. They provide additional pondage beyond that afforded by the dam proper to carry surplus water from time of minimum demand to maximum demand. They consist of a line of boards on the crest of the dam, sometimes adjustable and permanent, but often designed so that a sudden flood will carry them away, thus preventing damage.

FLASHERS, MISCELLANEOUS, NOT OTHERWISE LISTED.—The many combinations of circuits and varied effects that may be produced in electric signs and for decorative purposes, etc., are almost all controlled by a flasher of some type. In addition to the motor-driven, thermal and socket type flashers described below, there are a number of other types used. The so-called talking signs in which a group of words appear on the board for a few seconds or those in which the letters progress across the sign board are controlled by a special form of flasher. These generally have a perforated or stenciled tape which is driven across a bank of lamp contacts, one for each lamp. The color effects produced for decorative purposes and to attract attention are often controlled by special types of flashers operated by solenoids or small motors.

Manufacturers:

Electric Sign Flasher Co., 519 Baker-Detwiler Bldg., Los Angeles, Cal.

FLASHERS, SIGN, MOTOR-DRIVEN.—These flashers consist of motor-driven drums bearing a number of parallel contact arcs of various lengths on which contact fingers bear so as to make and break corresponding lamp circuits as the contact arcs pass under the fingers. One side of the circuit is connected to the contact arcs, the other to one side of the lamps on the sign; the other side of the lamp groups to be controlled as units is connected to the respective contact fingers, one to each lamp or group of lamps. By adjusting the lengths of the arcs and their relative angular position it is possible to secure a great variety of flashing effects. For a large sign having an intricate flashing cycle the flasher is seemingly complex, but consists of elements such as described. The contact drum is driven usually at low speed through belt, chain or gear drive by a small motor. If the flasher is mounted on or near an outside sign it is enclosed in a weatherproof metal housing or cabinet.

Manufacturers:

A & W Electric Sign Co., The, Cleveland, Ohio.
ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."
Ryan Corp., The, Phoenix, N. Y.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

FLASHERS, SIGN, THERMAL.—These types of flashers control the current through the making and breaking of the electric circuit by a thermostat. This thermostat is usually made of two strips of different metals and current through these strips causes one to expand more rapidly than the other, thus actuating the contact point of the strip to make and break the circuit. Such flashers may control small signs containing several lamps, but they usually produce only simple flashing effects.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B," "Wink-a-Lite."
Clinton Sign Co., 134 5th Ave., Clinton, Ohio.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Ryan Corp., The, Phoenix, N. Y.
SOLAR ELECTRIC CO., 124 W. Lake St., Chicago, Ill.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

FLASHERS, SOCKET TYPE.—A thermostatic flashing device consisting of two metals whose expansion and contraction makes and breaks the contact. In the socket type the thermostat is so small as to be inserted by a screw-shell attachment plug into an ordinary lamp socket. This flasher usually controls only a single lamp which may be within a translucent glass sign.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."
Ryan Corp., The, Phoenix, N. Y.
SOLAR ELECTRIC CO., 124 W. Lake St., Chicago, Ill.
United Electric Apparatus Co., 1529-33 Columbus Ave., Boston, Mass.

FLASHING OF DYNAMO.—This is a term sometimes used in referring to the sparking which occurs between the brushes and commutator of a motor or generator. It is more commonly used, however, to designate the long spark or arc that occasionally jumps or flashes over the surface of the commutator from one brush of a high-voltage generator to the nearest brush of opposite polarity when the load is suddenly changed.

FLASHING OF FILAMENT.—A process used on carbon filaments for incandescent lamps to give a hard uniform layer on the outside of the filament that will improve its conductivity and overcome or fill up any irregularities in cross section. The process consists of heating the filament to a high temperature by passing current through it, in the presence of a hydrocarbon gas, usually under a partial vacuum. Filaments so treated were called "metallized." The process has been practically abandoned, as has the production of carbon filament lamps.

FLASHLIGHT.—Trade name for electric alarm clocks manufactured by the Darche Mfg. Co., 643 W. Washington Blvd., Chicago, Ill.

FLASHLIGHT BATTERIES, CASES, LENSES, REFLECTORS.—See Batteries, dry, flashlight; Cases, flashlight; Lenses, flashlight and Reflectors, hand lamp and flashlight.

FLASHLIGHTS, DASHBOARD AND SPOTLIGHT TYPE.—See Spotlights, automobile.

FLASHLIGHTS, HAND AND POCKET TYPES.—The name flashlight was given to these small portable lights using a dry battery as a source of energy a long time ago. At that time the efficiency of the small carbon lamps that had to be used was so poor and the capacity of the batteries so small that they could only be

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used intermittently and merely flashed on and off. A steady light of any duration would quickly drain the battery and lower the voltage so that a rapidly dimmed light was obtained. The button for closing the circuit was usually not provided with a sliding arrangement so that it would remain closed as it now is, but was merely intended for flashing while it was held closed by the thumb.

While great improvements have been made in both the batteries and the lamps, and the use of tungsten filaments has greatly improved the efficiency so that the lamp may be burned steadily for many minutes, these devices are still called flashlights. The use of several cells in series and the increase of capacity of the cells has lengthened the working life and permitted the use of higher-voltage and more efficient lamps.

A large number of styles and sizes of flashlights are made, some even containing a standard No. 6 dry cell. The common forms have tubular cases, or flat cases, usually nickelplated or highly finished. Special cases, such as fountain pens, pencils, revolvers, etc., are also used. See Cases, flashlight. Flashlights are an extremely convenient type of portable lamp. They are used for hundreds of purposes. Enormous numbers of them were used by the soldiers in the trenches during the recent war. On a gasoline automobile or in the neighborhood of combustible or explosive material they are the only safe means of using a portable light. In the country, while camping, in summer resorts, etc., they enable one to find his way about readily and without danger or inconvenience.

Large or special types of flashlights are often given other names. See Lanterns, portable, dry cell type; Lamps, vehicle and bicycle. The latter are often also called vehicle or bicycle headlights.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready," "Daylo," "Spotlight."

Beacon Electric Works of National Carbon Co., Inc., Long Island City, N. Y. "Beacon."

Bright Star Battery Co., 310 Hudson St., New York, N. Y. "Bright Star."

Burgess Battery Co., Madison, Wis.

Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

Curfman Mfg. Co., F. L., 114 E. 2nd St., Maryville, Mo.

Diamond Electric Specialties Corp., 101-103 S. Orange Ave., Newark, N. J. "Diamond."

Doe Electrical Device Co., Kent, Ohio. (In preparation.)

Elgin Mfg. & Plating Co., The, 58 Peter St., Uniontown, Pa.

Enterprise Electric Novelty Co., Inc., 603 W. 130th St., New York, N. Y. "Super-Enco," "Enco."

Franco Electric Corp., Franco Bldg., Brooklyn, N. Y. "Franco."

French Battery & Carbon Co., Madison, Wis. "Ray-O-Lite."

Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.

International Battery Co., Inc., 453-455 Broome St., New York, N. Y. "Pathfinder."

National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "American."

Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y. "Niagara."

Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless."

Providence Electric Mfg. Co., 23 Broad St., Providence, R. I. "Little Rhody," "Nitelite."

TRIANGLE ELECTRO TRADING CO., 79 Chambers St., New York, N. Y. "Triangle" flashlights and batteries are of highest quality, individually tested before leaving the factory. Line is complete in tubular, searchlight, cigar-case and pocket designs. See also page 1298, display section.—Adv.

Usona Mfg. Co., Inc., The, 1 Hudson St., New York, N. Y. "Kwik-Lite."

WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio. "Red Spot."

Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

Winchester Repeating Arms Co., New Haven, Conn. "Winchester."

FLASHLIGHTS, LANTERN TYPES.—See Lanterns, portable, dry-cell type; Lanterns, portable, storage-battery type.

FLASHTRIC SIGN WORKS.—2124-2130 N. Hudson Ave., Chicago, Ill. Manufacturer of electric signs. Proprietor, Fred Parker; sales manager, Harry S. Parker.

FLATIRONS, ELECTRIC.—See Irons, electric, pressing, household; Irons, electric, pressing, laundry; Irons, electric, pressing, tailors' and Irons, electric, pressing, travelers'.

FLECK CARBON CO.—71 W. Broadway, New York, N. Y. Manufacturer of carbon, metal and graphite brushes. Business established 1900. M. F. Fleck, sole owner.

FLEMING'S RULE.—A rule for showing the relation among the directions of motion, of flux and of e. m. f. or current in the armatures of generators and motors. For generators, the right hand is taken and the thumb, the first and second fingers are held at right angles to each other. If the thumb and first finger point in the direction of motion of the conductor and of the magnetic field, respectively, the second finger points in the direction of the induced e. m. f. For motors, the left hand is taken with a like arrangement of thumb and first and second fingers. With the thumb and first finger indicating as before, the second finger points in the direction of the current.

FLETCHER MFG. CO.—302 E. Second St., Dayton, Ohio. Manufacturer of pole-line hardware and other line construction specialties. Sole owner, John R. Fletcher.

FLEUR-DE-LIS.—Trade name for dry batteries manufactured by the French Battery & Carbon Co., Madison, Wis.

FLEXCO.—Trade name for nonlocking lamp guard manufactured by the Flexible Steel Lacing Co., 4607-4631 Lexington St., Chicago, Ill.

FLEXCO-LOK.—Trade name for locking lamp guard manufactured by the Flexible Steel Lacing Co., 4607-4631 Lexington St., Chicago, Ill.

FLEX CORD.—Trade name for flexible cord for portable tools manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

FLEXIBLE ARMS FOR PORTABLE LAMPS.—These are metallic arms, often of brass, that are used on some desk, piano and similar portable lamps; they are also used occasionally on adjustable fixtures. These arms are made of spirals of wire or flat strip and resemble somewhat flexible steel conduit. Many fixture manufacturers and portable-lamp makers do not have facilities for making this flexible tubing themselves but buy the arms already formed.

Manufacturers:

Almond Mfg. Co., T. R., Ashburnham, Mass.

Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. "Fle-X-Met."

Faries Mfg. Co., Decatur, Ill.

LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv. page 1275.)

Metallic Mfg. Co., 544 W. 35th St., Chicago, Ill.

SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."

Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Phlexarm."

FLEXIBLE COMPOUND.—Trade name for impregnating and insulating compounds, armature lacquers, insulating and protective paints, wood preservative and waterproofing materials made by the Flexible Compound Co., Inc., 3607 Haverford Ave., Philadelphia, Pa.

FLEXIBLE COMPOUND CO., INC., THE.—3607 Haverford Ave., Philadelphia, Pa. Manufacturer of impregnating and insulating compounds, insulating and protective paints, wood preservatives and waterproofing materials. Business established 1902. President, J. E. Warner; secretary and treasurer, H. A. Brognard. Exclusive distributors, E. DeF. Wilkinson Co., Providence, R. I. (New England States); Tibbetts, Oldfield Co., Los Angeles, Cal. (Pacific Coast States.)

FLEXIBLE CONDUIT.—See Conduit, flexible steel. Also Tubing, flexible fabric or nonmetallic conduit.

FLEXIBLE CORD.—See Cord, flexible.

FLEXIBLE LEADS.—See Pigtails and flexible leads.

FLEXIBLE STEEL LACING CO.—4607-4631 Lexington St., Chicago, Ill. Manufacturer of belt lacing and fasteners and lamp guards. Business established 1907. President, George E. Purple; vice-president, H. J. Beach; secretary, treasurer and general manager, R. S. Rinaldo; sales manager, H. L. Coats.

FLEXIBLE WOVEN CABLE CO.—170 Purchase St., Boston, Mass. Manufacturer of flexible non-metallic conduit and cord.

FLEXILE.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

FLEXISHAFT.—Trade name for flexible shafting manufactured by the Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.

FLEX-ITE.—Trade name for leather belting manufactured by the F. Raniville Co., 241-247 Pearl St., Grand Rapids, Mich.

FLEXITE.—Trade name for magneto parts manufactured by the Slocum, Avram & Slocum Laboratories, Inc., Woolworth Bldg., New York, N. Y.

FLEXLUME SIGN CO.—74 Kail St., Buffalo, N. Y. Manufacturer of electric signs. Business established 1910. President and sales manager, R. R. Wiley; vice-president, W. K. Wiley; secretary and treasurer, E. B. Bennett. Branch office, Toronto, Ont., Can.

FLE-X-MET.—Trade name for flexible metal hose tubing and accessories made by the Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.

FLEXO.—Trade name for key socket attachments manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

FLEXO-FLINT.—Trade name for protective varnish manufactured by the Billings-Chapin Co., 1153 E. 40th St., Cleveland, Ohio.

FLEXOLITE.—Trade name for automobile spotlight manufactured by the Trolley Supply Co., Massillon, Ohio.

FLEXSTEEL.—Trade name for flexible metallic conduit and fittings and armored cables and cords manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

FLEXTUBE.—Trade name for nonmetallic conduit manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

FLICKER PHOTOMETER.—A type of photometer that is very useful in comparing the luminous intensities of light from two lamps. It employs rotating mirrors or diffusing screens which give rapidly alternating impressions of the light from both sources incident upon the comparison plane. By increasing the speed of rotation of the screens the lights appear to flicker and when the difference in intensities is great the flicker is more pronounced. By moving the comparison plane back and forth a point is reached where no flicker is noticeable and at this point the intensities are equal.

FLINTKOTE CO., INC., THE.—Boston, Mass. Manufacturer of insulating compounds. President, Reginald W. Bird; vice-president and general manager, Chester E. Rahr; vice-president, Frederick C. Overbury; treasurer, William J. Smith. Main office, 88 Pearl St., Boston, Mass. Factories, Rutherford, N. J.; Lockland, Ohio; Chicago, Ill.; Chicago Heights, Ill. Branch offices, Peoples Gas Bldg., Chicago, Ill.; 3030 Equitable Bldg., New York, N. Y.; 705 Canal Commercial Bldg., New Orleans, La.

FLINT-RIM.—Trade name for sprockets manufactured by the Link-Belt Co., 329 W. 39th St., Chicago, Ill.

FLINT SANITARY MOUTHPIECE CO.—132 Pleasant St., Newton Centre, Mass. Manufacturer of sanitary telephone mouthpieces. Secretary, treasurer and general manager, Arthur E. Lemont.

FLINT & WALLING MFG. CO.—Kendallville, Ind. Manufacturer of electric pumps. Business established 1866. President, H. H. Macomber; vice-president, A. H. Minor. Secretary and treasurer, F. B. Park.

FLINT ELECTRIC & MFG. CO., THE.—1412 Delgany St., Denver, Colo. Manufacturer of mine signaling systems, switchboards and cabinets. President, James J. Flint; vice-president, James A. Flint; secretary, C. A. Yont.

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FLIP FLOP.—Trade name for electric toasters manufactured by the Rutenber Electric Co., Marion, Ind.

FLOAT CAGE.—Trade name for metallic packing manufactured by the American Huhn Metallic Packing Co. Woolworth Bldg., New York, N. Y.

FLOAT SWITCHES.—See Switches, tank or float.

FLOATING BATTERY.—A storage battery which is connected across a line in parallel with the load. When the load is heavy energy from the battery is fed into the line, but when the load is light the battery is charged by the generator feeding the line. Because of this condition it is said to "float on the line" ready for whatever service is required. Batteries have been used for this purpose on d-c. distribution circuits to aid in carrying central-station peak loads and to maintain constancy of d-c. line voltage. They have also been used on some electric railway systems. Telephone batteries in an exchange are also floated on the line in many cases as the voltage has to be kept very nearly constant. Another use for floating batteries is on the excitation circuit of a-c. generating stations.

FLOOD LIGHTING.—A system of lighting exterior areas or structures by literally flooding them with projected light. One of its first applications was the lighting of Niagara Falls by means of batteries of searchlights. Such searchlights are expensive in first cost and in operation, since they require continual attention. Therefore, flood lighting received relatively little application until the development of high-power incandescent lamps with concentrated filaments that permitted locating the light source at the focus of a parabolic projector. Soon after the gas-filled tungsten lamp was developed in 1913, applications of it for this purpose were made. Special projecting lamps called projectors were used. Such projectors are now made in several types, some intended for concentrating the light on a relatively small area, others for spreading it more widely over larger areas. The selection of projectors depends upon the object to be illuminated and the degree of illumination desired. For details of projectors, see Projectors, floodlight.

Flood lighting has, in recent years, been widely applied. One application has been the illumination of the entire exterior of buildings, especially such as have imposing architecture as is true of many public buildings, banks and other important commercial structures. Illumination of monuments and statues has also been effected very satisfactorily. Flood lighting has also been used for illuminating bathing beaches, playgrounds, baseball fields, football fields, parade and drill grounds, etc. It has been applied successfully for construction work by night, such as for deep excavations, in shipyards, in cutting ice on ponds, etc. During the recent war it was extensively used for protective lighting of bridges, munition and other important industrial plants, power houses, military works, cantonments, fortifications, etc.

Among the advantages of flood lighting as compared with other methods of lighting are its ability to cover large areas with light by means of relatively few lamps. From this results low initial and operating cost, especially as contrasted with outline lighting of buildings that was formerly extensively used and which involved use of large numbers of lamps, a maze of wiring and rather indifferent results in spite of high cost.

In installing a system of flood lighting, care is necessary in location of the projectors. These are concentrated and powerful sources of light and, if located where they are in direct line of vision, serious glare results. However, by placing them high on the top of other buildings or on special towers, this difficulty is frequently overcome. The installation should also be weatherproof unless of a very temporary character to be used in the summer time only.

FLOODLIGHTS.—See Projectors, floodlight.

FLOOD-O-LITE.—Trade name for flood lighting unit manufactured by the Reflector & Illuminating Co., 565 W. Washington St., Chicago, Ill.

FLOOR PUSHES.—Special push buttons placed in the floor; see Pushes, floor.

FLOOR TREADS, CONTACT-MAKING.—In one form two disks of sheet metal are held apart and one above the other by insulating material, the thickness of both being about ¼ inch. A slight pressure of the foot upon the disks closes the contact between them. Can be placed under a rug or carpet and wires run inconspicuously to bell and battery or other alarm circuit. Sometimes used in connection with electric door openers to open a door automatically as one steps close to it.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Daisy."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Reliable."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

FLOORING, COMPOSITION.—Composition flooring of various kinds is often used in power plants and in steel cars for electric railway service and other places in factories and other electrical concerns where a fireproof and in some cases insulating floor is required. Steel cars for railway service require this flooring to prevent slipping and also so as to keep the floor from getting very cold in winter and the heat supplied from being radiated rapidly. In power plants, especially in the switchhouses, an insulating flooring is used so as to make the general use of rubber mats unnecessary. Electrical manufacturing plants often find composition flooring preferable to wood, concrete or metal from the standpoint of fire hazard, freedom from dust and decreased liability to slipping. In telephone exchanges special floorings are sometimes used to minimize noise and dust.

Manufacturers:

American Mason Safety Tread Co., 125 Perry St., Lowell, Mass. "Karbolith."
Johns-Mansville, Inc., Madison Ave. & 41st St., New York, N. Y.
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."

FLORIDA TELEPHONE ASSOCIATION.—President, W. G. Brorein, Tampa, Fla.; secretary, Frank L. Moor, Tallahasse, Fla.

FLORY MFG. CO., S.—Bangor, Pa. Manufacturer of electric hoists and winches. President, Milton Flory; secretary, E. G. Markley; treasurer, W. S. Ditchett; sales manager, S. J. Lenher. Main office, Bangor, Pa. Branch office, 95 Liberty St., New York, N. Y.

FLOUR CITY ORNAMENTAL IRON CO.—27th St. & 28th Ave., S., Minneapolis, Minn. Manufacturer of metal castings, machinery guards, ornamental street lighting units and posts, structural steel for outdoor substations, etc.

FLOWER CO., WALTER L.—312-314 S. 8th St., St. Louis, Mo. Manufacturer of oil filters. President, N. Stewart.

FLOWERS, ELECTRICALLY LIGHTED.—Decorative baskets and vases containing artificial flowers lighted by small incandescent lamps of various colors are used for display purposes and in homes. By combining skillfully concealed lights of low intensity and highly colored flowers, a much fresher and more natural and attractive decorative effect is produced.

Manufacturers

Botanical Decorating Co., 208 W. Adams St., Chicago, Ill.
Electrical Decorative Flower Co., Inc., 140 W. 116th St., New York, N. Y.

FLUE-GAS ANALYSIS INSTRUMENTS.—There are several forms of instruments for flue-gas analysis, the simplest and most common being several forms of the Orsat apparatus. In these instruments the sample of flue gas is exposed successively to solutions of potassium hydroxide, potassium pyrogallate and cuprous chloride for removing carbon dioxide (CO_2), oxygen (O_2), and carbon monoxide (CO), respectively. A graduated glass measuring chamber is part of the instrument and the gas is measured before starting and then returned to this chamber after passing through each of the solutions to measure the reduction in volume. There are other forms of apparatus which are more accurate and permit a more complete determination of the flue gas, but these are strictly laboratory instruments while the simple types may be used right at the boiler.

Some instruments have been designed to measure automatically and record continuously the CO_2 present in the flue gases; for these see Recorders, combustion or CO_2.

Manufacturers:

Dwight Mfg. Co., 564 W. Washington Blvd., Chicago, Ill.
Hays Corp., The Joseph W., Michigan City, Ind. "Hays."
Mono Corp. of America, 25 W. Broadway, New York, N. Y.
Pierce Co., The William B., 45 N. Division St., Buffalo, N. Y. "Vulcan."
Precision Instrument Co., 21 Halsey St., Newark, N. J.

FLUME.—A flume is usually a narrow waterway with nearly vertical sides. In modern hydraulic practice it refers to an aqueduct of relatively small dimensions employed to carry water long distances. It is made of timber, concrete, iron, steel or masonry with a smooth interior and the water is carried at a high velocity. There are both closed flumes and open flumes, the latter being on a practically level grade. Formerly the word flume was used to designate the canal or penstock conveying water to the wheels at its end. For manufacturers see Flumes, steel and wood.

FLUMES, STEEL AND WOOD.—Steel and wood are both used in the construction of flumes for conveying water to hydraulic power plants. Wood stave pipe has been used very largely for this purpose, especially in the western part of the country and is sometimes made in sizes up to 14 ft. in diameter. This pipe consists of staves carefully joined together laterally, the staves being made in lengths of from 6 to 20 ft. Steel cable equipped with turnbuckles or steel restrainbands are then placed around the pipe to reinforce it. Flumes are very often of open trough-like construction and wood has been used very largely for this purpose. Steel and iron flumes are also made in both the open type and closed or pipe form. These are sometimes made as long sections of open, semicircular sheet steel troughs with reinforcing and supporting steel rods surrounding it. Where the pressure is great or where a level grade is not possible, the flumes are made of reinforced steel pipe, like penstocks, which permits building portions of the flume as siphons. This is frequently necessary where water has to be conveyed a great distance over rough mountainous country before it gets to the penstocks of the power plant.

Manufacturers:

Continental Pipe Mfg. Co., Seattle, Wash. "Continental," "Creo-Wood."
Dow, Inc., L. B., Keene, N. H.
International Creosoting & Construction Co., Galveston, Tex. (wood).
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
Western Metal Mfg. Co., El Paso, Tex.

FLUORESCENCE.—That property which some bodies, particularly organic solutions, possess of emitting light while exposed to the action of certain light rays, either of the visible or ultra-violet spectrum, or of cathode rays, Roentgen rays, etc. The light produced in this manner is quite distinct from that reflected at the surface of the body which gives it its color, and also from that transmitted by the body. It is definitely related to the light the body is capable of absorbing and in the case of liquids and solids exhibits a continuous spectrum, the maximum of which is of somewhat greater wave length than the maximum of some band in the absorption spectrum of the substance.

FLUORSPAR.—The common name for the mineral calcium fluoride, CaF_2. It is frequently used as a flux in foundry cupolas, open-hearth, electric-furnace and other smelting processes.

FLUTO.—Trade name for socket manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

FLUTOLIER.—Trade name for fixture socket manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

FLUX.—The term flux is applied to electrostatic or magnetic fields to indicate a flow or passing of energy or lines of force through the magnetic or electrostatic circuit. It is most commonly used in connection with a magnetic field and generally means the total number of lines of force in the circuit. When referring to total number of lines of force in any unit area, such as a square inch or square centimeter, the term "flux density" is used.

Flux is also applied to light and in the modern theory of light is the actual quantity of light that radiates from a luminous source or falls upon a certain area at any

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instant. Similarly flux is used to refer to the flow of heat and is the quantity that flows through a given area at a given time.

FLUX SOLDERING.—See Soldering compounds or flux (fluid, paste, salts and sticks.).

FLUX, WELDING.—See Welding, flux.

FLY FOOT.—Trade name for belt dressing manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

FLYNN & EMRICH CO.—Holliday & Saratoga Sts., Baltimore, Md. Manufacturer of hand-operated stokers. James F. Turner, secretary.

FOAMITE FIREFOAM CO.—200 5th Ave., New York, N. Y. Manufacturer of fire extinguishers.

FOCO-LIGHT.—Trade name for lighting units manufactured by C. B. & J. Warner, Inc., 138 W. 14th St., New York, N. Y.

FOCUS.—A point at which rays of light, heat, sound, etc., meet after being reflected or refracted; in the case of a lens or concave mirror the point at which a clear image is formed. Also a point from which diverging rays appear to issue or a point at which converging rays would meet if allowed to meet without being reflected or refracted. It is very important for the successful operation of searchlights, headlights, and other projecting lamps that the source of light be kept at or near the focal point.

In mathematics the focus is one of the points whose distances from any point of a plane curve are linearly connected. The principal curves that have a focus or foci (plural of focus) are the so-called conic sections—the ellipse, parabola and hyperbola. In the case of the parabola, rays of light or some other forms of radiant energy emitted from the focus are reflected from the parabolic surface in straight lines parallel with the axis; nearly all projecting reflectors (searchlights, headlights, spotlights, etc.) are parabolic or nearly parabolic in section. In the case of the ellipse light emitted at one focus is reflected back from the curve to the other focus; little practical application is made of this principle.

FOEN.—Trade name for electric hair driers manufactured by the Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y.

FOG SIGNALING APPARATUS.—The use of radio equipment to promote further safety to vessels at sea during fog, when the ordinary lighthouse is of little value, has been successfully accomplished and adopted in some places. Equipment has been designed for use at the lighthouse, which is an automatic radio transmitting set. Once each minute it sends out a characteristic signal on a very short wave length, so that it will be readily received by all ships within a few miles of the lighthouse. Direction finders or radio compasses are used on the ships to indicate the direction from which the signals come, so that they can readily get their bearings by radio.

FOLLANSBEE BROS. CO.—Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa. Manufacturer of copper sheets, solder, sheet steel for electrical purposes, etc.

FOLSOM-MILLER CO., THE.—130 Sycamore St., Milwaukee, Wis. Manufacturer of electric washing machines. President, S. P. Folsom; vice-president, Paul Runnels; secretary, Ira W. Parker; treasurer, Guy Miller; general manager, Paul P. Runnels; sales manager, D. H. Sandler. Factory, Markesan, Wis. Sales representative, D. M. Emery, Lansdowne, Pa.

FONOLIER.—Trade name for phonograph light manufactured by the Stuart Products Corp., 665 Washington Blvd., Chicago, Ill.

FOOT-CANDLE.—A common unit of illumination, representing a luminous flux density equal to that produced by a source of a standard candle on a plane which is one foot distant from it and perpendicular to the rays of light at that point. The foot-candle may be thought of as the density of the light flux from a standard candle at a distance of one foot, if light is looked upon as a flow or flux of radiant energy emitted from a luminous source. This flux density or illumination is a measure of the light that the surface receives, but not of its brightness.

The illumination of a point on a plane one foot away would be two foot-candles (2 ft.-cdl.), if a concentrated source equal to two standard candles (2-candlepower) were used, and 5 ft.-cdl. if a 5-cp. source were used. If, however, the plane is removed to a distance of 2 ft. and the source is still one candle, the same flux or beam of light falling on this plane would have to cover four times the area it covered on the plane 1 ft. away. It follows then that the density of light flux at this point is only one-fourth as high as at the first point, or the illumination is ¼ ft.-cdl. Similarly at 3 ft. it would be 1/9 ft.cdl. The illumination in foot-candles is, therefore, inversely proportional to the square of the distance from a point source and directly proportional to the candlepower of the source.

FOOT-CANDLE METERS.—A portable instrument to measure the intensity of illumination in foot-candles at any desired point. The instrument is not as accurate as laboratory instruments but is sufficiently accurate for all practical determinations and for checking up installations to determine the condition of the lighting equipment and whether the illumination is ample. The instrument is placed upon the surface of which the illumination measurement is desired. The operation of the instrument is very simple. It contains a lamp within the box which is maintained at a definite voltage, indicated on a small voltmeter, by adjusting a small rheostat. Dry batteries furnish the energy for the lamp. A screen in the instrument is illuminated by the lamp to a much higher intensity at one end than at the other. The illumination from the outside source is uniform over the same screen, which is calibrated. Closely spaced translucent dots on the scale appear brighter at one end of the scale than at the other, and at the point where the illumination from the inside and outside are equal the spots are neither brighter nor darker than the white paper scale. This point then gives the desired intensity in foot-candles by direct reading.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. pages 1272-1273.)
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. on pages 1266-1269.)
Nela Specialties Division, National Lamp Works of G. E. Co., Nela Park, Cleveland, Ohio.

FOOT-O-SCOPE.—Trade name for X-ray machine manufactured by the X-Ray Foot-O-Scope Co., Inc., 100 Boylston St., Boston, Mass.

FOOT-POUND.—A foot-pound is the unit of work in the English system of units. It equals the work done by a one-pound force acting through a distance of one foot. One foot-pound equals 13,563,600 ergs, or 1.356 joules.

FOOT-POUND-SECOND.—A unit of mechanical energy. It is one foot-pound of work done in a second; 550 ft.-lb.-sec.= 1 horsepower-second (hp-sec.); 198,000 ft-lb.-sec.=1 horsepower-hour (hp.-hr.)

FOOTE BROS. GEAR & MACHINE CO.—213 N. Curtis St., Chicago, Ill. Manufacturer of gears. President and treasurer, J. B. Foote; vice-president, B. Foote; secretary, G. W. Donaldson.

FOOTE MINERAL CO., INC.—107 N. 19th St., Philadelphia, Pa. Manufacturer of mineral products. Business established 1876. President and general manager, W. M. Foote; vice-president, H. C. Meyer; secretary and treasurer, I. M. Mackly. Factory, Kensington, Philadelphia, Pa.

FOOTE, PIERSON & CO., INC.—160-162 Duane St., New York, N. Y. Manufacturer of fire alarm systems, telegraph and telephone instruments, etc. Business established 1895. President, treasurer and general manager, H. G. Pierson; vice-president, Arthur Townsend; secretary, William R. Stout; sales manager, Malcolm G. Pierson.

FOOTLIGHTS, STAGE.—Electric incandescent lamps mounted in receptacles and these in outlet boxes or iron or steel reflecting troughs or boxing along the front of a theater stage and just below the floor line, so arranged as to illuminate the scenery and performers. Special rules in the National Electrical Code govern the installation of such lights to minimize danger of fire. The lamps are frequently arranged in color groups, each color on a different circuit, so that colored lighting effects can be readily produced.

Manufacturers:

Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. The "X-Ray" system of footlights (see illustration) consists of special X-Ray reflector units to accommodate 75, 100 or 150-watt Mazda lamps. Each reflector has color frame. Wired in circuits for two, three or four colors, any number of lights per color. Built to order to meet structural conditions. See other stage lighting entries and adv. page 1405.—Adv.



"X-Ray" Footlight System

OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill.
PETERSON CO., INC., CHARLES J., 723-729 Fulton St., Chicago, Ill.
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill. "Ready-2-Install."
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Universal," "Kliegl."
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

FOOT WARMERS.—See Warmers, foot, indoor; Warmers, foot, outdoor, for traffic officers, etc.

FORBES.—Trade name for conduit threading and cutting machines manufactured by the Curtis & Curtis Co., 188 Garden St., Bridgeport, Conn.

FORCE ON CONDUCTOR IN MAGNETIC FIELD.—When a current-carrying conductor is in a magnetic field reaction exists which tends to force the conductor out of the field. This force is F=BIl dynes if B, l and I are expressed in C. G. S. units. B is the flux density, l is the length of conductor in the magnetic field, and I is the current.

FORCED ALTERNATING CURRENT.—An alternating current, the frequency and damping of which are equal to the frequency and damping of the exciting electromotive force.

FOREBAY.—A forebay in connection with water-power plants where the water wheels do not draw directly from the canal or penstock is an enlargement of the canal leading directly to the racks of the plant. Its object is to provide a basin of sufficient volume to allow the incoming water to settle quietly and enter the wheels smoothly and without eddy swirls.

FORBES & MYERS.—172 Union St., Worcester, Mass. Manufacturers of electric buffing, polishing and grinding machines. Business established 1913. Sole owner, A. W. Forbes.

FORE ELECTRICAL MFG. CO., INC.—5255 N. Market St., St. Louis, Mo. Manufacturer of battery charging outfits and rectifiers. Business established 1916. President, Albert Wehmeier; vice-president, treasurer and general manager, L. R. Brown; secretary, H. E. Mize.

FOREST CITY BIT & TOOL CO.—Rockford, Ill. Manufacturer of auger bits and other wood boring tools.

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FOREST CITY PAINT & VARNISH CO., THE.—Cleveland, Ohio. Manufacturer of insulating paints. President, A. D. Joyce; vice-president and general manager, L. F. Body.

FORG MFG. CO., PETER.—50 Park St., Somerville, Mass. Manufacturer of adjustable lighting fixtures. President and treasurer, H. Forg.

FORGINGS, COPPER.—Copper forgings are sometimes required in power plant construction, for use in heavy busbar connections, etc. Many manufacturers of switchboard fittings, connectors, etc., are not equipped to make copper forgings and find it necessary to have them made by other manufacturers. Certain electrolytic and furnace processes where a very heavy current density is required also use copper forgings in place of castings for terminal contacts, etc.

Manufacturers:

American Brass Products Co., Pottstown, Pa.
American Forge & Mfg. Co., 2433-41 W. 48th St., Chicago, Ill.
Billings & Spencer Co., The, Hartford, Conn.
Electric Materials Co., The, North East, Pa.
Eureka Co., North East, Pa.
Frasse & Co., Peter H., 417 Canal St., New York, N. Y.
Kilborn & Bishop Co., Chapel & Lloyd Sts., New Haven, Conn.
Lakeside Forge Co., East Lake Rd., Erie, Pa.
MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., W., Detroit, Mich. (See display adv. page 1285.)
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y.

FORGINGS, DROP.—Drop forgings are much used in the construction and manufacture of heavy electrical machinery and equipment. The equipment necessary for making these forgings is expensive and small manufacturers who do not have occasion to use forgings very often would not be warranted in purchasing the equipment. This classification is therefore, intended for those manufacturers who have facilities for making them and are equipped to supply the needs of other manufacturers.

Manufacturers:

Bearings Co. of America, The, Harrisburg & College Aves., Lancaster, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Billings & Spencer Co., The, Hartford, Conn.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Frasse & Co., Peter H., 417 Canal St., New York, N. Y.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa.
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y.

FORGINGS, ELECTRIC RAILWAY.—Electric railway construction requires the use of many special forgings, both in the track construction and construction of trucks and cars. The forgings used for track work are described under Track work, special, which see. The various types of motors to be mounted on the trucks, and the several sizes and weights of truck for the varied classes of service require many special steel forgings. As these are generally purchased by all but the largest operating companies for repair purposes, manufacturers of car equipment generally carry a stock of such forgings. In many cases it may be desirable to have forgings made nearby to avoid the delay of shipment from a distant manufacturer.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa. (bronze) "Spare's."
Bethlehem Steel Co., Bethlehem, Pa.
Blakeslee Forging Co., Plantsville, Conn.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Electric Materials Co., The, North East, Pa.
Harley Co., The, Page Blvd., Springfield, Mass.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Standard Forgings Co., The, Railway Exchange Bldg., Chicago, Ill.
Standard Steel Works Co., 500 N. Broad St., Philadelphia, Pa.
Strieby & Foot Co., Newark, N. J.
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."

FORGINGS, STEEL, MISCELLANEOUS.—This classification is intended to cover any miscellaneous forgings that might be required in the construction or repair of electrical equipment or power plant apparatus. Many users of such equipment do not have facilities for making forgings and, especially in the case of repairs, find it necessary to have them made by manufacturers who make a practice of this, rather than to await the arrival of a new part from the original manufacturer if he is located at a great distance. In building equipment in which forgings form a minor part it is often of advantage to have these made by specialists in this line instead of establishing a forge shop that would be kept busy only a small part of the time.

Manufacturers:

Erie Forge & Steel Co., Erie, Pa.
Hammond Steel Co., Inc., The, 2600 Milton Ave., Syracuse, N. Y.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa. (die blocks, etc.)
Standard Steel Works Co., 500 N. Broad St., Philadelphia, Pa. "Standard."

FORKS, INSULATED.—These are wrought iron forks designed to hold a porcelain spool type insulator between the prongs. They are for use on a pole or building to insulate these structures from the suspension wire or cable. The fork is provided with holes to be attached by bolts, or a bolt or lag screw is permanently attached to the fork itself. They are called either insulated or insulator forks.

Manufacturers:

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FORKS, RAISING.—Raising forks are tools used in overhead line construction in raising and setting wooden poles. They consist of a heavy forged iron U-shaped fork on the end of a long wooden pole or handle. The fork fits around the pole to be raised and is usually prevented from turning or slipping by a small pike that is placed right at the top of the long handle, in the center of the fork. These tools are used both in raising and bracing the pole; they are a safer type of tool than what are called pike poles.

Manufacturers

Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display advertisement on page 1253.)

FORKS, TROLLEY.—Trolley forks are more commonly called harps. See Harps, trolley.

FORKS, TUNING.—Tuning forks, both electromagnetically operated and freely vibrating, are used for laboratory and experimental work and for timing operations or speed of rotation. Forks of various lengths and weights may be made to vibrate at different periods or frequencies, which may be very accurately determined and produced. By using an electromagnet to cause constant vibration a uniform sound or uniform rate of interruptions of an electrical contact may be produced. For timing the speed of rotation of a motor or other apparatus a small disk having a certain number of alternate black and white spots is driven by the motor. Shutters are placed on the ends of the fork with a slot parallel to the sides of the fork. When the two shutters come together so that the spots line up the rotating disk may be viewed through them. When the speed of the disk bears the proper relation to the natural period of the fork the spots viewed through the slots will be very distinct and will appear to stand still. This is called the stroboscopic method of speed adjustment.

Manufacturers:

Deagan, Inc., J. C., 1770 Berteau Ave., Chicago, Ill.
Standard Scientific Co., 9 Barrow St., New York, N. Y.

FORM-FACTOR.—The form-factor of an alternating wave is the ratio between the effective and average values. For sine waves the form-factor is 0.707/0.636=1.11.

FORMICA INSULATION CO., THE.—Cincinnati, Ohio. Manufacturers of insulating material. Business established 1913. President, H. A. Faber; vice-president, D. J. O'Conor; secretary, D. B. Wallace. Main office and factory, 4614 Spring Grove Ave., Cincinnati, Ohio. Branch offices, 50 Church St., New York, N. Y.; 9 S. Clinton St., Chicago, Ill. Sales representatives, E. M. Wolcott, 1042 Granite Bldg., Rochester, N. Y.; G. A. Morrell, 410 Exchange Bldg., Cleveland, Ohio; J. L. Gruber, 419 Ohio Bldg., Toledo, Ohio; Sperry & Bittner, 423 First Ave. Bldg., Pittsburgh, Pa.; Hermans Griffith Co., Sheldon Bldg., San Francisco, Cal.

FORMING BLOCK.—A block or fixture on which the conductors of a cable are formed before being connected to their terminals. It refers particularly to telephone cables, where the separate conductors are formed out uniformly and compressed and laced together so as to remain in position and occupy as little space as possible. It is a process used especially on a multiple switchboard for connecting the jacks of different positions together.

FORMING OF BATTERY PLATES.—The process of electrochemically converting partially completed storage-battery plates into finished plates. In the case of pasted lead plates this is done by charging them after the paste has set, as anodes or cathodes in dilute sulphuric acid, thus changing them directly into positive and negative plates after a long, low-rate charge. In the case of electrochemically formed or Plantè plates the plates, after being prepared to present a large metallic lead surface, are used as anodes in an electrolytic bath of dilute sulphuric acid to which some oxidizing agent, such as nitric acid, has been added. This forms the lead surface into peroxide of lead, or positive active material. Those plates that are to be used as negatives are reversed by charging as cathodes, when they are ready to be assembled with the positives as a complete element. By some the word "forming" is restricted to the electrochemical conversion of the latter or Plantè type of plates. Also see Batteries, storage.

FORMS, COIL WINDING AND SHAPING.—Armature coils, field coils for motors and generators, transformer coils and magnet coils, etc., are all wound to have a definite form and uniform size. This is accomplished generally by using forms which are adjustable to a certain extent so that coils of various sizes and shapes may be wound on the same form. For giving the coil the desired shape after winding they are sometimes provided with clamping devices that will give a particular twist to the end turns, in the case of armature coils, or will give other desired slight changes in shape.

Manufacturers:

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

FORT ATKINSON.—Trade name for motor-driven ice cream freezers, milk bottle washers and electric milk and cream pumps manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

FORT DEARBORN.—Trade name for farm lighting plants manufactured by the Fort Dearborn Mfg. Co., Sterling, Ill.

FORT DEARBORN MFG. CO.—Sterling, Ill. Manufacturer of farm lighting plants. Branch office, 1212 1st National Bank Bldg., Chicago, Ill.

FORT-IFIED.—Trade name for electric heating devices manufactured by the Fortified Mfg. Co., 14th & Agnes Sts., Kansas City, Mo.

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FORT-IFIED MFG. CO.—14th & Agnes Sts., Kansas City, Mo. Manufacturer of electric heating devices. Business established 1916. President, George W. Foster; vice-president and treasurer, James N. Foster; secretary and general manager, Alexander Swan. Sales representative, Linograph Co., Davenport, Iowa.

FORTIER ELECTRIC MFG. CO.—Tulsa, Okla. Manufacturer of electric washing machines. President, W. N. Sill; vice-president, G. W. Moore; secretary and general manager, U. D. Fortier; treasurer, G. M. Schiek.

FORT WAYNE ENGINEERING & MFG. CO., INC.—Fort Wayne, Ind. Manufacturer of electric pumps, air compressors and controllers therefor. Main office and factory, 6th & Harrison Sts., Fort Wayne, Ind. Branch office, 195 High St., Boston, Mass.; 310 1st St., N., Minneapolis, Minn.

FOSKETT CO., INC., THE.—Port Jervis, N. Y. Manufacturer of illuminating glassware. President, John J. Foskett. Branch office, 59 E. Adams St., Chicago, Ill.

FOSSTON-CARPENTER CO. — 473 Cleveland Ave., N., St. Paul, Minn. Manufacturer of electric washing machines. President, K. B. Birkland; vice-president, A. T. Wherry; secretary, A. H. Bosshardt; treasurer and general manager, S. N. Sorensen; sales manager, F. W. Cleeland.

FOSTER.—Trade name for superheaters and economizers made by the Power Specialty Co., 111 Broadway, New York, N. Y.

FOSTER ENGINEERING CO.—Newark, N. J. Manufacturer of feed water regulators, air compressor governors, steam pressure regulators and valves. Business established 1890. President, R. C. Anderson; vice-president, Charles Hayden; general manager, C. A. Olson; sales manager, Charles R. Emerson. Branch offices, 712 Harrison Bldg., Philadelphia, Pa.; 1614 E. 40th St., Cleveland, Ohio.

FOSTORIA.—Trade name for incandescent lamps manufactured by the Fostoria Incandescent Lamp Division, National Lamp Works of General Electric Co., Fostoria, Ohio.

FOSTORIA INCANDESCENT LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Fostoria, Ohio. Manufacturer of incandescent lamps. H. H. Geary, general manager.

FOUCAULT CURRENTS.—The older name for stray currents which are liable to be set up within any conducting material of any apparatus in which an alternating magnetic flux is present. They are now usually referred to as "eddy currents," which see, but were formerly called Foucault currents in honor of the French scientist by that name who was one of the first to notice and investigate their presence.

FOUNTAINS, ELECTRIC, INDOOR OR SMALL TYPES, COMPLETE.—Small fountains for ornamental use indoors, while not used extensively, are occasionally found in restaurants, hotels, conservatories, etc., and sometimes in residences. Many of the smaller sizes are not connected to a water supply, but have a small electric pump which throws the water continuously over an illuminated dome. Various color effects within the dome are sometimes obtained by using a flasher or by slowly rotating colored lights within it. Such smaller fountains are made to mount on a pedestal or stand or directly on a table.

Manufacturers:

Darlington Electric Co., 123 N. Jefferson St., Chicago, Ill. "Darlington."
Friedley-Voshardt Co., 733 S. Halsted St., Chicago, Ill.
Jewel Electric & Mfg. Co., 5426 N. Broadway, Chicago, Ill.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill. "Randall."

FOUNTAINS, ELECTRIC, OUTDOOR AND OTHER LARGE TYPES, LIGHTING AND PUMPING EQUIPMENT FOR.—Fountains of this nature vary in size from those installed in amusement parks and gardens and upon lawns to very large fountains, such as those in the Place de la Concorde, Paris. In general unless ample water pressure is available, the water is thrown up over the basin by an electrically driven pump. The illumination is effected by lamps, either incandescent or arc, and reflectors. The color changes are produced by gelatine color screens mounted in rotating frames which in some instances are moved by a motor-driven color changer. The water streams can usually be varied in number, in height and to a certain extent in their spread, so that when combined with varicolored lighting a large variety of pleasing effects can be produced.

FOUR B.—Trade name for dry batteries manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

400.—Trade name for electric forge blowers manufactured by the Champion Blower & Forge Co., Lancaster, Pa.

FOUR-IN-ONE.—Trade name for industrial lighting units manufactured by L. Plaut & Co., 434 E. 23rd St., New York, N. Y.

4 IN 1.—Trade name for draft gages manufactured by the Precision Instrument Co., 21 Halsey St., Newark, N. J.

FOUR LEAF CLOVER.—Trade name for exhaust fans manufactured by the Centrifugal Fan Co., 9-16 17th Ave., Newark, N. J.

FOUR LEAF CLOVERS.—Trade name for ventilating systems manufactured by the Newark Cornice & Skylight Works, 9-15 17th Ave., Newark, N. J.

FOWLER LAMP & MFG. CO.—61 E. 24th St., Chicago, Ill. Manufacturer of floodlights, spotlights and special electric lamps. President and treasurer, H. N. Fowler.

FOX & CO., JOHN.—253 Broadway, New York, N. Y. Manufacturers of manhole covers and guards.

FOX ELECTRIC & MFG. CO., A.—397 W. Broadway, New York, N. Y. Manufacturers of complete commutators.

FOXBORO CO., INC., THE.—Foxboro, Mass. Manufacturer of indicating and recording instruments. Business established 1908. President and general manager, B. B. Bristol; vice-president, W. W. Patrick; secretary, B. H. Bristol; treasurer, E. H. Bristol; sales manager, Carl E. Sullivan. Main office and factory, Foxboro, Mass. Branch offices, 50 Church St., New York, N. Y.; Monadnock Block, Chicago, Ill.; Stock Exchange Bldg., Philadelphia, Pa.; Brown Marx Bldg., Birmingham, Ala.; Park Bldg., Pittsburgh, Pa.; Railway Exchange Bldg., St. Louis, Mo.; 461 Market St., San Francisco, Cal.; Oklahoma Gas Bldg., Tulsa, Okla.; Union Bldg., Cleveland, Ohio. Sales representative, Peacock Bros., 179 Delorimier Ave., Montreal, Que., Can.

F. P. & CO.—Trade name for punching registers for fire alarm and police signaling systems, recorders and automatic time stamps for printing telegraph systems manufactured by Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.

F. P. SARGENT.—Trade name for linemen's and welders' gloves manufactured by the Spencer Glove Co., Waverly, N. Y.

FRAHM.—Trade name for vibrating-reed tachometers and frequency meters manufactured by James G. Biddle, 1211-13 Arch St., Philadelphia, Pa.

FRAIM-SLAYMAKER HARDWARE CO.—Lancaster, Pa. Manufacturer of automobile and other locks. Business established 1888. President and general manager, Walter E. Fraim; vice-president, S. C. Slaymaker; secretary, John M. Kendig; treasurer and sales manager, Henry H. Hanton. Main office and factory, 1st St., West End Ave. and 2nd St., Lancaster, Pa. Branch office and warehouse, 113 Chambers St., New York, N. Y. District offices, Higgins Bldg., Los Angeles, Cal.; 312 Confederation Life Bldg., Winnipeg, Man., Can.; 2931 College Ave., Indianapolis, Ind.; 713 Chestnut St., St. Louis, Mo. Sales representative, John H. Graham & Co., 113 Chambers St., New York, N. Y.

FRALEY.—Trade name for electric vibrators manufactured by Schunck & Ogg, 235 Canal St., New York, N. Y.

FRALICK & CO., S. R.—15 S. Clinton St., Chicago, Ill. Manufacturers of conduit fittings and wiring devices. Business established 1907. President, Syles R. Fralick; vice-president, W. C. Duncan; secretary, E. W. Ostrom; treasurer, S. R. Fralick; sales manager, M. E. Flaherty. Factories, Chicago, Ill.; Cleveland, Ohio; Philadelphia, Pa.

FRAMBERG & CO., H. A.—24 S. Clinton St., Chicago, Ill. Manufacturers of lighting fixtures. President, H. A. Framberg; vice-president, Charles Collins; secretary and treasurer, C. A. Framberg; sales manager, H. O. Stewart.

FRAME OF ELECTRICAL MACHINE.—The stationary iron structure of a generator or a motor, not including the winding. Thus, a given frame may be wound for a low or a high voltage; for a low or a high speed, so that the same frame may be used for several machines of different characteristics.

FRAMES AND SUPPORTS FOR ELECTRIC SIGNS.—These are generally steel frames made largely of angle and channel irons. In signs that merely have large letters and figures on them, in order that the sign will be effective during the day the frame is made very open and light so that the letters or design will stand out in marked contrast; this also reduces the exposure to wind. For strength to withstand sleet and wind pressures the frames must be securely riveted or bolted together and braced or guyed from the back, on the sides or top, depending on whether the sign is mounted on a roof, in front or along the face of a building, or rests on the ground. The framing for box or plate signs almost invariably forms an integral part of the sign and the whole complete outfit is furnished by the sign manufacturer.

Manufacturers:

Enameled Steel Sign Co., 190 N. State St., Chicago, Ill.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.

FRAMES FOR LAMP SHADES.—Wire frames are used for making many silk, parchment, and other similar fabric lamp shades, to maintain the shape of the shade. Steel wire is generally used and it is bent to the proper shape, carefully braced and twisted together. The silk or other covering, together with the fringe or tassels are then placed on it and secured to the wire.

Manufacturers:

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
Art Metal Works, Aronson Sq., Newark, N. J.
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Dallmer Mfg. Co., T. C., 9 W. Kinzie St., Chicago, Ill.
Modern Wire Specialty Co., Inc., 334 S. Wabash Ave., Chicago, Ill.
Timberlake & Sons, J. B., 114-116 E. Washington Ave., Jackson, Mich.
Union Wire Frame Co., 931 W. 20th St., Chicago, Ill.

FRAMES, HACKSAW.—Steel frames in the shape of three sides of a rectangle, the fourth side being open for the insertion of hacksaw blades. An adjusting screw for tightening the blade, and a handle for operating are attached to the frame. (Also see Hacksaws, hand.)

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Union Hardware Co., Torrington, Conn.

FRAMES FOR MANHOLES.—These are heavy castings used in the top of a manhole to provide an entrance to the chamber. They are made in both round and rectangular form and in two or three sizes. The round frames have an opening about 22½ ins. in diameter and the rectangular from 22x24 ins. to 28x32 ins. The frames consist of an upright, usually about 8 ins. high, the top of which is set flush with the pavement. It contains a recess into which the cover fits; on the bottom of this upright is a wide flange with reinforcing ribs running to the upright. The flange rests on and is supported by cross beams, usually angle irons which form the top of the manhole.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Cherry Tree Machine Co., Cherry Tree, Pa.
Fremont Foundry & Machine Co., Fremont, Nebr.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display advertisement on page 1254.)
Keystone Iron & Steel Works, 2931 Santa Fe Ave., Los Angeles, Cal.
S. E. T. Valve & Hydrant Co., 50 Church St., New York, N. Y. "S. E. T."
Smyser-Royer Co., York, Pa.

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Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."

FRAMES, POLE OR TOWER EXTENSION.—Steel poles and towers used in power transmission and distribution lines are made in certain standard lengths. Very often an irregular contour of the ground over which the line is being built requires the use of some poles or towers that are of greater length than the standard, and instead of having these made specially, extension frames are used. The extensions are of similar construction to the rest of the pole or tower and are placed below it. They are either bolted or riveted to the standard length. Extension frames are made in standard lengths also, such as 5 or 10 ft.

Manufacturers:

Hull & Co., S. W. 3729 Prospect Ave., Cleveland, Ohio.

FRAMES, TELEPHONE DISTRIBUTING.—Iron or steel frameworks used in a telephone exchange having an arrangement of terminals or terminal blocks to permit any line on one side to be connected to any line on the other side. The permanent cables on each side are soldered to terminals. Cross connections are made by jumpers, each attached from any terminal on one side to any other terminal on the other side. There are two types of distributing frames, as follows:

Main Distributing Frame—(Abbreviated MDF). A distributing frame in the central office between the incoming subscriber lines and the switchboard. It permits any outside line to be connected to any switchboard number, so that if a subscriber moves and thereby has a new line, he may still keep his old number, unless he moves out of the region of his old central office.

Intermediate Distributing Frame—(Abbreviated IDF). A distributing frame in the central office between kinds of apparatus. In a manual office it is between the subscribers' multiple jacks and the answering jacks, and permits any operator to be given any line to answer. An automatic office may have several kinds of IDF's to give flexibility to the trunking.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

FRANCE MFG. CO., THE.—10325 Berea Rd., Cleveland, Ohio. Manufacturer of battery charging equipment, ammeters, remagnetizers, electric soldering irons and insulated wire scrapers. Business established 1916. President, Lester E. France; vice-presidents, Merle C. France and P. K. Ranney; secretary, treasurer and sales manager, L. A. Corlett; general manager, L. E. France. Sales representatives, Trosco Mfg. Co., Cleveland, Ohio; W. J. Barger, Minneapolis, Minn.; C. F. Bopp, Youngstown, Ohio; Pacific Products Co., San Francisco, Cal.

FRANCHE & CO., C. E.—440 Orleans St., Chicago, Ill. Manufacturers of lamp frosting and coloring compounds, shellac and insulating varnish. Business established 1908. C. E. Franche, sole owner. Sales representatives, Keeler, White & Co., 509 Mission St., San Francisco, Cal.; J. J. Waldman, 64 Murray St., New York, N. Y.; L. P. Clark, 249 N. 12th St., Philadelphia, Pa.

FRANCIS.—Trade name for electrically heated glue pots manufactured by the Charles E. Francis Co., Rushville, Ind.

FRANCIS CO., CHARLES E.—Rushville, Ind. Manufacturer of electrically heated glue pots. Business established 1880. President, Harry G. Francis; vice-president, Mrs. Charles E. Francis; secretary and treasurer, George J. Griesser.

FRANCKE CO., THE.—New Brunswick, N. J. Manufacturer of flexible shaft couplings. General sales agents, Smith & Serrell, Central Ave. at Halsey St., Newark, N. J.

FRANCO.—Trade name for lamp coloring compound manufactured by C. E. Franche & Co., 440 Orleans St., Chicago, Ill.

FRANCO.—Trade name for flashlights manufactured by the Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.

FRANCO ELECTRIC CORP.—Brooklyn, N. Y. Manufacturer of storage and dry batteries, incandescent lamps, reflectors, automobile testers, etc. President, C. Hubert; vice-president, J. Block; treasurer, W. Hakes; sales manager, H. B. Parke. Main office, Franco Bldg., Brooklyn, N. Y. Factories, Brooklyn, N. Y., St. Marys, Pa. Branch offices, 549 Washington Blvd., Chicago, Ill.

FRANKEL CONNECTOR CO., INC.—Hudson & Vestry Sts., New York, N. Y. Manufacturer of solderless electrical connectors, testing clips and spark plugs. Business established 1914. President, Harry Frankel; vice-president, Charles Frankel; secretary and treasurer, Ferdinand Frankel. Exclusive distributor of solderless connectors, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FRANKEL DISPLAY FIXTURE CO.—177-179 Hudson St., New York, N. Y. Manufacturer of display fixtures.

FRANKEL LIGHT CO.—5016 Woodland Ave., Cleveland, Ohio. Manufacturer of lighting fixtures, fixture fittings and parts, lighting specialties and metal spinnings. President, Harry Frankel; vice-president and treasurer, David Frankel; secretary T. Woodward; general manager, A. Peskin; sales manager, Edward J. Ruth.

FRANKELITE.—Trade name for lighting fixtures manufactured by the Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio.

FRANKFORD BRASS MFG. CO.—207-9 Quarry St., Philadelphia, Pa. Manufacturer of fixture bodies.

FRANKFORD LIGHTING FIXTURE MANUFACTURERS.—4273-75 Frankford Ave., Philadelphia, Pa. Manufacturers of lighting fixtures. Partnership, Abraham Stein and Jacob N. Samson.

FRANKLIN.—Trade name for high-tension specialties made by the Electrical Development & Machine Co., 221 N. 23rd St., Philadelphia, Pa.

FRANKLIN.—Trade name for illuminating glassware manufactured by Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.

FRANKLIN.—Trade name for battery zincs manufactured by the Grasselli Chemical Co., Cleveland, Ohio.

FRANKLIN.—Trade name for water tube boilers manufactured by the Nagle Engine & Boiler Works, Erie, Pa.

FRANKLIN.—Trade name for electric blueprint drying machines and enlarging lanterns manufactured by Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

FRANKLIN, BENJAMIN.—An American statesman, scientist, and author, born at Boston, Mass., 1706, and died at Philadelphia, Pa., in 1790. After a year or more at candle making in his father's shop, he was apprenticed to his brother, a printer and founder in 1721 of the New England Courant. Franklin published many of his articles in this paper anonymously. He quarreled with his brother and left his employ. He then made his way first to New York City, then in October, 1723, to Philadelphia and in 1724 to England. He returned to Philadelphia in 1726. In 1729 Franklin founded the Pennsylvania Gazette and in 1731 he established in Philadelphia one of the earliest circulating libraries in America. In 1732 he published the first of the "Poor Richards' Almanacks" under the pseudonym of Richard Saunders, and for twenty-five years these were issued with remarkable success. In 1736 he became clerk of the General Assembly, and the next year he was appointed postmaster for Philadelphia. About this time he organized for the city a police force and a fire company. He established the academy which has developed into the present University of Pennsylvania. In 1742 he invented the Franklin stove, which had the same principle as the hot air furnace. In 1746 he took up the study of electricity, when he first saw a Leyden jar. In November, 1749, he proposed the construction of lightning rods (long known as "Franklin rods"), which he described and recommended to the public in 1753 when the Copely medal was awarded to him for his discoveries. In June, 1752, he performed his famous experiment with the kite, proving lightning an electrical phenomenon. He was interested in the meaning of the two kinds of electricity, positive and negative, and offered as his explanation what is called the "one-fluid theory."

In 1753 Franklin was appointed postmaster-general for the Colonies. The question of taxing the proprietary estates in Pennsylvania for the defense of the province from the French and Indians had assumed such an acute stage in 1757 that the Assembly decided to petition the king upon the subject and Franklin was selected to present the petition. The remainder of his life was practically spent in diplomatic service of the colonies and of the newly organized United States. His services to the country in its early trying years proved of incalculable value.

FRANKLIN COTTON MILL CO.—N. E. Cor. Plum & Charles Sts., Cincinnati, Ohio. Manufacturer of power transmission belting. Business established 1875. President, T. C. Pearce; vice-president, J. Merrill Wright; secretary and treasurer, H. L. Hathaway.

FRANKLIN DIE-CASTING CORP.—Magnolia & Gifford Sts., Syracuse, N. Y. Manufacturer of die-cast parts. Business established 1893. President, H. L. Franklin; vice-president and general manager, H. C. Skinner; secretary and treasurer, C. E. Hull; sales manager, H. J. Bierhart.

FRANKLIN JUNIOR.—Trade name for busbar supports manufactured by the Electrical Development & Machine Co., Philadelphia, Pa.

FRANKLIN MACHINE CO.—Providence, R. I. Manufacturer of transmission and spun silk machinery. President, Edward B. Hough; vice-president, George R. Burt; treasurer and general manager, George P. Macready.

FRANKLIN MFG. CO., THE.—Franklin, Pa. Manufacturer of heat insulation and journal box packing. Main office, Franklin, Pa. Factories, Stoneboro, Pa., Franklin, Pa. Branch offices, 501 Fifth Ave., New York, N. Y.; 20 E. Jackson Blvd., Chicago, Ill.

FRANKLIN MOORE.—Trade name for electric cranes and hoists manufactured by the Franklin Moore Co., Winsted, Conn.

FRANKLIN OIL WORKS.—Franklin, Pa. Manufacturer of lubricating oils and greases. Business established 1877. President, Lewis Grimm; secretary and sales manager, T. F. Ramsey.

FRANKLYNE.—Trade name for lubricating compounds, oils and greases manufactured by the Franklin Oil Works, Franklin, Pa.

FRANKS MFG. CO.—Rock Island, Ill. Manufacturer of portable electric lamps and wall brackets. E. I. Franks, secretary.

FRASSE & CO., PETER H.—417 Canal St., New York, N. Y. Manufacturers of forgings, rust solvents, etc.

FRAZER LUBRICATOR CO.—3921 Normal Ave., Chicago, Ill. Manufacturer of lubricating greases.

FREAS.—Trade name for electric drying ovens, incubators, thermostats and baths for laboratories manufactured by the Thermo Electric Instrument Co., 8 Johnson St., Newark, N. J.

FREAS GLASS WORKS, INC., FRANCIS L.—156 E. 9th Ave., Conshohocken, Pa. Manufacturer of hydrometers and thermometers. Business established 1905. President, Oscar C. Freas; vice-president, Hiram M. Freas; secretary, John Z. Hoyer; treasurer and general manager, Francis L. Freas.

FREDERICK.—Trade name for underfeed stokers manufactured by the Frederick Engineering Co., Frederick, Md.

FREDERICK ENGINEERING CO.—Frederick, Md. Manufacturer of mechanical stokers.

FREDERICK, INC., E.—665 5th Ave., New York, N. Y. Manufacturer of electric hair wavers.

FREDERICK IRON & STEEL CO.—Frederick, Md. Manufacturer of steam pumps, coal and ash handling machinery and chain grate stokers. Main office, Frederick, Md. Branch offices, 61 Broadway, New York, N. Y.; 1242 Monadnock Block, Chicago, Ill.; 515 Commercial Trust Bldg., Philadelphia, Pa.; 48 Garfield Bldg., Detroit, Mich. Sales representatives, R. J. MacLeon, Southern Bldg., Montreal, Que., Can.; Cleveland Pump & Supply Co., Cleveland, Ohio.

FREDRO.—Trade name for illuminating glassware and nitrogen lamps manufactured by Oscar O. Friedlander, Inc., 40 Murray St., New York, N. Y.

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FREE ALTERNATING CURRENT.—The alternating current which follows any electromagnetic disturbance in a circuit having capacitance, inductance and less than the critical resistance.

FREE ENERGY.—That part of the energy of a chemical reaction which is convertible into mechanical work, electrical energy, or other forms of energy than heat.

FREE SEWING MACHINE CO.—Rockford, Ill. Manufacturer of electric sewing machines. Business established 1895. President, W. C. Free; vice-president, P. A. Peterson; secretary and general manager, V. M. Johnson; treasurer, A. E. Johnson; general sales manager, F. J. Kelley. Main office and factory, 18th Ave. & 13th St., Rockford, Ill. Branch office, 165 Broadway, New York, N. Y.

FREE WESTINGHOUSE.—Trade name for electric sewing machine manufactured by the Free Sewing Machine Co., 18th Ave. & 13th St., Rockford, Ill.

FREEMAN CO., THE LOUIS G.—909-911 Sycamore St., Cincinnati, Ohio. Manufacturer of motor-driven shoe machinery. President, Louis G. Freeman.

FREEMAN ELECTRIC CO., E. H.—803 E. State St., Trenton, N. J. Manufacturer of porcelain and electrical specialties. President, Edgar H. Freeman; secretary and treasurer, George E. Maguire; sales manager, P. T. Bradley. Sales representatives, Poindexter Electrical Supply Co., Denver, Colo.; P. & M. Products Co., Boston, Mass.; W. H. Beaven, Birmingham, Ala., and New Orleans, La.; F. H. Scarborough, Philadelphia, Pa., and Washington, D. C.; H. L. Reynolds, Pittsburgh, Pa.; Brown & Hall, St. Louis, Mo.; E. O. McDowell, New York, N. Y.; Electrical Distributors, Cleveland, Ohio; Baker-Smith Co., San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.; Stackhouse & Allen, 561 W. Monroe St., Chicago, Ill.

FREEMAN MFG. CO.—Racine, Wis. Manufacturer of water-tube boilers, smoke stacks and tanks. Business established 1868. President and treasurer, Charles Freeman; vice-president, Michael Freeman; secretary, Stephen H. Freeman.

FREEZERS, ICE CREAM, MOTOR-DRIVEN.—Household freezers of the usual type equipped with a small motor on the frame of the freezer and geared to the shaft operating the moving parts within the receptacle; a clutch in the drive prevents overloading the motor when the cream has become quite stiff. Ice-cream freezers are also made in large sizes for use in commercial plants. They may be driven by individual motors or by belt in a group drive, one motor serving several machines. For sanitary reasons the individual drive should be preferred.

Manufacturers:

Alaska Freezer Co., Winchendon, Mass.
Allman Gas Engine Co., 461 Canal St., New York, N. Y. "Champion."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Cherry Co., J. G., Cedar Rapids, Iowa. "Perfection."
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Fort Atkinson."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.
DEWSBERRY, R. A., 1932-36 W. Lake St., Chicago, Ill. The "American" ice-cream freezer, motor-driven, and furnished in 2, 4, 6, 8, 20 and 40-quart sizes. Suitable for restaurant or domestic use. Motors are furnished with this machine to operate under any current conditions, as to phase, voltage and frequency, and have been designed for every size of freezer, to furnish a generous amount of power for perfect operation under all load conditions imposed upon the freezer in actual service. Simple and economical in operation, the "American" manufactures a product of such quality and uniformity as can be obtained only by using a properly designed, electrically operated freezer.—Adv.



"American" Ice-Cream Freezer

Lange, Henry G., 162 N. May St., Chicago, Ill. "Little Giant," "Reliable," "Perfect," "Giant Improved."
Mills & Brother, Philadelphia, Pa. "Monitor", "Dana", "Advance", "Eureka", "Excelsior."
Peerless Freezer Co., The, Winchendon, Mass.
Piedmont Electric Co., Electrical Bldg., Asheville, N. C. "Peco."
Taylor Bros. Churn & Mfg. Co., 2951 N. Market St., St. Louis, Mo. "Jersey."
Thompson Machine & Supply Co., Emery, 271-75 Rider Ave., New York, N. Y.
Tyson Co., Canton, Ohio.
Whitney Co., F. E., 65 Sudbury St., Boston, Mass. "Boston."

FREMONT FOUNDRY & MACHINE CO. Fremont, Neb. Manufacturer of ornamental lighting brackets, posts, pedestals, etc. Business established 1883. President and general manager, C. D. Marr; secretary and treasurer, A. Truesdell; sales manager, Z. M. Marr.

FRENCH & SONS PIANO CO., JESSE.—New Castle, Ind. Manufacturer of electrically operated pianos.

FRENCH BATTERY & CARBON CO.—Madison, Wis. Manufacturer of incandescent lamps, flashlights, flashlight batteries and cases. Business established 1906. President, treasurer and general manager, J. B. Ramsay; vice-president, O. E. Ruhoff; secretary, J. C. Ford; sales managers, A. L. Thompson, G. A. Shipley. Main office, Madison, Wis. Factories, Madison, Wis., Newark, N. J. Branch office and warehouses, 22-24 W. Washington St., Chicago, Ill.; 71 Murray St., New York, N. Y.; 33 Western Ave., Minneapolis, Minn.; 621 Broadway, Kansas City, Mo.; Austell Bldg., Atlanta, Ga.; 531 Ervay St., Dallas, Tex.

FREQUENCIES, AUDIO.—Those frequencies which correspond to the normally audible or sound vibrations. These are assumed to lie below 10,000 cycles per second.

FREQUENCIES, RADIO.—The electrical frequencies of the electromagnetic waves made use of in radio communication range between 12,000 and 6,000,000 cycles per second.

FREQUENCY.—The frequency of an alternating current is its number of complete reversals or cycles per second. It is equal to ½ the number of poles of an a-c. generator multiplied by the number of revolutions per second; $f=P/2\times r.p.s.$ Generators, motors and transformers are designed to be operated at a specified frequency.

In the United States a frequency of 60 cycles is that in most common use for general service; 25 cycles was adopted for use with d-c. systems deriving their supply from synchronous converters, and is still used for this purpose in the large cities. Other frequencies, such as 30, 40, 50 and 62.5 cycles, are in use in the United States to a limited extent.

FREQUENCY CHANGERS OR CONVERTERS.—See Converters, frequency.

FREQUENCY, FUNDAMENTAL. — See Fundamental frequency.

FREQUENCY, GROUP.—The term group frequency is one used in connection with radio practice and replaces the term "spark frequency." Specifically, it is the number per second of periodic changes in amplitude or frequency of an alternating current. Where there is more than one periodically recurrent change of amplitude or frequency, there is more than one group frequency present.

When writing to manufacturers please mention the

E M F ELECTRICAL YEAR BOOK

FREQUENCY, HIGH AND LOW, TELEPHONE.—These are relative terms. Telephony regards as low any frequency of 200 or 300 cycles per second and under, and as high anything above that range, considering values up to perhaps 5,000 cycles per second. In radio practice all these are considered as being low frequency, for the oscillations run up into millions of cycles per second.

FREQUENCY METERS.—These are a-c. instruments which indicate the number of complete cycles per second of an alternating current. Frequency meters may be classed under three separate heads, resonance, induction, and electromagnetic or movable-iron types.

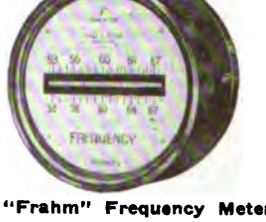
The resonance type consists of a number of reeds (each having a different free period of vibration) mounted in front of a flat coil with a soft iron core. When the current whose frequency is to be determined energizes the electromagnet, magnetic impulses are transmitted to the reeds which are thus set in vibration. The reed whose free period is twice that of the current frequency will have the greatest amplitude of vibration and hence may be marked to indicate the frequency. If the reeds are polarized, then the reed whose free period is the same as the frequency of the current will respond most vigorously. The instrument may thus be made to have two ranges. The absence of rotating parts and the constancy of its indications makes this a rugged and useful instrument.

In the induction type the essential feature is a pivoted disk, the two halves of which are eccentric circles. This disk is free to rotate between two diametrically opposite voltage coils connected in parallel across the line. In series with one of the voltage coils is a noninductive resistance and in series with the other is a condenser. The current through the noninductive resistance is thus independent of the frequency, while that through the condenser varies with the frequency. Since the voltage elements tend to rotate the disk in opposite directions, any change in frequency will change the torque due to the current in the condenser circuit, and the disk will rotate until the difference in torques is compensated by a smaller or larger surface of the disk being subjected to the influence of the noninductive circuit. When the two torques are equal the disk stops and a pointer attached to the staff indicates the frequency. Such an instrument has no control springs or damping magnets.

The movable vane type operates on the same principle as the movable-core type of electrical indicating instrument, except that instead of the actuating magnetic field varying in intensity, it varies in direction with the frequency. The direction of the field is determined by the ratio of the currents in two coils which are mounted at right angles to each other. The intensity of the current in one of these coils increases and in the other it decreases with frequency, hence the direction of the resultant field shifts and the movable vane takes the position of the resulting field. The intensities of the currents are determined by an ingenious arrangement of inductance and resistance coils.

Manufacturers:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Frahm" vibrating reed frequency meters, both portable and switchboard types; operating on the resonance principle. No delicate parts. High initial accuracy, which is maintained for years. All commercial frequencies.—Adv.



"Frahm" Frequency Meter

BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

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GENERAL ELECTRIC CO., Schenectady, N. Y. For portable and switchboard use the standard resistance-reactance type indicators are provided with external reactances and resistances for mounting on back of the switchboard. Instruments are adjustable to the characteristics of the circuit and those for use on circuits above 650 volts are provided with potential transformers. The tuned circuit type gives a scale on the same instrument running from 55 to 65 cycles, and the movement per cycle is many times greater than on the other type of instrument. It has also the advantages of smaller wave form and voltage areas than the earlier type. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.

Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

Roller-Smith Co. 233 Broadway, New York, N. Y.

THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

FRES-KO.—Trade name for soldering paste manufactured by the Fres-Ko Chemical Co., Fort Wayne, Ind.

FRES-KO CHEMICAL CO.—Fort Wayne, Ind. Manufacturer of soldering paste, sticks and commutator compound. Business established 1910. President and general manager, F. W. Edmunds; vice-president, Charles Gumpper; secretary and treasurer, Alice Bobay.

FRICK.—Trade name for electric clocks manufactured by the Landis Engineering & Mfg. Co., Waynesboro, Pa.

FRICK FURNACE.—One of the early types of electric induction furnaces for the production of electric steel.

FRICTION TAPE.—See Tape, friction.

FRICTIONAL ELECTRICITY.—A form of electricity largely of historical and experimental interest produced by converting mechanical energy into electrical by the friction between two dissimilar materials, such as a glass plate rotating between rubber or leather cushions. Several frictional machines of this nature have been built and will produce sufficient electrical energy to cause a long spark to jump between two electrodes; see Electrostatic machines. During very dry weather frictional electricity is developed between belting and pulleys, between paper sheets and printing presses, between writing paper and pencil, etc.

FRIDAY MACHINERY & SUPPLY CO.—Sigourney, Iowa. Manufacturer of farm lighting plants.

FRIEDLANDER, INC., OSCAR O.—40 Murray St., New York, N. Y. Manufacturer of illuminating glassware, nitrogen lamps, lamp bases, etc. Business established 1886. President and sales manager, William M. Friedlander; vice-president and general manager, Maurice W. Belmuth; secretary and treasurer, George M. Stiegler.

FRIEDLEY-VOSHARDT CO.—733-737 S. Halsted St., Chicago, Ill. Manufacturer of fixture fittings and parts. President and treasurer, H. F. Voshardt; vice-president, A. Friedley; secretary, W. T. Kettering.

FRIGIDAIRE CORP., THE.—Detroit, Mich. Manufacturer of electrically operated refrigerators. Business established 1915. President and general manager, J. Parker A. Fiske; vice-president, H. L. Barton; secretary, T. S. Merrill; treasurer, M. L. Prensky; sales manager, K. Spalding. Main office, 2435 Scotten Ave., Detroit, Mich. Branch offices and warehouses, 9 Central Ave., Newark, N. J.; 295 Union Arcade, Pittsburgh, Pa.; 118 S. Michigan Ave., Chicago, Ill.; 187 Peachtree St., Atlanta, Ga.; 208 W. 57th St., New York, N. Y.; 666 Main St., Buffalo, N. Y.; 21 E. Market St., Indianapolis, Ind.; Forsyth & Hogan Sts., Jacksonville, Fla.; 1627 Chestnut St., Philadelphia, Pa.; 415 Walnut St., Cincinnati, Ohio.

FRIGIDOR.—Trade name for electric household refrigerator manufactured by the Balsa Refrigerator Corp., 50 E. 42nd St., New York, N. Y.

FRINGES AND TASSELS, LAMP SHADE.—Silk lamp shades for floor and table lamps are often provided with a decorative fringe of silk or a band of small silk tassels or tufts of cord; beads are also used sometimes. The fringes and tassels are often made separately, and may be secured to the frame of a lamp shade. For beads used in making the fringes see Beads, glass for lamp shades.

Manufacturers:

Oehrle Bros. Co., 417-427 N. 3rd St., Philadelphia, Pa.

Wolf & Davis, 71-73 Spring St., New York, N. Y.

FRINGING.—The actual area of the air gap per pole in a dynamoelectric machine is not the area of the pole face. Fringing or branching out of the magnetic field as it passes across the air gap tends to increase the air gap area slightly.

FRINK.—Trade name for lighting reflectors manufactured by I. P. Frink, Inc., 239-43 10th Ave., New York, N. Y.

FRINK, INC., I. P.—New York, N. Y. Manufacturer of lighting fixtures, lighting reflectors, electric signs, portable lamps, etc. Business established 1857. President and general manager, George F. Spencer; secretary and sales manager, William H. Spencer; treasurer, Melvin Spencer. Main office, 239-43 10th Ave., New York, N. Y. Branch office, 175 W. Jackson Blvd., Chicago, Ill.

FRINK PYROMETER CO., THE.—Lancaster, Ohio. Manufacturer of electric pyrometers. President, R. L. Frink; vice-president, W. H. Frink; secretary, Ivy F. Frink; treasurer, F. J. Frink.

FRISBIE MOTOR CO., THE.—Middletown, Conn. Manufacturer of gasoline engines. President and general manager, Kirk W. Dyer; vice-president and sales manager, William E. Gibb; vice-president, Thomas H. Travis; secretary, Frank A. Brassill; treasurer, Minn S. Cornell, Jr.

FRITCHLE ELECTRIC CO., THE.—1544 Clarkson St., Denver, Colo. Manufacturer of electric trucks and vehicles, farm lighting and power plants and storage batteries. Business established 1906. President, O. P. Fritchle.

FROGS, TRACK.—That portion of two crossing or diverging tracks where one rail crosses another. Track frogs are of various kinds depending upon the conditions they have to meet; they are constructed from a variety of materials in a number of different ways. For kinds of material and methods of construction used on electric railway track, see Track work, special.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."

Buda Co., The, Harvey, Ill.

Cleveland Frog & Crossing Co., Cleveland, Ohio.

Conley Frog & Switch Co., Bodley Ave., Memphis, Tenn.

Kilby Frog & Switch Co., Birmingham, Ala.

Ramapo Iron Works, Hillburn, N. Y. "Ramapo."

Weir Frog Co., Station H, Cincinnati, Ohio. "Weir Titan."

FROGS, TROLLEY.—A device used in overhead electric trolley systems where a branch in the trolley wire occurs. It enables the trolley wheel to follow either the straight or the branched line without interruption and is guided to the proper wire by the relative location of the frog with respect to the car. It commonly consists of a bronze or malleable iron pan, in the latter case arranged with renewable bronze approaches which are held to the body by bolts or cam-shaped interlocking hooks. These bronze approaches clinch around the trolley wire and are tapered away from the body of the device.

Manufacturers:

American Mine Door Co., The, Canton, Ohio.

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.

OHIO BRASS CO., THE, Mansfield, Ohio. O-B types E and D frogs with renewable cam tips are installed in double-quick time. Smooth, certain operation for the wheel is assured.—Adv.

St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FROST, SAMUEL.—41-43 W. 14th St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1899.

FROSTOL CHEMICAL CO., INC.—799 Greenwich St., New York, N. Y. Manufacturer of lamp coloring and frosting compounds. Business established 1919. President, A. J. McGrail; vice-president, Louis Lombard; secretary and treasurer, Elliott Perry; sales manager, A. M. Henrion.

FROST-ON.—Trade name for lamp frosting and etching compound made by the Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.

FRYE & CO., J. MARSHALL.—Hattiesburg, Miss. Manufacturers of crossarms and brackets. President, J. Marshall Frye; secretary, H. L. Norsworthy; treasurer, Maud E. Frye.

FRYING.—The noise made by a telephone transmitter when the battery current flowing through it is too strong. Minute arcs form in the microphone cell and they make the noise. The term is also used to refer to the peculiar hissing sound which is produced when the carbons of an arc lamp are too near each other.

FRYING PANS AND KETTLES, ELECTRIC.—These pans or kettles are provided with heating elements in the bottom, consisting either of resistance coils or plates imbedded in the material of which the pan or kettle is made. The heating element may be divided into sections to give high, medium or low heating, the maximum wattage depending upon the size of the outfit. These frying pans and kettles are usually furnished in fairly large size for use in hotel, restaurant or club kitchens. The frying pan is relatively shallow whereas the kettles are much deeper and may be used for general cooking as well as frying.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

FT-CDL.—Abbreviation sometimes used for foot-candle, the most commonly employed unit of illumination.

FT-LB.—Abbreviation for foot-pound.

FT-LB-SEC.—Abbreviation for foot-pound-second.

FUEL ANALYSIS.—Much of the coal, gas and oil purchased for use as a fuel in electrical power plants is subjected to an analysis, to determine its quality. In many cases coal is sold on the basis of this analysis, which indicates its heating value. These determinations are usually by the "proximate or engineering analysis," which includes the determination of the heating value and the percentages by weight of moisture, fixed carbon, volatile matter, sulphur and ash. When a complete or "ultimate analysis" is made the components of the volatile matter are also determined. The heating value of fuels is determined by the use of calorimeters; see Calorimeters, coal, etc.

Fuel oils are tested for flash point, fire point, viscosity, chill point, percentage of asphaltum, etc., in addition to the heating value determination. Fuel or illuminating gases are analyzed for the following components in percentage by volume: carbon dioxide, carbon monoxide, oxygen, methane, ethylene, hydrogen and nitrogen.

FULCO.—Trade name for motor-driven motion picture rewind machines and motors manufactured by the E. E. Fulton Co., 3208 Carroll Ave., Chicago, Ill.

FULL-RAY.—Trade name for headlight deflectors made by the Bradsto Appliances, Inc., 65 Main St., Buffalo, N. Y.

FULLER.—Trade name for wet batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

FULLER & CO., W. P.—Mission & Beale Sts., San Francisco, Cal. Manufacturers of lubricating oils, etc.

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FULLER & JOHNSON MFG. CO.—1350 E. Washington St., Madison, Wis. Manufacturer of kerosene, gasoline and distillate engines. Business established 1840. President, Walter Ayer; vice-president, H. S. Johnson; secretary, P. Kney; treasurer, C. A. Johnson.

FULLER-LEHIGH CO. — Fullerton, Pa. Manufacturer of coal, cement and other pulverizing equipment, car wheels, etc. President, Col. J. W. Fuller; vice-president, R. S. Weaver; secretary and treasurer, J. S. Elverson. Main office, Fullerton, Pa. Branch offices, 50 Church St., New York, N. Y.; 1336 McCormick Bldg., Chicago, Ill.; L. C. Smith Bldg., Seattle, Wash.

FULLERBOARD.—See Paper, fullerboard and pressboard.

FULLMAN.—Trade name for floor boxes manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

FULPER POTTERY CO.—Flemington, N. J. Manufacturer of lamp bases and lamp adapters. President, E. P. Fulper; vice-president, E. B. Fulper; secretary, treasurer and general manager, W. H. Fulper; sales manager, S. L. Parker. Main office, Flemington, N. J. Branch offices, 37 E. 48th St., New York, N. Y.; Republic Bldg., Chicago, Ill.

FULTON BAG & COTTON MILLS.—Atlanta, Ga. Manufacturers of tool bags, twine, waterproofing compounds, etc. Business established 1870. President, Oscar Elsas; vice-presidents, Benjamin Elsas, Adolph Elsas; secretary, Louis J. Elsas; treasurer, W. T. Henry. Main office, Atlanta, Ga. Branch offices, Brooklyn, N. Y.; St. Louis, Mo.; New Orleans, La.; Dallas, Tex.

FULTON-BELL CO.—451 Greenwich St., New York, N. Y. Manufacturer of electric drink mixers. President, William L. Loeb; secretary, J. M. Harris; treasurer, T. Jones.

FULTON CO., E. E.—3208 Carroll Ave., Chicago, Ill. Manufacturer of motor-driven motion picture rewind machines, motors and solderless connectors. Business established 1910. President, E. E. Fulton; vice-president and sales manager, C. H. Fulton; secretary, R. H. Fulton; treasurer, L. M. Fulton.

FUNDAMENTAL FREQUENCY.—In a complex harmonic vibration or a current or voltage containing harmonics, the lowest frequency, or in the case of the current or voltage the basic or lowest frequency of which the harmonics are multiples.

FUNDAMENTAL SINE WAVE OR HARMONIC.—See Sine wave, fundamental; also Harmonics.

FURMAN-FISHER CORP.—30 Church St., New York, N. Y. Manufacturer of electric vegetable washing machines and tanks.

FURNACE CHARGING MACHINES, MOTOR-DRIVEN.—Furnace charging can be accomplished much quicker and easier by the use of machinery than by hand charging and generally with a reduction in cost and avoidance of labor difficulties. The machines used are generally motor-driven being operated from a trolley supported on brackets from the building wall and have a separate motor for driving them along a set of rails running in front of a battery of open-hearth or other similar furnaces. In the production of steel where a number of furnaces are operated simultaneously the charging machine conveys the coke, scrap iron or steel or pig iron, and whatever flux is used, from bins and piles in another part of the building. Sometimes a traveling crane is used to convey the material to the charging machine. When the charging machine is in front of the proper furnace the material is forced out on a ram which is operated by a separate motor, and the load is carried inside of the furnace on a scoop. A slight tilting of the scoop empties it and the ram is then withdrawn for another load. These machines are somewhat similar to coke-drawing and loading machines, but are of much heavier construction.

Manufacturers:

Morgan Engineering Co., The, Alliance, Ohio.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

FURNACE EFFICIENCY.—The ratio of the energy equivalent of the useful work done to the energy expended in the furnace. If the furnace is fuel-fired, and is, for instance, melting metal, its efficiency is measured by the ratio of the heat in the melted metal (expressed, say, in heat units or calories) to the calorific value of the fuel used, expressed in the same units. If the same furnace were run by electric current, the kilowatt-hours used in melting a given quantity of metal would be determined, converted into large Calories by the proper factor (1 kw-hr.=860 Calories), and this quantity used as the divisor, as the heat equivalent of the energy expended.

FURNACE ELECTRODES.—See Electrodes, furnace.

FURNACE HEAT INSULATION.—See Heat insulation, brick, cement, etc.; also see Brick, fire, for boiler, electric and other furnaces; Covering, pipe and boiler.

FURNACE REGULATORS.—See Regulators, furnace.

FURNACES, BOILER.—The furnace for a fuel-heated boiler is that part below, or sometimes within, the boiler in which the fuel is burned. Ordinarily it consists of the grates, the fire doors and adjacent part of the front of the boiler setting, the side and rear walls of the combustion chamber. The shape of the furnace depends upon the fuel used, highly volatile coals requiring a high furnace and one having a large area in the combustion zone so as to give abundant space for the flames without being chilled by contact with the relatively cool boiler surfaces, which would cause the production of a great deal of smoke through the deposition of the carbon that is partly unconsumed.

The necessity for designing the furnace to consume the fuel completely, and utilize the heat with as little loss as possible, has led to the development of many special designs known by various names, such as "smokeless," "down-draft," etc. This fact as well as the need for firing coal economically and uniformly has also resulted in the use of mechanically operated stokers which feed the fuel in either continually or at short intervals. Stoker-fired furnaces are usually designed by the stoker manufacturer and in many cases include a special construction of the grates which are furnished as either a part of or auxiliary to the stokers. In a case of hand-fired furnaces, these may be furnished by the boiler manufacturer or sometimes separately. The brickwork which is usually employed for lining the furnace as well as for supporting the boiler overhead is generally built by the contractor that installs the complete boiler setting. The furnace lining is generally of special fire brick or other refractory material as is the fire arch, if one is used.

Manufacturers:

American Welding Co., Carbondale, Pa.
Automatic Furnace Co., The, 1st & Harshman Sts., Dayton, Ohio. "Model Automatic."
Brightman Furnace Co., 2570 Broadway, Cleveland, Ohio.
Beggs & Co., James, 36 Warren St., New York, N. Y.
Burke Furnace Co., 320 E. North Water St., Chicago, Ill.
Chicago, Tile Arch Furnace Co., 321 W. Austin Ave., Chicago, Ill.
Cokal Stoker Co., 1029-31 N. Clark St., Chicago, Ill.
Decarie Boiler & Incinerator Co., 3324-30 St. Hubert St., Montreal, Que., Can.
Detroit Stoker Co., Woodward & Horton Aves., Detroit, Mich.
Green Engineering Co., East Chicago, Ind.
Heine Safety Boiler Co., 5316 Marcus Ave., St. Louis, Mo.
McClave-Brooks Co., Poplar St. & Park Pl., Scranton, Pa.
McMillan & Co., James, 114 Clarkson St., Chicago, Ill.
O'Brien Boiler Works Co., John, 1601 N. 11th St., St. Louis, Mo.
RILEY STOKER CO., SANFORD.—9 Neponset St., Worcester, Mass. "Murphy."
S & S Automatic Grate Co., 320 E. North Water St., Chicago, Ill. "Burke."
Surface Combustion Co., 368 Gerard Ave., New York, N. Y.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

FURNACES, ELECTRIC.—In general the electric furnace is an apparatus using electric current to do useful thermal work within an enclosed space such as heating substances, melting substances, converting one material into another, or heating a charge until its ingredients react chemically on each other. However, it is generally restricted to such apparatus as is designed for high temperatures only. Electric furnaces can use direct current, but alternating current is usually employed because it has no unilateral, or chemically separative, effects and because it is more economical and convenient to transmit and use. The useful effect depends on the energy or wattage consumed by the furnace, and not on the voltage or amperage of the current.

Principal Classes. Electric furnaces may be conveniently divided into arc furnaces, resistance furnaces and induction furnaces. The arc furnace is a type of furnace in which the principal source of heat is a gap across which the current jumps or arcs, passing through the gas or vapor between the terminals. To render it thermally efficient the arc is struck in an enclosed space, the walls of which prevent free radiation of the heat of the arc. The substance to be heated is either placed near the arc, usually beneath it (as in the arc-radiation furnace, such as the Stassano type), or is made one of the terminals of the arc, being then heated by contact with the arc and by the current passing through it (arc-resistance furnace, such as Girod type). In the Heroult type of furnace the metal bath lies beneath two electrodes and itself forms an intermediate electrode for two arcs in series, or lies beneath three electrodes using three-phase current and forms the neutral point of the circuit.

The electrodes used in arc furnaces are gradually consumed or evaporated, so that it is necessary to feed the electrodes continuously into the furnace to maintain the same distances between the arcing points. This is usually done by a motor-driven feeding mechanism. The electrodes are fed into the furnace through the top or side, or in a few types through both top and side. Many types are made to tilt or rock on their base, to permit pouring the refined or molten metal instead of tapping it.

In the resistance furnace the energy is converted into heat by the passage of the current through a solid or liquid resistor. The electrical energy is thus transformed into sensible heat at 100% efficiency of conversion. The resistor may be a solid block, or rod, or wire, or granulated solid material, or a liquid bath. The substances to be heated are either brought into proximity of the resistor, under the same roof, or in contact with it, or mixed in with it, or they may constitute the resistor itself. Heat-treating furnaces are commonly of this type, using granular resistance material in troughs. Almost all muffle and small furnaces are resistance furnaces and use resistance wire or rod.

An induction furnace is a type of furnace operating on the principle of the electric transformer. The metal bath is held in a ring-shaped crucible or hearth, the core of the transformer passing through the hole in the ring so that the bath forms a one-turn or short-circuited secondary circuit. Consequently the bath will carry a high current at a low voltage, and will be heated in the same manner as in the resistance furnace. It has the disadvantage of a low power-factor.

Principal Applications. Among the most important uses of the electric furnace is in the production of high-grade steel and steel alloys. Steel made in these furnaces has shown a higher strength and more uniform quality than that made in the fuel-fired processes. The freedom from flaws shown by electric steel makes it particularly valuable for such machine parts as are subjected to repeated stresses, as shafts, axles, gears or other rotating parts. Under impact test it has shown a much greater strength than open-hearth steels. Electric steels can be poured at a higher temperature in a still condition, and due to this characteristic they have come into use for thin castings which could not be made of steel molten by any other process. These advantages have been largely responsible for the rapid growth of the electric furnace industry.

The number of American electric steel furnaces in use increased from 155 in 1917 to 330 in 1919, about 113%, and the increase in the nine years since 1910 was about 2500%. Their total capacity was, in 1919, about 1350 tons. The total output of electric steel and alloy steel ingots and castings in the United States in 1918 was 802,325 gross tons. No exact data are yet available for 1919, but it is

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estimated on the basis of an 8-hour day that the output was about 1,215,000 short tons.

Furnaces for the melting of nonferrous metals have been a recent development in the metal industry. About five years ago there were no electric brass-melting furnaces in commercial use. In 1920 there were a total of 261 of these furnaces in use. They have shown a greater economy than the fuel-fired furnaces, the net amount saved being about $5 to $10 per ton. They produce a metal of higher strength as well. They have been found particularly successful in the melting of zinc and of refractory alloys, such as cupro-nickel, which is melted in the United States mint at less than half the cost of melting in a fuel-fired furnace. In the case of zinc electric melting practically eliminates the loss by vaporization.

Electric furnaces are also used in electrometallurgical and electrochemical processes for the reduction of ores and the production of chemicals. Many compounds and metals cannot be produced in any other way. These furnaces found one of their first uses in the manufacture of carborundum, a valuable artificial abrasive, and also of artificial graphite. All the aluminum produced is made in electric furnaces, as are calcium carbide, calcium cyanamide, alumina, and many other highly useful compounds. Electric furnaces are also used in the several processes for the production of nitric acid from the atmosphere, these furnaces being of a special arc type. Other uses for electric furnaces are mentioned in the detailed subclassified entries that follow.

FURNACES, ELECTRIC, ANNEALING.—To produce the best results in annealing it is necessary to accurately control the temperature and the time the material is in the furnace, also the atmosphere of the furnace. The perfect control of these elements possible in the electric furnace is one of its chief advantages. The furnace used is generally some form of the resistance type. The furnaces are made in various styles and sizes from the small manually operated furnaces to the continuous, automatic types with a capacity of several tons per hour.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.

Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Eaton Electric Furnace Co., The, Taunton, Mass. "Eaton."

Electric Furnace Co., The, Alliance, Ohio. "Bally."

Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves-Etchells."

Electric Heating Apparatus Co., 123-125 Sussex Ave., Newark, N. J. "Hevi-Duty."

GENERAL ELECTRIC CO., Schenectady, N. Y. All electrical equipment—heating and control—for equipping heat treating furnaces. See description under "Furnaces, electric, miscellaneous," or page 1208 for survey of G-E electric industrial heating equipment.—Adv.

Hayes, Carl I., Edgewood, R. I.

Holcroft & Co., 555 Book Bldg., Detroit, Mich.

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. For annealing small work. Vertical cylindrical furnaces up to 24 in. diameter and 17 in. deep, for 110 or 220 volts. Life of heating element, 5,000 hours.—Adv.

Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa. "Moore."

Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."

Tate-Jones & Co., Inc., Pittsburgh, Pa.

FURNACES, ELECTRIC, BRASS AND OTHER NONFERROUS METAL.—The electric furnace for melting brass, zinc and other nonferrous metals is usually of the arc or resistance type and, due to its comparatively small size, is generally designed for single-phase power supply. Its accurate control of the furnace atmosphere is one of its chief advantages, as this prevents metal losses by oxidization. The closed top of the furnace also reduces the losses due to volatilization, an important feature in melting zinc and alloys containing considerable percentages of zinc.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.

Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Detroit Electric Furnace Co., 642 Book Bldg., Detroit, Mich. "Detroit."

Eaton Electric Furnace Co., The, Taunton, Mass. "Eaton."

Electric Furnace Co., The, Alliance, Ohio. "Bally."

GENERAL ELECTRIC CO., Schenectady, N. Y. The principal characteristics of the G-E electric furnace for melting non-ferrous metals and alloys are: Temperature of heat generating source controllable at will, which prevents formation of slag cinders and makes metal readily recovered without crushing operation. Heat generated is of the "soaking" type, uniformly distributed, and any workable temperature gradient may be maintained, between charge and heat source. The charge is heated from all sides. Bath



G-E Electric Furnace and Control

is shallow and large surfaces are exposed to receive heat by conduction as well as radiation. Has normally a reducing atmosphere, which may readily be made neutral or oxidizing. Automatic control of power permits one man to operate several furnaces. Furnace atmosphere free from contaminating gases. Dead atmosphere exists in furnace normally as there is practically no circulation of air through furnace. Furnace may be "forced," i. e., heat may be fed to metal as fast as latter will absorb it and a high rate of melting results. This Company builds also electrical equipment for any type of electric arc furnace. (Bulletin 48710A.) See adv. pages 1203-1223.—Adv.

Hamilton & Hansell, Inc., Park Row Bldg., New York, N. Y. "Rennerfelt."

INDUSTRIAL ELECTRIC FURNACE CO., 53 W. Jackson Blvd., Chicago, Ill. "Snyder," "Von Schlegell," "Industrial," "Repelling Arc."

Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa. "Moore."

Volta Mfg. Co., Ltd., Welland, Ont., Can. "Volta."

Wile Electric Furnace Co., Pittsburgh, Pa. "Wile."

FURNACES, ELECTRIC, HARDENING.—To develop the best physical characteristics in certain steels they are subjected to heat-treating processes requiring accurate control in their various stages. Because of its perfect control of the time that the material is in the furnace, and the temperature and atmosphere of the furnace—the important elements in the heat-treating of steels—the electric furnace is found to be particularly adapted to these processes. To eliminate need for a skilled operator and at the same time obtain highly uniform results, they are sometimes built completely automatic. In these types the material is placed on cars or conveyors at the mouth of the furnace and carried continuously through the hardening furnace, quench and drawing furnace, the time and temperature control of each operation being entirely automatic.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J. (assay and other laboratory).

Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Electric Furnace Co., The, Alliance, Ohio. "Bally."

Electric Heating Apparatus Co., 123-125 Sussex Ave., Newark, N. J. "Hevi-Duty."

GENERAL ELECTRIC CO., Schenectady, N. Y. All electrical equipment—heating and control—for equipping heat-treating furnaces. See description under "Furnaces, electric, miscellaneous."—Adv.

Hayes, Carl I., Edgewood, R. I.

Holcroft & Co., 555 Book Bldg., Detroit, Mich.

Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Furnaces for use with the Hump method for the heat treatment of steel. Vertical cylindrical muffle; largest size, 17 by 17 in., wound for 110 or 220 volts, for use up to 1,800 deg. F. Life of heating element, 2,500 hours.—Adv.

Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa. "Moore."

Tate-Jones & Co., Inc., Pittsburgh, Pa.

FURNACES, ELECTRIC, LABORATORY.—The electric laboratory furnace is generally a muffle furnace, the heating elements used being of resistance wire or ribbon. They are made in sizes and types suitable for use in the dental or chemical laboratory, heat-treating iron and steel specimens, enameling jewelry, fusing optical glass and similar work where a high-temperature small-capacity furnace is desired. For assay and like work there is an unusual form of furnace which generates the heat by inducing eddy currents in the material being heated or, if this is a non-conductor, a conducting crucible is used in which the currents are induced.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J. (Induction.) "Ajax-Northrup."

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-3.)

Electric Heating Apparatus Co., 123-125 Sussex Ave., Newark, N. J. "Multiple Unit."

GENERAL ELECTRIC CO., Schenectady, N. Y. The Arsem vacuum furnace for obtaining very high temperatures, comprises a heater enclosed in a vacuum chamber. Two types are made, a vertical type and a box type. The vacuum chamber is of steel with windows for observation of heating. Uses: Preparation of metals, alloys and various compounds; determination of melting points by an optical pyrometer or by reference to the furnace calibration curves; calibration of optical pyrometers; distillation of refractory substances for separation or purification; study of equilibrium in the reaction depending upon the pressure of the gaseous phase. (Bulletin 49711.) Also an electric muffle furnace for temperatures up to 850 degrees C., especially adapted for heat-treating carbon steels and for laboratory and experimental uses. (Bulletin 69706.) See adv. pages 1203-1223.—Adv.

Hamilton & Hansell, Inc., Park Row Bldg., New York, N. Y. "Rennerfelt."

Hanovia Chemical & Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.

Heidbrink Co., The, 420 S. 6th St., Minneapolis, Minn. "Maves."

Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.

INDUSTRIAL ELECTRIC FURNACE CO., 53 W. Jackson Blvd., Chicago, Ill. "Snyder," "Von Schlegell," "Industrial," "Repelling Arc."

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.

Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."

Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa. "Moore."

White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. (for fusing porcelain) "S. S. White."

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FURNACES, ELECTRIC, MISCELLANEOUS.—This classification is intended to include those types of furnaces not separately classified herewith. These include such furnaces as for production of aluminum, calcium carbide, carborundum, graphite, and other electrochemical products: also furnaces for fusing quartz, glass and other refractory substances. Where an extremely high temperature is necessary such furnaces are of the arc type; where more moderate temperatures suffice and where constancy and very accurate control of temperature are needed the resistance type of furnace is usually employed.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.
Beckman & Linden Engineering Corp., 604 Mission St., San Francisco, Cal. (ore smelting.)
Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Electric Furnace Co., 642 Book Bldg., Detroit, Mich. "Detroit."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-3.)
Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves-Etchells."
Electric Heating Apparatus Co., 123-125 Sussex Ave., Newark, N. J. "Multiple Unit."
GENERAL ELECTRIC CO., Schenectady, N. Y. For heat-treating processes requiring temperatures from 900 to 1,800 degrees F., such as hardening, drawing and annealing of carbon steels, drawing high-speed steels, annealing brass and copper and baking vitreous enamels, this company has developed electric heating units and automatic temperature control for equipping either horizontal or vertical cylindrical furnaces. The advantages of heat-treating furnaces so equipped are automatic control of temperature, giving minimum temperature variation in the furnace, maximum rate of heating the charge, maximum efficiency in heat treating, and elimination of scale due to oxidation. Heat treating problems should be referred to industrial heating specialists in the nearest G-E office. See page 1223. This company has developed also an electric furnace for melting non-ferrous metals and alloys and electrical equipment for any type of electric arc furnace. (Bulletin 48710A.)—Adv.
Hamilton & Hansell, Inc., Park Row Bldg., New York, N. Y. "Rennerfelt."
Hayes, Carl I., Edgewood, R. I.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.
INDUSTRIAL ELECTRIC FURNACE CO., 53 W. Jackson Blvd., Chicago, Ill. "Snyder." "Von Schlegell," "Industrial," "Repelling Arc."
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."

FURNACES, ELECTRIC, STEEL.—The value of the electric furnace in the steel industry was not appreciated until about 1915 when it came into use in the manufacture of special alloy steels and steel castings. Since then their use has increased rapidly; in 1915 there were in use in the world 213 electric steel furnaces, while in 1920 their number had increased to over 1400. Some idea of their efficiency may be obtained from the results of a test of 18 arc-type furnaces for melting steel for castings conducted during the entire year 1918; these results showed that the power consumed varied from 635 to 840 kw-hrs. per ton melted, which is considerably lower than in the early designs. There are a large variety of steel furnaces used utilizing the arc, resistance and induction principles. They vary in capacity from less than one ton to over 10 tons at one charge. Most of the furnaces operate on three-phase or single-phase a-c. circuits. For steel foundries they have the advantage of producing steel castings exceptionally free from blow holes, fissures and other flaws and very dense and homogeneous in texture; their use has practically eliminated spoilage in such castings and resulted in a decidedly superior quality product. Their use in steel works has produced carbon and alloy steels of unexcelled purity and strength, and resulted in decided saving of tungsten, molybdenum, chromium and other expensive metals used in alloying certain steels, which in the open-hearth or other fuel-fired furnaces were to a large extent oxidized or burned out. (For further details as to processes and results, see Furnaces, electric, development and status of).

Manufacturers:

Booth Electric Furnace Co., 326 W. Madison St., Chicago, Ill.
Crowley Co., John A., 120 Liberty St., New York, N. Y. "Gronwall-Dixon."
Detroit Electric Furnace Co., 642 Book Bldg., Detroit, Mich. "Detroit."
Greene Electric Furnace Co., 1602 Hoge Bldg., Seattle, Wash. "Greene."
Hamilton & Hansell, Inc., Park Row Bldg., New York, N. Y. "Rennerfelt."
INDUSTRIAL ELECTRIC FURNACE CO., 53 W. Jackson Blvd., Chicago, Ill. "Snyder," "Von Schlegell," "Industrial," "Repelling Arc."
Leavitt & Co., C. W., 30 Church St., New York, N. Y. "Girod."
Ludlum Electric Furnace Corp., Watervliet, N. Y. "Ludlum."
Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa. "Moore."
United States Steel Corp., 71 Broadway, New York, N. Y. "Heroult."
Volta Mfg. Co., Ltd., Welland, Ont., Can. "Volta."
Vom Baur, C. H., 50 Church St., New York, N. Y. "Vom Baur."
Webb Electric Furnace Corp., 30 Church St., New York, N. Y. "Webb."
Whiting Corporation, Harvey, Ills.
Wile Electric Furnace Co., Pittsburgh, Pa. "Wile."

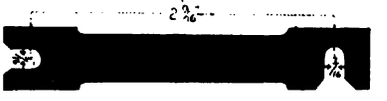
FURNACES, SOLDERING.—See Fire pots, electrician's; also Fire pots, electric.

FUSE ADAPTERS, BASES, BLOCKS, BOXES, CAPS, CLIPS, FERRULES, REMOVERS, SHELLS, TESTERS, TONGS.—See Adapters, fusé; Bases, cutout, for cartridge fuses; Bases, cutout, for open link fuses; Bases, cutout, for plug fuses; Blocks, fuse; Boxes, cutout or fuse; Caps, fuse; Clips, fuse; Ferrules, fuse; Removers, fuse; Shells, fuse; Testers, fuse; Tongs, fuse, high-tension; Tongs, fuse, low or medium-tension.

FUSE LINKS OR RENEWALS.—These are fusible elements of definite rating insertable in the renewable types of cartridge and plug fuses to replace an element that has "blown." For the cartridge type, which is the most used of renewable fuses, there are made three types of renewals but these are not interchangeable. The link type consists of a bare fuse strip, usually of special shape and designed to be used with fuse terminals and enclosure of corresponding rating; the enclosed renewal consists of a separately enclosed link designed to be used only within an outer enclosure and terminals of the same rating, thus virtually constituting a cartridge fuse within a cartridge fuse; the multiple renewal consists of two or more links intended to be used successively as one after another is blown. For the plug type renewable fuse there are also three types of renewals corresponding in a general way to the foregoing and likewise not interchangeable. All renewals should be purchased only from the manufacturer of the particular type of renewable fuse used or from his authorized agents. This classification does not include fuse links for open-link fuses; for these see Fuses, link.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brach Mfg. Co., L. S., 127 129 Sussex Ave., Newark, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
BUSSMANN MFG. CO., 3819 N. 23rd St., St. Louis, Mo. "Buss."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. (See descriptive advertisement under Fuses, cartridge, non-renewable.)
ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. (See display adv. page 1289.)
ECONOMY FUSE & MFG. CO. OF CANADA, LTD., Unity Bldg., Montreal, Que., Can.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."
ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. (See display advertisement on page 1291.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pierce Fuse Corp., Buffalo, N. Y.
Pierce Fuse Corp. of Canada, Ltd., 8 Lewis St., Bridgeburg, Ont., Can. "Pierce."
Ree-Nu-It Electric Mfg. Co., 958 Acushnet Ave., New Bedford, Mass. "Ree-Nu-It."
SNOW & CO., E. W., Rochester, N. Y. Snow fuse links have Underwriters' standard dimensions for any renewable fuse. Are interchangeable with the following makes of renewable fuse cases: Economy—Union—Buss—J. M. or Noark—G. E.—Chase—Shawmut. (Pierce from 61 amps. and up.) From



"Snow" Fuse Link

illustration of Class 35 to 60 amp. link, it will be noted that this type of link affords a great saving, in that it is slotted. This makes it unnecessary to remove your bolts or screws from your renewal fuse. The smaller renewal



"Snow" Fuse Link

links, from 3 to 60 amps, have one end bent at an angle, ready for insertion into fuse casing. Every fuse link thoroughly inspected; carrying capacity rating stamped on each link guaranteed accurate. Made in all sizes from 3 to 600 amps., 250 volts.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

FUSE MOUNTINGS, HIGH-TENSION.—These mountings are made for use with chemical or special fuses to be inserted in high-tension lines. The mountings consist of a suitable base, usually with steel pins at each end on which pin type porcelain insulators are mounted. The top of the insulator is provided with the contact-making and fuse-holding device and also lugs for connecting and soldering the line wire. Several different types of mountings are made, the form depending on the type of fuse, voltage of circuit and the framework or support on which the fuse is to be placed.

Manufacturers:

SCHWEITZER & CONRAD, INC., 4431 Ravenswood Ave., Chicago, Ill. "S & C."

FUSE WIRE AND STRIP.—Wire or strips of fusible metal for insertion in fuse or cutout bases designed for open-link fuses. The wire is of varying sizes according to the current it is designed to carry without fusing; common ratings available range from ⅛ ampere to 200 amperes. Fuse strip is furnished in standard widths of ¼ and 1 inch and different thickness to give nominal current ratings from 50 to 1000 amperes. Both fuse wire and strip are usually made up on spools, containing 5 lbs. in the larger sizes. Their use as open fuses is diminishing because of the great superiority of enclosed fuses.

To a limited extent aluminum wire is used for fuse elements where a smaller

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volume of metal is desired and where a higher blowing temperature is not objectionable, as in the case of expulsion fuses.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products.—Adv.

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMANN MFG. CO., St. Louis, Mo. "Buss" fuse wire and strip are carefully tested and guaranteed to be uni-



"Buss" Fuse Wire

form. "Buss" fuse wire is made in all capacities from ⅛ to 200 amperes. "Buss" fuse strip is made in all capacities from 50 to 1000.—Adv.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

Halstead Wire Co., Inc., 132 Front St., Rome, N. Y.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo.

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Ree-Nu-It Electric Mfg. Co., 958 Acushnet Ave., New Bedford, Mass. "Ree-Nu-It."

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Blow-Rite," "Reliable."

SMITH & MC CRORKEN, INC., 407 E. 18th St., New York, N. Y.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)—Adv.

FUSED SALTS.—Chemical compounds which are solid at ordinary temperatures, but are melted for the purposes of electrolysis. When melted they become conducting, and can be used as liquid electrolytes.

FUSED QUARTZ.—Produced by fusing pure sand (99.5 per cent SiO_2) by means of heat generated by a current passing through carbon rods embedded in the sand. The fusion and working of the material can now be controlled to produce a large variety of molded and blown shapes.

FUSEGUARD.—Trade name for fuses and boxes for electrical purposes manufactured by the Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J.

FUSES.—Electrical fuses are intentionally weakened spots introduced in a circuit, designed to fuse or melt from overheating due to excess current, thus opening the circuit before the excess current can damage any other part of the wiring or apparatus forming the circuit. They are a purely protective device and require replacement in whole or in part after having operated. Melting of the fuse is usually accompanied by a puff of vaporized metal, which has led to the melting of the fuse being called "blowing" of the fuse.

Development. The first fuses used in the earliest low-voltage direct-current lighting plants were small copper wires and their chief drawbacks arose from the high melting point of the copper and the consequent danger from the molten metal dropping from the fuse and the formation of copper globules on the fuse block. To reduce the heat of the molten metal, lead, tin or some alloy with a low fusing point was used, but such fuses had the drawback of being too soft and too easily damaged when the contact nuts were tightened. The next step was to use alloy fuses with hard copper tips or terminals forming the "open link" type still somewhat used in certain districts where inspection requirements are not very rigid. As the price of aluminum was reduced this material was used largely for fuses as it had a high conductivity (thus reducing the amount of metal fuse), a reasonably low melting point, and almost complete vaporization of the metal fused.

It was found that the use of open fuses resulted in considerable fire hazard and occasionally also in accidents. When the fuses blew globules of molten metal at high temperature were scattered around and occasionally came in contact with inflammable material, igniting it and starting a fire. In many cases also, when replacing open fuses on a live circuit, the link would fall across the terminals and blow in the face of the person trying to replace the fuse. The outcome of these conditions led to the recognition of the disadvantages of the open type and resulting in the development of the enclosed type of fuse in which the element is surrounded by a tube, usually of fiber or other insulating material, which is filled with a nonconducting powder that serves to absorb the molten or vaporized metal when the fuse blows; this powder, by absorbing the gases formed, relieves the pressure and also chills and extinguishes the arc between the ends of the fusible element. This type of fuse came to be known as the cartridge type and gradually replaced the open type.

Another type of the enclosed fuse developed was the plug type, making use of a small cup of porcelain within which the fusible wire serves to connect the center contact with the outer metal screw shell, the plug having the same dimensions as the Edison medium screw-shell lamp base. This type was rapidly introduced for the ordinary lighting branch circuits on panelboards.

In 1905 the present National Electrical Code Standard dimensions were adopted, replacing the different standards of various manufacturers, and rendering different makes of fuses interchangeable. This was a great step in advance, as it tended to eliminate the multitude of sizes formerly used. The standardization at first applied to fuses for up to 600 amperes on 250 volts and up to 400 amperes on 600 volts, but was later extended to 600 amperes, 600 volts. Code specifications have not been adopted above the latter current and voltage, but several manufacturers list 601 to 1000-amp. enclosed fuses, for either 250 or 600 volts. The former type of miscellaneously dimensioned fuses are known as "Old Code" fuses and some types of them can still be secured for use in certain cutout bases which, though nonstandard, had come into considerable use.

As larger electric motors came into use, their circuits had to be protected by larger fuses and these, of course, were quite expensive when of the cartridge type. Since overloads are much more common on motor than on lighting circuits, it was not infrequent to have the stock of large cartridge fuses exhausted at a critical time when power was needed. Electrical inspectors found that electricians were trying to meet this double problem by short-circuiting the fuse terminals or soldering a piece of bare fuse wire between the end caps or ferrules, thus defeating the very purpose for which a cartridge fuse was used. Some ten years ago a few types of cartridge fuses were introduced in which the manufacturer designed the cartridge in such a way that it could be easily opened by the user after the fuse element had blown and a new one inserted in place of it, thus making the fuse (after reclosing the cartridge) again serviceable; this type was called the refillable or renewable cartridge fuse, as contrasted with the standard N. E. C. cartridge fuses, which were purposely designed to be nonrenewable by the user and had to be returned to the manufacturer to be taken apart and rebuilt, if the enclosing case and terminals were not to be thrown away even though undamaged.

A long and stubborn controversy ensued between the advocates of the nonrenewable and the renewable types of fuses. On the one hand, it was contended that it would be hazardous to permit any user to take a fuse apart and reassemble it without knowledge of the many important details entering into the construction of a safe fuse; it was also declared that no design could adequately safeguard against improper fuse refilling. On the other hand, it was claimed that suitable designing of renewable fuses had already shown by the reports of inspectors that the hazard had actually been decreased because the low cost of fuse renewal eliminated the temptation to short-circuit or improperly refill the fuse; numerous tests were said to prove that well built renewable fuses fulfilled all of the test requirements of standard N. E. C. nonrenewable fuses. After many years of discussion and even litigation the claims of the renewable type fuse were recognized and in December, 1919, several makes of these fuses were formally approved for general use.

All types of N. E. C. enclosed fuses, whether nonrenewable or renewable, in order to secure approval by the National Board of Fire Underwriters, are required to carry 10 per cent overload indefinitely without a rise in temperature of more than 70° C. (126° F.) above atmosphere, and on 50 per cent overload must open within specified times, varying from one minute for the 30-ampere to 15 minutes for the 600-ampere size. They must also give satisfactory performance under short-circuit test. Manufacturers meeting Underwriters' requirements are permitted to affix the label "Und. Lab. Insp." to their product.

Fuses for above 600 volts are ordinarily classed as high-voltage and are of several types. Some are powder-filled and similar in design to N. E. C. fuses, others of the expulsion type where one end of the tube is left open and the force of the explosion assists in opening the circuit, and still others filled with a liquid tending to extinguish the arc. The choice of a suitable type depends largely on the location and on the service requirements to be met.

Application. Fuses have preference over circuit breakers in most locations outside of switchboards, because their cost is lower and the arcing parts are wholly enclosed in all modern types. Also, there is no possibility of the fuse getting out of order, as it has no moving parts. As a precaution against derangement of the breaker, a fuse of larger capacity is usually installed in series with a circuit breaker, except in the very large sizes.

The renewable fuse is usually of heavier and more expensive construction than the nonrenewable and its first cost is greater, but the refills are comparatively inexpensive. For a circuit where the current fluctuates widely, as on some motor loads, the renewable type is therefore, considerably cheaper, as the total cost, after two or three "blows," is lower than it would have been, had nonrenewable fuses been used. The latter are more economical on lighting and similar steady circuits with rare overloads or short-circuits, because of their lower first cost.

Mica-top Edison plug fuses are used on 125-volt circuits or on 125-250-volt three-wire circuits with grounded neutral, up to 30 amperes only. They are also made in the renewable types and must meet similar tests to those prescribed for enclosed fuses of the cartridge type, to receive the approval of the Underwriters' Laboratories.

Automobile fuses and stamped-link fuses are other forms which do not differ radically from those already described.

There is sometimes a misunderstanding regarding the requirements for safety on different voltages and ampere capacities. Any fuse suitable for a certain voltage may safely be used on any lower voltage and will then have an added factor of safety. It requires no more copper to carry a certain amount of current on 600 volts than

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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on 250, but the terminals should be spaced farther apart and the casing should be larger in diameter in order to overcome increased tendency of the higher voltage to maintain an arc when the fuse is blown. Clean and firm contact is desirable in all fuse mountings to prevent unnecessary and injurious development of heat.

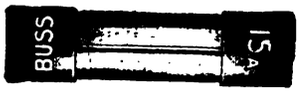
Some idea of the magnitude of the fuse branch of the industry can be obtained from the annual production of fuses in the United States. Although accurate figures are not available, it is known that many millions of fuses are made each year. In 1920 the total production of all types was estimated as valued at about $7,000,000.

FUSES, AUTOMOBILE.—Automobile fuses protect the battery of the automobile, as well as the apparatus they are connected with, from heavy overloads due to grounds or short-circuits. They are principally cartridge fuses and the many sizes run from ⅝x¼ inch to the standard 2x⅛ in. National Electrical Code type. The most commonly used types are inclosed in glass tubing. A few gasoline automobiles use small link fuses. The Society of Automotive Engineers has adopted as standard two commercial sizes of glass fuses, 1¼x¼ in. and 1½x⅜ in., each to be made in 10, 20, and 30-ampere ratings, for 25 volts or less. Electric vehicles usually operate on considerably higher voltages and should be equipped with N. E. C. cartridge fuses. Revision of the above standards is now under consideration, with the probability of further simplification.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMANN MFG. CO., St. Louis, Mo. "Buss" auto fuses are approved by Underwriters' Laboratories in all sizes recognized by the Society of Automotive Engineers. Fusible element is



"Buss" Auto Fuse

absolutely guaranteed against corrosion. All ferrules are brass, nickel finished, and have amperage stamped thereon. Made in glass tube, fiber tube, or link types, in any amperage from 1 to 30.—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill.

Commercial Enclosed Fuse Co., 1317 Willow Ave., Hoboken, N. J. "Commercial."

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. See display adv. page 1289.

Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Interstate Electric Co., 356 Baronne St., New Orleans, La. "Service."

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."

KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo.

Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."

Monarch Refillable Fuse Co., Jamestown, N. Y. "Monarch."

Pierce Fuse Corp., Buffalo, N. Y.

Trico Fuse Mfg. Co., 1009 Coldspring Ave., Milwaukee, Wis. "Trico."

United Electric Supply Co., 1250 Atlantic Ave., Brooklyn, N. Y.

Volk Mfg. Co., The, Westport, Conn. "Victor."

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

FUSES, BLASTING.—Blasting fuses, also called blasting caps or detonators, differ radically from all the ordinary electrical fuses in that they are not intended to fuse and thus protect a circuit, but they become heated to a high temperature and thereby ignite a blasting charge either directly or indirectly. The cap or fuse is a short tube partly filled with an explosive powder; the wire leads run into the tube through a sulphur plug and into the powder. Bridging the terminals of the two lead-in wires is a fine high-resistance wire which heats to a high temperature when the current passes through, thereby igniting the charge. Platinum was first used for this wire but cheaper materials are now employed. Delay caps, which have a time lag before firing, are similar to the regular or instantaneous caps but have a very uniform and slow burning fuse which supplies the time lag. For manufacturers, see Detonators, electric blasting.

Manufacturers:

Aetna Explosives Co., Inc., 120 Broadway, New York, N. Y. "Lion."

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

CHICAGO FUSE MFG. CO., Laflin & 15th St., Chicago, Ill. "Union."

Du Pont de Nemours & Co., E. I., Du Pont Bldg., Wilmington, Del. "Victor," "Pul Up," "U. S. Standard."

New York Blasting Supply Co., 11 Broadway, New York, N. Y.

FUSES, CARTRIDGE, NONRENEWABLE.—Enclosed type fuses in which the element is contained in an insulating tube with end closures, which is called the cartridge and in which the element cannot be replaced by the user after it has "blown" and broken the circuit. In this classification are included especially such cartridge fuses as are National Electrical Code Standard. These are made in the ferrule-contact type up to 60 amperes for circuits of 250 and 600 volts, and in the knife-blade-contact type in ratings from 61 to 600 amp. on 250 and 600 volts. Fuses for circuits up to 600 volts have a larger distance between contacts than those for circuits up to 250 volts. Surrounding the fuse link is a porous filling retained by the cartridge and provided to extinguish the arc formed by the blowing of the fuse.

Nonrenewable cartridge fuses that are not N. E. C. S. are also made in limited quantities, especially to fit cutout bases or fuse blocks whose terminal contacts, spacing distances, and other dimensions no longer conform to present Code standards. Such fuses are commonly designated as "Old Code" and are of restricted application. Cartridge fuses rated up to 2500 volts and to 100 amperes are also made for limited use on special 2300-volt motor circuits; several dimensions for the same ratings and several styles of terminals are made. None of these fuses are as widely interchangeable as the standard N. E. C. fuses.

All these cartridge fuses can in most cases be returned to the manufacturer to be refilled at a cost lower than that of an entirely new fuse.

Manufacturers:

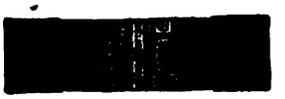
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

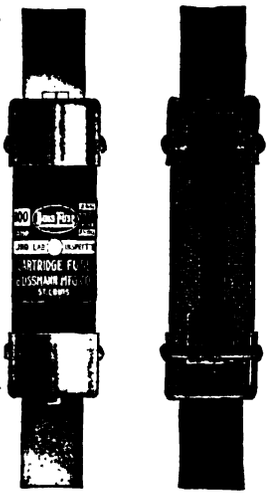
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMAN MFG. CO., St. Louis, Mo. "Buss" cartridge nonrenewable fuses are approved by the Underwriters' Laboratories in all sizes and labeled "Und. Lab. Inspected." (Fuses larger than 600 amp. are not tested or listed by the Underwriters' Laboratories.)



"Buss" Ferrule Type Non-Renewable Fuse

Ferrule contact type (first illustration) are made in sizes from 1 to 60-amp. Knife blade type (illustration at left), from 65 to 1000 amp., has all parts riveted. No screws to come loose or fall out. Fusible element is riveted and soldered. The construction is such as to always assure positive alignment of blades. The design of strip used in all "Buss" nonrenewable fuses, from 8-amp. to 1000-amp., is an exclusive "Buss" feature (see illustration at right). This strip makes the "Buss" fuse the coolest operating fuse and enables us to guarantee that each and



"Buss" Knife Blade Type Nonrenewable Fuse

Showing Design of Fuse Strip Used in "Buss" Nonrenewable Fuses.

every "Buss" fuse will operate under any overload without burning or charring the fiber tube.—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

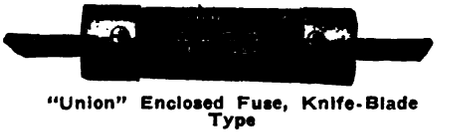
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill. Union non-arcing, enclosed fuses are designed to ensure the coolest normal running temperature, compatible with safe and noiseless operation under severe overloads. All Union parts strictly conform to the Underwriters' specifications. An ex-



"Union" Enclosed Fuse, Ferrule Type

cellent quality of fibre tubing, special alloy fuse wire and strip are employed, and the filling is compounded and treated to assure proper dissipation of the heat and positive neutrality to electric current, even under action of the arc, and is free from effects of atmospheric moisture. Union non-renewable fuses in all N. E. Code sizes; ferrule type from 3 to 60 amps., 250 or 600-volt; and knife blade type from



"Union" Enclosed Fuse, Knife-Blade Type

61 to 1000 amps., either voltage. Union non-renewable fuses can be refilled at moderate cost, in this company's refilling department, these fuses also being approved by the Underwriters'. Union non-arcing, enclosed fuses, for Old Code cutouts, are available in all principal types for 250, 500, 2500 and 5000 volt circuits, in all standard ampere capacities.—Adv.

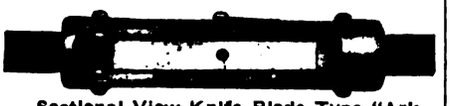
Commercial Enclosed Fuse Co., 1317 Willow Ave., Hoboken, N. J. "Commercial."

Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."

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D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. The manufacturers of D & W Fuses have incorporated the soundest of engineering principles in the design and construction of each individual fuse, and the closest attention is given to all details. The result is a fuse that has an accurate blowing point and that, therefore, protects equipment under the most exacting conditions. The range of sizes is from 1 to 1,000 amps. on all standard voltages. Enclosed fuse cutouts, fuse boxes, service switches, links, clips, terminals and all types of fuse accessories are manufactured, enabling the user to standardize equipment with D & W.—Adv.

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. This company's "Arkless" fuses are of the highest type of National Electrical Code Standard nonrenewable cartridge fuses. This line is one of the oldest and most widely known enclosed fuses man-



Sectional View Knife-Blade Type "Arkless" Indicating Fuse

ufactured under the supervision and label service of Underwriters' Laboratories. The novel feature of "Arkless" fuses is the positive mechanical indicator, which gives an unmistakable mechanical indication when the fuse has blown. "Arkless" fuses are made in a full line of standard ratings up to 600 amps. in both ferrule and knife-blade types for 250-volt and 600-volt circuits. See display adv. page 1289.—Adv.

Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J. "Essex."

FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "National." (See display advertisement on page 1291.)

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Interstate Electric Co., 356 Baronne St., New Orleans, La. "Service."

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."

KILLARK ELECTRIC MFG. CO., 3940-48 Easton Ave., St. Louis, Mo. Killark safety fuses (one-time N.E.C. Standard) have been featured by this company as having qualities which make them more economical than renewable fuses based on average blow outs of all fuses during a year's period. Statistics kept show that average fuse replacements are less than 15% per year and that 41% of all fuses used would have to be replaced every year before a saving would be effected by any but a one-time fuse.—Adv.

Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."

METROPOLITAN ELECTRIC MFG. CO., Long Island City, N. Y. N. E. C.



Metropolitan Non-Renewable Fuse

standard enclosed fuses in complete range of sizes from 1 to 600 amp., 250 and 600 volts.—Adv.

Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.

Monarch Refillable Fuse Co., Jamestown, N. Y. "Monarch."

Motor Protector Mfg. Co., 47 Kearny St., San Francisco, Cal.

SNOW & CO., E. W., 29 W. Water St., Rochester, N. Y.

Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.

TRUMBULL VANDERPOEL ELECTRIC MFG. CO., Bantam, Conn.

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

FUSES, CARTRIDGE, RENEWABLE.—These fuses correspond in dimensions and rating to the nonrenewable type listed above, but they are designed so that the fusible element may be readily renewed by the user with suitable renewal elements supplied by the manufacturer. The cartridge and terminals may be used repeatedly with new renewal elements. In this way considerable economy is effected, especially in the larger sizes of fuses, which accounts for the popularity of this type since it was introduced. These cartridge fuses may be divided into three general subtypes according to the character of the fuse element used. Most manufacturers make a link type renewal element that is easily secured to the terminals and may or may not have a filling material between the element and cartridge. In another type the fuse link is enclosed in a compact separate enclosing shell provided with end contacts, the entire enclosed renewal being readily inserted in the outer cartridge; this provides double protection for the fuse link. In the third type the fuse contains several links which can be placed in circuit in succession as one after another is fused.

About a dozen makes of renewable cartridge fuses have been found after test by Underwriters' Laboratories to conform to all the requirements of the National Electrical Code, supplemented by those of the Laboratories' Code; these requirements cover those features as will insure that the fuse will function for the purpose for which it is used in the circuit, namely its safe protection from currents exceeding its rating by more than 10 per cent. The higher the percentage of excess current the more rapidly the fuse must melt and do so without destroying the cartridge or igniting any inflammable material in immediate contact with it. A renewable fuse should be of such design as will fulfill these requirements and as will make it easy and desirable for the user to refill it properly with the rated element and difficult, or at least of no advantage, to refill it improperly. An ample supply of renewals should always be kept on hand, but in no case should renewals be purchased from anyone but the manufacturer of the particular fuse used or his authorized agents.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMANN MFG. CO., St. Louis, Mo. "Buss" renewable cartridge fuses are approved in all sizes by the Underwriters' Laboratories and labeled "Und. Lab. Inspected." They are not affected by dampness, heat or atmospheric conditions, and are capable of being renewed indefinitely. Ferrule contact type (top next column) can be renewed without the use of any tools, as the full length cap gives large gripping surface. Cartridge has metal ends permanently attached. One end open to permit renewal of burnt-out link. Other end completely closed, except a slot through which link is passed; therefore, only one washer required. Caps are full length and screw onto metal threads over ends of cartridge. A projection in cap assures perfect clamping of link and a recess in cap takes expelled metal from cartridge. Charring of fiber practically eliminated, because full length cap assures 100% contact; projection in cap assures positive contact; cap being held by fuse block clip prevents vibration from loosening the contact; recess in cap taking excess metal, prevents it from injuring contact points. Knife blade type (at left) is made with metal cap holding ring inside the fiber tube. Shrinking or swelling of a fiber tube causes its inside diameter to contract; therefore, the more the fiber shrinks or swells, the tighter the ring is held, and the fittings do not become loose or permit the escape of flame and gases. Terminals cannot possibly be out of line. "Buss" renewal links (15 amp. and larger) are made with two or more narrow sections. When the fuse is subjected to a very heavy overload or short circuit, only the narrow



"Buss" Ferrule Type Renewable Fuse

sections burn out. This reduces to a minimum the amount of metal volatized, preventing the development of excessive pressures, which might ex-



"Buss" Renewal Fuse Link

plode the case, and deviate the necessity for an arc-extinguishing filler.—Adv.



"Buss" Knife Blade Renewable Fuse

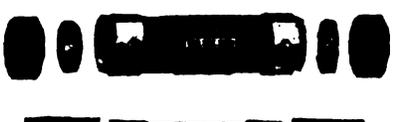
Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill. Union renewable fuses are rugged, simple, economical, and embody the best practices in renewable fuse construction. Made in two types. The type B, ferrule contact, for 0-60 amperes, in 250 or 600 volts, has many important mechanical features. (1) Fixed brass parts are securely attached to fibre tubing. (2) The fuse is carefully designed mechanically and is absolutely accurate electrically; the strength of construction and simplicity of design being the most important features. (3) Fuse will



"Union" Renewable Fuse, Type B

stand indefinite renewal. Renewal is easily effected by unscrewing caps on both ends of fuse, the washers which hold link firmly in position will then drop out or are easily removed. (4) Heavy metal parts ensure cool running. Official tests on both 30 and 60 amp. sizes, proved that their temperatures run much below the limits permitted by the National Board of Fire Underwriters. The Union type E, knife blade contact, possesses the inherent qualities typical of all Union fuses. This illustration shows parts of fuse



"Union" Renewable Fuse, Type E

exposed. Among its many advantages are, (1) Metal ferrules are securely riveted to the tubing. (2) In making renewals this connection is not disturbed, all changes being made between long-wearing metal surfaces. (3) Fuse contains but few parts, and these are easily assembled, which saves time and expense in renewing. (4) The knife blade is held firmly in place, with just enough flexibility to allow perfect contact in clip. (5) A screw driver is all that is required in making a renewal. The Union Type E, is made in all N. E. Code standard sizes, 65-600 amps., 250 or 600-volt circuits. All Union N. E. C. standard renewable fuses are approved by the Underwriters' Laboratories, Inc., for both 250 and 600-volt service.—Adv.

Cooley Mfg. Co., 98 Park Pl., New York, N. Y. "Koo-Lee."

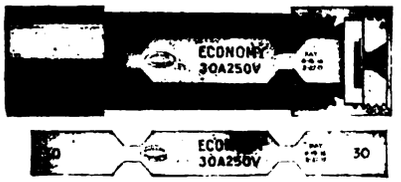
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

Daum, A. F., Pittsburgh, Pa. "Ideal."

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. This company has taken the leading part in the development of reliable and economical renewable fuses, in popularizing their use, and in securing the recognition of their full merit by inspection and Code

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authorities and insurance interests. It has spared neither pains nor expense in these efforts to the end that substantial economies and greater safety might



Sectional View Ferrule Type.

result in the general use of enclosed fuses. That the industry has appreciated these services in its interest is shown from the fact that this company is by far the largest manufacturer of renewable cartridge fuses. Our fuses are appropriately called "Economy" fuses because their use results in an average saving of about 80 per cent in the annual fuse maintenance cost as compared with one-time fuses. The cost of the renewal links is low and it is easy to keep a stock of renewals on hand for each size of fuse used. The design of the fuse is such that when a link has blown, the cartridge can be quickly opened, the proper renewal link inserted, the cartridge reclosed and the complete fuse replaced in the circuit. Accurate rating of the links is secured by special care in their manufacture and by the unique "Drop-Out" construction originated by this company. In this design of link the fuse strip has two restricted portions or narrow bridges between which the metal is considerably widened. When an overload or short circuit occurs, only the metal in the restricted portions of the link fuses and the larger intermediate section drops out of the circuit in metallic form, introducing a substantial gap and effectively opening the circuit without arcing. Because only the small amount of metal at the bridges is volatilized, the pressure created in the fuse tube is relatively small, hence there is no need for a nonconducting powder filler commonly used in one-time fuses. Economy Fuses are made in both ferrule and knife-blade types in a full line of current ratings up to 600 amps. in both 250-volt and 600-volt types. They are National Electrical Code Standard in every respect and were the first line of renewable cartridge fuses approved in all capacities by Underwriters' Laboratories employing an inexpensive bare link for restoring a blown fuse to original efficiency. The fact that Economy Fuses have been "approved" by the public and millions have been used for nearly ten years in every class of service and for the protection of all industries is ample proof of their safety, dependability, and service. See adv. page 1289.—Adv.

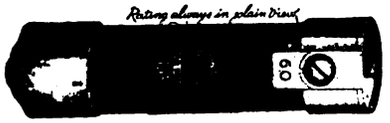


Sectional View Knife-Blade Type Fuse

ECONOMY FUSE & MFG. CO. of Canada, Ltd., Unity Bldg., Montreal, Que., Can. "Economy."

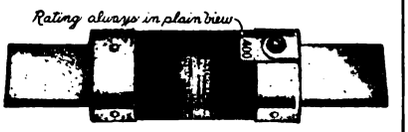
Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."

FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. Only renewable



Ferrule Type

fuse that is built to take surges in the line and still maintain proper rating under rules of Underwriters' Association. It is not necessary to overload this particular fuse to handle high starting torque of induction motors. Only one renewable powder-packed



Knife Blade Type

cartridge can be used at a time. Jobbers and distributors everywhere. See display adv. page 1291.—Adv.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y. "Yankee."

MULTIPLE ELECTRIC PRODUCTS CO., INC., 450 Fourth Ave., New York, N. Y. "Atlas 4-in-1" are the only multiple-element type renewable fuses made. Four fuses, of same amperage, are contained in each shell. When No. 1 blows take fuse from clips, pull down numbered ferrule, give





quarter turn to No. 2 and continue until all four are blown. When all are blown, return cartridge to jobber or district office to be exchanged for cartridge containing four unblown fuses. Amperage is stamped in ferrule and also printed on wrapper; 250 and 300-volt sizes. Approved by Underwriters' and Factory Mutual's Laboratories. As there is no depreciation, Atlas fuses offer a cheap, simple, definite system of fuse maintenance.—Adv.

Atlas Renewable Fuse

Monarch Refillable Fuse Co., Jamestown, N. Y. "Monarch."

Perfect Refillable Fuse Co., Brooklyn, N. Y. "Chief."

Pierce Fuse Corp., 752 Main St., Buffalo, N. Y.

Pierce Fuse Corp. of Canada, Ltd., 8 Lewis St., Bridgeburg, Ont., Can.

SNOW & CO., E. W., Rochester, N. Y. Enclosed Fuses, National Electrical Code Standard dimensions, from 1 to 600 amps., both 250 and 600 volts. These fuses are especially desirable for use in large public buildings, hospitals, hotels, department stores, factories, etc., on account of the refilling feature. This offers a worth while saving to users where the electric line is subject to frequent overloads, with the consequent burning out of the fuses. Illus-



"Snow" Enclosed Fuse

tration above shows knife-contact type, made in twenty-five capacities, 61 to 600 amps., 250 volts. Also made in twenty-five capacities, 61 to 600 amps., 600 volts. The ferrule type of fuse, also refillable, is made of the best material and designed to stand up under severe service. There are thirty-eight capacities made in this type, nineteen designed for 250 volts, 1 to 60 amps., and nineteen for 251 to 600 volt circuit, 1 to 60 amps. All fuses built to National Electrical Code Standard dimensions. This company also refills all makes and styles of enclosed fuses. This service means a great saving to large users of fuses.—Adv.

Star Fuse Co., Inc., 168 Centre St., New York, N. Y. "Star."

Trico Fuse Mfg. Co., 1009 Coldspring Ave., Milwaukee, Wis. "Trico."

United States Fuse Co., Buffalo, N. Y.

Volk Electric & Mfg. Co., Inc., Grand Central Terminal, New York, N. Y. "Volk."

Volk Mfg. Co., The, Westport, Conn. "Victor."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

FUSES, DISTRIBUTING-TRANSFORMER, PRIMARY.—See Cut-Outs, fusible primary.

FUSES, GLASS TUBE.—Enclosed fuses of small current-carrying capacity in which the casing of the fuse is of glass. They are used to protect pilot light, instrument and similar circuits on switchboards; for automobile fuses of not over 50 volts; for rosettes and attachment plugs of the fused types; and for other low-voltage circuits of ratings to about 30 amperes, and 110 or 220-volt circuits not exceeding 3 amperes. Glass tube fuses are inexpensive and show whether the fuse is blown or not. They cannot be used for high-currents or high voltages.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMANN MFG. CO., 3819 N. 23rd St., St. Louis, Mo. "Buss."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. See display adv. page 1289.

Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.

Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio. "Hi-Voltage."

Interstate Electric Co., 356 Baronne St., New Orleans, La. "Service."

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."

KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo.

Railway & Industrial Engineering Co., Greensburg, Pa. ("R. and I. E." high tension).

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."

Trico Fuse Mfg. Co., 1009 Coldspring Ave., Milwaukee, Wis. "Trico."

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

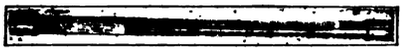
FUSES, HIGH TENSION, CHEMICAL.—One of the most effective forms of fuse for the protection of high-voltage circuits consists of a glass tube of proper length and diameter within which is mounted a short fuse at the upper end. The fuse is held in tension by a spiral spring secured at the bottom end. The tube is filled with an arc-quenching liquid, such as carbon tetrachloride, which has a dielectric strength of about 250,000 volts per inch. When the fuse melts the spring contracts very suddenly and opens a gap of 6 to 12 ins. or more in the circuit, the arc being extinguished by the liquid. The fuses must be mounted in a vertical position, and are carried in spring clips so as to be readily removable by insulated tongs. In small sizes they are suitable for use up to 33,000 volts. Special designs have been developed

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for indoor and outdoor use in circuits up to 115,000 volts and for currents up to 400 amperes.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Economy Fuse & Mfg. Co. of Canada, Ltd., Unity Bldg., Montreal, Que., Can. "Economy."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
PACIFIC ELECTRIC MFG. CO., 827-833 Folsom St., San Francisco, Cal.
SCHWEITZER & CONRAD, INC., 4431-39 Ravenswood Ave., Chicago, Ill. The construction of the S & C high potential fuse is remarkably simple. The glass tube contains a spiral spring, the lower end of which is connected to the bottom ferrule. The upper end of the spring connects to a terminal. Attached to this terminal is the fuse element and a non-corrosive very high resistance wire of high tensile strength, both wires passing through a cork. The upper ends of the fuse wire and the high resistance wire are attached to a cap on the top ferrule. The only function of the high resistance wire is to hold the spring in tension. It carries practically no current and "blows" at the same time as the fuse element proper. A flexible copper cable joins the lower ferrule and upper terminal to which the spring is attached, the spring carrying no current. At the top of the spring and just below the cork is a funnel-shaped liquid director. The glass tube is filled with a non-inflammable liquid of extremely high dielectric strength. This liquid has none of the objectionable characteristics of oil and in addition is one of the most effective fire extinguishing liquids known. The construction of the fuse as outlined above applies to the moderate capacity fuses. Fuses of large capacity differ slightly in that the fuse element proper is mounted in a special explosion chamber provided at the upper end of the fuse, and this chamber is so designed that excessive pressures are confined to this space and not imposed upon the glass tube. The melting of the fuse wire releases the spiral spring which instantaneously contracts, drawing the upper fuse terminal down towards the bottom of the tube, thus introducing a very large gap. At the same time the liquid extinguishes the arc and interrupts the current flow, the action being accelerated by the liquid director which is drawn down with the spring and which forces the liquid directly onto the moving terminal. Since the dielectric strength of the liquid is about 250,000 volts per in., the gap between the top ferrule and the top end of the submerged spring gives an enormous factor of safety. The ease with which the S&C Fuse operates is really remarkable. In from eighty to ninety per cent. of "blows," the fuse simply operates in the manner described, without arcing or other distress whatsoever. In cases of severe "blows" on dead short circuits on systems of large capacity the fuse sometimes vents through a cap on the upper end provided for that purpose, but even then there is little arcing or evidence of distress. The small amount of liquid thrown off is not inflammable and soon evaporates. It is but very rarely indeed that the glass tube is broken in operation, the average being considerably less than 1%. Because of the large open space between the top ferrule and the spring, blown fuses are readily distinguished. The proper trade name is "S&C Fuse."—Adv.

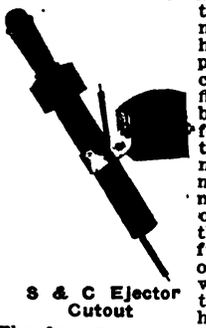


S & C High Potential Fuse

FUSES, HIGH-TENSION, EXPULSION.—For 1100 or 2200 volts it was found dangerous to use fuses unless they were covered up, and if they were placed in an air-tight box they were apt to rupture the box by the force of the explosion that occurred from the gases formed by the blowing of the fuse. The natural development, when venting the fuse box, was to so place the vent that the gases in expanding caused a draft through the vent that blew out the arc. This development led to the expulsion fuse that has been built in many forms. A typical modern design utilizes a fuse tube open at one end so that when the fuse blows the metallic vapors are expelled from the open end and successfully extinguish any arc incident to the blowing of the fuse. The fuse tube is so placed that the open end projects beyond the contact jaw so that there is no danger of the expelled vapors coming into contact with the metallic parts of the block. Expulsion fuses are suitable for voltages up to about 70,000 volts.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St. W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display advertisement on page 1260.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
GENERAL ELECTRIC CO., Schenectady, N. Y. Type TD327 Expulsion Fusible Cutouts, a combined expulsion fuse and disconnecting switch. Designed primarily for the protection of transformer banks when no primary switches are provided. Made for outdoor service up to 50 amp. and 70,000 volts capacity. Described with other G-E equipment for a complete outdoor substation in Bulletin 47706A.—See adv. pages 1203-1223.—Adv.
HI-VOLTAGE EQUIPMENT CO., Cleveland, Ohio. Manufacturers of air break switches, lightning arresters, choke coils, high voltage fuses, disconnecting switches, outdoor bus supports, steel sub-station structures, crossarms. Hi-Voltage Fuses are of either the horn gap type for open link fuses or glass cartridge fuses or of the expulsion type. The expulsion type fuse is of a design that automatically disconnects itself from the line, so that there is no danger of a leak across the fuse tube in case it becomes charred from the arc inside. —Adv.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
SCHWEITZER & CONRAD, INC., 4431-39 Ravenswood Ave., Chicago, Ill. The S & C ejector cutout consists of a main housing, an over lapping handle (both of moulded insulating material) and a fuse. The fuse is attached to a threaded stud, moulded in the handle. All live parts are entirely covered. Insulated flexible leads are brought out from ferrule type contacts inside the main housing. Connections can be made to line wires on either side of the cutout. The fuse holder consists of a Bakelite tube with terminal contacts that fit the housing contacts. The fuse proper consists of a phosphor bronze spring and fuse element. The spring is shunted by a flexible copper cable and is held in tension by a very high resistance, high tensile strength wire. In general it is similar to the standard S & C high potential fuse, described under "Fuses, high tension, chemical." In this type, however, no liquid is used. The fuse element is enclosed in a cork. This, in addition to other functions, protects the fuse from corrosive fumes so often prevalent in large industrial districts. The cutout, including a mounting clamp, requires a space 5½ ins. wide and 15 ins. high. The fuse element can be replaced by any lineman with a screw-driver and pliers. The cutout can be closed by one quick positive movement. It is placed on the arm at such an angle that when operating on short circuit, gases escaping at the lower end are directed away from the lineman on the pole. Fuses are made in various capacities up to 100 amps., and the cutout is suitable for voltages up to 6600. When the fuse blows the operation of the spring introduces a large gap and clears the line effectively on light overloads as well as extreme overloads, or short circuits.—Adv.



S & C Ejector Cutout

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

FUSES, HORN GAP.—Horn gap fuses are used for the protection of transformer substations and branch lines, and are intended to open the circuit without damage to any apparatus when a short-circuit or overload occurs on a high-voltage line. The fuses consist of a horn gap mounted on suitable porcelain insulators and separated a greater distance than the ordinary horn gap. A fuse is placed across the bottom of the gap, and connected in the line. A glass tube fuse is generally used, and when it blows under trouble conditions the glass breaks and the arc formed is transferred to the horn gap on which it rises and is extinguished. The contacts for the fuse are such that a new one may be replaced with insulated tongs and no screw connections are required. These fuses are made for use on high-voltage lines only.

Manufacturers:

HI-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio. "Hi-Voltage."

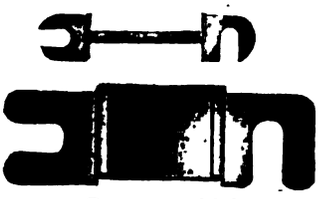
FUSES, LINK.—Link fuses are made of fuse wire or strips to which are soldered copper terminals for inserting in open-link fuse blocks or cutout bases. The terminals are stamped with the rated current capacity of the fuse, and are provided with either a round hole or slot for the screw mounting studs on the base terminal. The cross-section of the fusible portion will vary with the length employed; for the same amperage the carrying capacity of a link will vary somewhat with its mounting conditions and manufacturers usually allow from 150 to 200 amperes for each square inch of contact surface on one side of one terminal. The National Electrical Code prescribes the following break distances or spacings between the nearest edges of copper terminals or bars upon which they are to be mounted.

Amperes	125 Volts	250 Volts
0-100	¾ in.	1¼ in.
101-300	1 in.	1½ in.
301-1000	1¼ in.	1 in.

Link fuses are rated to blow at about 25 per cent overload. They may be secured in any capacity up to 5000 amperes, or even higher, if desired, and should be installed in such a manner that no hazard will be involved from molten metal when blowing. Because of the far greater safety and reliability of enclosed fuses, link fuses are now used but seldom and then in places where there is little hazard.

Manufacturers:

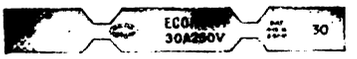
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
BUSSMANN MFG. CO., St. Louis, Mo. "Buss" open link fuses are made in all sizes with any form of copper terminal desired. They are guaranteed for accuracy. Amperage is stamped on terminal.—Adv.



Bussmann Links

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Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."
CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill. Union standard terminal links are easily installed and establish a perfect and reliable connection at all times by the screw and washer form of contact. They are very popular in many classes of work where the nature of service or character of installation makes it entirely satisfactory for protection to employ unencased or "open" fuses; e. g., on panel boards and cutouts, located in approved cabinets or on switch boards away from inflammable material. Capacities 1 to 5000 amps.—Adv.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. All Economy Renewal Links embody the "Drop-Out" construction originated and



Economy Renewal Link

patented by this company and later also utilized, under our license, by several other manufacturers. All Economy "Drop-Out" Renewal Links bear the inspection symbol of Underwriters' Laboratories. See display adv. page 1289.—Adv.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo.
Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Moss-Schury Mfg. Co., Inc., 444-446 Woodbridge St., E., Detroit, Mich.
SNOW & CO., E. W., 29 W. Water St., Rochester, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

FUSES, OIL-ENCLOSED.—Various forms of fuses having the link submerged in oil have been devised. Means are provided to relieve the pressure on blowing of the fuse by allowing the oil to rise in a tube through baffle plates. This type has been adapted especially for manhole use for 2200-volt circuits, the outfit being mounted in a cast iron case. Oil fuses have not been used generally at voltages above 6600.

Manufacturers:

Chemelectric Co., The, 4327 Kenmore Ave., Chicago, Ill. "S & H." (Exclusive distributor, G & W Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.)
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

FUSES, PLUG, NONRENEWABLE.—These are the plug fuses widely used in Edison screw shell plug cutout bases or fuse receptacles on panelboards, in lighting circuit cabinets, house service boxes, etc. They consist of a porcelain cup provided with screw contact shell and center contact, these terminal contacts being connected by a short piece of fuse wire passing through the cup and soldered to the contacts. A metal cap ring with a mica disk window is usually fastened over the open end of the cup, thus permitting view of the element without opening the fuse and preventing escape of molten metal when the fuse blows. A porcelain cap is used in some designs intended for circuits where violent short-circuits are likely to occur; this type may be further protected by use of an arc-extinguishing filler in the cup. The standard plug fuses are limited in rating from about 1 to 30 amperes on 125 volts. For 31 to 60 amperes on circuits up to 250 volts plug fuses of special dimensions may be used; they are of larger diameter and have a coarser thread than the 125-volt fuses so that they cannot be used in place thereof. Ordinary plug fuses, being low in cost, are discarded when the fuse is blown.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrowtype."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
BUSSMANN MFG. CO., St. Louis, Mo. "Buss" mica top plug fuses (left figure below) are approved by the Underwriters' Laboratories. Extra large opening in cap and proportionately large well in porcelain, combined with extreme care in selection of mica, makes the fuse plainly visible. Capacities: 3, 6, 10, 12, 15, 20, 25 and 30 amp. "Halja" porcelain top fuses (right figure below) are approved by Underwriters' Laboratories. This plug is without an equal from the standpoint of protection and durability. The design is such as to permit the use of an arc-extinguishing filler, so that on heavy overloads or extreme short circuits it will operate noiselessly and



"Buss" Mica Top Plug Fuse



Halja Porcelain Top Fuse Plug

without the slightest danger of its becoming a hazard in itself. Capacities: 3, 6, 10, 12, 15, 20, 25 and 30 amperes. —Adv.
CHICAGO FUSE MFG. CO., 1501 W. 15th St., Chicago, Ill. The "Chicago" fuse plug is superior in quality and service. (1) All sizes are correctly rated. (2) The fuse will operate safely, even on severe short-circuits. (3) Its correct dimensions insure perfect contact. (4) There are no exposed live parts. (5) The body is made of strictly high grade porcelain only. (6) The aluminum cap distinguishes the Chicago fuse plug from other makes. It will not corrode or discolor. These fuses can be supplied for capacities from 3 to 30 amps., 125 volts, and all are approved by the Underwriters' Laboratories.—Adv.



"Chicago" Fuse Plug

Commercial Enclosed Fuse Co., 1317 Willow Ave., Hoboken, N. J. "Commercial."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. See display adv. page 1289.
ESSEX MFG. CO., Newark, N. J.
Interstate Electric Co., 356 Baronne St., New Orleans, La. "Service."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo.
Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."
Merrill Mfg. Co., 50 State St., Boston, Mass. "Merrill."
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
Metropolitan Device Corp., 1250 Atlantic Ave., Brooklyn, N. Y. "Metropolitan."
METROPOLITAN ELECTRIC MFG. CO., Long Island City, N. Y. These plug



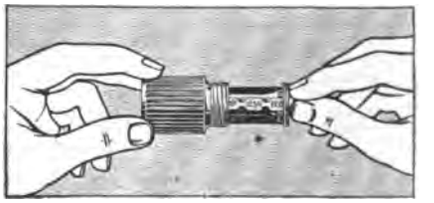
Metropolitan Plug Fuse

fuses are fitted with brass and mica caps. Plug proper is of porcelain. Supplied in sizes from 3 to 30 amp. and for use on voltages not exceeding 125. —Adv.
Osterhout Electric Co., 1013 Race St., Philadelphia, Pa.
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J. "Tecco."
Trico Fuse Mfg. Co., 1009 Coldspring Ave., Milwaukee, Wis. "Trico."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

FUSES, PLUG, RENEWABLE.—These plug fuses correspond in sizes and ratings to the nonrenewable type listed above and are used for the same purposes. When the ordinary plug fuse blows it must be replaced by a new fuse, which is not apt to be on hand, thus causing annoying delay in many cases before the lights are again in service. This condition led to the development of a type of plug fuse whose fuse element could be easily replaced and, being very inexpensive, would more likely be kept in stock ready for instant insertion. As with renewable cartridge fuses, three types of renewable plug fuses have been made. One type uses a bare renewal link, another an enclosed element that is virtually a miniature fuse within a fuse, and the third has a number of fuse elements that can be placed in circuit in succession as one after another is blown. These plug fuses are limited to 30 amperes, 125 volts, and are made in several current ratings within this limit. They usually employ a porcelain or molded insulation plug casing which is used over and over. The renewable type plug fuse has not replaced the nonrenewable type to anything like the extent that the renewable cartridge fuse has replaced the nonrenewable cartridge type. This is because they do not effect as high a percentage of saving.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
BUSSMANN MFG. CO., 3819 N. 23rd St., St. Louis, Mo. "Buss."
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
Clemens Electrical Corp., 725 Main St., Buffalo, N. Y.
Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. "Economy" Renewable Plug Fuses are of simple design, made of durable high-grade materials and accurately rated, and employ a "Drop-Out" Link. Econ-



Economy Renewable Plug Fuse

omy Plug Fuses are made in standard N. E. C. sizes in eleven ratings from 3 to 30 amps. for 125-volt circuits and are approved as standard by Underwriters' Laboratories. See display adv. page 1289.—Adv.
ECONOMY FUSE & MFG. CO. OF CANADA, LTD., Unity Bldg., Montreal, Que., Can. "Economy."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Interstate Electric Co., 356 Baronne St., New Orleans, La. "Service."

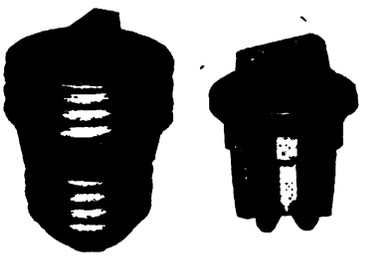
When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Monarch Refillable Fuse Co., Jamestown, N. Y. "Monarch."

MOSS-SCHURY MFG. CO., 444-46 East Woodbridge St., Detroit, Mich. The "Repeater—6—fuse plug," combines 6 fuses in one. It can be used six times and then refilled. The brass cap contains six numerals, as illustrated. When fuse is blown, inner porcelain is rotated to right until next number assumes upright position. The "Repeater—6" screws into regular fuse socket and does not have to be removed to establish new contact. Refillers (right figure above) are available at nominal cost. This plug is patented in 17 countries and permanently guaranteed. It is applicable to every user of electricity.—Adv.



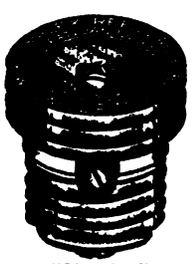
"Repeater—6—Fuse Plug"

MULTIPLE ELECTRIC PRODUCTS CO., INC., 450 4th Ave., New York, N. Y. "Six in One."

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

Pierce Fuse Corp., 752 Main St., Buffalo, N. Y.

POWELL, F. W., 420 Penn Ave.. Pittsburgh, Pa. The "Simplex" refillable plug is constructed for permanent service. Both mechanically and electrically it is designed to provide perfect contact. Should there be a short circuit or overload on the line, causing the fuse to blow out, it can be easily refilled with fuse wire. Fuse will blow at a 10% limit. The plug fuse can be furnished from 5 to 30 amps. Tested lead fuse wire can be used as element to meet N. E. Code Standards.—Adv.



"Simplex" Refillable Plug

Ree-Nu-It Electric Mfg. Co., 958 Acushnet Ave., New Bedford, Mass "Ree-Nu-It."

Star Fuse Co., Inc., The, 168 Centre St., New York, N. Y. "Star."

Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

FUSES, SPECIAL.—All of the various types of electrical fuses that are in general use are listed under various other classifications above and below. For a few purposes, however, it has been found desirable to use special types of fuses differing in construction and often also in rating, from those standardized. Among such special fuses is a form of special plug used for the protection of motor control equipment, which makes use of a left-handed thread so as to insure that the plug cannot be used in any standard Edison screw-shell plug cutout base. Some types of glass inclosed fuses are also made for testing circuits. There are numerous types of nonstandard or "Old Code" fuses that are also spoken of occasionally as special fuses, since they are not interchangeable with the standardized types.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

BUSSMANN MFG. CO., 3819 N. 23rd St., St. Louis, Mo. "Buss."

Chase-Shawmut Co., The, Newburyport, Mass. "Shawmut."

CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

Electric Fuseguard Co., Inc., 60 Shipman St., Newark, N. J. "Fuseguard."

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.

Interstate Electric Co., 356 Baronne St., New Orleans, La.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."

LINE MATERIAL CO., South Milwaukee Wis. (See display advertisement on page 1278.)

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Monarch Refillable Fuse Co., Jamestown, N. Y. "Monarch."

Moss-Schury Mfg. Co., Inc., 444-446 Woodbridge St., E., Detroit, Mich.

Motor Protector Mfg. Co., 47 Kearny St., San Francisco, Cal. "Synthermal."

Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.

Trico Fuse Mfg. Co., 1009 Coldspring Ave., Milwaukee, Wis. "Trico."

FUSES, TELEPHONE AND TELEGRAPH, MICA.—A form of fuse in which the body is a strip of mica, with the metal part at each end. The fuse wire unites the two ends. It is held onto a support by the two metal ends. These are flat fuses and generally have either a sheet copper or copper foil terminal. They are made in several sizes, both for different current capacities and for various kinds and sizes of terminal mountings.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

Charland, E. W., Tilton, N. H.

CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."

Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.

United Electric Supply Co., 1250 Atlantic Ave., Brooklyn, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

FUSES, TELEPHONE AND TELEGRAPH, MISCELLANEOUS.—Several kinds of fuses are used in the protection of telephone and telegraph equipment. One example is an alarm fuse, which is a fuse constructed so as to close an auxiliary circuit when the fuse blows. The auxiliary circuit usually lights a lamp and sounds an alarm. Other forms, generally tubular fuses, are made for use with protector blocks and protector strips for both inside mounting and for use as a line fuse on the outside. The tubes are commonly made of glass, porcelain or wood, having brass or other metal caps at each end. In the glass and wood fuses, generally one strip of fuse wire connects the two metal caps. Porcelain fuses are sometimes made with three holes and the fuse wire is doubled back on itself to give a longer fuse in a small space. Various kinds of terminals are used, some to provide soldered connections, others for use in fuse clips and still others for screw connections. Mica fuses are separately listed above.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.

CHICAGO FUS MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."

Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

ESSEX MFG. CO., 117 Mulberry St., Newark, N. J.

Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.

Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

FUSWITCH.—Trade name for line disconnecting switch and fuse manufactured by W. N. Matthews & Brother, Inc., 2912 Easton Ave., St. Louis, Mo.

FYBEROID.—Trade name for fish paper manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

FYBEROID.—Trade name for insulating paper manufactured by the Wilmington Fibre Specialty Co., Wilmington, Del.

FYBERWELD.—Trade name for welder's goggles manufactured by the Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

FYRAC.—Trade name for spark plugs manufactured by the Fyrac Mfg. Co., 214-16 E. State St., Rockford, Ill.

FYRAC MFG. CO—Rockford, Ill. Manufacturer of spark plugs. Business established 1915. President, treasurer and general manager, A. F. Hogland; vice-president, A. G. Bergstrom; secretary, D. H. Cusic; sales manager, A. B. Harris. Main office and factory, 214-216 E. State St., Rockford, Ill. Branch offices, 105 W. Monroe st., Chicago, Ill.; 1966 Broadway, New York, N. Y.; Monadnock Bldg., San Francisco, Cal.

G

G.—The small letter g is the abbreviation for gram as used in the metric and C. G. S. systems. It is also used as the symbol for acceleration due to gravity; this is expressed in centimeters per second and is generally about 980 cm. per sec., although it varies in different localities and altitudes. It is also the symbol for conductance, expressed in mhos.

G.—Trade name for hack saw blades manufactured by the Goodell-Pratt Co., Greenfield, Mass.

G. A. BALL BEARING CO.—123-141 Albany Ave., Chicago, Ill. Manufacturer of radial and thrust bearings. President and general manager, Emil A. Schreiber; secretary and sales manager, Thomas Moore.

GAFFGA & CO., J. S.—Greenport, N. Y. Manufacturer of gas engines. President, W. S. Gaffga; treasurer, J. F. Gaffga; general manager, J. S. Gaffga.

GAGE, CURRENT.—An instrument used for measuring the velocity of flow of water. (See Current meter.)

GAGE OF THIRD OR CONTACT RAIL.—The distance measured parallel to the plane of the running rails between the gage line of the nearer track rail and the inside gage line of the contact surface of the third or contact rail of an electric railway using this type of working conductor. This distance is determined by the physical characteristics of the rail and the character of the rolling stock passing over it, and the nature of the installation, whether it includes tunnel sections, etc. The gage

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varies from 20 ins. to 28 ins., while the height of the contact rail above the track is from zero to 8 ins.

GAGE, RAIN.—A rain gage is used to measure the extent of rainfall, and generally consists of a funnel receptacle connected to a graduated glass tube, the area of which is one-tenth that of the funnel mouth. The graduations of the tube marked for each inch enable accurate recording of the rainfall. Rain gages are used not only in connection with weather observations, but for observing rainfall in studying the water conditions affecting water-power, irrigation and drainage projects.

GAGE STANDARDS.—The importance of precision measurements in machine-shop practice makes necessary accurate calibration of gages, calipers and other measuring devices. To make these calibrations the measuring devices are checked against standard gage blocks. These standards are made up in small block forms in varying thicknesses of from very thin sheets up to several inches and are ordinarily accurate to 0.00001 part of an inch. The gage standard sets are usually provided with special holders so that the standards may be used temporarily as snap gages. They are carefully preserved in cases where they are protected from injury.

The high precision required in much of the munition production during the recent war resulted in great progress in raising the standards of accuracy in machine-shop practice. More accurate gages and gage standards were developed and used by the machinists with great success. In the manufacture of electrical instruments the highest possible precision is required, so that the developments in gages and gage standards have an important application to this industry.

Manufacturers:

Ibsen & Co., 404 Keefe Ave., Milwaukee, Wis. "I. & C."

GAGES, AIR PRESSURE.—Air-pressure gages are made which operate on the expanding tubular spring principle generally used in other forms of pressure gages. (See Gages, pressure.) Another principle frequently used is that of compression of an air column, the volume of the column being inversely proportional to the pressure. The air column is sealed in the end of a tube partially filled with a liquid, generally mercury, and the pressure to be measured is applied to the mercury column. The tube most commonly used is the U-tube form, one leg of the U being open to allow connection with the air to be measured. Both types of instruments are made either indicating or recording. Another type of air-pressure gage uses an air bell which floats in a liquid, generally water. Difference in pressure within the bell and the external chamber produces difference in the level of the float. This device is gnerally used in recording instruments. Air-pressure gages have many applications in power and gas plants, air brakes and motor-driven air compressors, and various industrial processes involving accurate control of air under pressure.

Manufacturers:

Ashton Valve Co., Boston, Mass.
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. "U. S."

GAGES, ALTITUDE.—One type of these gages is distinctly a water or liquid gage measuring the altitude in equivalent pressure of so many feet of water. In other respects it does not differ from an ordinary pressure gage. It is largely used to indicate the head or altitude of a water column in tanks, reservoirs, standpipes, water heating systems, etc.

Another type of altitude gage is that used to measure the height of poles, towers, tanks, etc., which is used largely by appraisers and engineers making tests and surveys. This device is a simple form of range finder in principle.

Manufacturers:

Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Foxboro Co., Inc., The, Foxboro, Mass.
Green, Henry J., 1191 Bedford Ave., Brooklyn, N. Y.
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
Pierce, Butler & Pierce Mfg. Corp., 282 James St., Syracuse, N. Y.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

GAGES AND CALIPERS, MICROMETER.—The micrometer gage is a measuring tool, like a rod in form, the length of the rod being variable and the variation being measured by a micrometer attachment. Rods of various lengths may be used to give a wide variation in the limits of the tool. This tool is usually designed to measure distances between two plane surfaces or as a depth gage, the latter feature being added by an auxiliary piece.

Micrometer calipers were the first form of micrometer instrument used in shops. The first types had a limited range, from one to two inches being the largest. With the development of high-accuracy work in shops the demand for such instruments became greater and larger types were designed. The commonest type has a U-shaped bar, the piece to be measured being placed in the opening in the U, one leg of which has a fixed point, the other a movable rod or spindle contact. This spindle is threaded through a hollow sleeve extension of the leg of the bar, its movement being controlled by a knurled barrel or sleeve to which it is attached. The threading is done with extreme accuracy. The angular rotation of the threaded spindle measures the distance it has passed, the instrument reading zero when the fixed and movable contacts touch each other. The spindle has very fine threads, so that one rotation of the barrel moves the spindle only a very small distance, 1/40 of an inch in many cases. This linear movement produced by one or more complete revolutions is measured along a scale scratched on a sleeve over which the barrel moves. The barrel itself has a scale which reads the equivalent length of one complete revolution fractionally by the fractional part of one revolution through which it has passed as 1/25; consequently each small division is 1/25 of 1/40 or 0.001 inch=1 mil. This is sometimes further refined by the addition size scales are similar to the type described of a vernier to the barrel scale. The larger above, but have a large U though the contacts measure only within certain limits, as from 10 to 12 ins.

Manufacturers:

Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Ibsen & Co., 404 Keefe Ave., Milwaukee, Wis. "I. & C."
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Morse Twist Drill & Machine Co., New Bedford, Mass.
Production Equipment Co., Inc., 5 Union Sq., New York, N. Y.
Randall, Frank E., 248 Ash St., Waltham, Mass.
Reed Small Tool Works, 23 Cherry St., Worcester, Mass.
Slocomb Co., J. T., 35 Oxford St., Providence, R. I.
Starrett Co., The L. S., Athol, Mass.
Waltham Micrometer Dial Gauge Co., 248 Ash St., Waltham, Mass.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

GAGES, BOILER WATER LEVEL.—The simplest form of boiler water level gage is a glass tube directly connected to the boiler water. The water in the tube rises to the same level as the water in the boiler and serves as a very simple indicating gage. More special gages, sometimes involving a float directly connected to an indicating arm are used. This type is particularly adapted to the electrical high and low-level alarm systems. Another type does not measure the water level directly, but measures, by means of a bellows placed at the lowest allowable water pressure, the pressure created by the head of water above this level, indirectly measuring the height of the head or the water level.

Manufacturers:

Ashton Valve Co., Boston, Mass.
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Huyette Co., The Paul B., 5 S. 18th St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Steigert Co., L., Elder & Logan Sts., Cincinnati, Ohio., (combined with alarm),

GAGES, DRAFT.—The draft gage is essentially an air pressure gage for determining differences in pressure over various points in the draft path through the furnace and gas passages of a boiler. The most common form is a tube containing a liquid. The tube is really a modified form of U-tube, one leg being tilted at a small angle so that a small difference in the liquid level produces a much greater difference in the length of the liquid column (the direction of the scale); the other leg is short and is vertical. The ends of this tube are connected by tubing to different points in the draft path so that the difference in the pressure between these two points is indicated by the difference in level of the liquid in the two legs of the tube. This difference is indicated on a scale mounted along the longer leg. For recording instruments and some of the indicating type the bell float principle is used.

The importance of exact knowledge of draft pressures throughout the draft path has led to the development of various modifications of the more simple instruments. These instruments can be used to indicate or record the difference in pressure at several points along the path, either by separate scales or on the same instrument and scale by providing a simple means of interchanging the tubes connecting the gage to the points within the boiler furnace and gas passages.

Manufacturers:

Bacharach Industrial Instrument Co., 422 1st Ave., Pittsburgh, Pa., "Hydro."
BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Dwight Mfg. Co., 564 W. Washington Blvd., Chicago, Ill. "Dwight."
Ellison, Lewis M., 214 W. Kinzie St., Chicago, Ill.
Foxboro Co., Inc., The, Foxboro, Mass.
General Scientific Equipment Co., North Philadelphia, Pa.
Hays Corp., The Joseph W., Michigan City, Ind. "Hays."
Huyette Co., Inc., The Paul B., 5 S. 18th St., Philadelphia, Pa.
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Precision Instrument Co., 21 Halsey St., Newark, N. J. "2 in 1," "3 in 1," "4 in 1," "5 in 1."
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Columbia."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Uehling Instrument Co., Paterson, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

GAGES, MICROMETER DIAL.—One of the simplest methods of quickly measuring the thickness of a sheet or block is by means of the indicating micrometer dial. The device consists of a watch case containing an inversing device, an indicating needle and dial scale. The inversing device is actuated by a sliding rod which is guided by a tube rigidly fastened to the instrument case, the amount of movement of the rod

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being read directly on the dial. For machine-shop work the instrument is mounted on small stands peculiarly adapted to the measurement of thin sheets or blocks of approximately some known dimension. These dials also are extensively used in material-testing laboratories for reading extensions directly, particularly when many readings must be taken during the test run.

Manufacturers:

Ames Co., B. C., Waltham, Mass.
Waltham Micrometer Dial Gauge Co., 248 Ash St., Waltham, Mass.

GAGES, OIL, MOTOR AND GENERATOR.—These gages are used to indicate the oil level in oil wells or reservoirs on motors or generators. They commonly consist of a simple glass tube, sometimes shielded by a slit brass tube, and a pipe fitting for connecting the tube to the liquid. The level of the liquid in the tube is at all times the same as that of the liquid within the well or reservoir.

Manufacturers:

American Injector Co., 175 14th Ave., Detroit, Mich.
General Scientific Equipment Co., North Philadelphia, Pa.
Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich. "Kant-Leak."
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Nagel Electric Co., The W. G., 28-32 St. Clair St., Toledo, Ohio.
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.

GAGES, PRESSURE.—Pressure gages are used to indicate or record the pressure of a gas or liquid. There are several types of gages used for special purposes described herewith, some of which are pressure gages, but there are many other uses of pressure gages, such as for air-brake or other compressed-air systems, hydraulic presses, ammonia compressors, etc. Many of these gages are made on the spring principle, having a coiled tube to which the gas or liquid is admitted, and a device for transmitting the motion obtained, when the internal pressure causes the tube to uncoil, to the recording or indicating system. For very accurate measurements on low pressures mercury columns or liquid gages are generally used. Other gages suitable for low-pressure measurement have a diaphragm tube movement. The principle is that of a small bellows having one side stationary; the motion of the opposite end is transmitted to the indicating device.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Ashton Valve Co., Boston, Mass.
BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Crosby Steam Gage & Valve Co., Boston, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. Gages furnished with air brake equipments for electric railway service. See adv. pages 1203-1223.—Adv.
Lonergan Co., J. E., 211-215 Race St., Philadelphia, Pa. (high-pressure water)
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Columbia."

GAGES, SCREW PITCH.—The screw-pitch gage is used to determine the pitch of screw threads of unknown cutting. It consists of a number of small templates generally mounted together on a pin or a ring. Each template has cut along one edge teeth which will fit exactly some size of threading, the size being stamped on the template. They are of importance when making apparatus to duplicate exactly a specimen or sample.

Manufacturers:

Ashton Valve Co., Boston, Mass.
Athol Machine Co., Athol, Mass. "Athol."
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

GAGES, STEAM, INDICATING.—The steam indicating gage is primarily an indicating device to allow the engineer or fireman on duty at the boiler to know the steam pressure at any moment so that he may govern his firing accordingly. The type in most common use utilizes the tubular expansion spring principle which is commonly used in all pressure gages. Where vibration is excessive, a double spring is substituted to give greater strength to the instrument.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Foxboro Co., Inc., The, Foxboro, Mass.
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "World."
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
Pierce, Butler & Pierce Mfg. Corp., 2822 James St., Syracuse, N. Y.
Precision Instrument Co., 21 Halsey St., Newark, N. J.

GAGES, STEAM, RECORDING.—To obtain the highest boiler efficiency it is necessary that charts be kept which will give an accurate record of the behavior of the boilers at all times and under all conditions. It is the purpose of the recording steam gage to furnish such a record of the steam pressure. These gages utilize the expansion-spring-tube principle for registering the steam pressure, but the device is usually more complex than the indicating types. The record is generally made on a rotating paper dial which is driven by a clock mechanism.

Manufacturers:

Aschroft Mfg. Co., 119 W. 40th St., New York, N. Y.
Ashton Valve Co., Boston, Mass.
BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crosby Steam Gage & Valve Co., Boston, Mass.
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Foxboro Co., Inc., The, Foxboro, Mass.
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Columbia."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

GAGES, TRACK.—An instrument for determining whether or not the two rails forming a track are at the proper distance from each other. Track gages vary somewhat in design, according to the make and type of rail with which they are to be used. As a usual thing they consist of a stiff bar with one end so arranged that when properly placed in contact with one rail the bar will be at right angles to the track and a point on the other end will accurately indicate the proper position of the other rail.

Manufacturers:

Aldon Co., 3338 Ravenswood Ave., Chicago, Ill. "Huntington."
Buda Co., The, Harvey, Ill. "Huntington," "Cafrey-Huntington," "McManus."
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

GAGES, VACUUM.—For accurate measurement of vacuum the mercury absolute-pressure gage is used. This instrument is simply a special form of mercury barometer. Air-bell float and spring-tube gages, very similar to draft gages, are sufficiently accurate for ordinary uses and are the most common forms of these gages. They are used for measuring low pressures in plants employing industrial vacuum or suction processes, power plants utilizing condensing equipment, and in laboratories, etc.

Manufacturers:

Ashton Valve Co., Boston, Mass.
Bacharach Industrial Instrument Co., 422 1st Ave., Pittsburgh, Pa. "Hydro."
BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Foxboro Co., Inc., The, Foxboro, Mass.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "World."
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corp., 282 James St., Syracuse, N. Y.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Columbia."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Uehling Instrument Co., Paterson, N. J.

GAGES, WATER LEVEL, ELECTRICALLY OPERATED.—These gages are used largely for recording water levels in streams, tanks, reservoirs, standpipes, sumps, etc., which are located at points remote from the observer or which must be located at points inaccessible for reading by the operator. The indicating device is actuated electrically through controls situated at the tank or other water body. These controls are operated by the water level, using a resistance varied by the water level, a series of contacts operated in succession by the various stages of the water or by a float actuating a relay or contactor device.

Manufacturers:

Foxboro Co., Inc., The, Foxboro, Mass.
Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
Leupold, Voelpel & Co., 107 E. 70th St., N., Portland, Ore. (long distance) "Stevens."
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

GAGES, WIRE.—The sizes of wire are standardized through a series of numbers for the various diameters made. These are known as the wire gage and in the copper wire standard they run from No. 0000, which is 0.46 inch in diameter, down to No. 40, which is 0.00314 inch in diameter. There is one wire gage for copper, another for iron and steel and another for heavy cables in sizes larger than the wire gage table provides for.

The American Wire Gage, formerly known as the B. & S. Gage, has been adopted by the United States Bureau of Standards and the American Institute of Electrical Engineers as the standard for copper wires.

The Steel Wire Gage, formerly known as the Washburn & Moen Gage, has been likewise standardized as the gage for iron and steel wires. The gage numbers in the Steel Wire Gage represent diameters which are about two sizes larger than corresponding numbers in the American Wire Gage.

The Birmingham Wire Gage, also known as the Stubb's Wire Gage, was established in England and has been used largely there, and is used in the United States for iron and steel wire. Iron wire used for telephone and telegraph lines and steel armor wire for use on cables are commonly designated by this gage.

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The Circular Mil Gage, originally devised to meet the large cable sizes used in Edison low-tension distribution systems, is made up by dropping the last three ciphers from the circular-mil area of the cable. Thus a 500,000-c.m. cable is referred to as a 500 cable, a 1,000,000-c.m. cable as 1,000, etc. This gage is not widely used, it being more customary to refer to large cables by their full circular-mil area.

Manufacturers:

Brown & Sharpe Mfg. Co., Providence, R. I.
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Peck, Stow & Wilcox Co., The, Southington, Conn.
Starrett Co., The L. S., Athol, Mass.

GAGES, WIRE-MEASURING.—For quickly determining the size of any wire a template called a wire gage is used. This is a circular disk in the rim of which are cut slots of various widths, each one corresponding exactly to the diameter of one of the wire sizes. Each slot is marked with corresponding wire gage size. The gages are made to correspond to wire sizes of the various standard wire gages, one wire-measuring gage being applicable only to the gage for which it was cut. These gages are very convenient and widely used.

Micrometer calipers are also used for wire measurement, but are not as convenient nor as rapid to use. They measure the wire diameter in mils, which must then be compared to a table of wire sizes.

GAINADAY.—Trade name for electric washing machines manufactured by the Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa.

GAINS, STEEL.—The incision made in a pole to provide a flat surface for the crossarm is called a gain. On concrete or tubular steel poles this is provided for by a cast iron or steel gain fastened to the pole. Pressed-steel gains have also been used to some extent on wood poles to avoid cutting the gains in the wood.

Manufacturers:

HALLETT IRON WORKS, Harvey Ill. The Hallett steel gain, as illustrated below, is a recently improved, simple, strong and efficient device for attaching crossarms to poles. It lengthens the life of poles by doing away with the cut gain which is responsible for much of the rapid pole line deterioration. It does away with the necessity of braces on short crossarms. In the building of telephone, telegraph, electric light and power transmission lines, it permits an improved construction which is cheap, practical and valuable. The Hallett steel gain, as it has been



Hallet Steel Gain

recently improved, consists of a pole plate and a gain plate of galvanized steel. All that is necessary to attach the gain and arm to the pole is to place the gain on the arm and insert the through bolt. Tightening up the through bolt causes the struts on the gain plate to press against the pole plate. This in turn causes the pole plate to grip very tightly about the pole. It is necessary when ordering, that vertical dimension of crossarms be given because the gain plate is made to conform to this dimension. See advertisement on page 1254.—Adv.

GAIR CO., ROBERT.—Brooklyn, N. Y. Manufacturer of corrugated fiber shipping boxes, cartons, labels, etc.

GAITES, PEACE & CO., INC.—204 Willoughby St., Brooklyn, N. Y. Manufacturer of lighting fixtures. Business established 1891. President and treasurer, J. M. Ehrlich; secretary, M. C. Abuza.

GALE'S.—Trade name for commutator compounds manufactured by K. McLennan & Co., 1751-9 W. 35th St., Chicago, Ill.

GAL-FAR.—Trade name for medical batteries manufactured by the Milo-Bar Bell Co., 301 Diamond St., Philadelphia, Pa.

GALION IRON WORKS & MFG. CO., THE.—Galion, Ohio. Manufacturer of motor-driven car unloaders. President and general manager, D. C. Boyd.

GALL-MONTLAUR PROCESS.—One of the early processes for the electrolytic production of chlorates.

GALVADUCT.—Trade name for interior rigid conduit, conduit couplings, nipples and unions manufactured by the Garland Mfg. Co., West Pittsburgh, Pa.

GALVANI, LUIGI.—An Italian physician and anatomist, and the discoverer of current or "galvanic" electricity. He was born at Bologna in 1737 and died in 1798. In 1762 he was appointed professor of anatomy in the University of Bologna. Galvani owes the wide celebrity attached to his name to his discoveries in animal electricity, which led to his conclusion that the source of electricity lay in the nerves, and that the metals which are necessary served merely as conductors.

GALVANIC.—An old term used to describe apparatus using or operating by the energy of a primary battery or voltaic cell. The term comes from the name of its discoverer, Luigi Galvani, an Italian physician, who while dissecting the legs of a frog accidentally allowed them to come into contact with dissimilar metals, which caused muscular action in them. The action was attributed to the metallic contact and led to the construction of the voltaic pile by Volta.

Physicians and manufacturers of electrotherapeutic apparatus still use the term and refer to galvanic cells or batteries, galvanic current, galvanic cabinets (cases containing a primary battery and electrodes), galvanic cautery, galvanic electricity, etc.

GALVANIC DEPOSITS.—Deposits of metals or metallic compounds produced by electrolysis. When the electrolyte contains a metallic salt, the metal is often deposited pure upon the cathode; if it is an easily oxidizable metal, it may be deposited out from aqueous solution as metallic oxide. A few metals, under proper conditions, can be deposited from solution on the anode as metallic oxide, usually as that oxide containing the maximum possible percentage of oxygen. Example: lead peroxide from lead nitrate solution strongly acidified with nitric acid.

GALVANIZE.—A term formerly used to refer to any electrical process of plating or depositing gold, silver, zinc or other similar metals on another metal. It was so named because the old term "galvanic electricity" or current electricity was used as long as current could be obtained only from primary (galvanic) batteries. At present the term galvanize is not strictly an electrical term and is applied only to the deposition of zinc on other metals, either by dipping the material in molten zinc or by heating to a high temperature with zinc dust. When an electrical process is used it is called electrogalvanizing, which see. Many materials and metal parts used in the electrical industry are galvanized.

GALVANIZED PRODUCTS CO.—First St., Phillipsburg, N. J. Manufacturer of pole-line hardware. Business established 1917. President and sales manager, E. R. Yarnelle; vice-president, treasurer and general manager, Charles G. Shirer. Factory, E. Stroudsburg, Pa.

GALVANIZING, ELECTRO.—See Electrogalvanizing.

GALVANOMETER.—A galvanometer may be defined as an instrument for the detection or measurement of an electric current. Galvanometers are nearly always very sensitive instruments and are used to detect or immediately to measure very small currents.

There are several types of galvanometers in use, but only one fundamental principle is employed. This is the reaction between a magnet and a current-carrying wire. The tangent galvanometer, which is mainly of historic interest, is an absolute instrument. It consists essentially of a circular coil of insulated wire at the center of which is suspended a small magnetic needle. The reaction between the field due to a current in the coil and the magnetic field of the needle produces a deflection, the tangent of which is proportional to the current. From the known dimensions of the coil and the magnetic moment of the needle the current is calculated. Such galvanometers are known as moving-magnet types.

In the other form the permanent magnet is comparatively large, fixed, and is of the horseshoe form. In the air gap of this is suspended a coil of many turns. The reaction between the current in the coil and the magnetic field of the permanent magnet deflects the coil. This deflection is proportional to the current. Such instruments are called moving-coil galvanometers. The controlling force is due to the torsion of the suspension.

Galvanometers may also be divided into portable and laboratory types. The former are more rugged and are used chiefly as current detectors in Wheatstone bridge measurements or for demonstration use in lectures or by elementary students. The laboratory type is used for very sensitive current detection and measurement of such high accuracy as can seldom be effected outside a laboratory. The deflection of the needle or coil of laboratory galvanometers is almost invariably read from a scale by reflection from a mirror mounted on the movable element. The reading is usually observed by a telescope, with its tube at right angles to the scale at zero, focused on the mirror. For demonstrations and abroad a lamp and scale are used, the lamp having a narrow luminous slit on the zero of the scale.

Ballistic Galvanometer is one whose movable element has a comparatively large moment of inertia and comparatively small restoring moment due to the suspension. It may be either of the movable-magnet or movable-coil type. The ballistic galvanometer is used in comparing capacitances and in measuring flux densities in iron.

String Galvanometer. This may be considered a special form of movable-coil galvanometer. The movable element of the galvanometer is a fine silvered quartz fiber or a very fine wire. This is stretched at right angles to a strong magnetic field due to an electromagnet. When a current is sent through the fiber of the galvanometer, it moves across the field. This motion is observed through a microscope with a magnifying power of about 100 diameters. Such an instrument is very sensitive, but it may have an uncertain zero, and the fiber may move out of focus.

Vibration Galvanometer is one whose free period of vibration is the same as that of the current to be measured or detected. The period may be varied by adjusting the length and tension of the suspension, and when its period is the same as that of the actuating current, a very weak current will produce a comparatively large deflection. The same principle is used in frequency meters. Such a galvanometer is valuable in a-c. bridge measurements. It may be of either the movable-coil permanent-magnet type or the movable-magnet type.

Thermal Galvanometer. This is a movable-coil permanent-magnet galvanometer. A fine wire coil is suspended between the poles of a strong magnet as in the other forms, but the coil terminates in a bismuth-antimony thermocouple. This couple is close to a heating coil through which the current to be detected or measured is passed. The heating of the thermocouple causes a current to flow in the coil, which in turn produces a deflection as in other galvanometers.

GALVANOMETER CONSTANTS.—For many measurements the galvanometers must first be calibrated. This is done by determining the deflection corresponding to unit quantity, or what quantity is necessary to produce unit deflection. For the tangent galvanometer the constant is the strength of field produced at the center of the coil by unit current. This constant depends upon the radius and number of turns on the coil.

The constants of other types of galvanometers have distinctive names, such as coulomb constant, ampere constant, megohm constant and volt constant. These

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are characteristics of what is known as sensitivity of the galvanometer.

Galvanometer Sensitivity is that characteristic of a galvanometer which determines the degree of accuracy of its measurements, and which gives some indication of its suitability for certain kinds of measurements. It is measured by the deflection produced by unit quantity or, conversely, the quantity necessary to produce unit deflection. All sensitivity constants are expressed in terms of the deflection on a scale one meter from the mirror of the galvanometer.

The ampere constant is the deflection produced by one microampere.

The volt constant is the deflection produced by one microvolt. The volt constant is equal to the microampere constant divided by the resistance of the galvanometer.

Megohm constant is the resistance expressed in megohms that must be connected in series with the galvanometer to reduce the deflection to one millimeter under an e.m.f. of one volt. Numerically this is the same as the microampere constant.

Coulomb constant is a constant of ballistic galvanometers. It is the deflection produced by one microcoulomb.

A galvanometer with a large ampere constant is desirable for high-resistance measurements, such as insulation resistance. One with a high volt constant is desirable for measuring small differences of potential and for use with low-resistance bridges, potentiometers, etc. A galvanometer with a high coulomb constant is desirable for magnetic measurements and for the comparison of small capacitances.

GALVANOMETER, MIRROR.—A receiving instrument used in telegraphy, operating like a laboratory galvanometer and originally used in submarine cable working. A moving coil connected in the cable circuit was fitted with a small mirror, which reflected a beam of light upon a reading screen. The movement of the beam of light is sufficient to enable the message to be read easily, even though the current actuating the galvanometer is extremely small.

GALVANOMETERS, LABORATORY.—Laboratory galvanometers are generally considered to be stationary or semiportable instruments; because of the delicate suspensions and the time required to set up a galvanometer, they are very seldom moved. They are usually set up on a mounting in a room where they will be practically free from external vibrations. In some cases extremely sensitive instruments are placed on a special pedestal or column that runs down to the ground, being entirely separate from the rest of the building and having its own foundation. Less sensitive instruments used for general testing purposes do not require such protection and are often of a semiportable nature.

The classes of galvanometers most used for laboratory purposes are sensitive moving-coil, ballistic and vibration galvanometers. The ballistic galvanometers are used to measure the quantity of electricity, as from the discharge of a condenser or the induced charge in a secondary circuit. With certain modifications they may also be used as fluxmeters to measure magnetic induction. Very sensitive moving-coil instruments which measure the permanent deflection rather than the first throw, as is done in the ballistic galvanometer, are also used very extensively in connection with potentiometer and other delicate tests. The vibration galvanometer is used for a-c. measurements.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
Beck Bros., 3648 N. 2nd St., Philadelphia, Pa.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "Delta."
Hindel, Charles F., 45 Spring St., Ossining, N. Y. "American."

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass. "Paul Unipivot."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
Sticht & Co., Herman H., 15 Park Row, New York, N. Y.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

GALVANOMETERS, PORTABLE.—Portable galvanometers are used in general testing work and in laboratory work where extreme sensitivity is not required. They are generally rather small and rugged instruments of the moving-coil type, either of the D'Arsonval or electrodynamometer principles. The operation is similar to the laboratory instruments except that the deflection period of portable instruments is much smaller than for laboratory types, and because of their suspension they are less sensitive and more rugged. Jewel bearings are generally employed and the moving element is supported on a steel pivot. Delicate fiber suspensions are but little used. Portable galvanometers are generally used in zero current determinations, as in portable potentiometer and Wheatstone bridge work and other similar testing sets. The zero of the scale is commonly in the center and the value of the other indications is frequently not given on the scale.

Manufacturers:

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa. (for blasting units)
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
General Radio Co., 11 Windsor St., Cambridge, Mass.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass. "Paul Unipivot."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sticht & Co., Herman H., 15 Park Row, New York, N. Y.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

GALVANOSCOPE.—A simple form of galvanometer that usually cannot be used for determining the value of a current but merely to indicate its presence. When the movement of the needle is calibrated, the instrument is called a galvanometer.

GAMEWELL FIRE ALARM TELEGRAPH CO., THE.—Newton Upper Falls, Mass. Manufacturer of police telephoning and signaling systems, fire alarm systems and accessories therefor. Business established 1864. President, William Gellatly; vice-president and general manager, V. C. Stanley; secretary and treasurer, W. C. Beck. Main office, Chestnut St., Newton Upper Falls, Mass. Branch offices, 200 Devonshire St., Boston, Mass.; 5708 Grand Central Terminal, New York, N. Y.; 417 S. Dearborn St., Chicago, Ill.; 312 Jacobson Bldg., Denver, Colo.; 1007 Aronson Bldg., San Francisco, Cal.; Atlanta, Ga.

GAMMA RAYS.—These are very penetrating rays of the same character as X-rays. They are ether pulsations of very short wave length which are produced by radioactive substances simultaneously with the beta rays.

G. & G.—Trade name for electric automobile heater manufactured by the G. & G. Electric Heater Co., Lafayette, Ind.

G & G.—Trade name for telescopic hoists manufactured by Gillis & Geoghegan, 537-539 W. Broadway, New York, N. Y.

G. & G. ELECTRIC HEATER CO., THE.—Lafayette, Ind. Manufacturer of electric automobile heaters.

G & W—Trade name for electrical distribution specialties made by the G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill.

G & W ELECTRIC SPECIALTY CO.—7430-52 S. Chicago Ave., Chicago, Ill. Manufacturer of electrical distribution specialties. Business established 1909. President, Paul F. Williams; vice-president and treasurer, H. B. Gear; secretary and general manager, George P. Edmonds; sales manager, A. Lund. Sales representatives, McClary-Jemison Machinery Co., Birmingham, Ala.; Charles Farnham, 207 I. W. Hellman Bldg., Los Angeles, Cal.; White & Converse, Minneapolis, Minn.; Electric Power Equipment Co., 519 W. 38th St., New York, N. Y.; Scheifer Electric Co., E & B Bldg., Rochester, N. Y.; Electric Power Equipment Co., 13th & Wood Sts., Philadelphia, Pa.; Electric Material Co., 539 Howard St., San Francisco, Cal.; W. R. Hendrey & Co., Hoge Bldg., Seattle, Wash.; White & Converse, St. Paul, Minn.; Robert H. Anthony, 261 Franklin St., Chicago, Ill.; General Supplies, Ltd., 122 W. 11th St., Calgary, Alta., Canada; A. H. Winter Joyner, Ltd., 62 Front St., W., Toronto, Ont., Canada.

GANSCHOW CO., WILLIAM.—Morgan St. & Washington Blvd., Chicago, Ill. Manufacturer of gears and pinions. Business established 1880. President, William Ganschow; secretary, C. F. Goedke; treasurer, E. J. Ganschow. Branch offices, 50 Church St., New York, N. Y.; 4835 Woodward Ave., Detroit, Mich.

GANTRY CRANE.—A crane which is supported from the ground by two vertical steel towers. The towers may be stationary, or may be equipped with wheels and suitable propelling equipment, so that they may travel on rails on the ground. See Cranes, electric, miscellaneous.

GAP, AIR.—See Air gap.

GAP, RADIO.—See Spark gaps, radio.

GAPCO.—Trade name for automobile wiring assemblies and magneto parts manufactured by the Grossman Auto Parts Co., White Plains, N. Y.

GARAGE, ELECTRIC VEHICLE.—The equipment in a garage in which electric vehicles are housed and maintained in good operating condition is quite interesting from an electrical standpoint. While many small garages, in which a single electric passenger or pleasure car is kept, do not differ greatly from an ordinary garage unless provided with charging equipment, there are many large and specially equipped garages for fleets of electric vehicles. Large merchandising houses or other industrial concerns having an extensive delivery service often operate a fleet of electric vehicles for this purpose. The operation of a fleet is more economical than operating one or a very few cars. The investment cost of the garage and charging equipment and labor cost of the necessary attendant to care for a single car is relatively high in proportion to the mileage obtained. When the number of cars increases to the proportions of a fleet the fixed charges and maintenance costs per car decrease rapidly.

The electrical equipment comprises the necessary battery-charging motor-generator, converter or rectifier and control equipment, together with a local distribution system so that several cars or trucks may be charged simultaneously while in their proper places. Where direct-current service is available the charging equipment consists essentially of a control switchboard having a separate panel for each charging circuit. A double-pole double-throw knife switch with suitable fuses is supplied for each circuit together with a rheostat which makes it possible to start the charge at the proper rate and reduce

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the current in suitable steps to the final amount required. A potential receptacle permits a voltmeter to be plugged in at any time to measure the voltage and similarly an ammeter to indicate the charging rate.

Charging from alternating-current sources is very common as a large percentage of garages are supplied with this form of energy only. This necessarily involves a conversion from alternating to direct current and four types of conversion apparatus may be employed, according to the size of the installation. For a very large garage polyphase synchronous converters are used. Motor-generator sets are made in a number of sizes and ratings and are suitable for smaller installations and for either single-phase or polyphase supply. Single-phase synchronous converters are also made in smaller ratings for this service. In other cases, rectifiers are used, generally of the mercury-arc type. The switchboards for such installations have separate panels for each circuit, generally arranged so that they may be added from time to time as the number of cars increases; they also have the necessary control equipment for the conversion apparatus. A water still and other battery maintenance and vehicle washing equipment is usually provided.

GARCO.—Trade name for asbestos gaskets, wick and rope packing and metallic brake band lining manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

GARCOBESTOS.—Trade name for asbestos metallic sheet packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

GARDEN CITY.—Trade name for blowers and ventilating fans manufactured by the Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill.

GARDEN CITY CHANDELIER CO.—552 W. Jackson Blvd., Chicago, Ill. Manufacturer of lighting fixtures.

GARDEN CITY FAN CO.—332 S. Michigan Ave., Chicago, Ill. Manufacturer of electric ventilating fans and blowers. President, E. D. Green; secretary, T. J. Flanagan; sales manager, W. Gardner.

GARDI.—Trade name for grinding wheel dressers manufactured by the Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa.

GARDNER GOVERNOR CO., THE.—Quincy, Ill. Manufacturer of electric and turbine driven pumps, motor-driven air compressors and governors. Business established 1859. President, J. Willis Gardner; vice-presidents, J. W. Wall and P. H. Gardner; secretary and treasurer, R. G. Gardner; sales manager, J. W. Wall. Main office and factory, 1 Williamson St., Quincy, Ill. Branch office and warehouse, 604 Arch St., Philadelphia, Pa. District offices, Fisher Bldg., Chicago, Ill.; Singer Bldg., New York, N. Y. Sales representatives, Rix Compressed Air & Drill Co., San Francisco and Los Angeles, Cal.

GARDNER MACHINE CO.—Beloit, Wis. Manufacturer of grinding and polishing wheels. President, L. W. Thompson; vice-president, F. E. Gardner; secretary, W. C. Ackley; treasurer, W. B. Leishman.

GARDNER-RIX.—Trade name for motor-driven air compressors and electric vacuum pumps manufactured by the Gardner Governor Co., 1 Williamson St., Quincy, Ill.

GARFIELD MFG. CO.—Garfield, N. J. Manufacturer of molded insulation, insulating materials, wiring devices, etc. Business established 1908. President and general manager, B. H. Howell; vice-president, H. W. Appleton; secretary, Eugene Nelley; treasurer, A. Meister; sales manager, B. A. Appleton.

GARLAND.—Trade name for car ventilators manufactured by Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill.

GARLAND MFG. CO.—West Pittsburgh, Pa. Manufacturer of armored cables, cord, interior conduit and fittings. Business established 1897. President, Robert Garland; secretary and sales manager, F. C. Hodkinson; treasurer, Charles Garland. Main office and factory, West Pittsburgh, Pa. Branch offices, 804 Citizens Bldg., Cleveland, Ohio; 509-11 W. 27th St., New York, N. Y. Sales representatives, S. B. Condit Jr. & Co., 297 Franklin St., Boston, Mass.; M. B. Austin & Co., 700 W. Jackson Blvd., Chicago, Ill.; B. K. Sweeney, 231 15th St., Denver, Colo.; H. C. Biglin, 29 Poplar St., Atlanta, Ga.; Elliott Reynolds, 63rd & Oxford Sts., Philadelphia, Pa.

GARMENT PRESSERS.—See Irons, electric, pressing, tailors'.

GARMENTS, ELECTRICALLY HEATED AVIATORS'.—Coat and gloves having in the lining of the apparel heating elements with suitable connections so that these elements may be heated by current from a storage battery in the same manner as warming pads are heated by connection to an ordinary lighting circuit. High levels of the atmosphere are extremely cold, so that when ascending to great heights in an airplane or balloon these electrically heated garments are found practically necessary.

GARMENTS, FIREPROOF, FOR FURNACE TENDERS, WELDERS, ETC.—Where very intense heat or spattering liquid metal makes it necessary, furnace tenders, welders and other workmen so exposed wear outer garments of fireproof materials. These garments are commonly of asbestos cloth made up in coats, pants, overalls, or aprons. Where the hazard is not so great, fireproofed leather aprons, similar to a blacksmith's apron, are used. Also see Shoes, boots, leggings, etc., fireproof; Gloves, fireproof.

Manufacturers:

Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill.

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."

GARRETSON.—Trade name for dental X-ray chairs manufactured by the Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

GARRISON.—Trade name for electrically operated domestic stoker manufactured by the Domestic Stoker & Mfg. Co., 519 Atlas Bldg., Salt Lake City, Utah.

GARTON-DANIELS.—Trade name for electric railway specialties manufactured by the Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa.

GARUTI ELECTROLYZER.—An electrolytic cell for the production of hydrogen and oxygen from a caustic potash (KOH) electrolyte.

GARVIN MACHINE CO., THE.—Spring & Varick Sts., New York, N. Y. Manufacturer of motor-driven surface grinders, tapping machines, coiling machines and other metal working machine tools. Business established 1865. President, Burr K. Garvin; vice-president, Warren Garvin; secretary, H. R. Garvin; treasurer, George Maclagan; general manager, Roger B. Garvin; sales manager, Frank A. Power.

GAS.—A fluid form of matter having neither independent shape nor definite volume but tending to expand indefinitely. Gases are either elements, such as hydrogen, oxygen, nitrogen, chlorine, or they are chemical compounds such as carbon dioxide, methane, sulphur dioxide, ammonia, etc. At normal temperatures they are gases, but at low temperatures and high pressures they may be liquefied. Several kinds of gas are used for illuminating and power purposes. The latter application is of interest to the electrical industry.

GAS CELLS.—Primary cells of various designs in which it has been attempted to convert into electrical energy the chemical energy of various gaseous reactions, such as $2\,CO+O_2\,2\,CO_2$. None of the attempts in this direction has proved commercial.

GAS-ENGINE IGNITERS.—See Igniters, electric, internal-combustion engine.

GAS-FIXTURE ATTACHMENTS.—See Attachments, electric, for gas fixtures.

GAS LIGHTERS, ELECTRIC.—See Lighters, gas, electric.

GAS LIGHTING, ELECTRIC.—Where gas lighting fixtures are still in use they are sometimes equipped with an electric attachment to produce a spark when the gas is turned on that will ignite it. These attachments are described under Lighters, gas, electric, which see.

GAS METERS, ELECTRICALLY OPERATED.—The accurate measurement of large flows of gas has been almost impossible with the types of gas meters ordinarily used. The output of large artificial gas works, natural gas supply systems, blast-furnace and coke-oven gas supplies, etc., should be accurately measured, however. This is now possible by means of an electrically operated gas meter. With this type an electric resistance heating coil is placed in the gas main; this heats the gas and causes a definite change in temperature that is measured by two screen-resistance thermometers. There is a definite relation between the watts input to the heating coil, measured by a wattmeter, the difference in temperatures and the volume of gas flowing. The meters are generally arranged to maintain a constant temperature difference and the flow is therefore directly proportional to the watts input. The wattmeter can therefore be calibrated to record the flow directly.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The Thomas Meter is operated electrically in a very unique way. An electric heater is placed in the path of the gas, warming it just 2°F. as it flows through the meter. Electric thermometers on the entrance and exit sides of the meter indicate this temperature rise. A suitable regulator varies the heater current, in accordance with the rate of gas flow, so that it is always just enough to warm the gas 2°. A meter measures the electric energy consumed by the heater in warming the gas. A measure of the electric energy required to warm the gas is a measure of the quantity of gas flow, independent of its pressure and temperature. As each standard unit of gas contains the same "quantity of stuff," regardless of pressure and temperature, it requires the same quantity of energy to warm it 2°. As a result, the Thomas Meter measures gases directly in standard units without any corrections or calculations whatever. In all former methods of gas measurement it was not possible to measure directly the quantity of gas flowing without regard to the variable conditions existing in the pipe line. It was necessary to make tedious corrections for temperature, pressure, etc., before the actual volume of gas could be ascertained. The Thomas Meter gives results directly in standard cubic feet. The Thomas Meter is made up of a housing, a regulator and a recorder panel. A heating unit and two thermometer units are mounted in the housing and this is placed directly in the pipe line. The recorder panel may be located several hundred feet away from the housing in the office of the superintendent, or wherever the records are most convenient. The recorder panel contains both totalizing and graphic instruments. By means of the totalizing instrument, the total gas output can be obtained for accounting purposes. The graphic record charts the gas flow. Thomas Meters are manufactured in capacities from 2,000,000 cu. ft. per hour to 25,000 cu. ft. per hour, and less.—Adv.



Thomas Meter Recorder Panel

Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.

GAS PLIERS.—See Pliers, gas.

GAS PRODUCERS, POWER PLANT.—Gas producers are used in power plants to produce gas out of coal or other fuel containing volatile constituents. They are large cylindrical or rectangular furnaces in which fuel is burned in a thick bed through which air or steam is circulated. Their use is one means of making possible the consumption of very poor grades of such fuels, the gas produced being utilized in internal-combustion engines. With bituminous coals the volatile matter is given off as hydrocarbon gases, which may include or be further broken up into methane, carbon monoxide and hydrogen by the heat in the producer. Anthracite coals cannot be used in this manner because of their relatively small amounts of volatile matter. Consequently gas is produced from anthracite coal by adding air, giving the reaction $2C+O_2=2CO$ (carbon+oxygen=carbon monoxide); when steam only is added, the reaction becomes $C+H_2O=CO+H_2$; if both

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steam and air are admitted to the combustion zone the reaction is $3C+O_2+H_2O=3CO+H_2$. The first of these processes is but little used, the second is used to make "water gas" for city distribution chiefly, and the third is the one most commonly used to make "producer gas," both anthracite and coke being used as fuel.

Gas producers are of two general types, suction producers and pressure producers. In the first type a flow of air, steam and gas is obtained by means of the slight difference of pressure due to the pump action of a four-cycle gas engine on the charging stroke, or by an extractor. Pressure producers are independent of the engine and obtain the gas flow by means of a pressure fan or blower for the air supplied and a boiler for the steam. Producers are further subdivided according to the direction of the draft as either up-draft or down-draft. The up-draft producers are arranged with the steam and air admitted at the bottom. The gas produced is removed from the top and contains some tar that must be removed by passing through scrubbers and purifiers. In down-draft producers the gas is removed under the fire-brick grate at the bottom and the air and steam are introduced at the top.

In using suction producers, the gas is not allowed to escape into the operating room and, as the carbon monoxide (CO) is very poisonous, this is quite important. Small-sized producers of this type do not generally have a suction fan, relying on the engine suction. Most of the down-draft producers are suction types, with exhaust fans used at the bottom.

Pressure producers always require a fan or steam-jet blower to produce the draft. When the steam is used it also enters into the reaction or gasification. The gas produced in this way requires more extensive cleaning, but the grates may be cleaned more easily in this type than with the down-draft or suction types. Mechanical stoking or poking may be employed. Provision is usually made with gas producers of nearly all types to recover valuable by-products, such as ammonium sulphate, benzol, toluol, tar, etc. To do this requires much more skilled attention than in the case of using the fuel directly under a steam boiler.

Manufacturers:

Akerlund & Semmes, Inc., 17 Battery Pl., New York, N. Y.
Downingtown Iron Works, Inc., Downingtown, Pa.
Flinn & Dreffein Co., 431 S. Dearborn St., Chicago, Ill.
Koppers Co., The, Union Arcade, Pittsburgh, Pa.
Otto Engine Mfg. Co., 33rd & Walnut Sts., Philadelphia, Pa.
Smith Gas Engineering Co., The, Dayton, Ohio. "Smith."
Toledo Metal Manufactures Co., Toledo, Ohio.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M." "Hughes."
Worthington Pump & Machinery Co., 115 Broadway, New York, N. Y.

GASCO.—Trade name for packings, washers, dies, etc., made by the Gasket Supply Co., 1729 Ludlow St., Philadelphia, Pa.

GASKET SUPPLY CO., THE.—1729 Ludlow St., Philadelphia, Pa. Manufacturer of gaskets, packings, washers, etc. Business established 1904. Sole owner, J. E. Wagenseller.

GASKETS, FELT.—See Felt cushions, gaskets, wicks, etc.

GASKETS, PIPE, VALVE, CYLINDER, ETC.—A gasket is a round flat ring of metal, asbestos, hemp, felt, rubber, or any other material used for packing or making tight a joint in a pipe, valve, cylinder head, etc. They resemble a washer in appearance but are generally of larger size and the width of the flange is usually small in proportion to the inside diameter of the gasket. There are a number of places in power-plant construction where gaskets are required in pipe lines, valves, small pump cylinders, etc. For heavy-duty service special packings are used in place of simple gaskets; for these see Packing, cylinder, piston, turbine, etc.

Manufacturers:

Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio. "Akro-Metal," "Summit," "Duplex."
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Asbestos Fibre Spinning Co., North Wales, Pa. (asbestos)
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brandt, Randolph, 70 Cortlandt St., New York, N. Y.
Chicago Leather & Mercantile Co., 1848-50 W. 14th St., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y. "Silver Thread."
FITZGERALD MFG. CO., THE, Torrington, Conn. "Never-Leak."
Gasket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa. "Right."
General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C. "Garco."
Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J. "Devo," "Goetzerit," "Triumph."
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Guillott Metal Gasket & Supply Co., 24-30 S. Clinton St., Chicago, Ill.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Metallo Gasket Co., New Brunswick, N. J. "Bethany."
No-Leak-O Piston Ring Co., 824 W. North Ave., Baltimore, Md.
Phoenix Specialty Mfg. Co., 48-50 Duane St., New York, N. Y.
Quaker City Rubber Co., 629 Market St., Philadelphia, Pa. "Regal," "Skihi," "Ebonite."
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa.
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

GASKETS, RUBBER.—Rubber gaskets are widely used in the construction of marine, water-tight and vaporproof fixtures. They are used in these to make a water-tight joint between the outer enclosing glass globe and the threaded globe-holding ring. A good quality of rubber is used in making these gaskets. Rubber gaskets are also used for a number of other purposes, such as in air or water hose, low-temperature piping systems, etc., and where the gasket is to be used merely for packing and leak-preventing purposes and is not depended on for great strength or special wearing qualities.

Gaskets are also used with various marine and underground conduit boxes and fittings to give water-tight joints. They are made rectangular in shape, both with and without openings, and also octagonal or round, in either the solid or open types.

Manufacturers:

Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Chicago Leather & Mercantile Co., 1848-50 W. 14th St., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Diamond Rubber Co., The, Akron, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Gasket Supply Co., 1729 Ludlow St., Philadelphia, Pa. "Right."
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.
New York Belting & Packing Co., 91 Chambers St., New York, N. Y.
Paiste Co., H. T., Philadelphia, Pa. "Pipe-Taplets." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Salisbury & Co., Inc., W. H., 308-10 W. Madison St., Chicago, Ill.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

GASOLINE.—A volatile distillate from crude petroleum. Sp. g. 0.66 to 0.69; b. p. 70° to 90° C. Gasoline is very widely used as a fuel in internal-combustion automotive and stationary engines; in the latter it is used a great deal in farm lighting plants and in other small electric power plants.

GASOLINE ENGINES.—Gasoline engines are of importance to the electrical industry because of their application to small power plants and farm lighting sets. See Engines, internal-combustion, gas, gasoline or oil; also Farm lighting and power plants.

GASPROOF.—Electrical apparatus is spoken of as being gasproof when so constructed or protected that the specified gas will not interfere with its successful operation.

GASSING, STORAGE BATTERY.—During the charge of a storage battery, the action of the charging current chemically reconverts the active materials back to the form wherein they can again serve as the source of e. m. f. As the charge proceeds and this conversion steadily progresses, there is less and less useful work for the current to do. It has been found to be the best practice to reduce the current as the conclusion of the charge approaches. However, in many cases the battery is put on charge at practically constant current throughout. In this case toward the end of charge the excess current not actually required for completing the reconversion process breaks up the water in the electrolyte into its constituent gases, hydrogen and oxygen, the former being set free on the negative plates and the latter on the positives. The bubbles of gas rise from the plates and as they reach the surface of the electrolyte are frequently carried above it in the form of fine spray which consists of small bubbles of gas enclosed in a thin film of electrolyte. This action is called "gassing."

To a certain extent it is an unavoidable accompaniment of the latter part of the charging process. It represents waste in several ways: (1) In that the current in decomposing the water into these gases is doing no useful work; (2) in that the spray of the bursting bubbles causes corrosion of battery connections and surroundings of the cells; (3) in that the bubbles as they emerge from the active material in the plates tend to loosen this material and cause it to be shed and thrown to the bottom of the cell.

For these reasons modern practice favors a gradual tapering down of the current as the charge proceeds and this method of charging, which is sometimes called constant-potential charging, improves the life of the cell since it diminishes the shedding of active material. There is still another objection to the violent evolution of gas during charge which is that the mixture of the hydrogen and oxygen is an explosive one, so that if a flame or spark is brought near the cell an explosion is liable to result which may tear off the cover. On account of the unavoidable gassing, which on a small scale accompanies charging under any conditions, the covers of storage cells are always vented, the vent serving also as means of adding water that has evaporated.

GAS-TIGHT.—Apparatus is designated as gas-tight when so constructed that any particular gas specified will not enter the enclosing case.

GASTROSCOPE.—Apparatus used in examining the human stomach. It generally is accomplished by using an incandescent lamp for illumination and by the use of prismatic reflectors.

GATES, ELECTRIC CAR AND TRAIN.—Electric cars and trains are very frequently equipped with gates on the platforms and steps to prevent passengers from boarding or leaving the train while it is in motion and also as a protection to passengers and trainmen on the platforms or passing between cars. Steel gates are most common and they are made in several forms. Some cars have gates extending from the floor to the top of the platform or doorway, while others only extend a little more than half way. Rigid gates hinged at one side are quite common, and folding gates hinged both at the side and middle are also used, this type occupying a smaller space when open and not requiring as much space to swing in. Folding or telescoping gates that move together into a small space are also used to a limited extent.

Manufacturers:

Brill Co., J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.

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Pitt Composite Iron Works, William R., 548 W. 27th St., New York, N. Y. "Bostwick," "Pitt."

GATES, FLOOD.—Gates are quite commonly used in water-power dams to control or modify extreme flood heights. They are usually designed to be raised so as to permit the escape of the water underneath them.

GATES, HEAD.—Head gates are usually installed at the entrance to a canal or headrace to control the amount of water let in, or to shut it off entirely in case of emergencies or for the purpose of making repairs in the canal in raceway. They are sufficiently substantial to permit the water to be entirely drawn out of the canal, and to protect the plant under flood conditions. The gates are either hand, hydraulic or power-operated, but modern requirements are usually demanding motor hoisting equipment. It is usually necessary to provide protection against ice and logs by floating booms.

GATES, SLUICE.—Gates controlling the flow of water in a sluice, as in a dam to regulate the flow of water through a log-way, or as an auxiliary to a head gate to permit the complete draining of a reservoir for repairing.

GATHERING LOCOMOTIVES.—See Locomotives, electric, mining, gathering.

GAUGE.—A standard of measurement or an instrument used to determine dimensions, pressures or capacity, etc. The spelling "gage" is now preferred and is used throughout the text of this book.

GAULIN.—Trade name for motor-driven homogenizer for milk and cream dealers manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

GAUSS.—The gauss is the unit of magnetic field intensity; it is that magnetic field intensity which gives rise to a force of one dyne upon unit magnet pole. The name gauss is also used for the unit of magnetic flux density; it is equivalent to one maxwell per square centimeter.

GAUSS, KARL FRIEDRICH.—German mathematician, born at Brunswick in 1777, and died at Gottingen in 1855. He was educated at Gottingen, where he solved the problem of how a circle can be divided into 17 equal parts. He calculated, by a new method, the orbit of the newly discovered planet Ceres, and afterwards that of Pallas. In 1807 he became professor of mathematics and director of the observatory at Gottingen. In 1821, being charged by the government of Hanover with the triangulation of that country and the measurement of an arc of the meridian, he rendered the most distant stations visible by means of the heliotrope, an instrument of his invention for reflecting solar light, and in connection with Weber made valuable investigations concerning terrestrial magnetism. The unit of magnetic field intensity is named, in his honor, the gauss.

GAY LUSSAC'S LAW.—More properly called the law of Charles, that the pressure (at constant volume) or the volume (at constant pressure) of a gas varies a constant amount for constant increments or decrements of temperature. Quantitatively, we now say that the volume of a gas (at constant pressure) varies directly as its absolute temperature, that is, as its temperature reckoned from —273° C. or —460° F.

GALYOR, FRANK W.—30 Barclay St., New York, N. Y. Manufacturer of electric egg testers. Proprietor, Frank W. Gaylor.

GAYNER GLASS WORKS.—Salem, N. J. Manufacturer of battery jars. Business established 1874. President, John Gayner; vice-president, J. William Gayner; treasurer and general manager, E. J. Gayner; secretary, John M. Gayner. Factories, Salem, N. J., and Bridgeton, N. J.

GAYNOR MFG. CO., THE.—Bridgeport, Conn. Manufacturer of flush switch plates, sheet metal stampings, etc.

G. B. C.—Trade name for battery charging rheostats manufactured by the Battery Appliance Corp., 3 E. 44th St., New York, N. Y.

G. D.—Trade name for commercial and marine wireless equipment manufactured by Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

GEAR CASES, CAR AND LOCOMOTIVE.—A metal cover surrounding the gearing water, snow and other foreign materials which would cause excessive wear. Made of malleable iron, cast steel or sheet steel, the latter being the preferred material for most installations on account of light weight and ease of repair.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. Keystone steel gear cases are of light weight, being constructed of best quality sheet steel and malleable iron brackets. They are rapidly supplanting the older and heavier types of malleable cases. In manufacturing them the different formed parts as well as the brackets are both riveted and electrically spot welded together.—Adv.



Keystone Steel Gear Cases

Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GEAR GRINDING MACHINE CO.—Conant Rd. & Christopher Ave., Hamtramck, Mich. Manufacturer of ground gears. Incorporated 1908. President, N. C. Banks; vice-president, F. A. Ward; secretary, treasurer and general manager, J. F. Barr.

GEAR SHIFTS, ELECTRIC AND MAGNETIC, AUTOMOBILE.—Mechanisms for shifting the gears on gasoline automobiles electrically or using the principle of an electromagnet. They are intended to eliminate the hand-operated gear-shift lever, and to make driving more pleasant by simplifying gear shifting and permitting a faster get-away. In one form of shift, a small lever mounted on the steering wheel controls the selection of the gear to be meshed, the actual operation being controlled by a switch operated by the clutch pedal. The main unit is mounted on a cross member of the frame directly beneath the front seat. It has two electromagnets, one for neutralizing the gears and the other for shifting. A selecting mechanism in the shift is controlled by the selecting lever on the steering wheel. When it is desired to change the car speed, if driving in first speed, the selector lever is moved to the second speed notch and the clutch disengaged slowly. When the clutch pedal is about half way depressed the neutralizing mechanism operates to disengage the gears, and as the pedal is near the end of the travel the shifting mechanism operates to engage the second speed gear. By releasing the clutch pedal slowly the car will then pick up speed in the next higher gear. The operation is the same for changing to any other gear. Gear shifts of this kind have not yet been very widely used, but no doubt will increase in popularity as their advantages become appreciated.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

GEARING.—Gearing is used to transmit power between shafts where the requirements are such as not to permit slipping. By the use of toothed gears or wheels that are meshed, that is, that have the teeth of one gear engaged with the teeth of the other, a positive drive between shafts is obtained. In this manner it is possible to transmit positively thousands of horsepower, as in a reduction gear for steam turbines, or extremely small amounts, as in a very delicate watch.

Gears are generally divided into two classes, depending upon the form of the teeth. Cycloidal gears are used to transmit energy at rather high speeds. Involute gears do not require as accurate spacing of centers as do cycloidal and they also have thicker teeth at the roots. The added strength due to this increased size very often causes them to be selected for high-torque or heavy-duty service.

A further subdivision of gears is according to their form and the relation between the two shafts. Spur gears are the simplest type, running in the same plane and having their shafts parallel. Bevel, worm and miter gears permit the driving and driven shafts to be at right angles. There are also a number of special forms, such as spiral, helical, herringbone, etc. They all maintain a definite ratio in speed between the driving and driven shaft. This speed is inversely proportional to the number of teeth. Where a large gear and small gear are used together to give a large change in speed, the small one is known as a pinion and the larger one a gear.

The following classifications of gears and pinions are made both with respect to the materials from which the gears are made and their uses.

GEARS AND PINIONS, BAKELITE.—Bakelite is used extensively for making small high-speed gears, which are used to reduce the noise and vibration occasioned by metal gears. They have the advantage over fiber gears that they are not affected by water, steam, many acids, alkalis or oils. Bakelite is also used in combination with other products to produce materials suitable for making gears and known under such trade names as Bakelite-Micarta and Bakelite-Dielecto. The combinations are usually for the purpose of increasing the tensile and compressive strengths. Gears and pinions made of Bakelite may be very accurately molded.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Braun Gear Works, 1321-25 Gates Ave., Brooklyn, N. Y.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass. "Crofoot."
Fairmont Mining Machinery Co., 10th St. & Belt Line, Fairmont, W. Va. "Fairmont."
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Bakelite-Micarta." (See display adv. pages 1395-1402.)

GEARS AND PINIONS, CAR AND LOCOMOTIVE.—The mechanical elements consisting of toothed wheels meshing together by means of which the comparatively high speed of motor armatures is suitably adapted to the required speed of the electric car or locomotive, and the rotative torque of the motor is transmitted to the car or locomotive axles. Made of cast steel and forged steel with cut teeth for railway service, in split and solid designs, the latter being the most frequently used. A modern development is helical gearing which gives promise of increased life and reduction of noise and vibration, as compared to plain spur gearing. For heavy service, such as interurban cars or electric locomotives, gears having springs interposed between hub and rim are frequently used. This type of gear reduces the effect of hammer blows on the gear teeth and reduces shock and vibration.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.

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GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
GENERAL ELECTRIC CO., Schenectady, N. Y. Railway gears and pinions suitable for various classes of service and differing in both chemical and physical characteristics. Each type has its particular field of usefulness, and selection must be governed to a great extent by local operating conditions. See adv. pages 1203-1223.—Adv.
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GEARS AND PINIONS, FAN MOTOR.—The mechanism for oscillating the entire motor and fan body usually consists of a reduction gear and pinion completely enclosed in a gear case which is packed with grease. They are almost invariably worm gears and generally have a worm cut on the motor shaft which drives a worm-wheel and spur-gear train. These are small accurately cut gears, and only consume a small percentage of the power supplied to the fan. The gear train usually operates through a connecting rod to give a slow oscillating motion about a vertical axis while the fan revolves about an approximately horizontal axis. Means for adjusting the angle of oscillation are often provided, also means for stopping the oscillating movement entirely and also for doing this when the fan body strikes any obstruction.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass. "Crofoot."
Foote Bros. Gear & Machine Co., 213 N. Curtis St., Chicago, Ill.
GANSCHOW CO., WILLIAM, Morgan & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GEARS AND PINIONS, FIBER.—Many small gears designed to run at high speeds and carry light loads are made of fiber. They are practically noiseless, even at high speeds, which is impossible with metal gears, and the slight elasticity of the fiber decreases vibration and thus increases the life of the machine and also of the meshing gear. Fiber gears are not affected by oil or grease and require practically no lubrication. They are used quite extensively, especially as pinions meshing with metal gears, but should not be used where subjected to dampness.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
Braun Gear Works, 1321-25 Gates Ave., Brooklyn, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass. "Crofoot."
Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."
Foote Bros. Gear & Machine Co., 213 N. Curtis St., Chicago, Ill.
GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
GENERAL ELECTRIC CO., Schenectady, N. Y. "Fabroil"—Made from cotton. Superior to other non-metallic gears by virtue of elasticity which allows meshing teeth to come to a good bearing across the full width of face, and absorbs shock of rapid variation of torque. Other advantages: Strong as the best cast iron; unaffected by atmospheric changes and neither shrink nor swell in extreme dryness or dampness; absolutely vermin proof; run equally well against cast iron, steel or bronze; can be run in cold or hot oil baths. Successful applications to lathes, planers, traveling cranes, drill presses, shears, punches, etc.; spinning frame drives in silk, worsted, carpet and similar mills; heavy machinery of paper and pulp mills, intricate mechanism of printing plants; automobile and other gas engine ignition drives; timing gear-trains. Bulletin 48703A. See adv. pages 1203-1223.—Adv.



Fabroil Gear

Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Meachem Gear Corp., The, 411-415 Canal St., Syracuse, N. Y.
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned."
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Fibre Co., 11 Miller St., Somerville, Mass.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Wilmington Fibre Specialty Co., Wilmington, Del. "Wilmington Fibre."

GEARS AND PINIONS, METER.—Integrating watt-hour meters and ampere-hour meters have a small, light train of gears (often mounted in jewel bearings) to reduce the speed of the disk or rotating element to a suitable speed for operating the register dials. The mechanism usually consists of a small worm mounted on or cut on the shaft of the rotating element which meshes with a small worm wheel in the gear train. The gears are cut from thin sheet metal, either brass or a bronze composition.

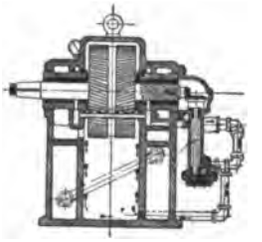
Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass. "Crofoot."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.

GEARS AND PINIONS, MOTOR SPEED-REDUCTION AND TRANSMISSION.—A small and a large gear used generally to produce a speed much lower than that of the driving motor. These are very often used with electric motors for machine tool drive, such as back-geared motors, and the gear train is sometimes rather complicated to permit a quick shifting from one speed to another. The gears are mostly spur gears, although worm, spiral and helical gears are also used for many purposes. They are also used extensively for mill and crane motors, for elevators and hoisting machinery, etc. Some speed-changing gear sets are made up for giving a very wide change of speeds and are furnished as complete, self-contained, enclosed outfits for ready connection to the motor and to the driven machine.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
American Die & Tool Co., 2nd & Buttonwood Sts., Reading, Pa. "Adco."
Brown Co., The A. & F., 79 Barclay St., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Cherry Tree Machine Co., Cherry Tree, Pa.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Dominion Steel Products Co., Ltd., Brantford, Ont., Can.
Elmira Machinery & Transmission Co., Ltd., Elmira, Ont., Can.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
Fawcus Machine Co., 2820 Smallman St., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 213 N. Curtis St., Chicago, Ill.
GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Johnson Machine Co., The Carlyle, 52 Main St., Manchester, Conn. "Johnson."
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill. "Jones."
Kerr Turbine Co., Wellsville, N. Y. "Economy."
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Meachem Gear Corp., The, 411-415 Canal St., Syracuse, N. Y.
Meisel Press Mfg. Co., 944-948 Dorchester Ave., Boston, Mass. "MP."
Nilson-Miller Co., Hoboken, N. J.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Smith, Winfield H., 10-16 Lock St., Buffalo, N. Y.
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
TERRY STEAM TURBINE CO., THE, Hartford, Conn. High speed reduction gears suitable for central station auxiliary equipment designed especially for turbine driven units.—Adv.



Terry High Speed Reduction Gears

Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GEARS AND PINIONS, RAWHIDE.—Rawhide is used largely for pinions and small gears where smooth running and quiet gears are required at high speeds. They are frequently made with metal flanges to give additional support. They were formerly used extensively on electric railway cars in connection with steel spur gears, but the development and widespread adoption of helical gears to this type of work has reduced their application for this purpose.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
Braun Gear Works, 1321-25 Gates Ave., Brooklyn, N. Y.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.

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GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
Gerdes & Co., Inc., 50 Church St., New York, N. Y.
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Meachem Gear Corp., The, 411-415 Canal St., Syracuse, N. Y. "New Process."
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, E. Vine St., Philadelphia, Pa.
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

GEARS AND PINIONS, TURBINE-SPEED REDUCTION.—Steam-turbine-driven generators, especially d-c. generators, frequently cannot operate at speeds as high as is advantageous for the turbine speed, and it is necessary to provide reduction gears between the two machines. Because of the large capacity of some of the generators the power transmitted by the gearing is often quite large, therefore, these gears form an important part of the unit. The reduction is not always carried out in a single step, as the speed ratio may be large. Helical gears are generally used for this purpose as they give a uniform and efficient transmission. This type of gear is also used in connection with steam turbines driving ship propellers and certain power-plant auxiliaries.

GEARS AND PINIONS, WASHING MACHINE.—Nearly all makes of washing machines use gears either to drive the wringer, or to reduce the motor speed and transmit the power to the washing element, or both. The gears are usually fully enclosed and run in grease so that they require practically no attention. Bronze gears, machine-cut, are used on many machines, but the type of gears used varies considerably with the various designs, including such as crown, bevel, miter, spur and helical gears. These gears are not always made by the washing-machine manufacturers, but are cast or cut to meet their requirements by other manufacturers specializing in gear production.

Manufacturers:

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
American Die & Tool Co., 2nd & Buttonwood Sts., Reading, Pa. "Adco."
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Crofoot Gear Works, Inc., 1601 Hyde Park Ave., Boston, Mass. "Crofoot."
GANSCHOW CO., WILLIAM, Morgan St. & Washington Blvd., Chicago, Ill. (See display advertisement on page 1316.)
Grant Gear Works, Inc., 151 Pearl St., Boston, Mass.
James Mfg. Co., D. O., 1120 W. Monroe St., Chicago, Ill.
Lebanon Gear & Machine Works, 15th & Forge Sts., Lebanon, Pa.
Stahl Gear & Machine Co., The, 1390 E. 40th St., Cleveland, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Titanium Bronze Co., Inc., Sugar & Lafayette Sts., Niagara Falls, N. Y.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.

GEARS, GROUND, MISCELLANEOUS.—Gears used for special purposes where extreme accuracy and smooth running are required are sometimes ground to their final form and size. The teeth are cut on a milling machine to the approximate form and then carefully ground by a motor-driven grinder as a rule.

Manufacturers:

Gear Grinding Machine Co., Conant Rd. & Christopher Ave., Hamtramck, Mich.

GEARY.—Trade name for water-tube boilers manufactured by the Oil City Boiler Works, Box 137, Oil City, Pa.

GEE ELECTRIC CO.—Wheeling, W. Va. manufacturer of commutators, commutator parts, armature and field coils, etc. Business established 1899. Branch office, Huntington, W. Va.

GEE VEE.—Trade name for conduit fittings made by the Gillette-Vibber Co., New London, Conn.

GEHRING.—Trade name for electric cigar lighters manufactured by the H. D. Taylor Co., 101 Oak St., Buffalo, N. Y.

GEIER CO., P. A., THE.—5112 St. Clair Ave., Cleveland, Ohio. Manufacturer of electric vacuum cleaners, vibrators and hair driers. President and treasurer, P. A. Geier; secretary and general manager, F. J. Gottron; sales manager, C. M. Randel.

GEISSLER MERCURIAL PUMP.—In extracting the air from the bulb of an incandescent lamp just before sealing it, mercury pumps, of which the Geissler pump is one form, are used. These produce the vacuum by the suction of mercury being drawn through glass tubes.

GEISSLER TUBES.—Geissler tubes are tubes of thin glass sealed at both ends and blown into a great variety of shapes, generally having a small bulb on each end. The air is withdrawn from the tube before sealing and a gas or vapor inserted at a very low pressure of from 0.08 to 0.25 in. of mercury. Platinum electrodes are fused into the glass at either end, the wire being led out to provide connection to the external circuit. When a discharge occurs between the electrodes under different conditions a great variety of luminous discharge phenomena may be observed. By using different gases and different pressures and voltages and different varieties of glass, discharge glows having a large number of colors and tints may be produced. Geissler tubes are sometimes made in beautiful designs and used to produce various decorative and amusing effects. A practical application of the Geissler tube principle is the Moore tube, which has been used for illumination to some extent.

Manufacturers:

Easter Electric Co., The, 827 14th St., Denver, Colo.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."

GELATINE.—Used in both the pure form and in the impure form, as glue, as an addition agent in various electrolytic processes. See Addition agents.

GELB CO., JOSEPH.—512 W. 36th St., New York, N. Y. Manufacturer of photographic lighting equipment and arch lamps. Business established 1915. Joseph Gelb, sole owner.

GEM.—Trade name for cord adjusters manufactured by the M. B. Austin Co., 108-16 S. Desplaines St., Chicago, Ill.

GEM.—Trade name for soldering furnaces manufactured by the Burgess Soldering Furnace Co., Columbus, Ohio.

GEM.—Trade name for storage batteries manufactured by the Gem Storage Battery Co., 1332 W. 21st St., Chicago, Ill.

GEM.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

GEM.—Trade name for battery motors manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

GEM.—Trade name for belt tighteners manufactured by the Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.

GEM.—Trade name for electric pumps made by the George J. Roberts Co., 251 E. 2nd St., Dayton, Ohio.

GEM CITY BOILER CO., THE.—Dayton, Ohio. Manufacturer of fire-tube boilers. Business established 1895. President, T. E. Tucker; vice-president and general manager, A. H. Kemper; secretary and treasurer, W. H. Durkin.

GEM STORAGE BATTERY CO.—1332 W. 21st St., Chicago, Ill. Manufacturer of storage batteries. President, C. B. Robinson; secretary and treasurer, W. C. Templeton; sales engineer, F. C. Ryan.

GENASCO.—Trade name for insulating asphalt compounds and acid resisting paints manufactured by the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa.

GENCO.—Trade name for electric cigar lighters, hydrometer syringes and thermometers manufactured by the General Scientific Equipment Co., North Philadelphia, Pa.

GENCO.—Trade name for light weight Regent glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

GENCO LIGHT.—Trade name for farm lighting and power plants manufactured by the General Gas-Electric Co., Hanover, Pa.

GENELITE.—Trade name for bearing metal manufactured by the General Electric Co., Schenectady, N. Y.

GENERAL.—Trade name for storage batteries manufactured by the General Storage Battery Co., 2005 Locust St., St. Louis, Mo.

GENERAL.—Trade name for air washers manufactured by the General Ventilating Co., 162 N. Clinton St., Chicago, Ill.

GENERAL ABRASIVE CO., INC.—College Ave., Niagara Falls, N. Y. Manufacturer of electrically produced abrasives. Business established 1915. President, C. L. Barlow; vice-president, J. D. Stiles; secretary, C. Lockwood; treasurer and general manager, H. A. Richmond; sales manager, R. J. Brown.

GENERAL ASBESTOS & RUBBER CO.—Charleston, S. C. Manufacturer of asbestos packings, brake lining, textiles, etc. President, C. B. Jenkins, Sr.; vice-presidents, M. B. Barkley and C. B. Jenkins, Jr.; secretary, J. T. Jenkins; treasurer, J. P. Thomas; sales manager, C. B. Jenkins, Jr. Main office and factory, 27 Cumberland St., Charleston, S. C. Branch offices and warehouses, 58 Warren St., New York, N. Y.; 311 Water St., Pittsburgh, Pa.; 14 N. Franklin St., Chicago, Ill.

GENERAL BAKELITE CO.—2 Rector St., New York, N. Y. Manufacturer of Bakelite and Bakelite products. President, Dr. L. H. Baekeland; vice-president and treasurer, W. A. Hamann; secretary, Philip Schleussner.

GENERAL CERAMICS CO.—50 Church St., New York, N. Y. Manufacturer of refractories and electric heating units.

GENERAL CHEMICAL CO.—25 Broad St., New York, N. Y. Manufacturer of acids, battery chemicals, etc.

GENERAL COMPRESSED AIR & VACUUM MACHINERY CO.—St. Louis, Mo. Manufacturer of electric vacuum cleaners. Business established 1900. President, J. G. Thurman.

GENERAL DEVICES & FITTINGS CO.—Chicago, Ill. Manufacturer of electrical construction materials. Business established 1914. President, secretary and general manager, J. M. Van Splunter; treasurer, Robert C. Price. Main office and factory, 441-443 S. Desplaines St., Chicago, Ill. Branch office, 25 Church St., New York, N. Y. Sales representatives, L. O. Morrow, Franklin Trust Bldg., Philadelphia, Pa.; Albrecht Henderson Co., 711 Empire Trust Bldg., Pittsburgh, Pa.; C. E. Wise, 845 Book Bldg., Detroit, Mich.; A. D. Fishel, Illuminating Bldg., Cleveland, Ohio.; A. H. Winter Joyner, Ltd., Toronto, Ont., and Montreal, Que., Can.

GENERAL ELECTRIC CO.—Schenectady, N. Y. Manufacturer of motors; generators; electrical indicating and recording instruments; control apparatus; high-tension protective and switching equipment; steam turbines; heating and labor-saving appliances; street and industrial lighting equipment; lightning arresters; pole-line hardware; wiring devices; farm lighting and power plants; lamps; lighting reflectors; locomotives; insulators, pumps; x-ray apparatus, wires and cables; battery-charging equipment; headlights, motor-driven mining machines and other electrical equipment. Business established 1892. President, E. W. Rice, Jr.; vice-presidents, A. W. Burchard, G. E. Emmons, J. R. Lovejoy, G. F. Morrison, F. C. Pratt, A. G. Davis, O. D. Young; secretary, M. F. Westover; treasurer, H. W. Darling; sales manager, J. G. Barry. Main office, Schenectady, N. Y. Factories, Schenectady, N. Y.; Lynn, Mass.; Pittsfield, Mass.; Harrison, N. J.; Newark, N. J.; Watsessing, N. J.; Erie, Pa.; Ft. Wayne, Ind.; Cleveland, Ohio. Branch offices and warehouses, Atlanta, Ga.; Boston, Mass.; Butte, Mont.; Chicago, Ill.; Cincinnati, Ohio; Dallas, Tex.; Denver, Colo.; El Paso, Tex.; Houston, Tex.; Joplin, Mo.; Kansas City, Mo.; Los Angeles, Cal.; Minneapolis, Minn.; New York, N. Y.; Oklahoma City, Okla.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Ore.; St. Louis, Mo.; Salt Lake City, Utah; San Francisco, Cal.; Seattle, Wash. District offices, Baltimore, Md.; Birmingham, Ala.; Buffalo,

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N. Y.; Charleston, W. Va.; Charlotte, N. C.; Chattanooga, Tenn.; Cleveland, Ohio; Columbus, Ohio; Dayton, Ohio; Des Moines, Iowa; Detroit, Mich.; Duluth, Minn.; Elmira, N. Y.; Erie, Pa.; Fort Wayne, Ind.; Grand Rapids, Mich.; Hartford, Conn.; Indianapolis, Ind.; Jacksonville, Fla.; Knoxville, Tenn.; Little Rock, Ark.; Louisville, Ky.; Memphis, Tenn.; Milwaukee, Wis.; Nashville, Tenn.; New Haven, Conn.; New Orleans, La.; Niagara Falls, N. Y.; Omaha, Neb.; Richmond, Va.; Rochester, N. Y.; Spokane, Wash.; Springfield, Mass.; Syracuse, N. Y.; Tacoma, Wash.; Toledo, Ohio; Trenton, N. J.; Washington, D. C.; Worcester, Mass.; Youngstown, Ohio.

GENERAL ELEVATOR CO.—400-402 S. Charles St., Baltimore, Md. Manufacturer of electric passenger and freight elevators.

GENERAL GAS-ELECTRIC CO.—Hanover Pa. Manufacturer of farm lighting and power plants. President, W. F. Kintzing; vice-president, John J. Schmidt; secretary, E. T. Gilliard; treasurer, V. K. Jordan.

GENERAL GAS LIGHT CO.—Kalamazoo, Mich. Manufacturer of commercial lighting units. President and general manager, A. H. Humphrey; secretary and treasurer, H. R. Humphrey. Main office and factory, Kalamazoo, Mich. Branch offices, 44 Broadway, New York, N. Y.; 768 Mission St., San Francisco, Cal.; 204 S. Wabash Ave., Chicago, Ill.; 1221 Arch St., Philadelphia, Pa.; 214 Wood St., Pittsburgh, Pa.; 1209 Boardwalk, Atlantic City, N. J.

GENERAL ILLUMINATING CO.—5317-5321 21st Ave., Brooklyn, N. Y. Manufacturer of incandescent lamps. Lambert Schneider, President.

GENERAL INCANDESCENT LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—225 Electric Bldg., Cleveland, Ohio. Manufacturer of vacuum and gas-filled tungsten incandescent lamps. H. C. Rice, general manager.

GENERAL INSULATE CO.—1004-1024 Atlantic Ave., Brooklyn, N. Y. Manufacturer of hard rubber substitutes and molded insulations for electrical purposes.

GENERAL INSULATING & MFG. CO.—705 Olive St., St. Louis, Mo. Manufacturer of insulating materials.

GENERAL LEAD BATTERIES CO.—Newark, N. J. Manufacturer of storage batteries. President, H. M. Keith; vice-president, E. G. Maqueston; secretary, H. H. Hanson; treasurer, E. S. Hyde. Main office and factory, Chapel St. & Lister Ave., Newark, N. J. Branch offices, 123 W. 56th St., New York, N. Y.; 2814 Wentworth Ave., Chicago, Ill.

GENERAL LIGHTING FIXTURE CO.—28 W. Lake St., Chicago, Ill. Manufacturer of lighting fixtures. E. A. Wangershein, president.

GENERAL PLATERS' SUPPLY CO., INC.—489-493 Broome St., New York, N. Y. Manufacturer of generators, buffers, grinders, motor-generators, rheostats, voltmeters, wire and electroplating equipment. Business established 1914. President, George W. Kyle; secretary, H. L. Haas; treasurer, Octave B. Hebert; sales manager, Harry Krieger. Factories, Newark, N. J.; Brooklyn, N. Y., Saugerties, N. Y.

GENERAL PORCELAIN ENAMELING & MFG. CO.—4554 W. Congress St., Chicago, Ill. Manufacturer of lighting reflectors. President, F. E. Hodek; treasurer, Louis Chochole.

GENERAL RADIO CO.—11 Windsor St., Cambridge, Mass. Manufacturer of radio apparatus. President, Melville Eastham; vice-president, E. H. Locke; treasurer, H. S. Shaw, Jr.; sales manager, H. B. Richmond.

GENERAL SCIENTIFIC EQUIPMENT CO.—North Philadelphia, Pa. Manufacturer of electrical and other scientific instruments. Business established 1893. President and general manager, Maurice Kline; secretary, Martin Kline; treasurer, Samuel Kline. Sales representatives, Giant Manufacturers Distributing Co., 1469 Michigan Ave., Chicago, Ill.; Stevens, Wallis & Brazier, 608 Deseret Bank Bldg., Denver, Colo.

GENERAL STORAGE BATTERY CO.—2005 Locust St., St. Louis, Mo. Manufacturer of storage batteries. Business established 1913. President and general manager, E. A. Downey; vice-president, Joseph Desloge; secretary, Louis Desloge; treasurer, W. H. Rowley; general manager, E. A. Downey; sales manager, J. M. Downey.

GENERAL VENTILATING CO.—162 N. Clinton St., Chicago, Ill. Manufacturer of air washers, ventilating fans, etc. Proprietor, H. M. Fregin.

GENERAL WELDING CO.—355-57 14th St., Hoboken, N. J. Manufacturer of oxy-acetylene cutting and welding equipment. Co-partnership, Paul Devarco and William Wirt.

GENERATING SETS, CAR LIGHTING.—See Car lighting equipments, railway.

GENERATING SETS, FARM.—See Farm lighting and power plants.

GENERATING SETS, LOCOMOTIVE HEADLIGHT.—A small steam turbine and a direct-connected generator are the essential parts of a generating set for a steam locomotive headlight. The outfit is mounted on any convenient part of the engine, and is controlled from the cab. The first electric headlights contained arc lamps, but in more recent years the gas-filled tungsten lamp has come into use. For the latter lamp the generators are no longer of the specially regulated type necessary for use with the arc lamp.

Manufacturers:

Buda Co., The, Harvey, Ill. "Buda-Ross."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.

GENERAL ELECTRIC CO., Schenectady, N. Y. A Turbine-Generator set designed especially to supply power for headlight and cab lights, although its use may be extended to steam shovels, derricks, wrecking cranes, launches, tugboats, etc. The set consists of a single stage Curtis turbine direct-connected to a compound-wound generator governed on the steam end by a self-contained pressure regulating valve, and controlled electrically by a stationary magnetic brake coil and rotating copper disc which maintains practically constant voltage under different loads. For locomotive headlight service, 500-watt capacity, 32 volts, for operation on 125-lb. to 250-lb. boiler pressure. For industrial applications 500-watt capacity, 110 volts, for operation on 70-lb. to 170-lb. boiler pressure. (Bulletin 42014A.) See adv. pages 1203-1223.—Adv.



Headlight Generating Set

Loco Light Co., The, 139 S. East St., Indianapolis, Ind. "Loco Light."

Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.

ROTH BROS & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."

Sunbeam Electric Mfg. Co., Evansville, Ind.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATING SETS, PORTABLE.—See Plants, portable lighting and power.

GENERATING STATION.—The generating station in any electrical system is the power plant in which electrical energy is produced from mechanical energy. There are three principal types of generating stations although a great deal of variation is found in each type. The classification depends upon the form in which mechanical energy is used, as follows: water power or hydro-electric station; steam generating stations; stations having internal-combustion engines. In the latter class small generating plants, such as farm lighting plants, are included as each of these is a separate electrical system. In contrast to these are the tremendous hydroelectric and steam power plants which are such an important part of the electrical industry and some of which daily supply the needs of over a million people.

GENERATOR.—Any device or machine used for the purpose of generating, that is producing, a form of energy or thing from some other form of energy or material thing. In electrical work it is generally taken to mean a machine for producing electrical energy from mechanical energy, see Generator, electric. It may also refer to a chemical process, as an acetylene generator or hydrogen generator for producing these respective gases.

GENERATOR, A-C.—A generator giving out energy in the form of alternating currents, either single or polyphase, three phase being the most common. A-c. generators are subdivided into synchronous and asynchronous, the former having a frequency strictly proportional to the number of poles and the speed, while the latter has a greater or less change of speed for a fixed frequency or a change of frequency for a fixed speed.

Synchronous generators are the most common. They are generally built with a stationary armature and a rotating field structure. The usual frequencies in the United States are 25 and 60 cycles; and voltages of approximately 110, 220, 2200, 6600, 11,000, 13,200 and 22,000 volts are considered standard. Excitation is provided by d-c. generators, called exciters, at about 125 or 250 volts and the voltage of a-c. generators is controlled either by hand or automatically almost wholly by changing the voltage of the exciters.

Asynchronous generators are nearly always three-phase induction machines. A-c. generators, steam and water-driven, are the largest primary sources of electrical energy. Also see Generator, induction, and Generator, synchronous.

GENERATOR, ACYCLIC, HOMOPOLAR OR UNIPOLAR.—A d-c. generator in which a conductor cuts a magnetic field always in one direction, hence the e. m. f. generated in a conductor always has the same direction with respect to that conductor. No commutator is required. If a voltage higher than that developed by one conductor is desired, several conductors may be provided and connected in series externally through slip rings. Since each conductor must have two slip rings, it is not practical to have a very large number of conductors. Such generators have an extremely limited commercial use.

GENERATOR, CONSTANT-CURRENT.—A generator operating so as to give an approximately constant current either with or without large changes in the voltage. It is usually a d-c. machine and may be of the series type, the compound type or of a special design, such as the Rosenberg and the third-brush generator. The constant current may result from internal characteristics or from external control devices.

Series generators giving a constant current were formerly widely used for street lighting but are rare now, being almost wholly confined to use in Europe for long-distance transmission by the Thury system. Other constant-current generators are used for train lighting on steam railroads and for ignition, starting and lighting on gasoline automobiles, and for arc welding.

GENERATOR, CONSTANT-POWER.—A d-c. generator used for arc welding which is so controlled that the power in the arc is approximately constant for a considerable change in the arc length.

GENERATOR COOLING EQUIPMENT.—The change in operating speed made possible by the use of steam turbines instead of reciprocating engines for driving generators resulted in a great increase in power output per pound of material used. This increase in rating, while it did add slightly to the efficiency and tend to decrease the percentage of losses, increased the losses to be dissipated per unit of active material and radiating surface. Artificial or forced ventilation involving the use of cool, clean air became necessary as a protection to the generator insulation and as a means of increasing the load that a generator could safely carry.

Air-conditioning apparatus and air washers thus became an important part of the generating station. Ventilating ducts are built in the generator and the cool air is forced through these at a very rapid rate, a 30,000-kv-a. unit requiring about 60,000 cu. ft. of air per min. Unless this air is properly treated before being used, dust, oil and grit present in it would soon collect in the ducts and choke up the passages and thus cause the generator to overheat. Air washers are used to remove these impurities. They operate by forcing all of the air used through a very finely divided

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spray, the dirt and impurities present being taken up by the water and dropping to the bottom of the tank. Screens, baffles, etc., and other auxiliary equipment to properly condition the air is required, as well as pumps for the spray water and blowers for forcing the air to circulate. These auxiliaries are nearly always motor-driven.

In some plants the air after passing through the generator is allowed to discharge into the turbine room. Other plants merely have a return duct to carry away the air to the outside. Still another method has been used, that of using the heated air for the boiler furnace to provide a forced draft. Its advantage in this application is that the temperature has been raised several degrees above that of outside air in winter time and, therefore, the heat that would otherwise be utilized in the furnace to bring the air to this temperature is saved. Also see Air-conditioning apparatus, and Washers, air, for other applications of similar equipment.

Manufacturers:

Atmospheric Conditioning Corp., 920 Lafayette Bldg., Philadelphia, Pa. "Webster."

Badger & Sons, E. B., 75 Pitts St., Boston, Mass.

Ridgway Dynamo & Engine Co., Ridgway, Pa.

Spray Engineering Co., Boston, Mass. "Spraco."

GENERATOR, D-C.—A generator which changes mechanical energy into electrical energy in the form of direct current. Such generators may be classified according to the method of producing the magnetic field as separately excited and self-excited machines. Self-excited generators are more common and are subdivided into shunt, series and compound machines. Shunt generators have a part of their own current passing through a field winding in shunt with the load; series generators have all, or nearly all, of their own current passing through a winding in series with the load; compound generators have two windings, one in shunt and one in series with the load. Separately excited generators have the exciting current supplied by a separate machine or battery.

Shunt and compound generators are usually approximately constant-voltage machines while the series generator is usually a constant-current machine. The former, especially compound generators, are used to supply constant-voltage distributing systems. When series generators are used the voltage rises as the load increases. By special design a series generator can be made to give an approximately constant current with a large change in terminal voltage. Such generators were formerly very commonly used to supply series street-lighting circuits, but are now nearly all replaced by a-c. devices. They are used to a limited extent in Europe as sources of electrical power for long-distance transmission by the Thury system.

With shunt generators the voltage drops as the load increases due to the effect of armature resistance and reaction so that hand or automatic control of the voltage is generally necessary. For this reason the shunt generator has a rather limited use.

In compound generators the series winding may be so connected as to add to or subtract from the magnetomotive force of the shunt winding. The generator is then cumulatively or differentially compounded, respectively. With cumulative compounding, the drop in voltage with increase of load which occurs in shunt generators is partly or wholly prevented. Very often the compounding is such that the voltage rises as the load increases. With differential compounding, the drop in voltage is increased. Cumulative compound generators are used for constant-voltage supply systems, and differential compound machines for arc welding and ignition and lighting on gasoline automobiles.

GENERATOR, DOUBLE-CURRENT.—A generator which gives out both d-c. and a-c. power from the same armature winding. Such a machine has an armature and commutator like that of a d-c. generator and in addition has slip rings connected to certain points of the armature winding so that single-phase or polyphase alternating currents may be obtained. Such generators find application in laboratories and other places where the ability of obtaining either direct or alternating current from a single machine is often advantageous. A synchronous converter when driven by some prime mover can be used as a double-current generator.

GENERATOR, ELECTRIC.—A machine which changes mechanical energy into electrical energy. The term is commonly applied to machines utilizing the principle of electromagnetic induction and is now seldom used to denote electrostatic machines or other devices. The usual form of electric generator has two essential parts, a magnetic field and an armature winding from which the electrical energy is delivered. Relative motion between the field and the armature winding, or changes in the strength of the field linked with the armature winding through the motion of an auxiliary part, provides a means of converting the energy of mechanical motion into electrical energy. Generators are classified into two main classes, according to the character of the electric current generated, direct-current and alternating-current generators.

GENERATOR, ELECTRON TUBE.—Since an electron tube can be made to produce alternating current of varying frequencies it is sometimes referred to as an electron tube generator. For method of operation and application see Electron tubes.

GENERATOR, INDUCTION.—An induction generator is like an induction motor in which the rotor is driven in the same direction as the rotating magnetic field but at a greater speed. The field, and therefore the excitation, is produced by alternating currents, preferably from a synchronous machine. The power output depends upon the slip and the constants of the secondary winding. The power-factor of the output is fixed by the constants of the machine. It cannot give out lagging current, but it can take lagging current for its own excitation from other parts of the system, such as the electrostatic capacity of underground cables or long overhead lines. Induction generators are used to a limited extent only in places where they can operate in parallel with synchronous generators and may receive a minimum of attention.

GENERATOR, MAGNETO.—A machine which changes mechanical energy into electrical energy by using the principle of electromagnetic induction. The magnetism is supplied by a permanent magnet, usually in the form of an inverted U, and an armature or an inductor is caused to rotate between the poles of the magnet so as to cause electric conductors to cut across the field of the magnet or to change the number of magnetic lines of force linked with the armature circuit.

Magneto generators may be constructed to give direct, pulsating or alternating current. A-c. magnetos are of two general types of construction, namely, those in which the armature conductors rotate and those in which the armature conductors are stationary and an "inductor" of iron is the only rotating element. They are also classified into "low tension" and "high tension," according to the relative value of the voltage developed. The high-tension magneto is really a combination of low-voltage generator and a stepup transformer. The low-voltage winding serves both as an armature winding and as the primary of a transformer. The high voltage is developed in the secondary of the transformer upon breaking the circuit of the primary at the proper time.

Magneto generators are used for furnishing the ignition current for gas, gasoline and oil engines and blasting work, for ringing telephone bells, for testing sets, for certain speed indicators, for charging small storage batteries, etc. For brevity they are very often simply called magnetos.

GENERATOR, ROSENBERG.—A variable-speed d-c. generator, used largely for axle-driven railway car-lighting systems, which gives a voltage whose direction is independent of the direction of rotation and supplies current to a storage battery which is practically constant over a very wide range of speed. The storage battery, in addition to supplying the load when the generator is not operating, supplies the excitation through a shunt winding. There are two pairs of brush sets on a two-pole machine. One set is short-circuited and gives a magnetic axis through the armature at right angles to that of the field winding. The other set constitutes the terminals of the generator and gives a magnetic axis through the armature in line with that of the field winding and in opposition to it. The voltage is developed by the armature conductors cutting the field set up by the current through the short-circuited brushes and the output current is limited by its demagnetizing action on the flux set up by the shunt field winding.

GENERATOR, SYNCHRONOUS.—An a-c. generator in which the ratio of the frequency to the speed is constant for all loads. The usual type of construction embodies a rotating field structure magnetized by direct current and a stationary armature having a single-phase or polyphase winding. In small generators, the armature may be the rotating part.

The voltage of such generators, without special control, is only approximately constant under a varying load, the change in voltage depending upon the value of the synchronous impedance and the magnitude and the phase of the current with respect to the voltage. Voltage control is accomplished by changing the exciting current, either by hand or by an automatic regulator.

The common frequencies in the United States for light and power supply are 25 and 60 cycles per second, though other frequencies are occasionally used. Synchronous generators are used very extensively in electric power plants from which energy is transmitted by alternating currents at high voltage much farther than would be economical by direct current.

GENERATOR, THIRD-BRUSH.—A d-c. generator used in gasoline automobiles for supplying energy for ignition, lighting and charging the storage battery, which depends for the regulation of its output upon the use of an auxiliary, or third, brush. The shunt-field winding is connected from the third brush to one of the main brushes, between which the armature reaction tends to decrease the voltage as the armature current increases, thus weakening the excitation and maintaining the output much more nearly constant than would a connection of the shunt winding across the main brushes.

GENERATOR, THREE-WIRE.—A d-c. generator designed and operated on a three-wire distribution system without a balancer set. The neutral of the three-wire system is usually connected to the armature winding through one or more slip rings and balance coils or balancing windings. The coils are wound on iron cores with the middle point of the winding connected to the neutral and the terminals connected to the armature winding. The coils may be mounted and rotate with the armature or may be stationary and external to it. The balancing windings are single-phase or polyphase, and are placed in the slots with the main winding and have their neutral connected to the neutral of the three-wire system and their terminals to the main armature winding.

Three-wire generators are usually designed for only a moderate amount of unbalance. When compounded, one half of the series winding is connected to one line and the other half to the other line.

GENERATORS.—Electric generators are selected to suit the conditions of current, voltage, frequency, and method of drive decided upon as best adapted for the electrical system to be supplied. If the generator is to supply a comparatively small and compactly arranged isolated plant or building, a direct-current two-wire system of 110 to 120 volts or a three-wire system of about 115 to 230 volts is likely to be chosen. In the case of special isolated service, such as farm lighting plants and railroad car lighting equipments, 32 and 64-volt d-c. generators are mostly used.

If the installation is to serve a group of scattered buildings or an extensive distribution system covering a town or city, as in the case of central-station systems, the generators in nearly all cases are alternating-current machines, whose voltage depends almost entirely upon the length of the lines to be supplied. Voltages of a-c. generators for such service range from about 220 volts to 11,000 volts, although in a few cases still higher voltages, such as 13,200, 18,000 and even 30,000 have been used. Such extreme voltages, however, require very heavy and expensive insulation of the windings and are used only in ex-

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ceptional cases where it is thought advisable to eliminate the stepup transformer between the generator and the transmission circuits.

For most a-c. installations 60 cycles is now the standard frequency and the other standard (25 cycles) is confined almost entirely to long-distance transmission, especially in connection with service for electric railway systems. As to whether single phase, two phase or three phase will be chosen depends on the extent of the system supplied and on the character of the load, whether it is chiefly lighting or power. Single-phase systems are confined almost entirely to small lighting plants or networks. If polyphase distribution is selected it is more likely to be the three-phase system than a two-phase. The generator, therefore, will be either a single-phase or a three-phase machine in nearly all cases, and in the great majority of cases will be a three-phase unit. In the selection of generators considerable expense is saved by choosing standard voltages, frequencies, and ratings, instead of using uncommon values that require special design.

The nature of the drive to be selected depends on the size of the unit, whether it is an isolated unit or one of a group in a plant, and on the available mechanical power for driving the generator. The principal methods of driving, in the approximate order from small to large machines, are the following: belt drive, direct-connected engine drive, waterwheel or hydraulic-turbine drive, and steam-turbine drive. Belt drive is used for small units and when the prime mover is either an internal-combustion engine or steam engine or in some cases a small waterwheel. Direct-connected engine drive is used somewhat with gasoline engines, but principally with gas or oil engines, such as the Diesel or semi-Diesel type, and with steam engines, either simple or compound; such direct-connected sets range in rating up to about 2000 kw. Water-wheel-driven generators are either the horizontal or vertical shaft type and direct-connected to individual waterwheels or hydraulic turbines. Steam-turbine-driven generators, more commonly called turbogenerators, are in most cases direct-connected, but in a few cases of d-c. generators reduction gearing is used between the turbine and generator so that the latter may operate at speeds suitable for commutation while the turbine operates at the higher speeds that are most effective for steam turbines.

The nature of the drive affects the speed of the generator and also mechanical features of its design, such as whether it is to be provided with a pulley or a flange for direct connection to the shaft of the prime mover or whether a continuous shaft shall be used for both generator and prime mover. On account of the importance of the driving element in the design of the generator, generators are usually classified by manufacturers according to this feature, which is used as the principal basis of subclassification of the following listings of various types of generators and manufacturers thereof.

Some idea of the relative importance of different types of generators may be obtained from figures on the annual production. The United States Census Bureau in its report on electrical manufactures for the year 1914 gives the total value of generator production in the United States as $23,233,437; this compares with the total of $12,824,768 in 1904, or an increase of very nearly 100% in ten years. No accurate figures are available for any later years, since the report of the census of manufactures taken in 1919 has not yet been published. It is highly probable, however, that during 1920 the production of generators amounted to over twice the value in 1914, since all productions in the intervening years were increased in valuation and to this was added the normal increase in output.

Some interesting facts are disclosed from the detailed figures of 1914. There were produced in that year 375 a-c. turbogenerators with a combined rating of 600,185 kw. and valued at $3,895,291. The other a-c. generators numbered 2137, with a combined rating of 587,820 kw. and a total value of $3,542,154. Direct-current turbogenerators for mostly small machines numbered 264, with a rating of 14,916 kw. and a value of $398,379. Small d-c. generators, such as for automobile lighting and starting sets, farm lighting plants and other units of about 1 kw. or less amounted to 208,545 in number and were valued at $5,933,273. Miscellaneous d-c. generators not otherwise included in the other two groups amounted to 9369, rated 206,305 kw. and valued at $2,569,086. Aside from the a-c. and d-c. generators there were various dynamotors, boosters, motor-generators, double-current generators, synchronous converters, synchronous condensers and rotary phase converters to a total of 8393, rated at 780,009 kw., and valued at $5,367,895. Miscellaneous generator parts and supplies were valued at about $1,527,000. At the present time, the preponderance of the a-c. generators is still more marked in total rating, as well as average and maximum rating, although in point of numbers the small d-c. automobile generators, farm lighting and similar small machines lead.

GENERATORS, AUTOMOBILE LIGHTING AND STARTING.—Variable-speed d-c. generators used for ignition, for lighting and for charging the storage battery on a gasoline automobile and driven by its engine. Since the speed is variable, regulation of some kind is necessary and is usually made for an approximately constant current or constant voltage by any one or more of several possible methods. These methods involve internal characteristics of design and construction without moving parts, such as the use of cumulative or differential series windings or an auxiliary brush; and external devices moved by electromagnetic or purely mechanical action, such as electromagnets controlling the resistance of the shunt-field circuit and centrifugal governors controlling the speed or the voltage or the current. The use of such generators is now very extensive. They are found on almost all makes of gasoline automobiles. Also see Generator, third-brush.

On some cars only one rotating unit is employed for the above mentioned duty, including battery charging, and for engine starting. The machines used for this purpose have two armature windings in some cases, one for motor duty and the other for generator duty. In other cases two commutators are built on the unit; these are connected in series when charging or operating as a generator, and in parallel when operating as a starting motor and drawing energy from the battery. Many automobiles have a separate starting motor used exclusively for engine starting; it is automatically disconnected by a clutch when the engine begins to drive.

Manufacturers:

A. B. C. Generator Co., 1115-17 S. Olive St., Los Angeles, Cal.
A-C Electrical Mfg. Co., The, 4th St. U. B. Bldg., Dayton, Ohio. "Dayton."
American Bosch Magneto Corp., Springfield, Mass. "Bosch."
Bijur Motor Appliance Co., 15th & Garden Sts., Hoboken, N. J.
Carleton Co., The, 170 Summer St., Boston, Mass.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
Kemco Electric Co., The, 1362 E. 3rd St., Cleveland, Ohio. ("Kemco" fan type.)
Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."
National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C. "Newbold."
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
Remy Electric Co., Anderson, Ind.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Simms Magneto Co., The, East Orange, N. J. "Simms."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J. (motorcycle) "Du-5."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Vesta Battery Corp., 2100 Indiana Ave., Chicago, Ill. (lighting)
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, CAR-LIGHTING.—Generators, usually d-c., for supplying electrical energy to lamps in steam railway cars. In some cases, a car-lighting generator is fastened under each car and belt-driven from an axle of a truck. The generator is driven when the car is in motion and, above a certain speed, furnishes energy for electric lamps in the car and for charging a storage battery, which supplies the lamps when the car is stationary or moving slowly. One important form of generator for this purpose is the Rosenberg generator, which see. In other cases, "the head-end system" is used; a single steam-driven generator is located in a baggage car near the locomotive and supplies energy for all the cars. In either case storage batteries are necessary to light the lamps when the generator is not running or is not connected. For manufacturers, see Car lighting equipments.

GENERATORS, ELECTROPLATING.—A d-c. generator, rated at 6 or 12 volts in properly designed machines, used for supplying energy for electroplating, electrotyping, for electric cleaning of metals, for electric pickling, electric etching, and similar processes. Such generators are customarily rated in amperes to correspond with the horsepower outputs of standard commercial a-c, or d-c, motors, using as an approximation 1 hp. of motor output per 100 amperes of current required at 6 volts. Under this system, standard generators are rated from 50 amperes to 7500 amperes, inclusive. For larger current requirements generators should be operated in multiple or the system split up into independent groups since it is not good practice to attempt to commutate and conduct from a single piece of apparatus more than 7500 amperes at electroplating voltages.

Machines of 1500-ampere capacity or less are usually compound wound and self-excited. The compound winding serves to maintain good voltage regulation on the supply buses and the self-excitation makes unnecessary the complication of a separate exciter. For machines of larger capacity the separately excited type is preferred and the compound winding is usually unnecessary due to the possibility of maintaining a more constant average load-factor. Electroplating generators are furnished either for belt drive or for direct connection to a-c. or d-c. motors.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Bishop, W. S., New Haven, Conn.
Bogue Electric Co., Charles J., 513 W. 29th St., New York, N. Y.
Boissier Electric Co., Long Island City, N. Y. "World."
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ont., Can.
Chandeysson Electric Co., 40942 Bingham Ave., St. Louis, Mo.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J. "American Giant."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eager Electric Co., The, Watertown, N. Y.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Ely, C. Upham, 50 Vesey St., New York, N. Y.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Hanson & Van Winkle, Newark, N. J.
Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.

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Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
L'Hommedieu & Sons Co., Charles F., 4521 Ogden Ave., Chicago, Ill. "Reliance."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y.
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
U. S. Electrical Mfg. Co., 459 E. 3rd St., Los Angeles, Cal.
U. S. Electro Galvanizing Co., 32-34 Stockton St., Brooklyn, N. Y. "Universal."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, EXCITATION, OR EXCITERS.—Generators which supply current for producing and maintaining the magnetic field of one or more generators or motors. They are commonly called exciters. Exciters are practically always d-c. generators, an exception being those for induction generators. They may be either shunt or compound wound, and may be driven by electric motors, separate prime movers, or built on extensions of the shafts of the machines to which they supply excitation and thus be driven by the same prime mover.

The voltage of exciters is often automatically controlled through the voltage of the generators which they serve by the opening and closing of a short-circuit around a resistance in series with the shunt-field winding of the exciter. The voltages used are low, 125 being standard for the majority of plants, with 250-volt exciters used only in the largest units.

Exciter sets are sometimes made, consisting of the generator and the motor, water wheel, turbine or engine which drives it.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co. Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eager Electric Co., The, Watertown, N. Y.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. In the excitation of an alternator in order to make the armature voltage respond quickly to changes in load and speed, its field strength must at times be varied momentarily between very wide limits. In order that the exciter can respond instantly to the demand upon its armature, its shunt field must have sufficient margin to give it a range of 25 to 160 volts at full load. G-E generators for excitation are designed to meet such requirements and commutate successfully over a wide range in voltage. Built for belt, steam turbine, induction motor, or direct drive. See adv. pages 1203-1223.—Adv.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display advertisement on page 1308.)
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
TERRY STEAM TURBINE CO., THE, Hartford, Conn. Built in sizes from 15 to 300 K. W. Illustration shows duplex drive which insures continuous excitation and saves first cost and floor space.—Adv.



Terry Excitation Generator

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

GENERATORS, HIGH-FREQUENCY, ELECTROTHERAPEUTIC.—Many of the outfits commonly designated by this name and used in the production of current for medical purposes do not operate on the same principle as other dynamoelectric machines known as electric generators which are listed here, and should not strictly be classed as an electrical generator, inasmuch as they do not produce electrical energy by the conversion of mechanical energy. The production of the high-frequency current is sometimes obtained by the use of a special transforming coil, usually a type of induction coil having an air core which produces a high voltage in the secondary winding, the current being interrupted to give the high-frequency effect. Other outfits operate from dry batteries or from small storage batteries and produce the high frequency by a special interrupter or vibrator. Many of the types of currents referred to as high frequency in connection with this apparatus are not high frequencies in reality, but are expressed in cycles per minute, rather than the standard expression of cycles per second, and when reduced to this figure do not appear as high values.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
BLEADON-DUN CO., 213 S. Peoria St., Chicago, Ill. "Multifrex." (See display advertisement on page 1295.)
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkeley, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CONTRA-POLE ELECTRIC CO., INC., 1227-1241 Prospect Pl., Brooklyn, N. Y.
Easter Electric Co., The, 827 14th St., Denver, Colo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Liebel-Flarsheim Co., The, 41-418 Home St., Cincinnati, Ohio.
McINTOSH BATTERY & OPTICAL CO., 217-223 N. Desplaines St., Chicago, Ill. "Universalmode" generates galvanic, faradic, rapid sinusoidal, slow sinusoidal, cautery and diagnostic light currents. It also provides mechanical vibration, air compression, suction and massage. "Polysine" generators give galvanic, sinusoidal and diagnostic light currents.—Adv.
Medical Appliance Corp., 631 Pennsylvania Ave., N. W., Washington, D. C. "Medaco."
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Radio Corp. of America, 233 Broadway, New York, N. Y.
RENULIFE ELECTRIC CO., Marquette Bldg., Detroit, Mich. "Renulife."
Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.
Ultima Physical Appliance Co., 136 W. Lake St., Chicago, Ill. "Sinustat."
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Virazone Co., The, 1111 Absopure Bldg., Detroit, Mich.
Vulcan Electric Co., 239 So. Los Angeles St., Los Angeles, Cal. "Vulcan."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis. "Vi-Ray-O."

GENERATORS, HIGH-FREQUENCY, RADIO.—Two types of high-frequency alternators are today giving satisfactory service supplying current for radio communication. The Alexanderson alternator is of the inductor type having both field and armature windings on the stator. The steel rotor is toothed, having the space between teeth filled with a nonmagnetic material. Rotation of the rotor produces varying magnetic flux which induces a current in the armature. The speed of rotation may run as high as 20,000 r. p. m. This extraordinary speed requires exceptional skill in the design and construction of the machines. Frequencies have been successfully generated as high as 200,000 cycles per second. The New Brunswick station contains two 200-kw. Alexanderson alternators and operates at a wave length of 13,600 meters. In the Goldschmidt alternator, the fundamental frequency generated is multiplied by tuned circuits outside the machine until high enough for radio work. The famous Nauen station in Germany contains a 150-kw. alternator of this type.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crocker-Wheeler Co., Ampere, N. J.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Liberty Electric Corp., Port Chester, N. Y.
Master Electric Co., 113 S. Jefferson St., Chicago, Ill.
Radio Corp. of America, 233 Broadway, New York, N. Y.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, HIGH-FREQUENCY RADIO, MISCELLANEOUS.—See Arcs, radio; Electron tubes; Spark gaps, radio.

GENERATORS, LIGHTING AND POWER, A-C., BELTED.—An a-c. generator belt-driven from a reciprocating steam engine or other prime mover. One object of the belt drive is to secure a generator of higher speed and less cost than one directly connected to a low-speed prime mover. They were formerly used in some

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water-power plants where a long shaft was driven by several small water wheels and several small generators were driven by means of belts. They are only made in the smaller sizes now, rarely exceeding 100 kw., and are not extensively used outside of small generating plants and places where the main supply is direct current but a small amount of alternating current is needed.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can. "King Edward."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Crocker-Wheeler Co., Ampere, N. J.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
De Vry Corp., 1250 Marianna St., Chicago, Ill. "De Vry."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. The lower first cost of belted generators compared with direct-connected units creates a large demand for such machines where space is not a first consideration. This company manufactures a standard line of revolving field alternators for belt drive in sizes from 30 to 240 kw. Designed for both power and lighting and operate at any power factor from 0.8 to unity. Furnished with either direct-connected or belted exciters. These alternators can be changed for use as synchronous motors or synchronous condensers with the addition of a squirrel cage winding to make the machine self-starting. All pole pieces are punched to receive this winding, which can be readily assembled by the station operator. (Bulletin 40400B.) Revolving armature, self-excited generators for use in small, isolated plants are available in three sizes, 10, 20 and 35 hp. (Bulletin 60500.) See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."
Ideal Electric & Mfg. Co., 153 E. 5th St., Mansfield, Ohio. "Ideal."
Kendrick & Davis Co., Lebanon, N. H. "K. & D."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
ROTH BROS & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Star Dynamo Co., Jefferson City, Mo. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, LIGHTING AND POWER, A-C., ENGINE.—A-c. generators built on the same shaft with a reciprocating engine or directly coupled to it. Steam, oil and gas engines are all used for the prime mover, and they are made mostly in units which are stationary, but also some portable sets that are mounted on trucks. The generators for the former sets are of special construction and are usually quite heavy, of large diameter (mostly of the revolving-field type), and operate at medium or low speeds. Engine-driven generators are found in isolated industrial plants more frequently than in central stations, but they are not installed for this service as much as formerly, having been replaced to a large extent by the turbine-driven units, especially in the larger sizes. They are still found in some of the older central stations and also in water-power plants, where they are used as an auxiliary to help carry the peak load.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Alternating current generators for engine drive ranging from 30 to 1,400 kw. Stationary armature or revolving field alternators are standard since this design avoids the use of high-voltage collector rings and brushes and allows the high voltage winding to be carried by the stationary portion of the machine. The stator and armature coils are form wound from carefully insulated wire. These machines, like all standard alternators, may be run successfully in parallel with each other if the engines have reasonable regulation. A special short circuit, squirrel cage or amortiseur winding over the revolving field to cut down the tendency to pulsate or hunt is added to machines for gas engine drive. Alternating current generators require a direct source of excitation which, preferably, should be controlled automatically. This Company manufactures for this purpose exciters for belt, steam turbine, motor, or direct drive and can furnish suitable voltage regulators for automatic control of the voltage generated. G-E steam engine driven generating sets rated up to 60 kw. are built with either a-c. or d-c. generators. See Generators, D-C., Engine, for brief description. See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, LIGHTING AND POWER, A-C., TURBO.—Alternating-current generators built on the same shafts with steam turbines. Such generators are usually driven at high speeds, 1500 r. p. m. being the upper limit for 25-cycle generators and 3600 r. p. m. that for 60-cycle machines. Generators of this type are now more common than any other type and represent by far the largest percentage of the total installed generating capacity of the United States. They are widely used in central stations of all sizes and in large industrial plants. Their rapid development is due to their very high efficiency over a large range of loads, their compactness, and relatively low cost per kilowatt of capacity. They were formerly constructed with a vertical shaft, and many units of this type are now in operation, but recent developments have led to the general use of horizontal units. They are made in many ratings, ranging up to the largest capacity generators built, single units rated at 45,000 kv-a. having been successfully operated for some time. Turbo units have been built with ratings as high as 70,000 kw., by having a compound turbine with two or three separate turbine cylinders in which the steam expansion is carried out, each turbine driving a separate generator, but all paralleled to operate as a single unit. The high speeds at which a-c. turbogenerators are operated necessitate special construction, the design proportions being radically different from slow-speed machines. The generators are usually small in diameter and long in axial length. Solid rotors are often used and the stator is provided with ventilating ducts, through which washed air is forced to cool the windings in the large units.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. Fairbanks-Morse."
GENERAL ELECTRIC CO., Schenectady, N. Y. The many years experience of this company in designing and building revolving field a-c. generators for direct connection to reciprocating engines and water wheels has been fully utilized in the design of generators for its Curtis steam turbine drive. However, the different conditions to be met by this service have resulted in the evolution of a generator peculiarly adapted to turbine drive, which has now been made in sizes up to 50,000 kw. In general these generators are designed along conservative lines which for many years have characterized G-E generating apparatus and embody features which experience has shown to be peculiar to steam turbine conditions. The sets are described and illustrated in Bulletin 42010 and 42206. For further information on G-E service in electric power generation see page 1204.—Adv.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Leffel & Co., The James, 426 East St., Springfield, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
TERRY STEAM TURBINE CO., THE, Terry Sq., Hartford, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, LIGHTING AND POWER, A-C., WATER-WHEEL.—A-c. generators driven by water wheels or hydraulic turbines. Most water-wheel generators are now direct-connected and may

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be on a vertical or a horizontal shaft. In some of the older plants the generators were connected through gearing or belting to a long slow-speed shaft driven by several water wheels. There is much variation in the generators constructed for this purpose because of the great difference in head, etc., at the water-power developments, and the types and sizes of water wheels used. The largest single units in operation, which are at Niagara Falls, N. Y., are rated at 37,500 hp., and are of the vertical type. The vertical type requires special care in design and construction. While these generators do not now represent a very large percentage of the total installed generating capacity of the country, they are an important type of generator and will no doubt represent a much larger percentage in a few years.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Units ranging in capacity from 30 to 40,000 kv-a., both horizontal and vertical types, individually designed to meet most efficiently the various requirements imposed by the supply of water available for any given development and the operating conditions involved in either constant or fluctuating hydraulic heads. G-E water-wheel-driven generators having an aggregate capacity considerably in excess of 3,000,000 kw. are now in successful operation. Vertical shaft units in 30 to 625 kv-a. sizes are described in Bulletin 40601. A list of many large installations are illustrated in Bulletin 40600. In addition to water-wheel-driven generators, this company manufactures electrical apparatus for the complete equipment of hydroelectric stations. See page 1204 for more information.—Adv.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Leffel & Co., The James, 426 East St., Springfield, Ohio.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

GENERATORS, LIGHTING AND POWER, D-C., BELTED.—D-c. generators are sometimes belt-driven from a low-speed engine or other prime mover. By using a belt a higher speed and less costly generator may be secured than one directly connected to a low-speed prime mover. Like the belt-driven alternators, they are only made in small sizes and are no longer very widely used. They are confined principally to isolated power plants for industrial service, and to semiportable sets where a prime mover may be used to drive other machinery at times and is only connected to the generator at night to carry the lighting load or to charge a set of batteries. They are used in some plants where the main power supply is alternating current and only a moderate supply of d-c. power is needed for variable-speed motors, lifting magnets, battery charging, etc.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can. "King Edward."
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Crocker-Wheeler Co., Ampere, N. J.
De Vry Corp., 1250 Marianna St., Chicago, Ill. "De Vry."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Electromotor Co., 32-40 S. Clinton St., Chicago, Ill.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Belt driven generators are readily adapted to existing power shafting and in the case of small plants the first cost is lower than that of direct-connected units. The d-c. type is applicable in office buildings, factories, hotels and other locations where the feeder length is reasonable, where central station power is not available, or where partial d-c. service is required. G-E Type LF generators are made from 20 to 90 kw., both compound and shunt wound. (Bulletin 40021).

Type RC generators with commutating poles are made in a unified design from ½ to 175 kw. and which permit installation on floor, wall or ceiling. (Bulletin 40019). Type ML generators and exciters are made for 125 to 250 volts 2-wire and the sizes above 7 kw. for 250 volts 3-wire. Furnished also in sizes up to 9 kw. for 35 volts for low voltage storage battery service (Bulletin 40017A). These generators are built also in three-bearing construction with heavy balance wheels for drive by gas or oil engines of the hit-or-miss governor type, to eliminate the pulsations of speed and, thereby, deliver current at a voltage reasonably steady for incandescent lighting and motor service. (Bulletin 40025.) See adv. pages 1203-1223.—Adv.
Globe Electric Co., 868 Broadway, Milwaukee, Wis. "Globe."
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Imperial Electric Co., The, Akron, Ohio. "Imperial."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Kendrick & Davis Co. Lebanon, N. H. "K. & D."
Kurz & Root, Appleton, Wis.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Lister & Co. (Canada), Ltd., R. A., 58 Stewart St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Main Electric Co., Cleveland, Ohio.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display advertisement on page 1308.)
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection," "Jupiter."
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
ROBBINS & MYERS CO., THE, Springfield, Ohio. Robbins & Myers generators are made in sizes ranging from ¼ to 10-kw. inclusive. They are supplied with pulley for belt drive, or for direct connection. Special designs are made on quantity orders for direct application to farm lighting plants.—Adv.
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y.
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Star Electric Motor Co., Miller St. & N. J. R. R. Ave., Newark, N. J. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Swartz Electric Co., Indianapolis, Ind. "Swartz-Light."
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

GENERATORS, LIGHTING AND POWER, D-C., ENGINE.—D-c. generators built on the same shaft as a reciprocating engine or directly coupled to it. They are usually of special construction and have a very heavy frame and bearings. The armature sometimes serves as a flywheel for the engine, which may be either steam, oil or gas. Steam engines are by far the most common, but oil engines are used rather widely in the southwest section of the United States. They are used more frequently on shipboard and in the isolated plants of office buildings, hotels, industrial plants, etc., than in central stations, and for such service are not made in very large sizes. They have the advantage, for industrial service, of permitting efficient operation of variable-speed motors. They are also used for d-c. electric railway plants that generate their power directly.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Engberg's Electric & Mechanical Works, St. Joseph, Mich.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Generators which possess every refinement of the best electrical and mechanical design as well as ability to meet successfully the most exacting service requirements that modern applications demand. Made in both 2-wire and 3-wire types, either shunt or compound and with armatures wound to meet standard heating specifications. The generator speeds conform to the most modern engine practice, having been selected according to the requirements of leading engine builders. The standard-speed machines can be run 5% above or below the rated speed, and the slow-speed machines 5% above the rated speed at rated voltage and output. For engine drive these generators are furnished without base, shaft, bearings or foun-

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dation bolts, unless these parts are desired. Description of 25 to 400 kw. sizes is given in Bulletin 60011. Information on larger sizes for 250 volts only can be had on application. Also small direct-connected sets designed primarily to meet the severe conditions of marine work, which demand light, compact and durable sets of close regulation and quiet operation. Adapted also for power supply to shipyards and for isolated plant operation. These sets have a great advantage in being manufactured complete at one factory, which insures perfect fit, uniformity of finish and a thorough test of the combined unit before shipment. Made in standard sizes ranging from 2½ kw. to 60 kw. (Bulletin 42300). See adv. pages 1203-1223. —Adv.



G. E. Generating Set

Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Kurz & Root, Appleton, Wis.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Main Electric Co., Cleveland, Ohio.
Marble-Card Electric Co., Gladstone, Mich.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Swartz Electric Co., Indianapolis, Ind. "Swartz-Light."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, LIGHTING AND POWER, D-C., TURBO.—D-c. generators driven by steam turbines. Some d-c. turbogenerators are driven at the same speed as the turbine, which may be 3000 r. p. m. or more; others are driven at a reduced speed through gearing. D-c. generators are not as easily designed for high speeds as are alternators, mainly on account of commutator troubles, hence the use of reduction gears. They are not used as extensively as turbine-driven alternators and they are rarely made in large sizes. To some extent they are used in steam-electric power plants where a small unit is installed merely to supply the station lights and motor auxiliaries; this permits economical and efficient operation of any variable-speed motors that may be required in a plant where the main power generation is alternating current. They are also used as exciters in many cases, such as an emergency exciter in a plant where each unit has its own exciter directly connected. Another application of small units is in steam railroad work where they are used to supply the train lights and charge the battery in the head-end car-lighting system. Small d-c. turbogenerators are also mounted on the locomotives in other cases, to supply the headlight and other locomotive lights. Their simplicity and compactness as compared with the usual marine engines is leading to their installation on shipboard. These same advantages account for their use in some portable lighting and power plants.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill "Fairbanks-Morse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Small d-c. sets are direct-connected, turbine and generator running at 600 r.p.m. Direct-current generators above 100 kw. capacity are driven through speed reduction gearing. The gearing is of standard design of the helical, herringbone type. The gear is self-oiling and operates quietly and with high efficiency. (Bulletin 42010A.) See adv. pages 1203-1223.—Adv.
Kerr Turbine Co., Wellsville, N. Y. "Economy."
Leffel & Co., The James, 426 East St., Springfield, Ohio.
Lucey Mfg. Co., Woolworth Bldg., New York, N. Y. "Turbolite."
Midwest Engine Co., Indianapolis, Ind.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Sunbeam Electric Mfg. Co., Evansville, Ind.
TERRY STEAM TURBINE CO., THE, Hartford, Conn. Built in sizes from 5



Terry Turbo Generator

to 1,000 K.W., condensing and non-condensing, geared or direct connected. —Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, LIGHTING AND POWER, D-C., WATER-WHEEL.—Direct-current generators driven by water wheels, usually by direct connection. They are not used as widely as a-c. generators driven in this manner, but are used to a certain extent for electric railway and electro-chemical work. The generators may be either horizontal or vertical. In some water-power plants they are installed in small sizes to supply the lights and station motor auxiliaries: separate exciter units of this type are often provided for a-c. hydroelectric plants. They are also used to some extent in paper mills, flour mills and other industrial plants, especially those in which variable-speed motors and electrolytic processes are employed.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St Catharines, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can "Westinghouse."
Cosby Electric & Machine Co., R. R. 1705 E. Broad St., Richmond, Va.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Direct-current generators for water-wheel drive for excitation purposes can be furnished in any standard sizes required. See adv. pages 1203-1223.—Adv.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Leffel & Co., The James, 426 East St., Springfield, Ohio.
Main Electric Co., Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display advertisement on page 1308.)
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GENERATORS, MAGNETO, IGNITION.—Magneto generators used for ignition of gas, gasoline or oil engines. Such generators are practically always of the a-c. type and the armature winding and core may rotate or the armature winding may be stationary with an inductor rotating. They are classified as low-tension or high tension, according to the relative value of the voltage. Low-tension magnetos are generally used for the "make-and-break" system of ignition and high-tension magnetos for the "jump-spark" system. The former is frequently applied to stationary engines while the latter is widely used for automobile engines. For general principles see Generator, magneto.

Manufacturers:

American Bosch Magneto Corp., Springfield, Mass. "Bosch."
American Swiss Magneto Co., The, 1682 Fernwood Ave., Toledo, Ohio.
Apollo Magneto Corp., Kingston, N. Y.
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Eisemann Magneto Corp., 32 33rd St., Brooklyn, N. Y.
Evinrude Motor Co., 279 Walker St., Milwaukee, Wis.
Gladiator Mfg. Co., Auburn, Ind. "Gladiator."
Gray & Davis, Inc., Boston, Mass.
Hercules Mfg. Co., 2122 Northwestern Ave., Indianapolis, Ind. "Star," "Wizard."
Kokomo Electric Co., Kokomo, Ind. "Kingston."
K-W Ignition Co., The, E. 30th St. & Chester Ave., Cleveland, Ohio. "K-W."
Lauraine Magneto Co., Inc., Long Island City, N. Y. "Lauraine."
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
Simms Magneto Corp., The, East Orange, N. J. "Simms."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J. "Dixie." "Aero." "Sumter."
Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.
Webster Electric Co., Clark St. & De Koven Ave., Racine, Wis. "Webster Tri-polar Oscillator."

GENERATORS, MAGNETO, TELEPHONE.—Small magneto generators having a permanent magnetic field created by from two to five or even six steel magnets The armature is of the shuttle form. It generates alternating current or pulsating current, which in some few cases is rectified by a little commutator. The magneto generator with a hand crank is used in local-battery telephone systems to signal the operator, and in some cases to supply the ringing current.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
International X-Ray Corp., 326 Broadway, New York, N. Y.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

GENERATORS, MAGNETO, TESTING.—Generators whose field is supplied by a

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permanent magnet. They are used for testing the continuity of circuits or the quality of insulation. They may be either d-c. or a-c. machines, and are usually hand driven through gearing. They are light enough to be easily carried about. For the complete testing outfits see Testing sets, portable (magneto and bell type); also Testing sets, portable (magneto, ringer and telephone type).

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

GENERATORS, MOTOR.—These are motor-driven generators, usually mounted on a single bedplate. They are commonly called motor-generators or motor-generator sets. See Motor-generators.

GENERATORS, PARALLEL OPERATION OF.—A connection of generators in parallel for the purpose of getting a combined output greater than that from one machine alone. The usual types of generators that are operated in parallel are (1) compound wound d-c. generators and (2) alternators (a-c. generators).

In the parallel operation of compound generators, machines of similar characteristics are desired; they must have like polarities joined together and develop approximately equal internal voltages. The brushes of the separate machines on the side of the series windings must be joined together through a low-resistance conductor called an equalizer) in order to give stable operation. The division of the load among the several machines in parallel is governed by the shunt excitation.

In the parallel operation of alternators the voltages must be approximately in phase with respect to the load and their frequencies must be identical. Inequalities of the voltages cause circulating currents, which tend to boost the lower voltage machines and reduce the higher ones. Any tendency to vary in frequency produces synchronizing currents which give power to the slower running machines and take it from the faster ones, thus tending to equalize the speeds. The division of the load among the several alternators is controlled by adjusting the governors of the prime movers so as to give more power to the lighter loaded or less power to the heavier loaded machines. The process of connecting a-c. generators in parallel is called "synchronizing," which see.

GENERATORS, SPECIAL AND MISCELLANEOUS.—Generators are often made to meet special operating conditions or voltages and for miscellaneous applications not listed above. Some of the applications are for rather special apparatus, such as certain marine generators, generators for operating ozonators where a high frequency is required, or for dust precipitation in smelters, cement plants, etc., where a high voltage d-c. generator is required.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa. (blasting)
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Boston Armature Works, 77 Washington St., N., Boston, Mass.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Carleton Co., The, 170 Summer St., Boston, Mass.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill. (demonstration)
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Kurz & Root, Appleton, Wis.
Marble-Card Electric Co., Gladstone Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display advertisement on page 1308.)
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., Driving Park Ave. & Argo Park, Rochester, N. Y.
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Shedd Electric Co., Inc., Clay & Locust Aves., Roselle Park, N. J.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Voltamp Electric Mfg. Co., 407-409 N. Paca St., Baltimore, Md. ("Voltamp" miniature and toy.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

GENERATORS, WELDING.—D-c. generators specially designed for supplying power for electric arc welding. They may maintain an approximately constant voltage at their terminals, or a nearly constant current through the circuit, or approximately constant power in the arc. The control is obtained by inherent characteristics of design, with or without external regulating devices. They are often mounted on trucks so as to be easily moved to the work, and are frequently made up as motor-generator sets with an induction motor, either single, two or three phase, or a d-c. motor to drive the generator or generators.

Manufacturers:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Generators for electric arc welding, which can be furnished for drive by any suitable electric motor engine or belt. Made up as single operator and multi-operator equipments. See Welders, Electric Arc, for further information on G-E welding apparatus. See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y. "Plastic-Arc."

GENEROMETER.—Trade name for automobile generator testers manufactured by Paul G. Niehoff & Co., Inc., 232-242 E. Ohio St., Chicago, Ill.

GENTRY.—Trade name for electric vibrator manufactured by the Shelton Electric Co., 16 E. 42nd St., New York, N. Y.

GENUINE WASHINGTON SLATE CO.—Slatington, Pa. Manufacturer of slate for electrical purposes. Quarry, Berlinsville, Pa.

GEOMETRIC.—Trade name for screw cutting tools and machines manufactured by the Geometric Tool Co., Blake & Valley Sts., New Haven, Conn.

GEOMETRIC TOOL CO., THE.—Blake & Valley Sts., New Haven, Conn. Manufacturer of screw cutting tools and machines. Business established 1895. President, treasurer and general manager, Howard E. Adt; vice-presidents, John T. Manson and F. B. Farnsworth; secretary, Thomas M. Steele; sales manager, George A. Denison. Branch office and warehouse, 627 W. Washington Blvd., Chicago, Ill. Sales representatives, Charles A. Strelinger Co., Detroit, Mich.; Tool Equipment Co., San Francisco, Cal.; Blackman-Hill McKee Machinery Co., St. Louis, Mo.; National Supply Co., Toledo, Ohio; W. M. Pattison Supply Co., Cleveland, Ohio; Root, Neal & Co., Buffalo, N. Y.; F. E. Satterlee Co., Minneapolis, Minn.; Somers, Fitler & Todd Co., Pittsburgh, Pa.; Vandyck Churchill Co., New York and Philadelphia, Pa.; Vonnegut Machinery Co., Indianapolis, Ind.; C. H. Wood Co., Syracuse, N. Y.; Canadian Fairbanks-Morse Co., Ltd., Man., Saskatchewan and Alberta; A. R. Williams Machinery Co., Ltd., Toronto, Winnipeg and St. John (N. B.); Williams & Wilson Ltd., Montreal, Que., Can.

GEOPHONE.—A type of sound detector, either mechanical or electrical, which is used to magnify earth vibrations. The electrical kind employs a very sensitive microphone cell or telephone transmitter, which is placed on or in the earth region which is to be studied. Very small vibrations or jars in the ground are magnified so as to be easily heard. The character of the sound gives much information, which the experience of the observer can interpret. By having two geophones in different locations, with one observer to listen to each of them alternately, the direction from which the sound in the earth is coming can be determined by the binaural effect. The geophone was much used during the World War for the detection of mining operations, and is used in mine rescue work. Leaking pipes underground are also explored with success.

GEOPHONE.—Trade name for telephonic detector for mine and other underground sounds, made by the Globe Phone Mfg. Co., Reading, Mass.

GEORGIA CREOSOTING CO.—Louisville, Ky. Producer of creosoted poles, posts, ties and underground conduit. Main office, 401 W. Main St., Louisville, Ky. Branch office, Bogalusa, La. Plants, Manville, N. J.; Paterson, N. J.; Rome, N. Y.; Toledo, Ohio; Indianapolis, Ind.; Bloomington, Ind.; Russell, Ky.; Marion, Ill.; Kansas City, Mo.; Springfield, Mo.; Hugo, Okla.; Shreveport, La.; Deridder, La.; Bogalusa, La.; Brunswick, Ga.; Trenton, Ont., Can.

GEORGIA INDEPENDENT TELEPHONE ASSOCIATION.—President, R. S. Stewart, Thomasville, Ga.; secretary, treasurer, J. R. Nunnally, Monroe, Ga.

GERDES & CO., INC.—50 Church St., New York, N. Y. Manufacturer of rawhide pinions.

GERMAN SILVER.—This alloy of nickel and copper, which formerly was known as German silver, is now more commonly called nickel silver. See Nickel silver.

GETZ POWER WASHER CO.—Morton, Ill. Manufacturer of electric washing machines. Business established 1913. President, John Getz, Sr.; vice-president, A. L. Kitselman; secretary, J. A. Getz; treasurer, E. C. Getz.

GEUDER, PAESCHE & FREY CO.—Milwaukee, Wis. Manufacturer of sheet metal parts and stampings. President, Charles A. Paeschke; secretary and treasurer, F. J. Frey. Main office, 1466-1766 St. Paul

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Ave., Milwaukee, Wis. Branch offices, 352-356 W. Ohio St., Chicago, Ill. District offices, 529 Odd Fellows Bldg., St. Louis, Mo.; 1312 Dime Bank Bldg., Detroit, Mich.

GEYSER.—Trade name for electric water heaters manufactured by the National Electric Water Heater Corp., Times Bldg., New York, N. Y.

GEYSER ELECTRIC CO.—5008-18 Bloomingdale Ave., Chicago, Ill. Manufacturer of electric washing machines. President, P. Junkersfeld; vice-president and general manager, C. W. Malcolm; secretary and treasurer, R. E. Schreiber. Branch office, Geyser Electric Washing Machine Co., Inc., 1270 Broadway, New York, N. Y.

G. I.—Trade name for incandescent lamps manufactured by the General Incandescent Lamp Division, National Lamp Works of General Electric Co., Cleveland, Ohio.

GIANT.—Trade name for electrotherapeutic lamp manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

GIANT.—Trade name for oil, gas, gasoline and steam engines manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

GIANT.—Trade name for dry batteries manufactured by the Delta Electric Co., Marion, Ind.

GIANT.—Trade name for telegraph sets and sounders manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

GIANT.—Trade name for belt lacing manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

GIANT HANDI-VISE.—Trade name for hand vise manufactured by the Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

GIANT IMPROVED.—Trade name for motor-driven ice cream freezers manufactured by Henry G. Lange, 162 N. May St., Chicago, Ill.

GIANT REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-3086 W. 106th St., Cleveland, Ohio.

GIBB INSTRUMENT CO.—348 E. Palmer Ave., Detroit, Mich. Manufacturer of electric welders, engravers and pyrometers. Business established 1915. President, W. H. Gibb; secretary and treasurer, J. R. Brueckner.

GIBBS.—Trade name for trailer and train jumpers manufactured by the Loeffelholz Co., 17-182 Clinton St., Milwaukee, Wis.

GIBRALTAR.—Trade name for insulating tape manufactured by the M. W. Dunton Co., Providence, R. I.

GIBSON CO., H. B.—38 Park Pl., New York, N. Y. Manufacturer of electric heaters and drink mixers. President, Bliss B. Johnson; vice-president, C. R. Johnson; secretary, Charles B. Whipple; treasurer, P. H. Bricklemaier.

GICO.—Trade name for incandescent lamps manufactured by the General Illuminating Co., 5317-5321 21st Ave., Brooklyn, N. Y.

GIESE ART METAL WORKS.—4414 Germantown Ave., Philadelphia, Pa. Manufacturers of lighting fixtures.

GIFFORD-WOOD CO.—Hudson, N. Y. Manufacturer of conveying machinery. Main office, Hudson, N. Y. Branch offices, New York, N. Y.; 565 Washington Blvd., Chicago, Ill.; Buffalo, N. Y.; Boston, Mass.; Philadelphia, Pa.

GILBERT.—Work must be done in moving a unit magnet pole once around a magnetic circuit against the magnetic field. When the work so expended is one erg, the difference of magnetic potential (or magnetomotive force) is one unit. The name often used for this unit is the gilbert. The gilbert may also be defined as the magnetomotive force produced by a current of $10/4\pi$ amperes in a coil of one turn. The unit of magnetizing force is the gilbert per centimeter.

GILBERT CO., THE A. C.—Blatchley Ave., New Haven, Conn. Manufacturer of radio apparatus, electric toys, fans, motors, vibrators, egg beaters and other labor-saving devices. President, treasurer and general manager, A. C. Gilbert; secretary, A. B. Alling; sales manager, J. E. McCrady. Main office and factory, New Haven, Conn. Branch offices, 200 5th Ave., New York, N. Y.; 718 North American Bldg., Chicago, Ill.; 816 Postal Telegraph Bldg., San Francisco, Cal.; A. C. Gilbert-Menzies Co., Ltd., Toronto, Ont., Can.

GILBERT ELECTRIC SHADE CO.—101 Warren St., New York, N. Y. Manufacturer of lighting reflectors and illuminating glassware.

GILBERT-GRANT CO., THE.—Grand Central Terminal, New York, N. Y. Manufacturer of electric cranes, hoists and winches. Business established 1914. President, Stuart Wilder; vice-president, J. G. Cline; secretary and treasurer, C. H. B. Chapin. Factory, Plainfield, N. J.

GILBERT SUPPLY CO.—Lock Box No. 2, Independence, Iowa. Manufacturer of electric retouchers for photographic studios. Business established 1917. President, C. H. Gilbert; secretary, treasurer and general manager, A. G. Rigby.

GILBERT, WILLIAM.—An English physician and physicist (born at Colchester, 1544, died 1603 in London), who was termed the "father of magnetic philosophy." He was educated at Colchester school and in 1558 he entered St. Johns' College at Cambridge. After taking the degrees of B. A. and M. A., he was graduated with the degree M. D. in 1569, in which year he was elected senior fellow of his college. Gilbert's fame rests on the discoveries which he made in electricity and magnetism and which he tersely recorded in his works on the magnet, "De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure," published in London in 1600. This work contains an account of the author's experiments on magnets and magnetic bodies and on electrical attractions, and also his great conception that the earth is nothing but a large magnet, and that it is this which explains not only the north and south direction of the magnetic needle, but also its inclination if free to swing on a horizontal axis. To commemorate his early magnetic discoveries, the unit of magnetomotive force is called the gilbert.

GILBERT, WILLIS H.—710 Conway Bldg., Chicago, Ill. Producer of white cedar poles. Business established 1918. Sales representatives, National Electric Supply Co., Washington, D. C.; L. Thomas Niblo, Box 403, Philadelphia, Pa.; Carter Electric Co., Atlanta, Ga.; Mathews Electric Supply Co., Birmingham, Ala.; Electrical Supply Co., 326 Camp St., New Orleans, La.; Perry-Mann Electric Co., Columbia, S. C.; Erner Electric Co., Cleveland, Ohio.

GILDING.—The act of depositing a layer of gold by electroplating, the current passing from an electrode of gold through a bath of gold cyanide in which the articles to be plated are suspended. The term is also used to designate the application of gold leaf or powder by hand.

GILFILLAN BROS., INC.—Los Angeles, Cal. Manufacturer of portable electric tools, automobile spotlights and contact and sparking points. Main office, 217½ W. 6th St., Los Angeles, Cal. Branch offices, Kansas City, Mo.; Atlanta, Ga.; 225 W. 57th St., New York, N. Y.

GILL.—Trade name for standard telegraph and telephone line automatic call selector manufactured by the Hall Switch & Signal Co., Garwood, N. J.

GILL BROS. CO.—Steubenville, Ohio. Manufacturer of illuminating glassware. President, J. W. Gill; vice-president, John Beiswanger; secretary and treasurer, D. R. Rooke. Main office, 627 Franklin Ave., Steubenville, Ohio. Branch offices, 200 5th Ave., New York, N. Y.; 700 Mallers Bldg., Chicago, Ill.; 21 N. Liberty St., Baltimore, Md.

GILL GLASS CO., INC.—Philadelphia, Pa. Manufacturer of illuminating glassware. President and general manager, Francis D. Gill; vice-president, M. A. Gill; secretary and treasurer, G. A. Gill. Main office, Amber & Venango Sts., Philadelphia, Pa. Branch office, 200 5th Ave., New York, N. Y. Sales representatives, C. G. Justice, 1123 Peachtree St., Atlanta, Ga.; Ira A. Jones Co., 17 N. Wabash Ave., Chicago, Ill.; R. E. Bau, 303 Rialto Bldg., San Francisco, Cal.; H. S. Bokee, 122 W. Baltimore St., Baltimore, Md.; H. Alex Hibbard, Century Bldg., Denver, Colo.

GILLESPIE.—Trade name for motors manufactured by the Gillespie-Eden Corp., 7 Dey St., New York, N. Y.

GILLESPIE-EDEN CORP.—New York, N. Y. Manufacturer of electric washing machines, extractors and motors. Business established 1910. President, Thomas H. Gillespie; vice-presidents, Harry G. Seaber and E. L. Bergland; secretary, F. J. Nash; treasurer, H. S. Hart; sales manager, R. T. Merrick. Main office, 7 Dey St., New York, N. Y. Factories, Alton, Ill.; Lowell, Mass.; Patterson, N. J. Branch offices, St. Louis, Mo.; Denver, Colo.; San Francisco, Cal.; Toronto, Ont., Can.

GILLESPIE-EDEN CORP., LTD., THE.—266 King St., W., Toronto, Ont., Can. Manufacturer of electric washing machines. Sales representative, Great Western Electric Co., Winnipeg, Man., Can.

GILLETTE CLIPPING MACHINE CO.—129-31 W. 31st St., New York, N. Y. Manufacturer of electric clipping, grooming and shearing machines for domestic animals. Business established 1891. President, King C. Gillette; secretary and general manager, Harold Leth; treasurer, V. H. Banning.

GILLETTE ELECTRIC CLOCK CO.—728 Buckingham Pl., Chicago, Ill. Manufacturer of electric clocks. Business established 1913. Proprietor, H. Gillette.

GILLETTE-VIBBER CO., THE.—New London, Conn. Manufacturer of conduit fittings. Business established 1904. President and general manager, W. H. Vibber; secretary and treasurer, C. Royce Boss. Sales representative, M. B. Austin & Co., 700 Jackson Blvd., Chicago, Ill.

GILLINDER & SONS, INC.—Tacony St., Philadelphia, Pa. Manufacturer of illuminating glassware. Business established 1861. President, E. A. Gillinder; secretary and treasurer, George A. Steele.

GILLINDER BROS.—Port Jervis, N. Y. Manufacturers of illuminating glassware. Partnership, William T. Gillinder, Edwin B. Gillinder and James Gillinder.

GILLIS & GEOGHEGAN.—537-539 W. Broadway, New York, N. Y. Manufacturers of telescopic hoists. Business established 1866. Branch office, Sherbrooke, Que., Can.

GILSONITE.—Trade name for insulating compounds manufactured by the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa.

GILT EDGE.—Trade name for square flax packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

GIMCO.—Trade name for pipe covering manufactured by the General Insulating & Mfg. Co., St. Louis, Mo.

GIMLET.—A screw-pointed tool with a small handle at the other end used to bore small holes in wood. They are sometimes used in bell wiring and in other wiring to drill a screw hole.

GIPSY.—Trade name for vises manufactured by the Bonney Vise & Tool Works, Inc., Allentown, Pa.

GIRDER CLAMPS.—See Clamps, beam.

GIROD.—Trade name for electric steel furnace imported by C. W. Leavitt & Co., 30 Church St., New York, N. Y.

GIROD FURNACE.—An electric furnace of the combined arc-resistance type, used chiefly in the production of steel and steel alloys. One electrode is built into the hearth of the furnace.

GIRTANNER ENGINEERING CORP., THE.—1400 Broadway, New York, N. Y. Manufacturer of coal and ash handling equipment.

GISHOLT MACHINE CO.—Madison, Wis. Manufacturer of electric clocks, drills, lathes, etc. Business established 1885. President and general manager, C. A. Johnson; vice-president, H. S. Johnson; secretary, G. E. Gernon; treasurer, M. I. Johnson; sales manager, Ellis F. Muther. Main office, 1241 E. Washington Ave., Madison, Wis. Factories, Madison, Wis., and Warren, Pa. Branch office, 30 Church St., New York, N. Y.

GITS BROS. MFG. CO.—1901 S. Kilbourne Ave., Chicago, Ill. Manufacturer of oil cups. Partnership, A. H. Gits and R. J. Gits.

G-K.—Trade name for battery sealing compound manufactured by the Atlas Mineral Products Co., Mertztown, Pa.

GLACIER.—Trade name for electric household refrigerators manufactured by the Glacier Machine Mfg. Co., 55-57 E. Lake St., Chicago, Ill.

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GLACIER MACHINE MFG. CO.—55-57 E. Lake St., Chicago, Ill. Manufacturer of electric household refrigerators.

GLADIATOR.—Trade name for ignition timer and generators manufactured by the Gladiator Mfg. Co., Auburn, Ind.

GLADIATOR MFG. CO.—Auburn, Ind. Manufacturer of ignition timers and generators. Business established 1920. President, J. D. Casey; secretary and treasurer, M. C. McIntyre.

GLASS.—Glass is extensively used as an insulating material. It has a high dielectric strength varying from 5900 to 11800 volts per mm. Its resistivity is from 10^{12} to 10^{18} ohm-cm. at ordinary temperatures but decreases very fast with an increase in temperature. Glass is composed principally of silica, its silica content varying from 50 to 75% of the total. Soda, potash, lead oxide and lime are also contained in varying proportions. Glass may be made into many forms and is used extensively in the lamp, lighting glassware, telegraph and telephone, and other branches of the electrical industry. It is very brittle and rather unreliable mechanically, with a tensile strength anywhere from 1000 to 10,000 lbs. per sq. in., depending on its composition and how it has been manufactured and annealed.

GLASS CUTTERS.—See Cutters, glass.

GLASS INSULATORS.—See Insulators, glass.

GLASS JARS.—See Jars, battery, glass; also Jars, hydrometer.

GLASS LETTERS.—See Letters, sign, glass.

GLASS, OPAL.—See Opal and opalescent glass.

GLASS REFLECTORS.—See Reflectors, glass, mirror; Reflectors, glass, opal; Reflectors, glass, prismatic.

GLASS SHADES.—See Shades, glass, plain, opal, decorative or "art."

GLASS SHEETS, RODS, TUBES ETC., FOR ELECTRICAL PURPOSES.—A great quantity of glass is used in the electrical industry. One of the chief uses is that of glass tubing in the manufacture of electric lamps. Other common uses are thin plate glass for lantern type fixtures, glass-type condensers, electrotherapeutic apparatus and other scientific instruments; also for glass tube fuses, and battery separators, and for special apparatus made up for testing and measurements laboratories. Also see Jars, battery, glass; Covers, battery jar; Jars, hydrometer; Insulators, glass; Tubes, glass, floor.

Manufacturers:

American 3 Way-Luxfer Prism Co., 1309 S. 55th Court, Cicero, Ill.
Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.
Easter Electric Co., The, 827 14th St., Denver, Colo. (tubes)

GLASSINE.—Trade name for insulating paper manufactured by the Diamond State Fibre Co., Bridgeport, Pa.

GLASSWARE, ILLUMINATING.—Glass made up into shades, globes, reflectors, bowls and domes for use on illuminating fixtures and appliances. This is a much used term or classification of glass according to use rather than according to kind, as many kinds of glass are used in illuminating glassware. Some of the principal forms of illuminating glassware are as follows:

Diffusing globes which completely surround the lamp are made in various decorative forms, the plain spherical or ball globe being the most common. In diffusing globes the aim is to so diffuse the light as to avoid serious glare from the light source inside, and yet absorb as little light as possible. White opal is one of the best diffusers but of rather high absorption. It has been largely superseded by opal of less perfect diffusion which absorbs much less light. Diffusing globes of pressed, sandblasted or blown glass known to the trade as CRI (crystal rough inside) or CRO (crystal rough outside) are in common use and give a certain degree of diffusion with an absorption under 20%, but have the disadvantage that they are very hard to clean when once the dirt is rubbed in. Diffusing globes of the types described are usually of blown glass. Another type of diffusing globe is of pressed glass, clear or crystal, with irregularities pressed into the glass which give some diffusion. In the Holophane type of globe, scientifically and accurately designed prisms are pressed into the inner and outer surface, to throw the light where it is useful or desired and also to diffuse it.

The term shade applies to all illuminating glassware (except the enclosing globe) which is designed to go over a lamp for eye shielding, reflecting or decorative purposes. This includes also reflectors which are designed specifically to reflect light in desired directions. Three kinds of glass reflectors are in common use: (1) opal reflectors; (2) clear glass reflectors with 90° prisms on the outside, known as prismatic reflectors; (3) mirrored reflectors in which mirroring is placed over clear glass.

Illuminating glassware for use on street lamps comprises principally globes and refractors. For ornamental lighting on downtown streets and boulevards, opal diffusing globes of various designs are commonly used. For protecting magnetite or luminous arc lamps from the weather, clear glass globes are generally used. A refractor as used on street lamps takes on various forms. The object of the refractor is to intercept light going upward in directions where it is not useful and direct it by means of prisms into the most useful directions. It is sometimes placed inside of a globe, and sometimes used as a substitute for the globe.

For separate listing of the principal forms of illuminating glassware see bowls, lighting; domes; globes; reflectors, glass; refractors; shades, glass. The following manufacturers are producers of several or all of these forms of glassware.

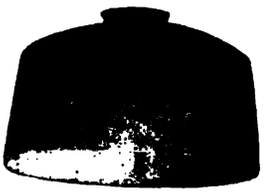
Manufacturers:

American Glass Specialty Co., Monaca, Pa.
Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y. "Equalite."
Bent Glass Novelty Co., The, 394 Canal St., New York, N. Y.
Cambridge Glass Co., Cambridge, Ohio.
Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.
Consolidated Lamp & Glass Co., Coraopolis, Pa.
Corning Glass Works, Corning, N. Y.
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.
Eagle Mfg. Co., Wellsburg, W. Va.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Foskett Co., Inc., The, Port Jervis, N. Y.
Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y. "Fredro."
Gilbert Electric Shade Co., 101 Warren St., New York, N. Y.
Gill Bros. Co., 627 Franklin Ave., Steubenville, Ohio. "Parian," "Nu-Acmelite."
Gill Glass Co., Inc., Amber & Venango Sts., Philadelphia, Pa. "Velva," "Una," "Nova."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y. "Celestialite," "Camia," "Gletieco," "Blanco," "Polycase," "Carrara," "Amazon," "Prestopal."
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Hocking Glass Co., Lancaster, Ohio. "Lumina."
HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y.
Imperial Glass Co., Bellaire, Ohio. "Nu-art."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, O. Manufacturers of Ivanhoe glassware for commercial, ornamental and home lighting. Ivanhoe glass is made in numerous textures as follows: Crystal, clear, or roughed inside or outside, for ball and pointed enclosing globes and shades: also enameled for commercial lighting units, such as the Ivanhoe Ace and Ivanhoe Keldon (see display pages 1266-9). "Genco," a light-weight but highly diffusive glass, for ball and pointed globes. "Druid," a heavy-weight light-density opal glass with smooth surface and slight amber tinge, for commercial lighting reflectors, bowls and shades. "Sudan," a heavy-weight and heavy-density white opal glass of high reflecting power, especially adapted for semi-indirect lighting bowls because the direct light passing through the glass is exceptionally well diffused; and for direct lighting reflectors of high efficiency. "Veluria," a light-density ornamental opal glass with a velvet surface; unlighted, it has a soft, white color; lighted, it shows the true pink opal "fire"; Veluria is made in various fired colors, with or



Semi-Indirect Etched Bowl

without engraved or relief etching, also with Rozelle color decorations. "Ivre," a beautiful glass named after its resemblance to old ivory; its color is an integral part of the glass and not merely applied to the surface; made with etched or Rozelle color decorations. Decorations and coloring used for Ivanhoe glassware are as follows: Molded decorations, made by blowing or pressing in molds which have the decorations cut into them. These decorations stand out in high relief, and give a sharpness and accuracy of contour which resembles carved work. Etched decorations, made by etching the surfaces of glass blown to shape in smooth molds, are applied in two ways, relief and engraved. Relief etchings are made with the design raised above the surface of the bowl. Engraved etchings are made with the design etched down into the glass. Colors regularly supplied are of two



1326 Roz. 291

characters, fired and unfired. Fired colors are applied to the glass and then subjected to heat until the color burns into and becomes part of the glass; they are permanent. Unfired colors are applied to the glass and allowed to harden at ordinary room temperature; these are durable but their performance cannot be guaranteed. Colored relief etchings, made by coloring the decorations of relief etchings leaving the body of the bowl in natural glass. "Rozelle" is the name of artistic color decorations that can be applied to crystal, "Veluria" and "Ivre" glassware by a special process; Rozelle designs have the pure and permanent color qualities of the best hand-painted work, but are immeasurably superior to most hand painting; bowls and shades with Rozelle decorations are very attractive when unlighted, but when lighted the colors blend with a soft radiant color harmony. (Also see display adv. pages 1266-1269.—Adv.

Jeanette Shade & Novelty Co., Jeanette, Pa.
Jefferson Glass Co., The, Follansbee, W. Va. "Moonstone," "Nitroglass," "Opal."
Kokomo Opalescent Glass Co., Kokomo, Ind. ("Kokomo" opalescent sheet glass.)
Laco-Philips Co., 131 Hudson St., New York, N. Y. "Laco-Dalite."
Libbey Glass Mfg. Co., The, Toledo, Ohio.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
Lustre Art Glass Co., Maspeth, Long Island, N. Y.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa. "Alba," "Decora," "Thebian," "Monax."
Morgan & Co., Brooklyn, N. Y.
National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.

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NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Northwood Co., H., 36th & Wetzel Sts., Wheeling, W. Va. "Luna."
Opalux Mfg. Co., The, 200 Fifth Ave., New York, N. Y. "Opalux."
Pennsylvania Glass & Mfg. Co., Pittsburgh, Pa.
Phoenix Glass Co., Federal Reserve Bank Bldg., Pittsburgh, Pa. "Phenixlite," "Phoenix."
Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa. "Delica White," "Havana," "Pilasbrasgo," "Utopia."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Berylite."
Quezal Art Glass & Decorating Co., Brooklyn, N. Y.
Star Glass Co., Star City, W. Va.
U. S. Glass Co., Pittsburgh, Pa. "Chatham," "Colonial," "Lenox," "Ultimate."
Wellington Glass Co., Cumberland, Md.
Williamsburg Flint Glass Co., 260 Boerum St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y. "Sun Shell."

GLAZE.—A glossy, smooth, glasslike, transparent surface applied to high-tension porcelain insulating material for the purpose of closing the pores of the material and making the insulator waterproof. The glaze is a mixture of clays that fuses into a glass at the firing temperature of the porcelain. A special form of such glaze is applied to steel reflectors, for which it is more commonly called porcelain enamel.

GLAZIER HEADLIGHT CORP.—25-27 Otsego St., Rochester, N. Y. Manufacturer of automobile headlights, signals and reflectors. President and treasurer, Frank Ocumpaugh; vice-president, F. C. Kimmel.

GLEASON & CO., J. L.—241 Franklin St., Boston, Mass. Manufacturers of mining machine cables, reels, plugs, etc.

GLEASON-TIEBOUT G L A S S CO.—Brooklyn, N. Y. Manufacturer of glassware for lighting fixtures. President, M. W. Gleason; secretary and treasurer, C. H. Tiebout, Jr. Main office, 99 Commercial St., Brooklyn, N. Y. Factories, Brooklyn, N. Y., & Maspeth, L. I., N. Y. Branch offices, 200 5th Ave., New York, N. Y.; 6 E. Lake St., Chicago, Ill.

GLETIECO.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

GLIDE.—Trade name for transmission belting manufactured by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

GLOBE.—Trade name for storage batteries, farm lighting and power plants made by the Globe Electric Co., 368 Broadway, Milwaukee, Wis.

GLOBE.—Trade name for motor-driven air compressors and air compressor controllers manufactured by the Globe Mfg. Co., Battle Creek, Mich.

GLOBE.—Trade name for electric ranges, hot plates, griddles and irons manufactured by the Globe Stove & Range Co., Kokomo, Ind.

GLOBE.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Inc., Parkersburg, W. Va.

GLOBE.—Trade name for leather belting manufactured by the Schwartz Belting Co., 74-76 Murray St., New York, N. Y.

GLOBE CHEMICAL CO.—727 Ridgeway Ave., Cincinnati, Ohio. Manufacturer of brazing, battery sealing, coloring and frosting compounds and other chemicals and chemical supplies. Business established 1889. President and general manager, F. C. Grote. Factory, St. Bernard, Ohio.

GLOBE CLEANING BRUSHES. — See Brushes for globe cleaning.

GLOBE ELECTRIC CO.—6340 Stony Island Ave., Chicago, Ill. Manufacturer of motors, electric ventilating fans and blowers, grinders, buffers, etc. Business established 1905. George Parradee, general manager.

GLOBE ELECTRIC CO. — Milwaukee, Wis. Manufacturer of storage batteries, farm lighting and power plants. Business established 1912. President, John I. Beggs; vice-president, J. H. Gughs; secretary and treasurer, C. O. Wanrig; general manager, J. D. Wanrig, Jr.; G. M. Gardner. Main office and factory, 368 Broadway, Milwaukee, Wis. Branch offices, 25 Cleveland Place, New York, N. Y.; 6026 Center St., Pittsburgh, Pa.

GLOBE HOLDERS.—See Holders, shade, globe and reflector.

GLOBE IRON ROOFING & CORRUGATING CO.—Cincinnati, Ohio. Manufacturer of iron sheets for electrical purposes, lead washers, etc. Rolling mill and corrugating works, Newport, Ky.

GLOBE MFG. CO.—Battle Creek, Mich. Manufacturer of electric pumps, air compressors and air compressor controllers. Business established 1893. General manager and proprietor, Dr. H. M. Dunlap; secretary, R. S. Dunlap; treasurer, Nenna B. Dunlap.

GLOBE MFG. CO.—Perry, Iowa. Manufacturer of electric washing machines. Business established 1907. President and general manager, B. C. Dilenbeck; secretary, A. W. Powell; sales manager, F. W. Schuster.

GLOBE OPTICAL CO.—Boston, Mass. Manufacturer of electric testing cabinets. Main office, 403 Washington St., Boston, Mass. Branch offices, Augusta, Me.; Bangor, Me.; Bridgeport, Conn.; Burlington, Vt.; Hartford, Conn.; Lewiston, Me.; New Haven, Conn.; Providence, R. I.; Springfield, Mass.; Worcester, Mass.

GLOBE PHONE MFG. CO.—Reading, Mass. Manufacturer of stethoscopes, hearing devices for the deaf, telephones and accessories. Business established 1907. President, Albert G. Barber; vice-president, Walter C. Mooney; secretary and sales manager, W. C. Mooney; treasurer and general manager, Fred E. Bronson. Main office and factory, Reading, Mass. Branch offices and warehouses, 1388 Broadway, New York, N. Y.; 88 Tremont St., Boston, Mass.; 404 Parkway Bldg., Philadelphia, Pa.; Masonic Temple Bldg., Chicago, Ill.

GLOBE PORCELAIN CO.—127 Mulberry St., Trenton, N. J. Manufacturer of electrical porcelain specialties. Business established 1913. President, Joseph Steinert; secretary and treasurer, Morris Steinert.

GLOBE STOVE & RANGE CO., THE.—Kokomo, Ind. Manufacturer of electric household cooking and heating devices. Business established 1872. President, W. T. Patten; vice-president, George W. Charles; secretary and general manager, F. M. Ruddell; treasurer, Raymond Ruddell; sales manager, Charles R. Curlee.

GLOBES, ARC LAMP AND STREET LAMP.—Globes for this class of lamp are usually of opal glass, spherical or pear-shaped in form, though for "white way" lighting they are sometimes made in special shapes. Clear glass is little used, except for inner enclosing globes for arc lamps and for lamps hung so high above the illuminated area that the glare of the light source is not objectionable. As they are designed for outdoor service, they are generally totally enclosing.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa. "Mellilite."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Glorianna."
Jefferson Glass Co., The, Follansbee, W. Va.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa. "High Speed," "Thermo."
Pease Co., The C. F., 329 N. Franklin St., Chicago, Ill. "Peerless."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

GLOBES, MISCELLANEOUS LIGHTING.—The term globe was first applied to the shades used on gas lighting fixtures which were in reality a zone of a globe. The character of the old flat gas flame made it necessary to use this form of shade. The electrical fixtures, however, did not require this open form of shade and they took on a bell shape. The term globe was then abandoned for the more general term shade and the specific type of shade which was totally enclosing and approximately spherical was designated as a globe. These globes are largely used on porch lighting and sun-parlor fixtures in residences and to some extent in commercial lighting, particularly for entrance lights over or at the side of doorways. Due to the excellent diffusion and distribution obtained by using opal glass globes .this type of globe is widely used for street and park lighting by means of modern incandescent lamps.

Manufacturers:

Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
Gillinder & Sons, Inc., Tacony St.. Philadelphia, Pa.
Gillinder Bros., Port Jervis, N. Y.
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display advertisement on pages 1266-1269.)
Jefferson Glass Co., The, Follansbee, W. Va.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Berylite."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

GLOBES, VAPORPROOF.—These globes are generally made of heavy glass molded or blown to a simple bell shape. The open end is generally threaded or flanged so that the bell may be fastened in a suitable fitting and the joint made air-tight. For some few types of fixtures these globes are made spherical in shape. The globe is usually made of clear glass, though opal glass is better adapted for the purpose because it diffuses the light and reduces the glare from the filament of the bare lamp usually employed in these fixtures.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill. "Besco."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
CROUSE-HINDS CO., Cor. Wolf & 7th North St., Syracuse, N. Y.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y. Holophane "Vapor Proof Reflecror Globes" Nos. 2208 for 60-watt lamps and 2328 for 75 and 100-watt lamps combine reflector and vapor-proof globe, fulfilling perfectly the functions of each. Diameters are 6½ and 7¼ ins. and heights 6⅞ and 8¼ ins., respectively.—Adv.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display advertisement on pages 1266-1269.)
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S.-M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

GLOCATOR.—Trade name for luminous pendant manufactured by the Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

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GLOVES, ACIDPROOF.—Electroplaters, storage-battery workers, and other workers who must dip their hands in acid or handle acid-wet objects wear acidproof gloves. These gloves are often provided with long gauntlets which protect the forearm as well as the hands. They are usually made from a very heavy grade of rubber.

Manufacturers:

Goodyear Rubber Co., 787-789 Broadway, New York, N. Y.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.

GLOVES, ELECTRICALLY HEATED.—Gloves frequently worn by chauffeurs and electric vehicle or truck drivers. Resistance wires or elements are imbedded in the material of the inner glove, after the manner of the ordinary electric heating pad. The current is drawn from the storage battery with which most automobiles are provided, either for ignition, starting or lighting purposes, or, in the electric car, from the vehicle propelling battery. The current required is about that taken by a 6-cp. side or tail lamp.

GLOVES, FIREPROOF, FOR FURNACE TENDERS, WELDERS, ETC.—Intense heats developed in furnace and welding work make it necessary that the workman be provided with some protection, especially to his hands. The hands must be protected not only from the heat but also from hot particles of metal, scale, etc. As a means of protecting the hands mittens or gloves of fireproof materials, such as woven asbestos, are used. The gloves are often extended into a gauntlet to protect the wrist and forearm. Also see Garments, fireproof; Shoes, boots, leggings, etc., fireproof.

Manufacturers:

American Insulation Co., Roberts Ave. & Stokley St., Philadelphia, Pa.
Asbestos Fibre Spinning Co., North Wales, Pa.
Dagnall Asbestos & Insulation Co., 316 Lagauchetiere St., W., Montreal, Que., Can.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Kramig & Co., R. E., 8th St. & Eggleston Ave., Cincinnati, Ohio.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.
Modern Engineering Co., 23rd & Walnut Sts., St. Louis, Mo. "Meco."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
SPENCER GLOVE CO., Waverly, N. Y. "F. P. Sargent."

GLOLOG.—Trade name for electric fireplace heaters made by Strait & Richards, Inc., Fabyan Place, Newark, N. J.

GLO-RAY.—Trade name for bulbs for luminous radiators manufactured by the Branford Electric Co., Inc., 9 Church St., New York, N. Y.

GLORIANNA.—Trade name for illuminating glassware made by the Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

GLOVES, LINEMEN'S LEATHER OR BUCKSKIN.—The use of gloves by linemen for mechanical protection and insulation is very general. In cold weather they are also required for warmth. For mechanical protection a substantial leather glove is required. Buckskin, a very strong leather, is often used for this purpose.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Eisendroth Glove Co., Armitage & Elston Aves., Chicago, Ill. "Asbestol."
Hansen Mfg. Co., O. C., Milwaukee, Wis.
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."
Hodgman Rubber Co., Tuckahoe, N. Y.
Morrison Ricker Mfg. Co., Grinnell, Iowa. "Grinnell."
SPENCER GLOVE CO., Waverly, N. Y. "F. P. Sargent."

GLOVES, LINEMEN'S RUBBER.—When depended upon for insulation the lineman's glove must be of rubber, of good quality, and kept in first-class condition. Gloves should be tested when purchased and it should be the duty of the foreman or his assistant to inspect the gloves in use on the wagon regularly to see that they have not been damaged.

Safety rules usually require that any man working on live wires above 600 volts shall wear rubber gloves, but gloves are not solely depended upon for safety without other insulating media.

Manufacturers:

American-LaFrance Fire Engine Co., Elmira, N. Y. "LaFrance."
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Davol Rubber Co., 69 Point St., Providence, R. I.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Faultless Rubber Co., Ashland, Ohio. "Hi-Test and Hi-Voltage," "Wearever."
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Goodyear Rubber Co., 787-789 Broadway, New York, N. Y. "Hi Test."
Hansen Mfg. Co., O. C., Milwaukee, Wis.
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."
HERBST, PAUL W., 180 N. Dearborn St., Chicago, Ill. (See display adv. page 1258.)
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Perfection."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. U. S. linemen's gloves are made of pure gum seamless stock, maroon colored. Furnished in heavy, medium and light weights. Palms, thumbs and fingers of



Linemen's Rubber Glove

extra heavy stock if desired. Two sizes 10 and 11. Tested for 10,000 volts. Gloves and gauntlets, made of best quality, stockinet lined rubber. Fingers and palms well reinforced, sizes 13 to 17. Tested for 10,000 volts.—Adv.

Wilson Rubber Co., The, 1216 Garfield Ave., S. W., Canton, Ohio. "Hi-Test," "Lo-Test."

GLOVES, SIGNAL.—Gloves in which a small incandescent lamp is mounted in a transparent enclosed case on the back, flexible wires connecting to a battery in the pocket of the wearer and the circuit being closed by bringing the contacts on the thumb and first finger together. Such gloves are occasionally used by traffic officers, carriage or cab starters, crossing watchmen, etc.

Manufacturers:

SPENCER GLOVE CO., Waverly, N. Y. "F. P. Sargent."

GLOW DISCHARGE.—The discharge of electricity through air or other gas without disruption but by constant flow. It occurs only with very high potentials, and appears as a constant glow. See Corona.

GLUE.—Frequently used as an addition agent in electrolysis. See Addition agents. Its main use, of course, is in joining wood and similar surfaces together.

GLUE POTS, ELECTRICALLY HEATED.—Pots in which glue is heated to and maintained at the proper temperature by means of a one, two or three-heat resistance element which is generally in the base of the pot. It is very essential that glue be kept at a uniform temperature to get uniform results in veneering and many other kinds of joining, and this is more easily accomplished with an electrically heated pot than with a steam or gas-heated pot subjected to pressure variations. There are two types of pots or heaters used: the dry type, without a water jacket, and those in which the heat is applied to water and this water circulated in a jacket around the glue container. In the first type the copper or aluminum glue pot makes good contact with the sheet steel protector plates of the heating element, and a dead air space below the unit causes the heat to be radiated upwards towards the pot. With the water-jacket type, the heating element is either of the coiled type surrounding the pot or a flat disk which is placed in the bottom. A thermal insulating cover usually surrounds the whole pot. The power required varies from 20 to 650 watts, depending on the capacity of the pot.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric glue pots are so made that glue can be kept at exactly the right temperature. Three heats and furnished with three heat plug and receptacle switch. Outer vessel is of



"American Beauty" Glue Pot

cast iron, thoroughly galvanized before painting. The inner vessel or glue container is of seamless copper spun from one piece, and is equipped with a bail and wiping rod.—Adv.

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Divine Bros. Co., Utica, N. Y.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."
Francis Co., Charles E., Rushville, Ind. "Francis."
GENERAL ELECTRIC CO., Schenectady, N. Y. Both jacketless and water jacketed types. The latter is for intermittent use, as it permits high starting heat to melt the glue quickly. The jacketless type for continuous service automatically maintains the correct working temperature and requires about one-half as much current. (Bulletin 69100.) See adv. pages 1203-1223.—Adv.



Halverson Co., The, Union Ave. at E. Oak St., Portland, Ore. "Ideal."
INTERNATIONAL ELECTRIC CO., 218-222 S. McCrea St., Indianapolis, Ind. Glue heaters and cookers; sizes, 1 pt.



International Glue Heater

to 50 gals. Operate on less current than any other glue heater. Write for bulletin.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Mabey Electric & Mfg. Co., 968 Ft. Wayne Ave., Indianapolis, Ind.
Munning & Co., A. P., Church St., Matawan, N. J.
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C. "Calorel."

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New Advance Machinery Co., The, Van Wert, Ohio. "Advance."
Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."
S. U. E. Co., 89 Beach St., Boston, Mass. "Unitize."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GLYCERINE. — A substance occurring combined with organic acids in the natural fats. Formula $C_3H_5(OH)_3$. It is hygroscopic and is used in the construction of some cells to absorb water so that the cell does not become too dry.

GLYCO.—Trade name for babbitt bearings manufactured by Joseph T. Ryerson & Son, 16th & Rockwell Sts., Chicago, Ill.

G M.—Trade name for tungsten and nitrogen lamps manufactured by the Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.

G. N. Y.—Trade name for switch boxes manufactured by the Greater New York Metal Box Co., Inc., 143 W. 19th St., New York, N. Y.

GODFREY.—Trade name for fixture fittings manufactured by the Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill.

GODFREY CONVEYOR CO., THE.—Elkhart, Ind. Manufacturer of coal and ash handling machinery. Business established 1916. President and general manager, J. F. Godfrey; vice-president, B. C. Godfrey; secretary, R. R. Grossman; treasurer, D. H. Herbster; sales manager, J. F. Lipscomb.

GOETTMANN, O. J.—525 E. Ohio St., N. S., Pittsburgh, Pa. Manufacturer of low-voltage transformers and steel switch cabinets.

GOETZE GASKET & PACKING CO.—New Brunswick, N. J. Manufacturer of gaskets and packings. Business established 1887. President, Peter F. Daly; vice-president and treasurer, Louis W. Conover; secretary and general manager, Walter Gierlich. Main office and factory, Georges Road, New Brunswick, N. J. Branch office, 242 Lafayette St., New York, N. Y. Sales representative, W. H. Wirden Co., Inc., 126 Pine St., San Francisco, Cal.; 94 First St., Portland, Ore.; 528 First Ave., S., Seattle, Wash.

GOETZ, INC., A. EDGAR.—55 Barclay St., New York, N. Y. Manufacturer of lighting fixtures.

GOETZERIT.—Trade name for gaskets and packing manufactured by the Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J.

GOGGLES, ARC-LAMP TESTERS', WELDERS', GRINDERS', ETC.—Goggles similar in form to the common automobile type are extensively used in industrial work for eye protection. For testers of arc lamps and concentrated-filament incandescent lamps and for welders they are primarily to protect the eye from dangerous infra-red and ultra-violet rays of the open arc and the high brightness common to both light sources. The lenses are therefore of color suitable to remove the dangerous rays and reduce the brightness to a safe value. The color depends upon the kind of welding being done as a different glass is required for arc and acetylene sources. Frequently black or a deep blue or purple are used. Grinders' goggles are of clear glass, sometimes backed with mica to prevent splintering, as their sole purpose is to give the necessary protection from flying particles of the work or wheel.

Manufacturers:

American-LaFrance Fire Engine Co., Elmira, N. Y. "La France."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Carbic Mfg. Co., Duluth, Minn. "Carbic."
Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill. "Fyberweld," "Fitswell," "Kraftguard," "Essentialite."
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
General Scientific Equipment Co., North Philadelphia, Pa.
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."
Indianapolis Switch & Frog Co., Springfield, Ohio.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Modern Engineering Co., 23rd & Walnut Sts., St. Louis, Mo. "Meco."
Safetee Glass Co., 326 N. Broad St., Philadelphia, Pa. "Safetee Glass."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
Strauss & Buegeleisen, 16 Hanover Pl., Brooklyn, N. Y. "Resistal," "Ok-I-Cup," "Insula Welda."
Willson Goggles, Inc., Reading, Pa. "Willson Goggles."

GOLD.—A soft, yellow, heavy metal, very malleable and ductile. Symbol Au; at. wt. 197.2; sp. gr. 19.3; m. p. 1071° C.; b. p. 2500° C. It occurs widely but in very small amounts, both in the free state and combined with sulphur, tellurium, etc. Gold ores are treated principally by amalgamation, cyaniding, and chlorination. In amalgamation the ores are finely ground with the addition of some mercury, or passed over amalgamated plates, the mercury readily absorbing the gold. The amalgam is distilled in retorts, driving off the mercury and leaving the gold. In the cyanide process the ores are treated with very dilute solutions of cyanide, which dissolve gold. The gold is recovered from the solutions by precipitation with zinc or aluminum, or sometimes by electrodeposition. In chlorination the ores are treated with chlorine in vats or barrels or by roasting the ore with salt, converting the gold into soluble gold chloride, which may be leached from the ores with hot water. The gold is then precipitated from the solutions or sometimes deposited electrolytically.

Much gold is also recovered in the electrolytic refining of copper and lead. It is usually associated with the ores of these metals and in smelting remains with the metal, from which it is recovered in refining. In electrolytic refining, gold and silver drop to the bottom of the tanks with the slimes. These are treated by boiling with acid, roasting, and smelting in small reverberatory furnaces, yielding doré metal, a mixture of silver and gold. This is treated electrolytically to part the gold and silver, as in the Moebius or Balbach-Thum process, which see, or the silver is dissolved in nitric acid, the residue cast into crude gold anodes and refined by the Wohlwill process. In fire refining of lead, doré metal is obtained by the Pattinson or Parkes processes.

The world's production of gold has been declining rapidly in recent years, amounting to $350,000,000 in 1919, compared with $380,000,000 in 1918 and the peak production of $474,000,000 in 1912. The value of the metal is fixed by international agreement at the equivalent of $20.67 per troy ounce. The principal producing country is now the Transvaal, Africa, with $160,000,000 in 1919, followed by the United States with $59,000,000, Australia with $27,000,000, and Mexico, Canada, and many other countries with smaller amounts.

GOLD.—Trade name for electric heaters, regulators, switches, thermostats, car ventilators, wire, etc., manufactured by the Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y.

GOLD ANODES.—Gold anodes are used for supplying the gold for the gold-plating process used for plating jewelry, etc. They are made of very pure gold in sizes and shapes suitable to the character of the work to be plated.

Manufacturers:

Bishop & Co. Platinum Works, J., Malvern, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Hagstoz & Son, T. B., 709 Sansom St., Philadelphia, Pa.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."

GOLD BAND.—Trade name for motors manufactured by the Marchand Electrical Works, Ltd., 55 Cote St., Montreal, Que., Can.

GOLD CAR HEATING & LIGHTING CO.—220 36th St., Brooklyn, N. Y. Manufacturer of electric heaters, regulators, switches, thermostats, car ventilators, wire, etc. President, Edward E. Gold; vice-president and general manager, E. B. Wilson; secretary, C. W. Osborne; treasurer, H. C. Poillon; sales manager, F. R. Cooper. Main office and factory, 220 36th St., Brooklyn, N. Y. Branch office, Canadian Gold Car Heating & Lighting Co., Ltd., 346 St. James St., Montreal, Que., Can.

GOLD FOIL.—The first electroscopes were made with a gold leaf to hold the charge. This was for many years the only material used in these instruments but more recently aluminum leaf has come to be the more common material. Gold leaf is still used to a limited extent in scientific instruments and laboratory work.

GOLD-LEAF ELECTROSCOPE. — An electroscope used to determine the presence of an electric charge, which consists of two strips of gold foil suspended from a brass rod in a glass jar. Also see Electroscopes.

GOLD SEAL.—Trade name for lighting fixtures manufactured by the J. H. Edmunds Co., Ltd., 221-227 Richmond St., W., Toronto, Ont., Can.

GOLD SEAL.—Trade name for storage batteries manufactured by the Gold Seal Storage Battery Co., Green Bay, Wis.

GOLD SEAL.—Trade name for electric washing machines manufactured by the Philip Smith Mfg. Co., Sidney, Ohio.

GOLD SEAL STORAGE BATTERY CO.—Green Bay, Wis. Manufacturer of storage batteries. F. J. Mongin, secretary.

GOLDBERG OZONE MACHINE CO.—800 Fort Wayne Ave., Indianapolis, Ind. Manufacturer of ozonators and accessories. Business established 1908. Louis Goldberg, owner.

GOLDEN-ANDERSON VALVE SPECIALTY CO.—1214 Fulton Bldg., Pittsburgh, Pa. Manufacturer of valves.

GOLDEN GLOW.—Trade name for locomotive headlights and projectors manufactured by the Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa.

GOLDEN STATE.—Trade name for power transmission belting manufactured by the H. N. Cook Belting Co., Howard & Fremont Sts., San Francisco, Cal.

GOLDIE & McCULLOCH CO., LTD., THE.—Galt, Ont., Can. Manufacturer of electric pumps, engines, boilers, transmission machinery, etc. Business established 1849. President and treasurer, R. O. McCulloch; vice-president and general manager, A. R. Goldie; secretary, A. C. Fleming; sales manager, W. G. Bishop. Main office and factory, Galt, Ont., Can. Branch offices, 1101 Bank of Hamilton Bldg., Toronto, Ont., Can.; 248 McDermott Ave., Winnipeg, Man., Can. Sales representatives, Ross & Greig, 400 St. James St., Montreal, Que., Can.; Robert Hamilton & Co., Bank of Nova Scotia Bldg., Vancouver, B. C., Can.

GOLDMAN SAV-A-LITE CO.—111 W. 23rd St., New York, N. Y. Manufacturer of sewing machine lights. Business established 1919. President, A. Goldman.

GOLDMARK CO., THE JAMES.—83 Warren St., New York, N. Y. Manufacturer of commutator lubricating compounds.

GOLDSMITH.—Trade name for throttle valves manufactured by the Scott Valve Mfg. Co., Detroit, Mich.

GOLDSCHMIDT PROCESS OF DETINNING.—Tinplate scrap or tin is used as anode in an electrolyte of salt and caustic soda solution. The tin goes into solution, while the iron is not affected. The tin is deposited on the cathode when the electrolyte has reached a moderate concentration in tin.

GOLIATH. — Trade name for socket manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

GOLIATH.—Trade name for spark plugs manufactured by the Sharp Spark Plug Co., Wellington, Ohio.

GONGS, ELECTRIC, MISCELLANEOUS.—Electric gongs operate on the same principles and are built in practically the same types as electric bells; in fact, they are really, for the most part, large and powerful electric bells. There is no sharp dividing line between bells and gongs, but the latter are made in much larger sizes, ranging in some cases to 30 ins. in diameter; some types of relatively small bells giving a distinctive tone are also called gongs. The vibrating type of mechanism is mostly used for the smaller sizes; single-stroke mechanisms are used to give code signals, especially in fire-alarm systems.

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For the very large gongs either electromechanical or motor-operated mechanisms are much used, or a specially wound vibrating type on 110 or 220-volt circuits Electric gongs are used mostly in places where there is considerable noise and a powerful signal is necessary if it is to be heard. Railway crossings, factories, school yards, etc., require gongs or similar loud signals. Also see Bells; Horns; Sirens; Whistles.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Water-tight and weatherproof types for industrial and fire signals.—Adv.
Hass Electric & Mfg. Co., The R., 305 E. Monroe St., Springfield, Ill. "Ideal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Ekla," "PR," "Eclipse," "Marlo."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

GONGS, ELECTRIC RAILWAY CAR.—Devices consisting of large metal gongs and suitable clappers attached to the car, usually under the platform, and operated by foot pressure by the motorman to give warning of approach of the car.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa. "Dedenda."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Gong Bell Mfg. Co., The, East Hampton, Conn. "Good Service."
Reiter, G. C., Canton, Ohio.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.

GONGS, ELECTROMECHANICAL.—As the name indicates these gongs are electrically controlled but mechanically operated. They have a spring mechanism which is released by a magnetic trip that operates on a very low current. The spring must be rewound when the tension is low; some gongs are provided with an attachment which gives a signal when the spring needs rewinding or if it should break and consequently be out of operation. They are made single-stroke or continuous-ringing to suit the requirements of their use. As with electromechanical bells, they are used where it is desired to use a very low current in the circuit, just sufficient to control the gong but insufficient to ring it continuously or even for several strokes.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement pages 1231-1234.)
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Reiter, G. C., Canton, Ohio.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

GONGS, FIRE-ALARM, ELECTRIC.—Fire-alarm gongs are usually large, loud sounding gongs and may be either continuous-ringing or single-stroke for code signaling to indicate the source of the alarm by repeating the box number, etc. The smaller gongs operate with a contact-breaking armature similar to the ordinary bell or buzzer, but some of the larger types where it is desirable to obtain a very powerful stroke are constructed so that the current through the coils is not broken until the hammer strikes the gong. Where gongs are mounted out of doors or where they might be tampered with they are usually protected by a weatherproof casing, which covers the mechanism completely and has at least a grid over the gong proper.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement pages 1231-1234.)
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Reiter, G. C., Canton, Ohio.
Rope Fire Escape Co., 1626 Market St., Philadelphia, Pa.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

GONGS, UNMOUNTED.—Gongs or bells having fancy or special forms and tones are made by some manufacturers who have specialized in the manufacture of bells, gongs and chimes, and are intended for mounting on electric bell or gong mechanisms. Some are merely large sizes of gongs which are made up to 24 ins. (or even larger) in diameter, while others give a much richer tone than the ordinary by using a special design and a different alloy or better grade of bell metal. Among the special forms are such gongs as used on cow, sleigh, tea, garland and dome bells.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement pages 1231-1234.)
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
East Hampton Bell Co., The, East Hampton, Conn.
Gong Bell Mfg. Co., The, East Hampton, Conn.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Reiter, G. C., Canton, Ohio.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "PR."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

GOOD MFG. CO., THE.—180 N. Wells St., Chicago, Ill. Manufacturer of insulating materials, cartons, coils, etc.

GOOD POLES QUICK.—Trade name for cedar poles manufactured by the Lindsley Bros. Co., Peyton Bldg., Spokane, Wash.

GOOD SERVICE.—Trade name for foot gongs for cars, patrol wagons, ambulances, etc., made by the Gong Bell Mfg. Co., East Hampton, Conn.

GOODALL RUBBER CO., INC.—Philadelphia, Pa. Manufacturer of belting, gaskets, tubes, sheets, tape and other rubber products. Business established 1905. President, H. W. Goodall; vice-president, F. B. Williamson, Jr.; secretary and treasurer, A. W. Swartz. Main office, 11th & Race Sts., Philadelphia, Pa. Branch offices and warehouses, 38 Vesey St., New York, N. Y.; 112 W. Pratt St., Baltimore, Md.; 532 4th Ave., Pittsburgh, Pa.

GOODELL-PRATT CO.—Greenfield, Mass. Manufacturer of electricians' and mechanics' tools. Business established 1888. Main office, Greenfield, Mass. Factories, Greenfield, Mass., Shelburne Falls, Mass. Branch offices and warehouses, 107 Lafayette St., New York, N. Y.; 38 N. Clinton St., Chicago, Ill.

GOODMAN LUMBER CO.—Goodman, Wis. Manufacturer of cedar poles and posts.

GOODMAN MFG. CO.—Chicago, Ill. Manufacturer of electric coal mining machines, locomotives and mining supplies. President, Frank S. Washburn; vice-presidents, Charles H. Strawbridge, Charles A. Pratt; secretary and treasurer, Fred H. Johnston. Main office and factory, Halsted St. & 48th Pl., Chicago, Ill. Branch offices, 511 5th Ave., New York, N. Y.; Farmers Bank Bldg., Pittsburgh, Pa.; 317 Sycamore St., Cincinnati, Ohio; Union Bldg., Charleston, W. Va.; Boatmen's Bank Bldg., St. Louis, Mo.; Boston Bldg., Denver, Colo.; Brown-Marx Bldg., Birmingham, Ala.; 576 1st Ave., S., Seattle, Wash.

GOODRICH.—Trade name for tires manufactured by the B. F. Goodrich Rubber Co., Akron, Ohio.

GOODRICH RUBBER CO., B. F.—Akron, Ohio. Manufacturer of tires, rubber sheets, rods, tubing, linemen's gloves and boots, battery jars and covers and other rubber products. President, B. G. Work. Main office and factory, Akron, Ohio. Branch office, 1925 S. Michigan Ave., Chicago, Ill.

GOODWILL.—Trade name for electric heating pads manufactured by the Goodwill Electric Co., 59 E. Van Buren St., Chicago,

GOODWILL ELECTRIC CO.—Chicago, Ill. Manufacturer of electric heating pads. Business established 1916. President, Walter Richmond; secretary and treasurer, J. Elliott Jenkins. Main office, 59 E. Van Buren St., Chicago, Ill. Branch office, 70 5th Ave., New York, N. Y.

GOODYEAR RUBBER CO.—New York, N. Y. Manufacturer of electricians' and linemen's rubber gloves. E. S. Lyons, manages. Main office, 787-789 Broadway, New York, N. Y. Factories, Middletown, Conn.; Lambertville, N. J.; New York, N. Y. Branch offices, St. Louis, Mo.; Kansas City, Mo.; Milwaukee, Wis.; 189 W. Madison St., Chicago, Ill.

GOODYEARITE.—Trade name for asbestos sheet packing manufactured by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

GOODYEAR TIRE & RUBBER CO.—Akron, Ohio. Manufacturer of tires and other rubber products. Business established 1898. President and general manager, F. A. Seiberling; vice-presidents, C. W. Seiberling, G. M. Stadelman, P. W. Litchfield; secretary and treasurer, W. E. Palmer; sales manager, L. C. Rockhill. Main office, 1144 E. Market St., Akron, Ohio. Factories, Akron, Ohio; Los Angeles, Cal.; Goodyear, Conn.; Goodyear and Litchfield, Ariz.; Toronto and Bowmanville, Canada.

GOOSENECKS, STREET LAMP.—The gooseneck is a simple and graceful form of lighting fixture frequently used for outdoor lamps. It consists of a sweeping bend like the letter J inverted, and may be mounted on top of an ornamental post, or fastened at the side of the pole (as in combination trolley and lighting poles), or fastened to a building on either side of the entrance or to the portal columns of an entrance gateway. The gooseneck may be highly ornamental, in which case it is sometimes called a "bishop's crook."

Manufacturers:

Dunlap Co., John, Carnegie, Pa. "J-D."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GORDON.—Trade name for switches, cut-out bases and receptacles manufactured by the Gordon Electric Mfg. Co., Waterville, Conn.

GORDON.—Trade name for wet batteries manufactured by the Waterbury Battery Co., 30 Church St., New York, N. Y.

GORDON ELECTRIC MFG. CO., THE.—Waterville, Conn. Manufacturer of switches, cutout bases and receptacles. Business established 1915. President and general manager, Ira R. Seltzer.

GOSHEN LIGHTNING ROD CO.—Goshen, Ind. Manufacturer of lightning rods and fixtures. Business established 1909. A. G. Hoovens, owner.

GOSHEN NOVELTY & LAMP CO.—Goshen, Ind. Manufacturer of electric lamps.

GOSS PRINTING PRESS CO., THE.—Chicago, Ill. Manufacturer of motor-driven printing presses. President and general manager, George A. Eddy; vice-president and sales manager, M. L. Redfield; secretary, F. J. Halsey; treasurer, J. J. Walser. Main office and factory, 1535 S. Paulina St., Chicago, Ill. Branch offices, 220 W. 42nd St., New York, N. Y.

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GOTTSCHALK MFG. CO., JOHN W.—Lehigh Ave. & Mascher St., Philadelphia, Pa. Manufacturer of wires and cords. Business established 1911. President, Christopher Huber; vice-president, Frederick C. Yockel; secretary, Charles L. Glanz; treasurer and general manager, John W. Gottschalk.

GOULD.—Trade name for electric ironing machines manufactured by the Gould Appliance Co., Inc., 7 W. 42nd St., New York, N. Y.

GOULD & EBERHARDT.—Newark, N. J. Manufacturers of gear cutting machinery. Business established 1833. President and general manager, Frederick L. Eberhardt; vice-president and treasurer, Ulrich Eberhardt; secretay, H. Ezra Eberhardt.

GOULD-ANDERSON.—Trade name for adjustable lighting fixtures manufactured by the Franklin Specialty Mfg. Co., 540 W. 58th St., New York, N. Y.

GOULD APPLIANCE CO., INC.—7 W. 42nd St., New York, N. Y. Manufacturer of electric ironing machines. Business established 1920. President and general manager, Benjamin Gould; vice-president, S. Bischoff; secretary, M. Gould; sales manager, J. Sears.

GOULD STORAGE BATTERY CO.—New York, N. Y. Manufacturer of storage batteries. President, Charles A. Gould; vice-president and general manager, William S. Gould; secretary, Charles A. Gould, Jr. Main office, 30 E. 42nd St., New York, N. Y. Factory, Depew, N. Y. Branch offices, 225 E. 22nd St., Chicago, Ill.; Cass & Sibley Sts., Detroit, Mich.; 1660 Pine St., San Francisco, Cal.; 1st National Bank Bldg., Huntington, W. Va.

GOULDS MFG. CO., THE.—Seneca Falls, N. Y. Manufacturer of electric pumps and hydraulic machinery. Business established 1848. President, N. J. Gould; vice-presidents, C. W. Colby, W. D. Pomeroy, W. E. Dickey; secretary, H. S. Fredenburgh; treasurer, E. W. Medden; general manager, W. D. Pomeroy; sales manager, E. S. Jenison. Main office and factory, Seneca Falls, N. Y. Branch offices and warehouses, 58 Pearl St., Boston, Mass.; 16 Murray St., New York, N. Y.; 111 N. 3rd St., Philadelphia, Pa.; 12-14 S. Clinton St., Chicago, Ill. District offices, 636 Oliver Bldg., Pittsburgh, Pa.; Citizens & Southern Bank Bldg., Atlanta, Ga.; 804 Dime Bank Bldg., Detroit, Mich.; 1001 Carter Bldg., Houston, Tex.

GOVERNOR.—A mechanism used to regulate and control the speed of machinery. It is usually called by the name of the machine it regulates, such as steam-turbine governor, hydraulic-turbine governor, engine governor, etc.

GOVERNORS, COMPRESSOR OR PRESSURE PUMP.—Electric pressure governors are either of the diaphragm type or gage type. The diaphragm type consists of a metal or rubber diaphragm, to which the operating mechanism is connected. The motion of the diaphragm is opposed by a spring, by means of which the operating points of the regulator are adjusted. As the pressure rises the spring is compressed until, at the pressure for which the governor is set, the electrical circuit is opened and the motor stopped. In the same way the motor is restarted when the lower limit is reached. Governors of this type may control the motor directly, or control the operation of an automatic starter. The gage type regulator is merely a contact-making pressure gage. At the lower limit the gage needle touches a contact button and causes a relay to close, which in turn controls the automatic starter for the motor. At the upper limit, the needle touches another contact which short-circuits the relay and causes it to open and stop the motor. (Also see Controllers, compressor and pump, automatic).

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Burrows Mfg. Co., York, Pa. "Burrows."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chaplin Fulton Mfg. Co., The, 28-34 Penn Ave., Pittsburgh, Pa.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Pressure Regulators of the diaphragm type are made for use with motor-driven pumps on systems handling air, gas, water or any fluid not injurious to the rubber diaphragm. Regulators of the gage type



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are used as an automatic means of controlling the pilot circuits of automatic starters used with motors operating pumps, compressors, etc. See display adv. pages 1225-1230.—Adv.
Davis Regulator Co., G. M., 420 Milwaukee Ave., Chicago, Ill. "Davis."
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill.
Fisher Governor Co., The, Marshalltown, Iowa. "Fisher."
Flint & Walling Mfg. Co., Kendallville, Ind. "Hoosier."
Foster Engineering Co., 109-117 Monroe St., Newark, N. J.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Mason Regulator Co., 1190 Adams St., Dorchester Center, Boston, Mass.
National Brake & Electric Co., Ft. Belleview Pl., Milwaukee, Wis.
Nordberg Mfg. Co., Milwaukee, Wis.
S-C Regulator Mfg. Co., The, Fostoria, Ohio. "S-C."
Standard Electric Machinery Co., Baltimore, Md. "Standard- Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. "Usaco."
Westinghouse Traction Brake Co., Pittsburgh, Pa.

GOVERNORS, ELECTRIC ORGAN.—To obtain proper operation of an organ the air pressure must be very constant. As most large organ blowers are electrically driven the pressure is usually controlled through control of the driving motor. The governor, acting as motor controller, starts and stops the motor as the lower and upper operating limits of the air pressure are passed, thereby maintaining the pressure between these predetermined limits. The governing device is practically the same as that used on other air compressors or pressure pumps.

Manufacturers:

NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display advertisement on page 1286.)
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

GOVERNORS, ELECTRIC PUMP.—For governors of the diaphragm or gage type, see Governors, compressor or pressure pump. For governors of the float-switch type, see Switches, tank or float. Also see Controllers, compressor and pump, automatic.

GOVERNORS, ENGINE.—Engine governors are almost always of the centrifugal flyball type and are connected through either suitable belting or gearing to the main shaft. As the speed of the engine increases the rotating balls spread out and thus operate the spindle to which they are connected. This actuates a throttling valve to increase or decrease the admission of steam and thus to control the speed. Some engine governors are very complete and permit adjustments for the desired speed to be made while they are in operation, and they also permit a wide range of adjustment.

Manufacturers:

Judson Governor Co., The, Rochester, N. Y. "New Judson," "Judson."
Pickering Governor Co., The, Portland, Conn. "Pickering."

GOVERNORS, HYDRAULIC-TURBINE.—Governors regulating the speed of hydraulic turbines generally operate by opening or closing the regulating gates, thus varying the amount of water supplied to the wheel, although for tangential wheels the regulation is secured by means of the nozzles. In the first type, because of the large force required to move the turbine gates, a relay is used, which permits employment of an independent source of energy for moving the gates, controlled in its application by the centrifugal governor balls. If the gate-moving power is transmitted from the water wheel by pulleys, gears, etc., it is called a mechanical governor. Hydraulic governors are those in which the gate mechanism is operated by the pressure of water from the penstock or by means of oil supplied under high pressure.

Manufacturers:

Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "I. P. Morris."
Leffel & Co., The James, 426 East St., Springfield, Ohio.
Pelton Water Wheel Co., 19th & Harrison Sts., San Francisco, Cal.
S-C Regulator Mfg. Co., The, Fostoria, Ohio. "S-C."
Woodward Governor Co., 240 Mill St., Rockford, Ill.

GOVERNORS, STEAM TURBINE.—Large steam turbines, such as those used for driving turbogenerators, generally have their speed controlled by a relay governor of the hydraulic type. These consist of a cylinder to which oil under pressure is fed through a pilot valve under the control of the main governor. The piston rod of the cylinder actuated by the oil operates the main steam valve of the turbine. The action of the oil in the cylinder is controlled in various ways, one form of which has a centrifugal flyweight governor that overcomes a spring and operates a relay plunger which admits oil to the cylinder. Other forms operate on a somewhat similar principle, all controlling a pilot valve or plunger which in turn controls the flow of oil.

GOWANUS.—Trade name for belt lacing manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

G. P. S.—Trade name for electroplaters' supplies manufactured by the General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

G-R.—Trade name for feed water heaters manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

GRABAPHONE.—Trade name for hand telephone set manufactured by the Kellogg Switchboard & Supply Co., Adams & Aberdeen Sts., Chicago, Ill.

GRABLER MFG. CO., THE.—Cleveland, Ohio. Manufacturer of conduit fittings.

GRABO MACHINE WORKS, E. O.—180-182 Centre St., New York, N. Y. Manufacturer of motor-driven saws.

GRA-D.—Trade name for lighting fixture, especially for hospitals, made by the M. J. Grady Fixture Mfg. Co., 608 1st Ave., N., Minneapolis, Minn.

GRADIENT, ELECTRICAL OR POTENTIAL.—The rate of increase or decrease of a variable magnitude or of the curve that represents it. This last application is made to varying electrical potentials or currents to designate the rate of change.

GRADY FIXTURE MFG. CO.—608 1st Ave., N., Minneapolis, Minn. Manufacturer of lighting fixtures. M. J. Grady, owner.

GRAHAM.—Trade name for twist drills maufactured by the Detroit Twist Drill Co., Fort St., W., at 14th St., Detroit, Mich.

GRAHAM & CO., JAMES.—293 Wooster St., New Haven, Conn. Manufacturers of metal castings, journal bearings and babbit metal. Business established 1861. Part-

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nership, Charles E. Graham and A. L. Shutter.

GRAHAM ROLLER BEARING CORP.—Coudersport, Pa. Manufacturer of bearings and automobile wrenches. President, Scott H. Penfield; vice-president and general manager, B. C. Davis; secretary and treasurer, Fletcher Goodwill.

GRAKNIGHT AND GRAKNIGHT DYNAMO.—Trade name for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

GRAM.—The unit of mass in the metric system. Commonly abbreviated g.; ig.= 0.002205 lb. (avoirdupois). The kilogram, which equals 1000g., is more commonly used as the commercial unit.

GRAM-ATOM.—A gram-atom is that number of grams of an element which is equal to the atomic weight. Similarly a gram-molecule is the number of grams of a substance which is equal to its molecular weight. Thus a granatom of oxygen (O)= 16 g.; but a gram-molecule of oxygen (O_2)=32 g.

GRAMME ARMATURE WINDING.—A Gramme armature or ring armature consists of a laminated iron ring, which serves as the core, and the winding of insulated copper wire wound uniformly around the ring both on the inside and outside. At equal intervals on the winding taps are led out and connected to the commutator segments. Half of the winding, being on the inside of the ring, does not cut the magnetic field in a generator and is practically useless. This type of winding is therefore, now confined practically to toy motors; it was widely used in the early forms of dynamoelectric machines.

GRAND LEDGE CLAY PRODUCT CO.—Grand Ledge, Mich. Manufacturer of underground clay conduit. Business established 1906. President, A. R. Gillies; secretary, treasurer and general manager, F. A. Taber.

GRAND RAPIDS GAS ENGINE CO.—Grand Rapids, Mich. Manufacturer of gasoline and kerosene engines. Business established 1893.

GRAND RAPIDS GRINDING MACHINE CO.—Grand Rapids, Mich. Manufacturer of motor-driven grinding machinery. President and treasurer, S. Owen Livingston; vice-president, J. DeKoning.

GRAND RAPIDS SHOW CASE CO.—Grand Rapids, Mich. Manufacturer of show cases and wall cases for electrical stores.

GRANDEN ELECTRIC CO.—1511 Howard St., Omaha, Neb. Manufacturer of portable lamps and lighting fixtures. President, Charles A. Granden; vice-president, J. L. Archer; secretary, D. L. Jones; treasurer, R. J. Pugsley.

GRANGER'S.—Trade name for medical batteries manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

GRANITE-OAK.—Trade name for leather belting manufactured by George Rahmann & Co., 31 Spruce St., New York, N. Y.

GRANITE STATE MICA CO.—East Cambridge, Mass, Manufacturer of ground mica.

GRANT GEAR WORKS, INC.—151 Pearl St., Boston, Mass. Manufacturer of gears, pinions, sprockets and chains. Business established 1878. President, E. A. Bailey; treasurer and general manager, J. J. Lannon.

GRANT MFG. CO.—208 N. Wells St., Chicago, Ill. Manufacturer of egg testers and candlers. President and treasurer, J. R. Grant; secretary, R. H. Grant.

GRANULAR CARBON.—Grains of carbon made from anthracite and used in telephone transmitters to give a varying resistance between electrodes, corresponding to the voice waves. For manufacturers, see Carbon, granular, for telephone transmitters.

GRAPHIC METERS.—See Instruments, electric, curve drawing, graphic recording or printing.

GRAPHITE.—A form of carbon occurring in nature in either crystalline or amorphous form, and also produced artificially by electric-furnace conversion of anthracite or coke. When native, it is also called plumbago. It is used for the manufacture of graphite crucibles, for electrodes in electrolytic cells, for lubricating grease, for lead pencils, anticorrosion paints, etc. Natural graphite is recovered by dry or wet concentration of the ore. There are many producing countries, the leading ones being Ceylon, Madagascar, Austria, Bavaria, and Italy. The normal world's production is about 150,000 tons per year. The United States produced about 12,000 tons in 1918, but only about 4000 tons annually just before the war.

Artificial graphite is made by the Acheson Graphite Co. at Niagara Falls, to the amount of 6000 or 7000 tons per year. The artificial product is turned out in powdered form for many purposes, but is little used in crucible manufacture. The furnace for the production of powdered graphite is similar to the carborundum furnace, the charge consisting of anthracite or petroleum coke and a small amount of a metallic oxide which acts as a catalytic agent for the conversion, probably through the formation of a carbide of the metal at a high temperature, which decomposes at a still higher temperature, yielding graphite.

For making electrodes, motor brushes and similar articles, powdered petroleum coke is compressed and molded into the desired shape with a binder of tar or pitch and an oxide catalyser and baked. They are then placed in a furnace similar to that used for powdered graphite, but without core, the articles themselves, arranged transversely across the furnace at right angles to the flow, carrying the current. They are separated by layers of granulated coke.

GRAPHITE BRUSHES.—See Brushes, carbon and graphite.

GRAPHITE FOR LUBRICATION.—Graphite for lubrication is of two forms, natural and artificial. The natural form as mined contains impurities injurious to its lubricating properties. These are removed by air or liquid washing processes. Artificial or deflocculated graphite is an electric furnace product of great purity. The raw materials are placed in the furnace and the temperature raised to such a degree that all the impurities are removed by volitalization. Graphite in a flake form is sometimes used for low-speed work where the load carried is very high. For general lubricating purposes the powdered forms are mixed with oil or water, or blended with grease. Unless the graphite is very pure, it produces some abrasion; this is due to the gritty nature of the impurities. Pure graphite, especially the electrically prepared variety, has no abrading action and is an ideal lubricant.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Acheson Oildag Co., Port Huron, Mich.
Allen Crucible Co., 714 50th Ave., Oakland, Cal.
American Oil Corp., 172 S. Water St., Jackson, Mich. "American," "Amoilco," "Amoco."
Dixon Crucible Co., Joseph, Jersey City, N. J.
Franklin Oil Works, Franklin, Pa.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
International Carbon Products Co., Inc., 230 W. 13th St., New York, N. Y. "Electrophite."
Pettinos, George F., Real Estate Bldg., Philadelphia, Pa. "Paragon."
Randall Graphite Products Corp., 711-721 Fulton St., Chicago, Ill.

GRAPHITE, MISCELLANEOUS.—Graphite, either pure or in carbon mixes, is molded or shaped by dies into blocks, rods, tubes, and sticks for electrodes (furnace and electrolytic work), brushes, rheostats, contacts, pyrometer tubes, muffles, crucibles and pencils. The powdered form, aside from use for lubrication (see above), is used in foundry facing and wash compounds and as an ingredient in dry-cell fillers, rustproof paints and certain boiler compounds. Also see Brushes, carbon and graphite; Disks, graphite resistance; Electrodes, furnace; Electrodes, electrolytic cell.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dixon Crucible Co., Joseph, Jersey City N. J.
Huff Electrostatic Separator Co., Box 66 Arlington, Mass. "Electrophite."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
International Carbon Products Co., Inc., 230 W. 13th St., New York, N. Y. "Electrophite."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Products." (See display advertisement on page 1320.)
Ohio Carbon Co., The, 8219 Almira Ave., Cleveland, Ohio. "Ohio."
Pettinos, George F., Real Estate Bldg., Philadelphia, Pa. "Paragon."

GRAPHOMETER.—Trade name for graphic recording demand meter manufactured by the Minerallac Electric Co., 1045 Washington Blvd., Chicago, Ill.

GRAPHON.—Trade name for insulating paint manufactured by the Dielectric Mfg. Co., St. Louis, Mo.

GRAPHOSCOPE MFG. CO.—49 Mechanic St., Newark, N. J. Manufacturer of motion picture machines and accessories. President, A. K. Baylor: vice-president, J. R. White: secretary, H. K. Dodd; treasurer, C. P. Hall.

GRAPNEL.—A pronged instrument useful in grappling, as in searching for and seizing a submarine cable or other object under water.

GRASSELLI CHEMICAL CO., THE.—Cleveland, Ohio. Producer of chemicals.

GRATE SURFACE.—Grate surface in a furnace is any surface upon which coal is being burned. In hand-fired furnaces it is merely the total area of the grate, which usually is horizontal. With automatic stokers the value is harder to determine as part of the surface may be used exclusively for coking, or part for accumulating clinker and ash, or the grate may not be horizontal. The ratio of heating surface to grate surface is not considered as important now as formerly and recent installations show this ratio to have decreased to about 30 to 1 instead of the 60 to 1 that was at one time considered to be good practice.

GRATES FOR BOILER FURNACES.—Grates for boiler furnaces are divided into several types. In ordinary hand-fired furnaces they are a separate and distinct part of the furnace. In these cases they are not always made by the boiler manufacturer, but are cast in local foundries or made in other factories. When automatic stokers are used the grate is usually an integral part of the stoker and is generally furnished by the stoker manufacturer. In case of grate burnouts or necessary repairs to the grates the stoker manufacturer generally must carry a stock of grates for immediate supply.

Chain grates are probably the most popular form of grate for use in automatic stokers. In these cases the entire grate and driving mechanism is mounted on a permanent truck and may readily be removed from the boiler. Overfeed step grates are also used. With these the coal is pushed in at the top of the grate, which slopes downward, and is fed downward progressively by the movement of the grate bars aided by gravity. In the sprinkling type of stoker the grate is generally separate and the coal is sprinkled uniformly over the entire area by revolving spreaders.

Manufacturers:

Automatic Furnace Co., The, 1st & Harshman Sts., Dayton, Ohio. "Culver."
Beggs & Co., James, 36 Warren St., New York, N. Y. "McClave."
Canton Grate Co., 1706 Woodland Ave., N. W., Canton, Ohio.
Cokal Stoker Co., 1029-31 N. Clark St., Chicago, Ill.
Combustion Engineering Corp., 43-47 Broad St., New York, N. Y. "Grieve."
Cyclone Grate-Bar Co., 9 Grimes St., Buffalo, N. Y. "Cyclone."
Green Engineering Co., East Chicago, Ind.
International Engineering Works, Inc., Waverly St., Framingham, Mass.
McCleave-Brooks Co., Poplar St. & Park Pl., Scranton, Pa.
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
New England Roller Grate Co., 95 Liberty St., Springfield, Mass.
Pechstein Iron Works, Box 344, Keokuk, Iowa.
Simmons Hand Stoker Co., The, Wilmington, N. C. "Simmons."
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

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GRATES OR FIREPLACES, ELECTRIC.—See Fireplace, electric; also see Logs, electrically illuminated and heated.

GRATON & KNIGHT MFG. CO.—Worcester, Mass. Manufacturer of leather belting. Main office, 356 Franklin St., Worcester, Mass. Factories, Cleveland, Ohio; Detroit, Mich.; Montreal, Que., Can. Branch offices, Boston, Mass.; Fall River, Mass.; 428 Broadway, New York, N. Y.; Pittsburgh, Pa.; Atlanta, Ga.; 34 S. Jefferson St., Chicago, Ill.; Cincinnati, Ohio; Minneapolis, Minn.; Milwaukee, Wis.; Kansas City, Mo.; St. Louis, Mo.; San Francisco, Cal.; Portland, Ore.; Seattle, Wash.

GRAVER CORP.—East Chicago, Ind. Manufacturer of feed water heaters, water filters and other power plant equipment. Business established 1857. President, J. P. Graver; vice-president and general manager, P. S. Graver; secretary, H. S. Graver; treasurer, W. F. Graver; sales manager, K. W. Bartlett. Main office, East Chicago, Ind. Branch offices, 28 E. Jackson Blvd., Chicago, Ill.; Fort Worth, Tex.; Kansas City, Mo.; Cincinnati, Ohio; Toledo, Ohio; New York, N. Y. Sales representatives, C. L. Dean, Denver, Colo.; C. J. Martin, San Francisco, Cal.

GRAVERT, INC., WILLIAM J.—246 Jackson Ave., Long Island City, N. Y. Manufacturer of refractories and firebrick. President, William J. Gravert; secretary and treasurer, Carl C. Plischke.

GRAVITY CELL.—A primary battery containing two metal electrodes, one above the other, and two different solutions as the electrolyte, the heavier solution in contact with the under electrode and the lighter solution in contact with the upper, and two solutions remaining separated because of their difference in specific gravity. Specifically a primary cell with a copper electrode below immersed in copper sulphate solution, above which is a zinc electrode immersed in zinc sulphate solution; one type of Daniell cell.

GRAY & DANIELSON MFG. CO.—579 Howard St., San Francisco, Cal. Manufacturer of radio apparatus. Business established 1918. Amateur radio apparatus distributed by the AudioTron Sales Co., 35 Montgomery St., San Francisco, Cal.

GRAY & DAVIS, INC.—Boston, Mass. Manufacturer of automobile lamps, lighting, starting and ignition equipment.

GRAY, ELISHA.—An American inventor, born at Barnesville, Ohio, 1835, and died at Newton, Mass., 1901. He was educated at Oberlin College. In 1867 he received his first patent for a self-adjusting telegraph relay. Later he invented the telegraphic switch and annunciator, the telegraphic repeater, and a private telegraph line printer. Claims were advanced in behalf of Gray as one of the inventors of the speaking telephone, for which he filed specifications on Feb. 14, 1876, only a few hours after the filing of an application by Alexander Graham Bell, to whom the patent was awarded and whose rights were sustained by the Supreme Court. Gray's inventions include a system of multiplex telegraphy, a type-printing telegraph, the telautograph and numerous telegraphic and telephone appliances and adjuncts. For many years he was engaged in the manufacture of electrical apparatus in Chicago and Cleveland. He founded the Gray Electric Co. in Highland Park, Ill.

GRAY-HEATH CO.—544 N. Parkside Ave., Chicago, Ill. Manufacturer of ignition coils and heating device plugs. Business established 1911. President and general manager, B. L. Gray; vice-president and treasurer, Mark W. Heath; secretary, John P. Schott.

GRAY TELEPHONE PAY STATION CO.—16-30 Arbor St., Hartford, Conn. Manufacturer of telephone coin collectors and meters. Business established 1891. President, Amos Whitney; vice-president, Frank C. Sumner; secretary and treasurer, Charles Soby; sales manager, George A. Long. Sales representatives, Western Electric Co., 195 Broadway, New York, N. Y.; Kellogg Switchboard & Supply Co., 1066 W. Adams St., Chicago, Ill.; Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.; Erner & Hopkins Co., Columbus, Ohio; Northern Electric Co., Ltd., Montreal, Que., Can.

GREASE CUPS.—See Oil and grease cups.

GREASE, LUBRICATING.—Lubricating greases are compounds of heavy oils or fats containing mild soaps to give them greater consistency. Graphite, soapstone, and sometimes mica are added to the grease where the surface to be lubricated is under high pressure.

Manufacturers:

Acheson Graphite Co., Niagara Falls, N. Y. "Gredag."
American Oil Corp., 172 S. Water St., Jackson, Mich. "American."
Cook & Swan Co., Inc., 148 Front St., New York, N. Y. "Swanovia."
Cook's Sons, Adam, 708-710 Washington St., New York, N. Y. "Albany."
Crew Levick Co., 111 N. Broad St., Philadelphia, Pa.
Dearborn Chemical Co., 332 S. Michigan Ave., Chicago, Ill.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Franklin Oil Works, Franklin, Pa. "Alyear."
Frazer Lubricator Co., 3921 Normal Ave., Chicago, Ill. "C-J."
Harris Oil Co., A. W., 326 S. Water St., Providence, R. I. "Harris."
Indian Refining Co., 244 Madison Ave., New York, N. Y. "Havoline."
Moore Oil Refining Co., The, York & McLean Sts., Cincinnati, Ohio.
National Refining Co., Cleveland, Ohio. "National."
New York & New Jersey Lubricant Co., 401 Broadway, New York, N. Y. "Non-Fluid."
Ohio Grease Co., The, Loudonville, Ohio. "Ohio."
Pigot, Sayre Co., The, 17 Battery Pl., New York, N. Y. "Aurora."
Pure Oil Co., Columbus, Ohio.
Swan & Finch Co., 522 5th Ave., New York, N. Y. "Slo-Flo," "Atlas."
TEXAS CO., THE, 17 Battery Pl., New York, N. Y. "Texaco" greases of all kinds, for power plants, central stations, electric street railways, marine railroads, etc. There is a "Texaco" lubricant for every purpose.—Adv.
Warren Lubricant Co., 20-26 Maurice St., Buffalo, N. Y. "Spermo."
Wire Rope Lubricating Co., 40 Clinton St., Newark, N. J. (for wire rope)

GREAT LAKES ELECTRIC MFG. CO.—11-17 S. Desplaines St., Chicago, Ill. Manufacturer of motors, generators and lighting and power plants. Business established 1917. President, G. A. Johnstone.

GREAT LAKES GEOGRAPHIC DIVISION, NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, W. C. Lounsbury, Superior Water, Light & Power Co., Superior, Wis.; secretary, R. V. Prather, 305 DeWitt Smith Bldg., Springfield, Ill.

GREAT LAKES RADIO SUPPLIES CO., INC.—1st National Bank Bldg., Elmhurst, Ill. Manufacturer of radio apparatus. Business established 1916. President, treasurer and general manager, J. Donald Vandercook; secretary, A. Thoma.

GREAT WESTERN.—Trade name for cream separators manufactured by the Rock Island Plow Co., Rock Island, Ill.

GREAT WESTERN ELECTRIC FIXTURE CO.—292 Church St., New York, N. Y. Manufacturer of electric lighting fixtures. Business established 1921.

GREAT WESTERN MFG. CO.—Box 813, Leavenworth, Kans. Manufacturer of gyratory foundry riddles. Business established 1858. President, Samuel H. Wilson; vice-president, M. E. V. Wilson; secretary, F. A. Pickett; treasurer, P. L. Wilson.

GREATER NEW YORK METAL BOX CO., INC.—143 W. 19th St., New York, N. Y. Manufacturer of switch boxes.

GREAVES-ETCHELLS.—Trade name for electric furnaces manufactured by the Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa.

GREBE & CO., INC., A. H.—70 Van Wyck Blvd., Richmond Hill, N. Y. Manufacturer of radio apparatus. Grebe radio apparatus includes a complete line of receiving instruments, audion detector units and audio-frequency amplifying sets. Receivers are built, employing the regenerative circuits, for wave lengths from 150 to 20,000 meters. Business established 1909. President, Alfred H. Grebe; vice-president and secretary, Louis G. Pacent; treasurer and general manager, Douglas Rigney. Sales representative, Maurice Raphael, 414 Walter P. Story Bldg., Los Angeles, Cal.

GREBE RADIO.—Trade name for radio apparatus manufactured by A. H. Grebe & Co., Inc., 70 Van Wyck Blvd., Richmond Hill, N. Y.

GREDAG.—Trade name for lubricating grease manufactured by the Acheson Graphite Co., Niagara Falls, N. Y.

GREEN & BAUER, INC.—234 Pearl St., Hartford, Conn. Manufacturer of X-ray tubes.

GREEN AUTOMATIC.—Trade name for electric razor blade sharpening machine manufactured by the American Sharpening Machine Co., Inc., 184 W. Washington St., Chicago, Ill.

GREEN ELECTRIC CO., THE W.—81 Nassau St., New York, N. Y. Manufacturer of electroplating generators, motor-generators, motors, demagnetizers, drills and other electrical specialties.

GREEN ENGINEERING CO.—East Chicago, Ind. Manufacturer of coal and ash handling machinery, hoppers, boiler arches, settings, etc., and other power plant equipment. Sales manager, T. O. Grisell.

GREEN EQUIPMENT CORP.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric hoists, lighting fixtures and commutator undercutting tools. Business established 1919. President and general manager, J. H. Green; secretary and treasurer, L. C. Howard.

GREEN FUEL ECONOMIZER CO.—Beacon, N. Y. Manufacturer of fuel economizers and mechanical draft apparatus. Business established 1821. President, Frank Green; vice-president, C. F. Field; secretary, W. A. Frame; treasurer, E. David. Main office and factory, Beacon, N. Y. Branch offices, 90 West St., New York, N. Y.; 1445 Old Colony Bldg., Chicago, Ill.; 141 Milk St., Boston, Mass.; 412 Bessemer Bldg., Pittsburgh, Pa.; 816 Hippodrome Bldg., Cleveland, Ohio; 752 Penobscot Bldg., Detroit, Mich.; 905 Healy Bldg., Atlanta, Ga.; 1302 Pennsylvania Bldg., Philadelphia, Pa.; Green's Economiser, Ltd., Kent Bldg., Toronto, Ont., Can. Sales representative, C. C. Moore & Co., San Francisco, Cal; Los Angeles, Cal.; Salt Lake City, Utah; Tucson, Ariz.

GREEN, GREEN & GREEN.—604 E. 39th St., Chicago, Ill. Manufacturers of silk shade covers. Business established 1919.

GREEN HEAD.—Trade name for jacks manufactured by the Clinton E. Hobbs Co., 30-35 Pearl St., Boston, Mass.

GREEN, HENRY J.—1191 Bedford Ave., Brooklyn, N. Y. Manufacturer of barometers, hygrometers, precision instruments, and thermometers. Business established 1832.

GREEN JACKET.—Trade name for spark plugs manufactured by the Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

GREEN RIVER.—Trade name for threading dies manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

GREENE.—Trade name for electric furnaces manufactured by the Greene Electric Furnace Co., 1602 Hoge Bldg., Seattle, Wash.

GREENE ELECTRIC FURNACE CO.—1602 Hoge Bldg., Seattle, Wash. Manufacturer of electric furnaces.

GREENE, TWEED & CO.—New York, N. Y. Manufacturers of piston packing. Main office, 109 Duane St., New York, N. Y. Branch office, 646 W. Washington Blvd., Chicago, Ill.

GREENFIELD.—Trade name for flexible steel conduit manufactured by the Sprague Electric Works of General Electric Co., 527-534 W. 34th St., New York, N. Y.

GREENFIELDUCT.—Trade name for rigid conduit manufactured by the Sprague Electric Works of General Electric Co., 527-534 W. 34th St., New York, N. Y.

GREENFIELD TAP & DIE CORP.—Greenfield, Mass. Manufacturer of threading dies, die stocks, screw plates, etc. President, F. H. Payne; vice-president and general manager, F. G. Echols; secretary, L. M. Lamb; treasurer, F. A. Yeaw. Main office and factory, Sanderson St., Greenfield, Mass. Branch offices and warehouses, 13 S. Clinton St., Chicago, Ill.; 15 Warren St., New York, N. Y. District offices, 74 Congress St., W., Detroit, Mich.; 138 Locomotive Engineers Bldg., Cleveland, Ohio. Sales representatives, J. T. Rowntree, Inc.,

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601 Higgins Bldg., Los Angeles, Cal.; Corry & Mitchell, 1320 Healey Bldg., Atlanta, Ga.

GREENFIELD TAP & DIE CORP. OF CANADA, LTD.—Front & York Pl., Galt, Ont., Can. Manufacturer of taps, dies and screw plates. Business established 1905. President, Francis G. Echols; vice-president, Frederick H. Payne; secretary, James A. Carrick; treasurer and general manager, Luther W. Smith; sales manager, L. W. O'Connor.

GREENPORT.—Trade name for gas engines manufactured by J. S. Gaffga & Co., Greenport, N. Y.

GREENWOOD ADVERTISING CO.—Knoxville, Tenn. Manufacturer of electric signs. President, A. Greenwood; treasurer and manager, H. C. Williams.

GRENZIG, J. A.—359 Jay St., Brooklyn, N. Y. Manufacturer of portable drills and hammer stands.

GRETHER.—Trade name for portable searchlight manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

GRETHER FIRE EQUIPMENT CO.—Dayton, Ohio. Manufacturer of electric hand lanterns. President and general manager, William Grether; vice-president and secretary, Fred E. Grether; treasurer, A. E. Millard; sales manager, William O. Schleinitz.

GREYHOUND.—Trade name for electric sewing machine manufactured by the New Home Sewing Machine Co., Orange, Mass.

GRIDDLES, ELECTRIC, HOTEL TYPE.—Griddles of this type are constructed on the same plan as the smaller electric frying and cooking utensils, and are of such size that the heating elements are divided into groups controlled by individual switches accordingly as more or less surface of the griddle is needed. Some types take as much as 6000 watts when under full operation.

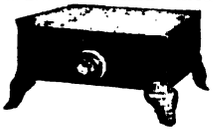
Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Griddles are made in three sizes. The top of the one shown, G318, is made of aluminum and measures 18 ins. in width and depth and 10 ins. in height. Another type, G636, has a frying surface of 18x54 ins. and is 10 ins. in height. Still another type, G954, similar to the one illustrated, except it has a polished steel cooking surface, measures 18x36 ins. All are strongly made of steel and cast iron. The bodies are of heavy gauge steel and equipped with heating elements, controlled by three-heat switches. Satisfactorily used for cakes, eggs, chops, steaks, etc., by thousands of hotels and restaurants. See display adv. page 1292-3.—Adv.



"Hotpoint" Electric Griddle

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Weeks Mfg. Co., H. G., Hamilton, Ohio.

GRIDDLES, ELECTRIC, HOUSEHOLD TYPE.—Griddles of this type have the heating element in the base and are made to operate on about 800 watts. They are usually operated through a cord and plug attached to a special circuit.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Globe Stove & Range Co., The, Kokomo, Ind. "Globe."

Power Mfg. Co., The, Marion, Ohio. "Primm."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

GRIDS FOR STORAGE-CELL PLATES.—In modern storage-battery construction the active materials used in the plates are applied to a skeleton framework in such a manner that they fill pockets in this framework, which is called the grid. In the case of lead storage batteries, this construction gives what are called Faure or pasted plates, and the grids are made of hard or antimonious lead and are usually cast in molds. Various constructions have been devised with the idea of affording secure pocket-like supports for the active material. The grid usually consists of thin bars shaped so as to retain the pellets of active material within its pocket-like openings. In the case of alkaline storage cells, such as the Edison battery, the grid is made of nickel-plated steel and the pellets of active material are specially prepared and inserted in the grid under heavy hydraulic pressure.

On top of the grid, in any type of battery, is an extension or lug which is connected to the crossbar or connecting strap joining the similar plates of the cell and serving to conduct the current to the grid. In some cases the grid is of heavier cross section in the upper portion so that it will distribute the current to the various pellets more uniformly than if it were of the same section throughout.

GRIDS, RESISTANCE.—Resistance grids are resistors made of cast iron or steel usually in the form of a flat open zigzag grid provided with terminal lugs for mounting side by side in a rheostat frame. They are used where resistance must be inserted in a circuit carrying a fairly heavy current. Cast iron is particularly suitable for this purpose, because it combines a fair amount of resistance with considerable conductance and is not so readily oxidized or disintegrated when heated even to red heat, which is not uncommon in grid resistors that must dissipate a large amount of power. On account of this heating the adjacent grids are spaced apart and usually hung vertically to give ample opportunity for radiation and ventilation; the rheostat is entirely open if there is not likelihood of combustible material coming in contact with it, or protected by open-mesh wire screen or other ventilated cover to guard against ignition of such material. Resistor grids are used extensively with electric railway motors, slip-ring induction motors, elevator, crane and hoist motors, rolling-mill and other heavy-duty motors, and for similar intermittent or continuous resistance service.

Manufacturers:

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

National Lead Co., 111 Broadway, New York, N. Y.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "UEMCO."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GRIESHEIM-ELEKTRON CELL.—One of the most important German cells for the electrolytic production of alkali and chlorine from salt solution. The anodes are of magnetite, the cathodes of iron, and the diaphragm of a specially prepared cement.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

GRIEVE.—Trade name for boiler furnace grate manufactured by the Combustion Engineering Corp., 11 Broadway, New York, N. Y.

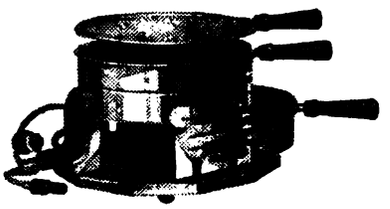
GRIFFIN WHEEL CO.—Chicago, Ill. Manufacturer of wheels for electric street and interurban cars. President, F. L. Whitcomb; vice-president, C. K. Knickerbocker; secretary and treasurer, S. L. Prest. Main office and factory, N. Sacramento Blvd. & C. & N. W. Tracks, Chicago, Ill. Branch offices, Detroit, Mich.; Denver, Colo.; Boston, Mass.; Kansas City, Mo.; St. Paul, Minn.; Los Angeles, Cal.; Tacoma, Wash.

GRIFFITHS & SON, JAMES A.—1315-17 Buttonwood St., Philadelphia, Pa. Manufacturers of ejectors, injectors, valves and other power plant specialties.

GRILLS, ELECTRIC.—These cooking appliances as used on the table consist of a combination frier, broiler, toaster and hot plate. The heating element is so arranged that food may be cooked either above or below it, or in both places at the same time. With some of these appliances a vessel is provided for boiling water or steaming eggs, or for using the grill as a chafing dish; in some cases a small oven can be secured as an accessory. These grills may be used for preparing almost any food in any form, but only in relatively small quantities. They are attractively finished, usually having a nickel or copper finish, and are quite suitable for use on the table, the food being served hot directly from the cooking dish.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric grill, equipped with three heats; made of sheet steel, beautifully finished in polished nickel. Handles of ebony finish. Has open coil type of heating element. Furnished complete with a 6-ft. triple conductor cord, having detachable porcelain plug and attachment plug.—Adv.



"American Beauty" Grill

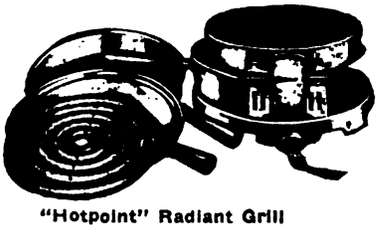
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Curtainless Shower Co., Inc., 507 5th Ave., New York, N. Y. "Reddy."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Two styles are manufactured—a round and rectangular grill. Of the glowing, open-coil reflector type, they boil, broil, fry and toast. The round model has three heats, adjustable to "high, medium and low." Made of pressed steel and finished in polished nickel. Have deep under dishes with broiling grid, shallow dish, and cover to fit either dish; complete with cord and lamp socket attachment plug. The round grill illustrated (Cat. No. 136G1) is also made in single heat (Cat. No. 116G1). See display adv. pages 1292-3.—Adv.



"Hotpoint" Radiant Grill

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

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LANDERS, FRARY & CLARK, New Britain, Conn. Four heats, 175-300-350-650 watts. Cooking can be done both above and below the heating element



"Universal" Grill

at the same time. Diameter of top, 8 ins. Three cooking pans with ebonized handles. Fibre feet. Nickel plated. Complete with 6-ft. heater cord and plug.—Adv.

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."

Manning, Bowman & Co., Meriden, Conn.

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Rutenber Electric Co., Marion, Ind. "Rutenber."

Standard Stamping Co., The, 1st St. & 7th Ave., Huntington, W. Va. "Armstrong."

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

UNION ELECTRIC CORP., 103 Mott St., New York, N. Y. "American Lady."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

GRIMSHAW.—Trade name for insulating tapes manufactured by the New York Insulated Wire Co., 114 Liberty St., New York, N. Y.

GRINDERS, ELECTRIC.—Motor-driven grinders can be divided into two general classes, according to the purpose of the grinding operation. One class consists of those which are used to remove a portion of a surface, or to cut into the surface of materials. This type has commonly an abrasive wheel driven at a high speed, the wheel being made of emery, carborundum, corundum and other such hard abrasive compounds. The second class of grinders are those which pulverize or break up a substance into smaller pieces. These machines, which are sometimes called attrition mills, usually run the material between grinding wheels, rollers or plates. The material may be cut by blades on the moving surfaces or crushed by pressure between these surfaces.

The first class of machines are most commonly used on metals, fibers or other hard substances; the second class for cereals, various other food products, and more or less brittle materials, such as bone. The high speeds at which both classes of machines operate make the electric motor drive particularly applicable to such machinery. In the following entries electric grinders are further subdivided into their principal uses. In all cases these grinders include both the motor and grinding wheel, as well as mounting and connecting means. For grinding wheels as detached appliances and as belt or otherwise mechanically driven machines, see Wheels, grinding.

GRINDERS, ELECTRIC, BENCH.—Electric bench grinders are generally equipped with two wheels, one on either end of the armature shaft. The motor is usually encased in or mounted on a single-piece casting which supports the motor of the machine and an adjustable rest is generally provided with the machine. This casing may partially enclose the wheels to hold the dust which is sometimes carried off by a dust suction or accumulating system. For grinding tools and other tempered pieces a water-cooling system may be incorporated in the machine. The size of the machine will, of course, vary with its duty but the size is usually smaller than the post or pedestal type, since bench mounting is used chiefly for light work such as is required in connection with other bench work. The smaller types are usually equipped with a universal motor, the larger sizes with a-c. or d-c. motors according to the power supply.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.

Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."

Cincinnati Electrical Tool Co., 1501-3-5 Freeman Ave., Cincinnati, Ohio. "Cincinnati."

Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.

Connecticut Dynamo & Motor Co., The, Lyons Ave. & Coit St., Irvington, N. J.

CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. The illustration shows a double-ended grinder designed



Crawford Double-Ended Grinder

for continuous service under severest conditions. Same general characteristics as the "Wooten" described under Grinders, Electric, Post or Pedestal.—Adv.

Dillon Electric Co., Mahoning Rd. & 11th St., N. E., Canton, Ohio. "Dillon."

Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."

Forbes & Myers, 172 Union St., Worcester, Mass.

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.

Grand Rapids Grinding Machine Co., Grand Rapids, Mich.

Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.

Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."

JANETTE MANUFACTURING CO., 556-558 W. Monroe St., Chicago, Ill. Janette ¼ hp., a-c. or d-c. motor bench grinder (fig. below), can be had in standard voltages; also with floor pedestal. Easy to install. Accessible from all sides. Flush push button



Janette Motor Bench Grinder

switch with protecting hood. S.K.F. ball bearings; low friction loss; long life; clean; dustproof. Runs 3,500 r.p.m.; wheels 5 in. diam., ¾ in. face.—Adv.

Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. (A. C. only.)

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.

MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."

MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."

Nell & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."

Piedmont Electric Co., Asheville, N. C. "Peco."

Rochester Electric Products Corp., Driving Park Ave. & Argo Park, Rochester, N. Y.

ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."

Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.

Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."

U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.

U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U. S."

Webster & Perks Tool Co., The, Center & Jefferson Sts., S. E., Springfield, Ohio.

Winchester Optical Co., Horseheads, N. Y. "Monarch."

Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

GRINDERS, ELECTRIC, BONE.—In these machines an electric motor is mounted on the frame of the grinder and either geared or directly connected to the grinder shaft. The bones are ground or crushed to be used in fertilizer mixtures and for use in making bone charcoal which is employed in many industrial processes.

Manufacturers:

Braun Co., The, 1615-35 N. 23rd St., Philadelphia, Pa. "Coles."

Deer Co., Inc., The A. J., Hornell, N. Y. "Royal."

Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves-Etchells."

Enterprise Mfg. Co. of Pa., 3rd & Dauphin Sts., Philadelphia, Pa. "Enterprise."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Louisville Machine & Mfg. Co., The, Louisville, Ohio. "Electri-Cut."

GRINDERS, ELECTRIC, COFFEE.—These coffee grinders are commonly used in coffee and tea stores and grocery and delicatessen stores. They usually consist of a motor mounted in a pedestal base, either for floor or counter use, a set of cutting knives directly connected to the motor shaft and a hopper mounted above the grinding knives. The coffee is dumped in the hopper and fed by gravity through the knives falling into a pan or receptacle beneath the knives. They are usually snap-switch-controlled and can be connected directly to the lighting circuits, as they do not take as much as 660 watts. The machines may be made with two sets of knives, one at either end of the armature shaft or they may have only one set at one end, or one end may have coffee-grinding knives and the other end may drive meat-cutting or chopping knives.

Manufacturers:

Angidile Computing Scale Co., Elkhart, Ind.

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Braun Co., The, 1615-35 N. 23rd St., Philadelphia, Pa. "Coles."

Deer Co., Inc., The A. J., Hornell, N. Y. "Royal."

GRUENDLER PATENT CRUSHER & PULVERIZER CO., 928 N. 1st St., St. Louis, Mo.

Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.

Holwick, B. C., Canton, Ohio. "Holwick."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Louisville Machine & Mfg. Co., The, Louisville, Ohio. "Electri-Cut."

Steiner Mfg. Co., 4100 N. 21st St., St. Louis, Mo.

Stimpson Scale & Electric Co., Northville, Mich. "Stimpson."

Troemner, Henry, 911 Arch St., Philadelphia, Pa.

GRINDERS, ELECTRIC, FEED.—See Feed cutters and grinders, motor-driven.

GRINDERS, ELECTRIC, LABORATORY.—As these grinders are especially designed for miscellaneous small grinding jobs, they are sometimes provided with detachable grinding wheels, so that the motor-driven device may be used with various kinds of abrasive wheels or buffers, or a grooved pulley substituted for the wheel. They may be either portable or stationary bench or floor types.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.

Braun Co., The, 1615-35 N. 23rd St., Philadelphia, Pa. "Coles."

Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.

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Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves-Etchells."

EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

GRINDERS, ELECTRIC, PEANUT AND OTHER NUT.—Peanut grinders are of two general types, steel wheel and stone wheel. Their purpose is to reduce nuts of all kinds to a paste or butter. The two types differ in construction and also in that the stone wheels produce an unctuous product and the steel wheels one of a more granular nature. They are usually equipped with an automatic salting device. Motor drive makes a very sanitary outfit.

Manufacturers:

Deer Co., Inc., The A. J., Hornell, N. Y. "Royal."

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich. ("Leader" peanut butter mill.)

GRINDERS, ELECTRIC, PORTABLE.—One of the chief advantages of portable electric grinding equipment is that it may be used on parts in a machine, or which are being machined, without dismantling the machine or removing the part. It is, therefore, much used for repair work in automobile and general machine shops. It also has many advantages as a tool for cleaning castings and grinding machine parts too heavy to be conveniently moved from the floor and mounted on a milling machine, planer, or lathe, especially where it is not necessary to have a perfectly true plane surface.

These portable grinders may be divided into two classes, those driven from a separate motor through belting or a flexible shaft and those in which the tool is directly driven from the shaft of a small motor. The types utilizing a separate motor sometimes mount the motor on a small cart which can be easily moved about. The armature shaft is connected directly or through belting to a universal joint which in turn drives a flexible shaft. To give greater range to the tool the universal joint may be mounted on the end of a long rod which is fastened rigidly to the motor case, the motor being mounted on a pivot which allows it to be turned through any angle horizontally and also through a considerable angle in a vertical plane. To the end of the flexible shaft is fastened the shaft of the grinding wheel. These wheels are made in many sizes and are provided with handles for holding the wheel when in use. The smaller types of flexible-shaft-driven wheels have a light motor which can be carried about and are, therefore mounted on a small flat base instead of a cart.

The directly driven types are for light-duty work. The motor is usually mounted in a light case provided with a handle at the back or a handle on either side of the motor or, particularly for surface grinding, with a handle at either end of the motor shaft. This direct-driven type is sometimes suspended through a spring and rope or chain suspension and it is then called an aerial or suspension grinder.

Manufacturers:

Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Chicago."

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."

Cincinnati Electrical Tool Co., The, 1501-3-5 Freeman Ave., Cincinnati, Ohio. "Cincinnati."

Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.

Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."

Gilfillan Bros., Inc., Los Angeles, Cal.

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.

Hisey-Wolf Machine Co., The, Colerain & Marshall Aves., Cincinnati, Ohio. "Hisey."

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. "Thor."

Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.

MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."

Mummert-Dixon Co., Philadelphia, & Gay Sts., Hanover, Pa.

Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."

Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill. "Racine."

Standard Electric Tool Co., The, Cincinnati, Ohio. "Standard."

Stow Flexible Shaft Co., 3446-54 Ludlow St., Philadelphia, Pa.

Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.

Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."

U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U. S."

WISCONSIN ELECTRIC CO., Racine, Wis. "DUMORE" grinders are of the portable, tool-post type, and contain features found in no other portable grinders. Speeds ranging from 10,000 to 50,000 r.p.m. give even small wheels the correct cutting speeds, while the dynamic balance of every armature insures smooth quiet operation. Work done with a "Dumore" is free from chatter-marks, taper or bell-mouth. Model 3 Multispeed "Dumore", with its wheel and tool equipment is shown below Its combination of interchangeable spindles and quick-change pulleys enables the operator to obtain exactly the right cutting speed for a job. The motor swivels to five different angles. It develops ¼ hp., and is mounted on rubber insulators, preventing the transmission of vibration to the grinding



Wheel Equipment



Dumore Grinder



Tool Equipment

spindle. The grinder is reversible, end for end, as the shank is at the center of the slide, and swivels as well as pivots. There are other models of "Dumore" grinders manufactured. The No. 2 develops 1/6 hp., and its interchangeable spindles permit deep internal grinding and button die grinding, as well as internal work. The No. 1 JG grinder is a still lighter tool, having a 1/8 hp. motor, but giving the same degree of accuracy as the larger and more expensive types. For fine tool making, as well as for production work where close limits are essential, "Dumore" grinders give good results. See display adv. page 1311.—Adv.

Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

Woods Machine Co., S. A., 27 Damrell St., Boston, Mass. "Planers of Woods."

GRINDERS, ELECTRIC, POST OR PEDESTAL.—Post or pedestal grinders, sometimes called floor or column grinders, are one of the commonest types of grinders. They consist of a motor mounted on a post or pedestal, grinding wheels being mounted on the ends of the motor shaft. As they are run at a very high speed, they are very accurately balanced to give uniform, smooth running. A tool rest or a jig or other fitting is usually provided in front of the wheel and the wheel enclosed, except for a small cutting surface, by a metal casing. These machines are widely used in machine shops, foundries and other metal-working shops for grinding tools and for rapidly removing metal from castings or various other metal parts. They are sometimes provided with a water spray or pipe for pouring water or a cutting fluid on the material being ground.

Manufacturers:

CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. The electrical component has been given careful consideration in these machines and is designed for continuous operation without excessive temperature rise. Motors



Crawford Electric Grinder

furnished from ⅛ to 2 h. p. Ends are of cast iron accurately machined and so designed as to enclose the field and interior from emery dust. The stators are wound as in the standard a. c. motors made by this company. Rotors are also of same general construction. The bearings are doublerow radial ball mounted on the shaft with locking nut, enclosed in a dust proof housing. Shaft is of special axle steel furnished in various lengths, with collars and nuts or special attachments. It will be noted that the grinder in this case may be detached from the pedestal and used as a bench grinder if desired.—Adv.

Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.

ROTH BROTHERS & CO., Chicago, Ill. Roth electric motor polishing and grinding machines are made in several types for use on both direct and alternating current circuits. The diameter of the armature is built small so



Roth Grinder

as to allow high speeds with perfect safety. These machines are designed with the particular idea of providing a large working radius around the wheels, this feature being particularly advantageous where long work is handled.—Adv.

GRINDERS, ELECTRIC, RAILWAY TRACK.—An electrically driven machine for grinding the track rails to any desired shape. Such machines are most frequently used for grinding corrugations from the head of the rail and for bringing the head to a proper surface at welded joints. They vary from grinding wheels driven directly by a small motor and readily operated by one man, to complicated machines with large motors and belt-driven grinding wheels controlled to a very high degree of accuracy with regard to their plane of movement. These larger machines are usually mounted on specially constructed cars.

Manufacturers:

Buda Co., The, Harvey, Ill.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."

Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa. "Atlas." "Universal."

Rochester Electric Products Corp., Driving Park Ave. & Argo Park, Rochester, N. Y.

Stow Flexible Shaft Co., 3446-54 Ludlow St., Philadelphia, Pa.

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GRINDERS, ELECTRIC, SEED, SPICE, ETC.—These grinders are used to pulverize various seeds, spices, flour, and in the manufacture of other food products, such as evaporated milk. They are also used for recovering such products by regrinding when they become caked or hardened into lumps. There are two types of machines used, one with rotating rollers, the other with rotating disks, both types having very fine knife blades on the rollers or disks. The material to be ground is caused to fall between the disks or rollers and is cut up by the knife blades, the degree of fineness being regulated by the shape of the blades and the distance between the cutting surfaces. For very fine grinding a series of grinders of varying degree of fineness are employed. For all these machines motor drive makes a very sanitary outfit besides presenting all the other advantages of electric drive.

Manufacturers:

Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa. "Challenge."
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Little Giant."
Cincinnati Electrical Tool Co., The, 1501-3-5 Freeman Ave., Cincinnati, Ohio. "Cincinnati."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Eager Electric Co., The, Watertown, N. Y.
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Forbes & Myers, 172 Union St., Worcester, Mass.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y. "Hyfield Wonder."
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. (A. C. only.) "Kimble."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
LeBron Electrical Works, 318-320 S. 12th St., Omaha, Neb.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Miller, Charles E., Anderson, Ind. "Miller-Anderson."
Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.
Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U. S."
Webster & Perks Tool Co., The, Center & Jefferson Sts., S. E., Springfield, Ohio.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

GRINDERS, ELECTRIC, SPECIAL AND MISCELLANEOUS.—Under this classification are included the various types of grinders for special purposes not otherwise listed. Among the most important in this class is the lathe carriage or tool-post grinder. It is sometimes referred to as a portable grinder, because it generally may be used on any machine which has a moving carriage or tool post, but does not belong among grinders for general portable use. It is a small electric motor to which is directly connected a grinding wheel, either being mounted on the armature shaft or driven through multiplying gears. The device has a base suitable for mounting on a tool post or lathe carriage. It is largely used for internal grinding and for grinding spindles, bearings, bushings, crankshafts, etc.

The radial grinder is another form of foundry and machine-shop tool of special type. This machine has a long rod pivoted on a floor base or column, the grinding wheel being placed at one end of the rod, the motor at the other. The machine is heavily built and the rod which supports the wheel and motor runs in a rack and gear to give a steadier and more uniform control of the movement of the wheel. The rod mounting is pivoted so that the rod may be moved radially, horizontal motion being obtained by movement of the gear along the rack. This machine is generally used on large castings, the work being done on the floor. The base is usually bolted to the floor but it is sometimes mounted on wheels to make the machine portable.

The cutting faces of milling-machine cutters are sometimes cut by a special grinder. This grinder is a bench tool and consists of a grinding wheel and a movable spindle and arbor for holding the cutter. The spindle is provided with an eccentric adjustment for feeding the wheel against the work. This machine is also used for grinding reamers, butt mills, saws, and various special cutters. Other special motor-driven machines which are included in this classification are: Oil-stone grinders, for sharpening woodworking tools; razor-blade sharpeners, for sharpening either safety or open razor blades; also various special grinding machines for grinding optical glass, etc.

Manufacturers:

Cochrane Mfg. Co., F. W., 5829 S. Vermont Ave., Los Angeles, Cal. "Duplex," "Quadruplex," "Original Velvet Edger, "New Velvet Edger" razor blade resharpeners.
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Gould & Eberhardt, Newark, N. J.
Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y. ("Hatfield" razor blade sharpeners).
Washburn Shops, The, Worcester, Mass. "Worcester." (drill)

GRINDERS, ELECTRIC, SURFACE.—Surface grinders are used in machine shops for grinding a plane surface to a high degree of accuracy. The wheel is mounted on a shaft, the surface to be machined on the bed of the machine, and the surface and wheel moved with respect to each other by moving the surface only, the wheel only or by movement of both so that the entire surface is uniformly passed over by the rotating wheel. The bed of the machine is sometimes made so that it may be tilted through an angle to allow the grinding of a surface at an angle with the plane of its base. The term surface grinder is also applied to all forms of grinders particularly adapted to grinding a plane surface, and sometimes even to machines similar in construction to scrubbers, which have an abrasive plate used for surfacing tile, marble and mosaic floors; the latter are more commonly called floor surfacing machines (see Surfacing machines, floor, motor-driven).

Manufacturers:

Clark, Jr., Electric Co., James, 520 W. Main St., Louisville, Ky. "Willey."
Garvin Machine Co., The, Spring & Varick Sts., New York, N. Y.
Reed-Prentice Co., 53 Franklin St., Boston, Mass.

GRINDERS, ELECTRIC, VALVE.—Grinders in which the motor and equipment may be moved by the hand and provided with an extended shaft for the grinding wheel so that valves and valve seats may be ground. Extensively used for fitting valves for automobiles and other internal-combustion engines.

Manufacturers:

Air-Way Electric Appliance Corp., Toledo, Ohio.
Arnold Electric Tool Co., Inc., Fort Trumbull Bldg., New London, Conn.
Black & Decker Mfg. Co., The, Towson Heights, Baltimore, Md.
Eclipse Valve Grinder Co., 20th & Oak Sts., Kansas City, Mo. "Eclipse."
Knight Engineering & Sales Co., 447 E. 3rd St., Los Angeles, Cal. "One-Hand-Y."
Louisville Electric Mfg. Co., 31st & Magazine Sts., Louisville, Ky.
Stenman Electric Valve Grinder Co., 42 Southbridge St., Worcester, Mass. "HusKee."
U. S. Electrical Tool Co., The, 2480 W. 6th St., Cincinnati, Ohio. "U. S."
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

GRINDING MACHINES, ELECTRIC, HEAVY-DUTY AND MISCELLANEOUS.—In some cases it is found advantageous to use carborundum or other very hard abrasive wheels for heavy grinding of large castings, wheels, frames, etc. Such outfits are more often spoken of as grinding machines than merely as grinders, since their heavy-duty service makes a more formidable machine out of them. There are also numerous special grinding machines that require more intricate mechanism than that of simple grinders.

For instance, for parallel and taper grinding of rods and shafts a special grinding machine is sometimes used in machine shops and factories. These machines have a grinding wheel which rotates at a high speed and is moved at a uniform rate along the piece being ground; this piece in turn is rotated, the method being the equivalent of the similar lathe operation but having the cutting tool replaced by the grinding wheel. These machines are capable of very close adjustment for fine cutting and are largely used for high-accuracy work, the pieces ground usually being first turned to a size slightly greater than the finished dimension.

Manufacturers:

Bartlett & Snow Co., The C. O., Cleveland, Ohio.
Excelsior Tool & Machine Co., East St. Louis, Ill. "Excelsior."
Gisholt Machine Co., 1241 E. Washington Ave., Madison, Wis.
Grand Rapids Grinding Machine Co., Grand Rapids, Mich.
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. (mosaic floor grinding)
Rivett Lathe & Grinder Co., 20 Riverview Rd., Brighton District, Boston, Mass.

GRINDLE FUEL EQUIPMENT CO.—1901-11 S. Rockwell St., Chicago, Ill. Manufacturer of coal and ash handling and pulverized coal equipment, signaling systems and switches. Business established 1916. President and general manager, Aubrey J. Grindle; vice-president, George Furman; secretary and treasurer, E. M. Pridmore.

GRINNELL.—Trade name for linemen's leather gloves manufactured by the Morrison Ricker Mfg. Co., Grinnell, Iowa.

GRINNELL ELECTRIC CAR CO.—Detroit, Mich. Manufacturer of electric vehicles.

GRINNELL WASHING MACHINE CO.—Grinnell, Iowa. Manufacturer of electric vacuum cleaners and washing machines. President, Fred J. Whinery; vice-president, A. C. Lyon; secretary and treasurer, J. L. Fellows; manager, W. S. Dodge.

GRIP.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

GRIPALL.—Trade name for combination pliers manufactured by Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.

GRIP-IT.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Inc., Parkersburg, W. Va.

GRIPKUT.—Trade name for combination pliers manufactured by Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.

GRIP-O.—Trade name for carbon holders manufactured by the Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.

GRIPS, CABLE.—In attaching the pulling cable to a lead-sheathed cable that is to be drawn into a conduit a secure connection must be provided, since the tension is considerable. The most convenient and readily attached connection consists of a cable grip made up of a cylindrical wire mesh which when released slips over the cable. When tension is applied the wire mesh is extended lengthwise and its diameter is reduced, causing it to grip the lead sheath securely while the tension is maintained.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
HERBST, PAUL W., Chicago, Ill. We are sole distributors of the "Gem" wire woven cable grip. See display advertisement on page 1258.—Adv.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. For information respecting cable grips, see page 1259 and write for our catalog of construction tools.—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

GRIPS, LAMP.—Lamp grips are small devices attached to a lamp socket or receptacle subjected to vibration, to keep the lamp from jarring loose and falling out. They consist of a strong spring which operates through a slot in the screw shell usually, pressing against the lamp when it is in place with sufficient force to prevent it working loose. They are of special value

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in railway cars, in factory rooms where punch presses operate, in forge shops, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington St., Chicago, Ill. (See display advertisement on pages 1231-1234.)

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

GRIPS, MESSENGER.—Messenger grips are very similar to wire grips, but are made for gripping messenger wire, or strand while it is being pulled tight. They are much heavier and larger than wire grips, usually having a gripping surface from 7 to 9 ins. long. Parallel jaws are so arranged that when a pull is put on two eye rings by the pulling block or tackle the jaws will grip the strand. The jaws are made with serrated or roughened surfaces to give a large contact surface and good grip without injuring the strands.

Manufacturers:

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. For information concerning these and other Klein products, see page 1259 and write for our catalog of construction tools.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GRIPS, PLUG, SOCKET AND ROSETTE STRAIN RELIEF.—Clamping devices designed to furnish a secure mechanical attachment between wires and wiring devices to eliminate strain on the wiring connections due to weight of cord or attachment or caused by ordinary use. These sometimes take the form of a special split bushing that relieves any strain at the point where the cord enters the attachment. In sockets used with drop cords two bushings, one of which is cone-shaped, are occasionally used. The cone-shaped bushing fits the cord tightly and transfers the strain to a fixed bushing in the socket cap. Rosettes and many other devices have a small rod or piece around which the cord may be twisted to relieve any strain. Other devices, especially attachment plugs, are arranged with a large slot or recess so that the conductors may be knotted and thus remove the strain from the screw connections. On attachment plugs it is particularly necessary to prevent strain on the connections, such as is caused by pulling on the cord of a prong-type cap, which would likely cause the cord terminals to slip from their connections and open the circuit, if not short-circuit it.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Weber Electric Co., Schenectady, N. Y. (Exclusive distributor, Henry D. Sears, 30 Boylston St., Boston, Mass.)

GRIPS, WIRE.—A device used in various kinds of overhead line construction, such as power, lighting, trolley, telephone and telegraph lines, for clamping line wire in order to pull it up tightly enough for tieing onto the insulators. Several forms of grips are made; most of them utilize the tension on the line to tighten the clamping pressure on the wire, so that the harder the pull the firmer the grip. They are generally so arranged that neither the insulation nor wire are injured. The Buffalo grip is one common form. This has two parallel jaws which can be locked open to insert the wire. An eye or pulley on the end of a simple lever arrangement is attached to the pulling block and when the tension is applied the jaws come together to grip the wire. There are several other forms utilizing the principle of an eccentric or cam which turns to reduce the size of an opening when tension is applied on an eye or pulley. The most common of these are known as the "Come Along," "Haven's Grip," "Compound Eccentric," "Chicago," etc. Larger and heavier grips, generally with parallel jaws either serrated or roughened, are used for handling messenger wire or strand, and trolley wire.

Manufacturers:

BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.

Dicke Tool Co., The, Downers Grove, Ill.

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. The Klein wire grip for all around work is almost automatic in action. A shake of the rope releases the grip. The heavier the strain, the tighter the grip. Our wire grip is forged from bar steel. The types of grips furnished are the "Havens" grips and the "Chicago" grips. The other types of grips constructed of castings are the "Samson" grips and "Come-along" grips. They are used all over the world. Klein catalog fully illustrates and describes the merits of each grip. Write for it. See also page 1259 for illustrations and information concerning other Klein products.—Adv.

Rittenhouse Co., The A. E., Honeoye Falls, N. Y.

SMITH & HEMENWAY CO., INC., Irvington, N. J. This company makes the "Buffalo Grips" in all sizes with loop



"Red Devil" No. 471

or pulley and the automatic locking device, see first illustration. "Haven



"Haven Grip"

Grips," see second illustration, in the various sizes, are furnished either in Gun Metal or galvanized finish.—Adv. Western Electric Co., Inc., 195 Broadway, New York, N. Y.

GRIPTITE.—Trade name for combination pliers manufactured by Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.

GRIPTITE.—Trade name for hand vise holder manufactured by the Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

GRISCOM-RUSSELL CO.—New York, N. Y. Manufacturer of steam and oil separators, feed water heaters and other steam specialties. President, E. T. Hargrove; vice-president and general manager, R. C. Jones; treasurer, J. J. O'Brien. Main office, 2141 West St. Bldg., New York, N. Y. Branch offices, Philadelphia, Pa.; Boston, Hartford, Conn; Springfield, Mass.; Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Toledo, Ohio; Chicago, Ill.; Minneapolis, Minn.; Milwaukee, Wis.; St. Louis, Mo.; New Orleans, La.; Houston, Tex.; Fort Worth, Tex.; Charlotte, N. C.; San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.; Kansas City, Mo.

GRITT.—Trade name for electrical advertising specialties manufactured by the National Retailers Advertising Corp., 1846-48 Ogden St., Indianapolis, Ind.

GRONWALL-DIXON.—Trade name for electric steel furnaces manufactured by the John A. Crowley Co., 120 Liberty St., New York, N. Y.

GROOMERS, ELECTRIC.—Electric groomers are motor-driven devices operating a rotating cylindrical grooming brush through a flexible shaft. The motor is often suspended from an overhead support and may be moved from stall to stall as desired. The brush used is cylindrical, but is in other respects of similar construction to a flat grooming brush. A reversible rotating motion is obtained which makes the speedy cleaning and proper grooming of a horse a simple matter. Some groomers are arranged on portable stands which may be moved from place to place. They are also operated interchangeably with motor-driven clippers in some cases, the same motor being used for both. The motors are made for 32-volt d-c. and also for 110 and 220-volt a-c. or d-c. circuits.

Manufacturers:

American Shearer Mfg. Co., Nashua, N. H. "Priest's."

Gillette Clipping Machine Co., 129-31 W. 31st St., New York, N. Y.

Taber Pump Co., Buffalo, N. Y. "Taber."

GROSS CHANDELIER CO.—21st & Morgan Sts., St. Louis, Mo. Manufacturer of lighting fixtures.

GROSSMAN AUTO PARTS CO.—White Plains, N. Y. Manufacturer of automobile wiring assemblies and magneto parts. Partnership, Wallace G. Grossman and Mortimer M. Grossman.

GROTE MFG. CO., F.—123 3rd Ave., Evansville, Ind. Manufacturer of electric elevators and hoists. Business established 1908. President and treasurer, F. Grote; secretary, E. F. O. Ruller; general manager, Emil Grote.

GROTON ELECTRICAL DEVICES, INC.—Groton, N. Y. Manufacturer of electric hand and face driers. Business established 1917. President, Benn Conger; secretary, L. J. Conger; treasurer and general manager, D. J. Watrous; sales manager, R. B. Hibbard. Main office and factory, Main St., Groton, N. Y. Branch offices and warehouses, 129 W. 42nd St., New York, N. Y.; Little Bldg., Boston, Mass.; 110 S. Dearborn St., Chicago, Ill. Sales representatives, E. W. Hall Co., 720 2nd Ave., Seattle, Wash.; Frick-McClay Electric Co., 19 S. 13th St., Philadelphia, Pa.; Newbury Electric Co., 724 S. Olive St., Los Angeles, Cal.

GROUND.—The term ground is used in electrical work in referring to the earth as a conductor or as the zero of potential. Thus a grounded circuit, as on a telegraph or telephone line, is one in which the earth is used as one conductor of the circuit. For safety purposes many circuits and much electrical apparatus is grounded permanently, and in special cases grounded only while any work is being done on a line; grounding for safety is usually called protective grounding. On other lines or circuits a ground is a very troublesome condition as it permits a leakage or flow of current to ground rather than to the desired apparatus. To ground means to connect a circuit or frame of apparatus or conduit, etc., to the ground. Abroad this is more often called "to earth" and a ground connection is called an earth.

GROUND CLAMPS.—See Clamps, ground connection.

GROUND CONNECTIONS, RADIO.—The use of an elevated antenna in radio work makes necessary some sort of ground or counterpoise for the other plate of the condenser. For receiving circuits and small sending sets, grounding upon the water system is often sufficient. Better grounds are made by laying wires in the earth beneath the antenna. Sometimes a network is suspended on short posts directly under the antenna, but insulated from the ground; this is called a counterpoise. For transmitting stations a much better and lower resistance ground is necessary in order to avoid energy loss and danger of fire. The voltages generated in an aerial used for transmitting are often very high and if the resistance in the ground lead is not very low, the current will jump to the lighting circuit, or some other metallic body which is better grounded. The spark which results may be sufficient to start a fire.

GROUND DETECTOR.—An instrument used to determine whether any part of an electrical circuit has accidentally come in contact with ground or become grounded. See Detectors, ground.

GROUND PIPE CAPS.—See Caps, ground pipe.

GROUND PIPES.—See Pipes, ground.

GROUND PLATES.—See Plates, ground.

GROUND RETURN.—A term used in referring to any circuit or system in which the ground is used as one of the conductors. It originated in connection with grounded d-c. systems in which the negative pole was always grounded, and the current was considered to go out on the positive conductor and return in the ground. Grounded d-c. trolley systems operate in this manner and the track circuits are referred to as negative or ground-return circuits. Single-phase and polyphase electric railway systems also use the track rails as one conductor. The use of the rails as one of the d-c. railway conductors often gives rise to electrolysis troubles in underground piping and lead-covered cables, which requires special provision for its elimination. Telegraph and some telephone lines also utilize the ground as a return circuit.

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GROUND RODS.—See Rods, ground.

GROUND TELEGRAPHY AND TELEPHONY.—A method of sending telegraph or telephone messages by the aid of earth currents. For telegraphing, alternating voltages generated by a buzzer are applied to two metal conductors driven in the ground 100 ft. or more apart in a line at right angles to the direction of the receiving station. For receiving, a similar pair of metal stakes are used and are connected directly to an electron tube amplifier. For telephony the buzzer currents are replaced by speech-modulated current. This type of communication was used to some extent in the recent war, and is called T P S communication, this name coming from the French words meaning telegraphy through the soil. It is not applicable to long-distance communication.

GROUND WIRE, TELEPHONE.—Many telephones require a connection to earth or ground. The wire which makes this is called a ground wire. It runs to the ground rod, driven into the dirt, or to a water or gas pipe which itself enters the earth. The latter requires a ground clamp to attach the wire to the pipe. Telephone poles are often equipped with ground wires, simply a wire run from the top of the pole to the butt, and usually coiled up a little under the pole. It is a lightning protection to the pole.

GROUND WIRE, TRANSMISSION LINE.—As a protection against lightning striking a transmission line, it has become the practice to install a continuous wire over the line, running from top to top of all the poles or towers and frequently grounded by means of a ground connecting wire along the pole or tower. This top or ground wire is commonly made of heavy galvanized steel strand. See Strand, galvanized steel; also Wire, transmission ground (solid wire).

GROUNDING.—Grounding of electric circuits is usually for one of two reasons. (1) So that the ground may form part of the circuit, such as one of its conductors, under normal conditions; this is usually confined to low-voltage circuits, such as telephone and telegraph. (2) The neutral conductor of a three-wire system is generally grounded to guard against excessive voltage being imposed upon either side of the system from some external source, as by a connection with some higher voltage system. In case of a-c. distribution systems which are fed through transformers, one side of the distribution circuits is always grounded if the normal circuit voltage does not exceed 150 volts and frequently is grounded even when the voltage exceeds this value. Such grounding is purely as a protective measure and for the purpose of preventing persons being exposed to a voltage to ground which is higher than the normal voltage to ground of the circuit. For instance, breakdown of the insulation in the distribution transformer would subject the low-voltage distribution circuits to the high primary voltage, thus producing a very hazardous condition. Other circuits which are also exposed to contact with high-tension circuits either directly or through induction are similarly grounded.

The frames of generators, motors and other equipment, metal conduit systems, wire raceways and similar enclosures for wires are generally required to be grounded chiefly as a protection against possible breakdown of the insulation of the conductors within such machines, conduits or raceways or of metal fittings connected therewith. In all cases the ground connection must be a reliable one and should normally carry no current, since it is reserved as a protective measure and not as a connection to ground of the circuit itself.

GROUNDING DEVICES, MISCELLANEOUS.—Protective grounding is required on wiring and distribution systems for lighting and power and grounding is widely used in other systems, such as telephone, telegraph and radio communication, both as a protection to the apparatus and as a means of completing the circuit. The various conditions under which grounds have to be made require the use of many grounding devices. Interior wiring systems, when possible, are connected to the house or building water-piping system, as this gives the best possible ground connection and is known as a natural ground. Gas pipes may be used when the other is impractical but are not to be preferred. Suitable connections of this kind require the use of a ground clamp for the pipe; see Clamps, ground connection.

Artificial grounds are used where the water pipe or natural grounds are not available. These are made in a number of ways. One of the most common is the use of a ground pipe or ground rod. See Pipes, ground, also Rods, ground. These devices are driven into the soil for a considerable distance to give a large contact area and reach moist soil, if possible. The ground wire is then attached either by soldering to the ground rod or by using a ground pipe cap; see Caps, ground pipe. Another system makes use of ground cones or ground plates, which are buried in the soil or in a bed of charcoal or other material that will retain moisture and make a good connection. See Plates, ground, also Cones, ground.

There are other methods of grounding, some of which make use of home-made devices. Coils of bare copper wire or copper strap are sometimes used. These are buried, sometimes under a pole in pole-line construction, and then connected to the ground wire. Copper gauze networks are also used in some cases. They are buried in the ground. Elaborate grounding systems, involving several special devices are required in the operation of powerful radio stations.

Manufacturers:

Arrow Conductor & Mfg. Co., 1536 W. Adams St., Chicago, Ill.

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.

Cavin, F. T., 400 W. Ave., 26, Los Angeles, Cal. "Cavin."

CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.

Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "Maxum."

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

PARAGON ELECTRIC CO., Old Colony Bldg., Chicago, Ill. Paragon Grounds, adequate and dependable under all conditions, are made of pure continuous copper (the toughest metal for resisting underground corrosion) from base to point of connection with leading-in wire above the surface of the earth. No galvanic action can destroy connections. Have ample discharge area. Not expensive. Complete directions furnished with each shipment to insure accurate installation.—Adv.



Paragon Ground Cones

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

GROUT.—Portland cement mixed with enough water to be thin enough to pour, and without the use of any aggregates (sand, gravel or stone). In construction work "grouting" or filling or building up with grout is necessary, to give a solid bearing to a frame or to fasten anchor bolts, dowels, etc.

GROVE CELL.—A laboratory form of primary battery having an outer jar containing a dilute sulphuric acid solution and a zinc electrode and an inner porous cup in which nitric acid and a platinum electrode are placed. See Batteries, primary.

GROWTH, PLANT, EFFECT OF ELECTRICITY ON.—There have been numerous experiments extending over a long period of time to determine the influence on the growth of plants through the action of an electrical discharge. Many of these experiments consisted in subjecting the plants to discharges in the atmosphere about the plants and other experiments have subjected the plants to a flow of current through the ground. The best results have been obtained by using a network of conductors over the plants and charging this to a potential of from 50,000 to 75,000 volts. The network acts as a leaky condenser and a discharge to ground takes place. When potentials of this value are used the discharge is audible. The effect of electric light on plant growth has also been studied and found to be beneficial.

While there is no doubt that the electrical discharge and electric light have a stimulating effect on the plants the best length of time of application of the current has not been determined. There are many other features that are still in the experimental field, such as influence of the nature of the crop, the effect of moisture in the soil, composition of the soil, time of planting, etc.

GRUENDLER PATENT CRUSHER & PULVERIZER CO.—928 N. 1st St., St. Louis, Mo. Manufacturer of electric grinders, crushers and pulverizers. Business established 1886. President, E. Gruendler; vice-president and sales manager, William P. Gruendler; secretary and general manager, H. J. Shelton; treasurer, F. E. Shelton.

GRUNDY.—Trade name for insulated shaft couplings manufactured by the Charles Bond Co., 617-19 Arch St., Philadelphia, Pa.

GRUNDY.—Trade name for flexible insulated coupling manufactured by the Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.

GRUVA.—Trade name for grinding wheel dressers manufactured by the Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa.

G. T. D.—Trade name for threading dies, pipe threaders, taps, screw plates, etc., manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

GUARANTEE.—Trade name for household labor-saving devices manufactured by the Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y.

GUARANTEE.—Trade name for annunciators manufactured by the Partrick & Wilkins Co., 51 N. 7th St., Philadelphia, Pa.

GUARANTEE CONSTRUCTION CO.—140 Cedar St., New York, N. Y. Manufacturer of pneumatic conveyors. Business established 1901. President, Charles L. Inslee; vice-presidents, W. G. Hudson and Edward Burns, Jr.; treasurer, W. W. Ricker.

GUARANTEE ELECTRIC PRODUCTS CO.—110-112 W. 40th St., New York, N. Y. Manufacturer of electric household labor-saving devices and high-frequency apparatus. Business established 1917. Dr. E. A. Martin, sole owner. Factories, Brooklyn, N. Y., and Chicago, Ill.

GUARANTEE LIQUID MEASURE CO.—Rochester, Pa. Manufacturer of electrically operated gasoline pumps. President, H. C. Fry; vice-president, F. J. Woodruff; secretary and treasurer, D. H. Sage.

GUARANTEED BATTERY CO.—2017-2025 Lucas Ave., St. Louis, Mo. Manufacturer of storage batteries and battery repair shop equipment. President, F. A. Carpenter; vice-president, C. Alfeld, Jr.; vice-president and treasurer, J. Oscar Boeck; secretary, W. C. Schawacker.

GUARANTEED CHAIN.—Trade name for fixture chain manufactured by the Lightolier Co., 569-71 Broadway, New York, N. Y.

GUARD.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

GUARD WIRES.—Where high-tension transmission lines or distribution circuits cross trolley lines or telephone circuits, guard wires or cradles are sometimes placed above the trolley or other low line to prevent the high-tension wires from falling across and making contact.

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GUARDIAN.—Trade name for fire detector thermostat manufactured by the Dee Electric Co., 79 W. Monroe St., Chicago, Ill.

GUARDIAN.—Trade name for electric time detectors manufactured by E. O. Hausberg, 49 Maiden Lane, New York, N. Y.

GUARDS, ARC LAMP AND STREET LAMP.—Guards for outdoor lighting service are used on arc lamps and incandescent lamps for lighting streets, dry docks, wharves, buildings, railroad yards and construction work where there is special danger of breakage of glassware or where broken or cracked parts of globes must be prevented from falling. They are generally made of heavy steel wire, galvanized, and are arranged to fasten or lock to the fixture or reflector. In many cases the wires are welded together into a strong, rigid network which effectively prevents falling at least and usually any accidental breakage, as well as theft of the globe or lamp. For interior guards see Nets and guards, for bowls, clusters, globes, etc.; also Guards, lamp.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

FLEXIBLE STEEL LACING CO., 4607-4631 Lexington St., Chicago, Ill. "Flexco-Lok."

Hamblin & Russell Mfg. Co., Worcester, Mass.

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

Morse, Frank W., 289 Congress St., Boston, Mass.

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GUARDS, LAMP, LOCKING.—Wire or similar protective cages installed over incandescent lamps to prevent their unauthorized removal or outright theft, as well as breakage. They are used on any lamps accessible to reach, especially on drop cords, pendent and wall bracket fixtures, also on portable extension lamps; wherever in any of these cases the lamp is exposed to breakage and liable to be removed and a wrong one substituted or deliberately carried off without replacement, a locking lamp guard should be used. This is particularly true in factories, railroad stations, tunnels, subways, etc. The wire cage usually has a collar that fits around the socket like a shade holder, but it is locked in place so as to make it difficult to remove. Sometimes the guard is fastened directly to the outlet-box cover. The cage may include a small circular reflector in place of the open collar, or a reflector at one side. Where breakage of the lamp is not likely, but provision is necessary against theft or removal, a locking socket is usually employed in place of a locking guard (see Sockets, locking).

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Lamp guards for ceiling fixtures. The lamp guard at the left has grooved band and eye bolt for attaching to the bead of the reflector. It is made in sizes of 6 to 20 ins. Similar guards for many other styles of reflectors and fixtures are included in the Benjamin line.—Adv.



Ceiling Fixture Lamp Guard

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can. "Edmunds."

FLEXIBLE STEEL LACING CO., 4607-4631 Lexington St., Chicago, Ill. "Flexco."

Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.

Hamblin & Russell Mfg. Co., Worcester, Mass. "Eureka."

Hubbell, Inc., Harvey, Bridgeport, Conn.

Leveridge, Inc., Charles W., 133 Liberty St., New York, N. Y.

McGill Mfg. Co., Valparaiso, Ind. "Loxon."

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Holdfast."

Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

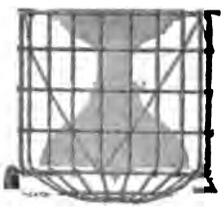
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

GUARDS, LAMP, NONLOCKING, PORTABLE AND MISCELLANEOUS.—These guards are similar to the locking guards described above, but they serve primarily as a protection against lamp breakage and therefore have no locks. On ship decks the guards are used extensively with watertight fixtures in which case they protect the enclosing globe as well as the lamp proper; such guards, as well as those used in cargo spaces, ship boiler and engine rooms, in baggage cars, etc., are of very substantial construction and usually securely fastened to the outlet-box cover. Portable extension, inspection or trouble lamps should always be protected by a guard, since lamp breakage is otherwise very frequent, due to the rough handling such lamps receive in machine shops, factories in general, garages, locomotive roundhouses, railroad yards, etc. The guards for these lamps and for other miscellaneous single lamps, if nonlocking, are included in this classification. The inspection and similar lamps described are often provided with a special handle, including the socket, lamp proper, guard with hook at the end and reflector at the side; these complete units are listed under Lamps, hand, inspection, extension or trouble.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

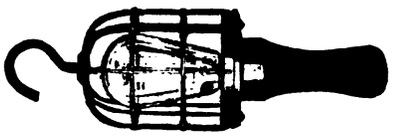
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Lamp guards for ceiling fixtures. The lamp guard at the left has grooved band and eye bolt for attaching to the bead of the reflector. It is made in sizes of 6 to 20 ins. Similar guards for many other styles of reflectors and fixtures are included in the Benjamin line.—Adv.



Ceiling Fixture Lamp Guard

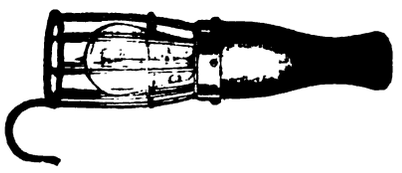
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria, Sts., Philadelphia, Pa.



New Keystone Type

Keystone portable lamp guards are made in three general types, namely, New Keystone, ESSCO, and Pennsylvania. They are all of the same general construction although they differ in size and in design. The type B



Pennsylvania Type A

Pennsylvania guard may be fitted with a 100-watt type C lamp. The cages are made of Bessemer steel wires and pressed metal parts and are sufficiently strong to sustain an average man's weight. All types may be used on voltages up to 750 and are approved by the Board of Underwriters.—Adv.

Electrical Dealers Supply House, 162 W. Randolph St., Chicago, Ill. "Edsh."

Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.

Hamblin & Russell Mfg. Co., Worcester, Mass.

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Hubbell, Inc., Harvey, Bridgeport, Conn.

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. (Portable) "Holdfast."

McGill Mfg. Co., Valparaiso, Ind. "Protector," "Bulldog," "Dreadnaught," "Standard," "National," "Crescent," "Security," "Universal," "Mogul," "Cable Rack," "Monitor."

Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.

Morse, Frank W., 289 Congress St., Boston, Mass. "Harvard," "Ryerson Handy," "Webster," "Eureka."

Racine Iron & Wire Works, Racine, Wis. "Buck."

Standard Wire Co., The, Grant & Sampson Sts., New Castle, Pa. "Standard," "Just Right."

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

GUARDS, MANHOLE.—Where manholes are opened for work in crowded streets it is important that the opening be guarded by a railing, or by a heavy wire screen. A sectional pipe railing so hinged that it can be carried in a compact way on a wagon is commonly used; a red danger flag is usually placed on it to attract attention. Where there is danger of horses stepping into the opening a heavy wire screen in a strong frame placed on the hole as a cover has been found useful.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Fox & Co., John, 253 Broadway, New York, N. Y.

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display advertisement on page 1254.)

Smyser-Royer Co., York, Pa.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

GUARDS, POLE.—Guards are placed on wooden poles used in distribution circuits to protect them from gnawing of horses and from accidental bumps by wagons. The narrow metal strips nailed vertically on the pole as a protection against horses are called pole strips or cribbing guards; they are listed under Strips, pole. Wagon guards, hub plates or butt protectors are listed under Plates, pole, hub or butt and strain.

GUARDS, PUNCH PRESS AND OTHER MACHINERY.—Safety guards are placed around punch presses or any machinery having movable parts to protect the operator and other persons who have to work or pass by near the machine. The guards are usually made of stiff woven wire of a mesh small enough to keep the operator's clothing from being caught on a moving part, such as belting, gearing, etc. Guards are also placed over grinding and cutting machines to keep pieces of metal or abrasive from flying through the air.

The great hazard entailed in the operation of punch presses lies in the possibility of the operator's hand being still in the machine when the clutch releases and the die descends. In the electrical industry punch presses are extensively used, particularly in the manufacture of armature and transformer cores, wire terminals, telephone parts, metal reflectors, parts of lighting fixtures, etc., some parts used going through twenty or more punch-press operations. In any shop where presses are used to such an extent accidents would be numerous were it not that they are made impossible by the use of special guards. These guards are made of wire mesh or a deformable gate is employed, the guard or gate being so linked with the press that just as the die starts to descend the gate flies across the front of the press, knocking the hand out of the way if it is still between the dies. Some types of gates are so arranged that they start to shut before the die descends and must be almost completely down before the clutch releasing the die can operate, thereby making it impossible for the clutch to operate when the hand is in the machine. The gates also may be arranged to cut off the power in case they fail to operate or are obstructed in their path.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

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BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benjamin punch press guard makes fingers safe without diminishing production. Both hands of the operator must be out of the way before the ram descends. A compressed air cylinder attached to the punch press releases a blast of air on the upward stroke, so that the work is blown off the die. This does away with the necessity of the operator putting his fingers under the ram in order to remove the work.—Adv.



Benjamin Press Guard

Buffalo Wire Works Co., 316-332 Terrace, Buffalo, N. Y. (Wire enclosures) "Buffalo."

Corbin Cabinet Lock Co., New Britain, Conn.

Flour City Ornamental Iron Co., 27th St. & 28th Ave., S., Minneapolis, Minn.

Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.

New Britain Machine Co., New Britain, Conn. "New Britain."

Page Steel & Wire Co., 30 Church St., New York, N. Y.

Roberts Electrical Device Corp., 517 W. Monroe St., Chicago, Ill.

Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Surty Guard Co., 4139 W. Kinzie St., Chicago, Ill. "Surty."

Wickwure Spencer Steel Corp., Worcester, Mass.

GUARDS, THIRD RAIL. — Protecting boards which partly surround the third rail to prevent accidental contact with it. In the underrunning type of third rail the protection may be in the form of an inverted trough leaving the under surface of the rail exposed for the contact. In the over running type of third rail the guard may be in the form of a trough open both top and bottom. In some cases the guard may be of specially formed fiber or other insulating material arranged to fit around the third rail.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.

OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."

GUARDS, TROLLEY.—Trolley or trolley-wheel guards are used to guard against the trolley wheel jumping off the trolley wire and thus stalling the car at perhaps an important crossing or in a hazardous place. They are used at steam railroad grade crossings, on and under viaducts, at entrances to car barns, on curves and other similar points. They consist of a galvanized steel or copper wire mesh formed into an inverted trough and mounted just above the trolley wire. It is usually suspended from a messenger or supporting wire by means of a special yoke. The guard is insulated from the messenger or supporting system, but is connected to the trolley. Being energized it thus catches the wheel as it flies off and again completes the circuit and allows the car to continue over the crossing. They are usually placed so that the trolley is protected from the time the car is 50 ft. from the crossing until it is 50 ft. clear of the crossing.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

Automatic Trolley Guard Co., 61-69 Carroll St., Buffalo, N. Y.

National Railroad Trolley Guard Co., Olean, N. Y.

OHIO BRASS CO., THE, Mansfield, Ohio. "National" trolley guard is a wire mesh trough, inverted over the trolley at railroad crossings. If the wheel jumps the guard catches it and supplies power to take the car out of danger.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GUARDS, WHEEL, STREET CAR.—Equipment installed close to the track and attached to and all around the car truck, consisting usually of wooden boards in vertical positions to prevent persons or objects from passing under the wheels. Nonprotruding fenders are sometimes designated under this heading, though they are more properly classed as fenders.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.

GUDEMAN & CO.—New York, N. Y. Manufacturer of electrical novelties, portable lamps and lamp shades. Main office, 30 Irving Pl., New York, N. Y. Branch offices, 141 E. 4th St., Cincinnati, Ohio; 126 Post St., San Francisco, Cal.

GUIDE.—Trade name for automobile lamps manufactured by the Guide Motor Lamp Mfg. Co., Cleveland, Ohio.

GUIDE MOTOR LAMP MFG. CO., THE.—Cleveland, Ohio. Manufacturer of electric automobile lamps. President, H. J. Monson.

GUILLOTT METAL GASKET & SUPPLY CO.—24-30 S. Clinton St., Chicago, Ill. Manufacturer of metal gaskets and washers. Business established 1886. Sole owner, F. W. Bowen.

GULF CROSS ARM CO.—Dothan, Ala. Producer of creosoted pine poles and crossarms.

GULFPORT CREOSOTING CO.—Gulfport, Miss. Producer of creosoted poles, ties and crossarms. General manager, A. E. Fant.

GULF STATES STEEL CO.—Brown-Marx Bldg., Birmingham, Ala. Manufacturer of galvanized wire, wire rods, etc. President, James Bowron; vice-president, H. Sanborn Smith; vice-president and general manager, C. A. Moffett; vice-president and treasurer, A. R. Forsyth; secretary, W. H. Moore. Factory, Alabama City, Ala.

GUM, INSULATING AND SPLICING.—Natural gums or resins are very seldom used for insulation purposes in their native condition. Such gums as caoutchouc, pitch, gutta-percha, resin, etc., are often mixed with other materials or treated in special ways to prepare insulating compounds of which they form the principal part. These compounded gums are then used to insulate wires and cables in the process of manufacture and also to protect cable splices. They are used largely on rubber-insulated cables, especially for submarine and underground cable installations.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton; Ont., Can.

Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.

Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display advertisement on page 1320.)

Mica Insulator Co., 68 Church St., New York, N. Y.

Mica Insulator Co., Victoriaville, Que., Can.

Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

GUM SHELLAC.—Gum shellac is a very high-grade shellac made from carefully selected special gum. The gum is very carefully filtered and refined so that all wax and other foreign matters are entirely removed. No resin is added to the gum. This gives a transparent and pure shellac that dries very rapidly. It is used on metal, glass, leather, paper, jewelry, etc.

Manufacturers:

Franche & Co., C. E., 440 Orleans St., Chicago, Ill.

Zinsser & Co., William, 195 William St., New York, N. Y.

GUMMON.—Trade name for molded insulation manufactured by the Garfield Mfg. Co., Garfield, N. J.

GUMP CO., B. F.—431-437 S. Clinton St., Chicago, Ill. Manufacturer of motor-driven grinders for flour mills, feed mills, etc. Business established 1872. President, George W. Moore; vice-president, A. D. Dorman; secretary and treasurer, W. M. Williams.

GUN.—Trade name for threading taps manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

GUN, CONDUIT-CLEARING. — Through neglect or accident it sometimes happens that conduit is left open while other construction work is going on in a building and plaster or concrete may enter the conduit and fill it so that the wires cannot be drawn through. The problem of removing this material within the pipe is usually very difficult. A simple device that has had some success in removing such obstructions consists of a metal cap which threads onto the conduit, a blank cartridge, which is inserted in a hole drilled in the cap, and an auxiliary cap which fits over the cap and cartridge, holding the latter from flying backward. The auxiliary cap has a small hole drilled through it directly over the fulminating cap so that it can be struck by a nail and hammer or a sharp rod and the cartridge exploded. The air pressure created by the explosion forces out the obstruction. This device has also been used to drive out ice that has formed in a conduit. In the case of practically complete choking of the conduit, two or three shots did the trick.

GUN FIRING ON BATTLESHIPS.—Guns are fired by any one of three methods: central electrical energy, local electrical energy, or mechanical. Central energy consists of an a-c. generator located well below the water line and behind armor with supply mains running the length of the ship below the protective decks. Fused risers are taken from this main at suitable points and led up through armored tubes to a small stepdown transformer located near the gun. The firing current for the gun is taken from the secondary of this transformer. The advantage of this method is that a ground or short-circuit at one gun will not affect the circuits to the other guns. Should this source of energy fail a transfer switch conveniently located to the gun pointer permits shifting this circuit to a local storage battery. In the event of the storage battery failing he fires the gun mechanically.

GUND MFG. CO.—326 Jay St., LaCrosse, Wis. Manufacturer of cord adjusters and guy anchors. President, Henry Gund, Sr.; vice-president, Harry Gund; secretary and treasurer, O. F. Cassaday; general manager, O. T. Cassaday.

GURLEY, W. & L. E.—Troy, N. Y. Manufacturers of water level gages, electrical precision and graphic recording instruments, current meters, etc. Business established 1845. President, Paul Cook; vice-president, Henry L. Beveridge; secretary and treasurer, E. H. Betts; general manager, C. I. Day; sales manager, H. M. Dibert. Main office, 514 Fulton St., Troy, N. Y. Branch office, 454 Empire Bldg., Seattle, Wash.

GURNEY BALL BEARING CO.—Jamestown, N. Y. Manufacturer of ball and thrust bearings. J. T R. Bell, general sales manager.

GURNEY CO.—Honesdale, Pa. Manufacturer of electric elevators.

GURNEY ELEVATOR CO.—62 W. 45th St., New York. Manufacturer of electric elevators.

GUTTA-PERCHA. — A natural gum, whose properties are nearly the same as those of rubber. It is obtained from the latex of the Isonda gutta tree found in Malacca, Sumatra and Borneo. It is reduced in the same way as rubber, and is used in its pure state principally for submarine cable insulation as it is less porous and more waterproof than rubber. The resistivity is about 34×10^9 ohm-cm. at ordi-

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nary temperatures and pressure, but decreases with an increase in pressure, having a multiplying factor of (I-0.00023p) where p is the pressure in lbs. per sq. in. This relation is important in submarine cable work.

GUY ANCHORS.—See Anchors, guy.

GUY CLAMPS.—See Clamps, guy.

GUY HOOKS AND RODS.—Guy hooks are made of half oval steel, 1¼ to 1¾ ins. wide and from 3½ to 6 ins. in length. There is a straight flat surface with holes provided for one or two bolts for fastening to the pole, and the lower end of the bar is turned up to give a hook for attaching the guy wire. Guy rods are made of steel, hot galvanized, and in sizes up to 1½ ins. in diameter and 12 ft. long. They are made with either a drop-forged or welded eye for attaching to the guy wire and are often threaded at the other end for attaching to the anchor or dead man. They are sometimes called anchor rods. Both guy hooks and rods are widely used in overhead line construction, for power transmission and distribution systems, and for electric railway, telegraph and telephone lines.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
HUBBARD & CO., Pittsburgh, Pa Hubbard guy hooks are made of open hearth steel, hot galvanized. (For Hubbard guy rods, see entry under Rods, anchor.)—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

GUY WIRE.—See Strand, galvanized steel, for overhead construction.

GUYAN MACHINE SHOPS.—Logan, W. Va. Manufacturers of trolley wheels.

GUYS.—To keep poles used in overhead line construction from bending over or breaking from the pull of the wires which they carry, they are guyed to the ground wherever possible. The guy wire is usually stranded (made of seven or more small steel wires), and is usually held at the ground end by an anchor. There are two principal kinds of guys, side and head guys. Side guys consist of a guy wire which runs out approximately at right angles to the pole line to take up side stresses, as where a branch runs off at right angles or where there is special exposure to wind or sleet storms. A head guy is a guy which lies in the line of the poles to take up longitudinal stresses, as at railroad or other important crossings, or just beyond exceptionally long spans; head guys are also used at intermediate points of a heavy line to guard against breakage of many poles in case the wires of one span should break. Sometimes a short pole or post is set in the ground to hold the guy wire so as to raise it above the road, or sidewalk, or some obstacle. This is called a guy stub and is usually itself guyed to ground, but occasionally it must be self-supporting. Also see Strand, galvanized steel.

GWYNN-BACON VULCANIZER CO.—2504 Cass Ave., St. Louis, Mo. Manufacturer of electric vulcanizers. W. A. Gwynn, sole owner.

GYRATING FANS.—See Fans, gyrating.

GYROFAN.—Trade name for gyrating fans manufactured by the National Screw & Tack Co., AB Products Division, Cleveland, Ohio.

GYROSCOPES, MOTOR-DRIVEN.—Any wheel rotating at a high speed about its own axis and free to place itself in any plane is called a gyroscope. If such a wheel supported by its axis, is placed upon another larger wheel which is also revolving, the rotation of the large wheel would so influence the smaller wheel that its axis would point in the same direction as the axis of the larger wheel. This principle is used in the construction of gyroscopic compasses, where the earth is used as the larger wheel, and also in stabilizers. A small motor is used to drive the rotating wheels at a high and constant speed. Also see Compasses, gyroscopic, and Stabilizers, airplane and ship, motor-driven gyroscopic.

Manufacturers:

Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.

H

H.—The chemical symbol for the element hydrogen; also the symbol for the intensity of a magnetic field, the unit of which is a gauss; also the symbol for the horizontal intensity of the earth's magnetic field. The form h is used sometimes as an abbreviation for the henry, the unit of inductance; also as an abbreviation for hour, as in m. p. h. (miles per hour); k. w. h., although the form kw.-hr. is preferred for kilowatt-hour.

HAAG BROS. CO.—Peoria, Ill. Manufacturer of electric washing machines. Business established 1912. Partnership, Albert R. Haag and George A. Haag.

HAAG TWIN.—Trade name for electric wishing machine manufactured by the Haag Bros. Co., Peoria, Ill.

HAAS ELECTRIC & MFG. CO., THE R.—305 E. Monroe St., Springfield, Ill. Manufacturer of bells, gongs and bell-ringing transformers.

HAAS-OETTEL CELL.—An electrolytic cell employing bipolar electrodes of Acheson graphite for the production of a dilute hypochlorite solution (bleach liquor) from salt solution.

HABER PROCESS.—An electrothermal catalytic process in which nitrogen and hydrogen are combined under pressure to form ammonia, NH_3.

HABERMAAS & DELPORTE, INC.—1325-1327 S. 7th St., St. Louis, Mo. Manufacturer of outlet boxes. President, A. F. Delporte; vice-president, F. H. Haskins; secretary and treasurer, O. C. Habermaas.

HABIRLITE.—Trade name for locomotive headlight wire manufactured by the Habirshaw Electric Cable Co., Yonkers, N. Y.

HABIRSHAW ELECTRIC CABLE CO.—Point St., Yonkers, N. Y. Manufacturer of wire and cables. Business established 1886. President, J. Nelson Shreve; vice-president and general manager, G. F. Waterbury; secretary, John S. Keith; treasurer, J. Nelson Shreve; sales manager, George H Moss. Factories, Yonkers, N. Y. and Bridgeport, Conn. Sales representative, Western Electric Co., 195 Broadway, New York, N. Y.

HACKSAWS, HAND.—Rectangular metal frames fitted with handles and with end fastenings on the open side for securing in place and drawing tight the steel hacksaw blades. Hacksaws are much used by electricians for cutting flexible steel conduit, armored cords and cables, large wires and cables, as well as miscellaneous metal work, certain insulating materials and, in the absence of ordinary wood saws, even wood.

Manufacturers:

Aldon Co., The, 3338 Ravenswood Ave., Chicago, Ill. "Aldon."
American Saw & Mfg. Co., Springfield, Mass. "Lenox."
Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind. "Atkins' Silver Steel."
Century Tool & Metal Co., 180 N. Market St., Chicago, Ill. "Century."
Clark, Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Napier Saw Works, Inc., Roland St., Springfield, Mass. "Quality", "Expert."
Simonds Mfg. Co., 470 Main St., Fitchburg, Mass.
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
Spartan Saw Works, 41 Taylor St., Springfield, Mass. "Spartan."
Starrett Co., The L. S., Athol, Mass.

HACKSAWS, MOTOR-DRIVEN.—These machines are used to cut heavy metal bars, rods, pipes and tubing. The saw is mounted in a weighted arm that rests on the material to be cut, which is held in a vise on the bed of the machine. The saw is driven with a reciprocating motion by a crank and eccentric directly connected or geared to the motor shaft. Cutting oils or other fluids are generally used and a pumping device which feeds the fluid continuously is usually included in the machine.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind. "Atkins' Silver Steel." "Kwik-Kut."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Myers Machine Tool Corp., Columbia, Pa. "Myers."
Napier Saw Works, Inc., Roland St., Springfield, Mass. "Quality", "Expert."
North Wales Machine Co., Inc., Elm Ave. Center St., North Wales, Pa. "North Wales."
Oliver Instrument Co., Adrian, Mich.
Ryerson & Son, Joseph T., 16th & Rockwell St., Chicago, Ill.

HADFIELD-PENFIELD STEEL CO., THE.—Bucyrus, Ohio. Manufacturer of clay working machinery, fuel oil engines, bakery machinery, etc. President and general manager, R. C. Penfield; vice-president, L. W. Penfield; secretary, R. O. Perrott. Main office and factory, Bucyrus, Ohio. Branch offices, 1619 Conway Bldg., Chicago, Ill.; Grand Central Palace, New York, N. Y.; 516 Liberty Bldg., Philadelphia, Pa.; 404 Hippodrome Bldg., Cleveland, Ohio.

HAGAN CORP., THE.—Pittsburgh, Pa. Manufacturer of combustion, steam pressure and temperature regulators, high temperature cement, etc. President, J. M. Hopwood; secretary, Harry Easton; treasurer, H. G. Hammer. Main office, 491 Peoples Bank Bldg., Pittsburgh, Pa. Factory, Orrville, Ohio. Branch offices, 108-110 W. 34th St., New York, N. Y.; 728 Monadnock Block, Chicago, Ill; 300 Bailey Bldg., Philadelphia, Pa.; 79 Milk St., Boston, Mass.; Murphy Bldg., Detroit, Mich.; 517 National City Bldg., Cleveland, Ohio.

HAGSTOZ & SON, T. B.—709 Sansom St., Philadelphia, Pa. Producers of electrolysis and electroplating anodes.

HAGSTROM.—Trade name for cord adjuster manufactured by the Nygren Bros. Mfg. Co., Lindsborg, Kans.

HAGSTROM MFG. CO.—Lindsborg, Kans. Manufacturer of carbon and porcelain tube cutters. Business established 1904. President and secretary, Charles Lander; general manager, Carl Lander.

HAINERT & SON, F. H.—Minneapolis, Minn. Manufacturers of electric heating devices.

HAIR CURLING IRONS OR CURLERS, AND CURLING IRON HEATERS.—See Curling irons, electric; Heaters, electric, curling iron.

HAIR CUTTERS.—See Cutters, hair, motor-driven.

HAIR DRIERS.—See Driers, hair, electric.

HAIR WAVERS.—See Wavers, hair, electric.

HALE.—Trade name for motor-driven air compressors, pumps, oiling devices, etc., manufactured by the Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio.

HALE & KILBURN CORP.—Philadelphia, Pa. Manufacturer of passenger car seats and metal stampings. President, John B. Kilburn; vice-president, R. E. Benner.

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Main office, 1800 Lehigh Ave., Philadelphia, Pa. Branch offices, Hudson Terminal Bldg., New York, N. Y.; McCormick Bldg., Chicago, Ill.; Munsey Bldg., Washington, D. C.

HALE ELECTRIC & ENGINEERING CO.—1114 Guardian Bldg., Cleveland, Ohio. Manufacturer of motor-driven air compressors, oiling devices, pumps, etc. Business established 1912. Acting president, Willis W. Hale; 2nd vice-president, N. G. Gray; secretary and treasurer, E. E. Costley; general manager, Willis W. Hale.

HALE ELECTRIC MFG. CO.—1114 Guardian Bldg., Cleveland, Ohio. Manufacturer of electric radiators.

HALELECTRIC.—Trade name for electric radiators manufactured by the Hale Electric Mfg. Co., Guardian Bldg., Cleveland, Ohio.

HALJA.—Trade name for plug fuses made by the Bussmann Mfg. Co., 3819 N. 23rd St., St. Louis, Mo.

HALL, A. W.—633 Plymouth Ct., Chicago, Ill. Manufacturer of motor-driven printing machinery. Business established 1908. Sole owner, A. W. Hall.

HALL EFFECT.—A phenomenon, first observed and described by E. H. Hall in 1879, in relation to the electron theory. If a thin metal plate has a current flowing in it, say, from left to right there is an electron flow in the plate from right to left. If a line be drawn on the plate at right angles to the direction of the current flow and the extremities of the line be joined by a circuit including a galvanometer no current will be noted in the circuit. If, however, the plate be placed in a uniform magnetic field at right angles to it, a current will flow through the branch circuit. This is the "Hall effect" and is explained by the bending of the paths of the electrons by the magnetic field which drives them through the branch circuit. According to this theory the Hall effect should have the same sign for all metals, i. e., the current in the branch circuit should flow in the same direct with all metals. This is not the case, however, the difference probably being due to the more complicated structures of some metals.

HALL KITCHEN KING CO.—909 Mutual Life Bldg., Philadelphia, Pa. Manufacturer of electric labor-saving devices for hotels and restaurants. Business established 1912. President and general manager, Orville Reed: vice-president, J. Osborne Hopwood: secretary and treasurer, Orville Reed.

HALL PROCESS.—The process by which aluminum is commercially produced. The metal is deposited electrolytically from a solution of pure alumina (Al_2O_3) (15-20%) in molten cryolite (Na_3AlF_6). The alumina is obtained by purifying bauxite. The cell consists of a soft steel box or pot lined with carbon, the carbon lining acting as cathode. The anodes are a series of carbon rods dipping into the electrolyte and extending to within about an inch of the bath of molten aluminum which collects on the bottom of the cell. The metal is tapped off from time to time. Fresh alumina is stirred in at intervals to keep up the concentration in the bath as aluminum is deposited out. The cryolite is not attacked or decomposed to any extent. The oxygen liberated at the anodes attacks these with formation of CO, which burns to CO_2 at the top of the cell, the electrode consumption being an important item in the cost of the process. The temperature is kept just above the melting point of the bath, at from 900° to 950° C. A cell absorbs about 7 volts.

HALL SWITCH & SIGNAL CO.—Garwood, N. J. Manufacturer of motors, signaling, train dispatching and selective calling systems, boxes for electrical purposes, castings, etc. Business established 1868. President, Myron J. Brown; vice-presidents, William P. Hall, W. J. Gillingham; secretary, Edward P. Goetz; treasurer and general manager, H. W. Wolff. Main office and factory, Garwood, N. J. Branch office, Peoples Gas Bldg., Chicago, Ill.

HALL-THOMPSON CO., THE.—Hartford, Conn. Manufacturer of fire extinguishers, soldering paste, etc.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

HALLBERG, J. H.—25 W. 45th St., New York, N. Y. Manufacturer of stage-lighting equipment. Proprietor, J. H. Hallberg.

HALLETT IRON WORKS.—Harvey, Ill Manufacturer of telegraph and telephone construction tools and materials. Business established 1895. President, T. E. Hallett: secretary, J. A. Hallett; treasurer, S. V. Hallett.

HALLIWELL & CO.—62 E. 12th St., New York, N. Y. Manufacturers of electric hair driers and violet-ray high-frequency apparatus. Business established 1881. Richard H. Brown, sole owner. Factory, East Rutherford, N. J.

HALOWAX.—Trade name for synthetic wax and oils for electrical purposes manufactured by the Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.

HALSTEAD WIRE CO., INC.—132 Front St., Rome, N. Y. Manufacturer of lamp, fuse and other wires. Business established 1919. President, H. T. Dyett; vice-president, C. R. Keeney; secretary, treasurer and general manager, J. P. Halstead.

HALVERSON CO., THE.—Portland, Ore. Manufacturer of electric sterilizers. President, G. Deekum; vice-president, Mrs. A. A. Dekum; secretary and treasurer, A. A. Deekum. Main office and factory, Union Ave., at E. Oak St., Portland, Ore. Branch office, 180 N. Dearborn St., Chicago, Ill.

HAMBLIN & RUSSELL MFG. CO.—Worcester, Mass. Manufacturer of hardware specialties and standard wire goods. President, W. T. Russell; treasurer, F. H. Hamblin.

HAMILTON.—Trade name for steam engines manufactured by the Hooven, Owens, Rentschler Co., Hamilton, Ohio.

HAMILTON & HANSELL, INC.—Park Row Bldg., New York, N. Y. Manufacturer of electric furnaces. Business established 1904. President, N. V. Hansell; vice-president, H. A. De Fries; secretary and treasurer, J. Herlenius.

HAMILTON-BEACH MFG. CO.—1301-39 Rapids Drive, Racine, Wis. Manufacturer of electric motors, fans, and labor-saving devices. President and general manager, F. J. Osius; vice-president, M. D. Osius: secretary and treasurer, A. J. Druse; sales manager, E. Q. Bangs. Factories, Racine, Wis.; Waterbury, Conn.

HAMILTON ENGINE PACKING CO.—54-56 Alanson St., Hamilton, Ont., Can. Manufacturer of boiler and pipe coverings, cotton waste, belting, etc.

HAMILTON-LOW CO.—62-66 Van Winkle Ave., Jersey City, N. J. Manufacturer of motor-driven dishwashers. Business established 1890. President and general manager, P. H. Davis; secretary, H. E. Almberg; treasurer, M. A. Conyers.

HAMLER BOILER & TANK CO.—Chicago, Ill. Manufacturer of steel tanks, smoke stacks, etc. President and treasurer, E. H. Kyler; vice-president, George Childs; manager, L. P. Kornfeld. Main office and factory, 39th & Halsted Sts., Chicago, Ill. Branch offices, 1516 Ford Bldg., Detroit, Mich.; 26 Cortlandt St., New York, N. Y.; Federal Reserve Bank Bldg., St. Louis, Mo.

HAMMER DRILLS.—See Drills, hammer and spring, brick and stone.

HAMMERS, MOTOR-DRIVEN.—Portable hammers operated by a motor and striking from 15 to 30 blows per minute. Used for cutting channels or other openings in brick, stone and concrete, for scaling rust and paint from iron work, for making holes in masonry and concrete walls and ceilings where expansion bolts are to be installed, etc. Electric hammers have also been adapted for riveting, but are not yet extensively employed for this purpose.

Manufacturers:

Champion Blower & Forge Co., The, Lancaster, Pa. "Hercules."
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. (Chipping) "Boyer," "Boyer-Keller."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass. "Flexishaft."
Electric Hammer Co., Louisville, Ky.
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.
High Speed Hammer Co., Inc., The, 313 Norton St., Rochester, N. Y.
Little Giant Co., Mankato, Minn. ("Little Giant" large power type)
Nazel Engineering & Machine Works, 4041 N. 5th St., Philadelphia, Pa.
Titan Automatic Tool Co., 25 W. Broadway, New York, N. Y.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

HAMMERS, SPRING.—See Drills, hammer and spring, brick and stone.

HAMMOND.—Trade name for feed water meters manufactured by the Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.

HAMMOND.—Trade name for physicians' electric vibrator manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

HAMMOND STEEL CO., INC., THE.—260 Milton Ave., Syracuse, N. Y. Manufacturer of electric furnace, electric tool and alloy steels. Business established 1912. President, Frederick B. Scott; 1st vice-president and general manager, Clyde E. Dickey; 2nd vice-president and sales manager, Alexander MacInnes; secretary, Stewart F. Hancock; treasurer, Percy Ridings. Factory, Solvay, N. Y.

HAMR-HANDL.—Trade name for screw drivers made by the Crescent Tool Co., Jamestown, N. Y.

HANCOCK INSPIRATOR CO.—New York, N. Y. Manufacturer of injectors and ejectors. Main office, 119 W. 40th St., New York, N. Y. Branch office, 27 N. Jefferson St., Chicago, Ill.

HAN-D.—Trade name for automobile wrenches manufactured by E. Edelmann & Co., 2633-56 N. Crawford Ave., Chicago, Ill.

HAND LAMPS.—See Lamps, hand, inspection, extension or trouble.

HAND DRIERS.—See Driers, hand and face, electric.

H. & E.—Trade name for jacks manufactured by the Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.

HANDEL CO., THE.—Meriden, Conn. Manufacturer of electric portable lamps and lighting fixtures. President and treasurer, F. H. Turner; secretary, W. F. Hirschfeld. Main office, 381 E. Main St., Meriden, Conn. Salesroom, 200 5th Ave., New York, N. Y.

H & H.—Trade name for switches and receptacles manufactured by the Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

HANDHOLE, BOILER.—A small opening, called a handhole, is made in the outer firebox or shell of a steam boiler, and closed with a small elliptical door which is held in position by a dog and bolt. The hole is just large enough to admit the hand and arm for inspection purposes. They are also placed in mud drums, headers, etc., which are too small to admit the body, but which must be cleaned and inspected. They are generally about 4×6 ins. or 6×8 ins. in size.

HANDHOLES.—Where lateral connections are taken from an underground conduit system for service to buildings a shallow form of hole is sometimes sufficient. Such holes, which are only large enough for a man to stand partly within them, are known as handholes. Such holes are used also in conduit runs on viaducts where full depth is not available.

HANDLAN-BUCK MFG. CO.—212 N. Third St., St. Louis, Mo. Manufacturer of rail benders, rail joint and tie plates and track tie spikes. Business established 1864. President, A. H. Handlan; vice-presidents, E. W. Handlan, A. H. Handlan, Jr.; secretary, E. R. Handlan; treasurer, E. W. Handlan; general manager, A. H. Handlan, Jr. Sales representatives, Fleming & Cardozo, Inc., Richmond, Va.; Herbert G. Cook, San Francisco, Cal.; H. S. LaBarge, 343 S. Dearborn St., Chicago, Ill.; E. W. Leland, New Orleans, La.; R. M. Wiggin, Dallas, Tex.

HANDLES, BATTERY BOX AND TRAY.—To facilitate the handling of storage-battery boxes the boxes are provided with very strong handles. They are usually made of cast or malleable iron and well coated with an acid-resisting enamel or paint. Where the space on the automobile for the battery box is very crowded the handles may be hinged and recessed into the sides of the box to avoid projecting, or they may be rigid and project over the upper edge of the box. For storage-battery trays the handles are quite similar but of heavier cross-section if the tray is to hold more than five large electric vehicle type storage cells.

Manufacturer:

BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J. "Batoco."

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HANDLES, CONTROLLER. — See Controller, handles.

HANDLES, FLATIRON AND PRESSING IRON.—These are most frequently made of wood or other ebonized material and so placed as to assist in manipulating the iron and not expose the operator's hand to undue heat. In some types the control switch for the iron is mounted on one end of the handle.

Manufacturers:

American Enamel Co., Neville St., Providence, R. I.
Estes & Son, E. B., 362-364 5th Ave., New York, N. Y.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Novelty Turning Co., 34 Main St., Norway, Me.
Piqua Handle & Mfg. Co., The, Piqua, Ohio.
Stephenson Mfg. Co., South Bend, Ind.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HANDLES, HAND LAMP.—These handles are simple turnings usually made of wood, fiber or insulating composition. They are drilled axially through the center or drilled a short distance at the socket end and have an open slot to the hole to allow the entrance of the connecting cord to the socket. The end where the cord enters is smoothly rounded or bushed; the socket end is provided with a ferrule for fastening the guard and usually a nipple fitting to which the lamp socket is attached. For the complete unit see Lamps, hand, inspection, extension or trouble.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
McGill Mfg. Co., Valparaiso, Ind. "Crescent."
Stephenson Mfg. Co., South Bend, Ind.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

HANDLES, INSULATED TOOL.—Electricians' tools for working on live circuits are generally provided with insulated handles to prevent the danger to the workman when he is working around electrical machinery or circuits carrying voltages above those used for telephones, ordinary bells, buzzers, and similar signaling devices. The handle itself may be of insulating material, such as fiber, rubber, or molded composition, or the handle may be a fair insulator, such as wood, and then entirely covered with rubber or an insulating compound. For common tools furnished complete with insulated handles see Pliers, insulated; Screw drivers, insulated.

Manufacturers:

American Enamel Co., Neville St., Providence, R. I.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

HANDLES, MISCELLANEOUS.—This classification includes the many special handles used on electrical appliances, utensils, instruments and other equipment. Such handles include fiber and ebonized wood handles used on electric household table appliances; electric hand appliances, such as soldering irons, curling irons, vibrators; portable vacuum cleaners, drills, grinders, reamers, etc.; electrical instruments and portable meters; miscellaneous tools, etc. Many materials are used for such handles and they are of numerous shapes and sizes to suit the device on which they are used.

Manufacturers:

Buck Bros., Millbury, Mass.
Cassidy-Fairbank Mfg. Co., 6126 S. La Salle St., Chicago, Ill.
Columbus Handle & Tool Co., The, Columbus, Ind.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Novelty Turning Co., 34 Main St., Norway, Me. (For electrical appliances.)
Osgood Tool Co., J. L., 45 Pearl St., Buffalo, N. Y. "Indestructible."
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display advertisement on page 1253.)
Peterson Co., F. W., 18 Greene St., New York, N. Y.
Piqua Handle & Mfg. Co., The, Piqua, Ohio.
Schutz Bros., Inc., 152 Chambers St., New York, N. Y.

HANDLES, SWITCH AND CIRCUIT BREAKER.—Handles used on these devices are made of carefully kiln-dried and treated hard wood, of hard rubber, fiber or molded insulating material. They are made in a wide variety of forms and sizes suitable to the various types of switches and circuit breakers and, if of wood, are usually given an enamel finish to improve their appearance. For small rotary snap switches the handles resemble socket keys; for these see Keys, socket and snap switch.

Manufacturers:

American Enamel Co., Neville St., Providence, R. I.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. (With ratchet locks)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
GARFIELD MFG. CO., Garfield, N. J.
General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.
Novelty Turning Co., 34 Main St., Norway, Me.
Rowe Mfg. Co., Henry, Newaygo, Mich.
Stephenson Mfg. Co., South Bend, Ind.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilmington Fibre Specialty Co., Wilmington, Del.

H & S.—Trade name for high-tension switching and protective line maintenance and construction equipment manufactured by Hickey & Schneider, Inc., 439-43 E. Jersey St., Elizabeth, N. J.

H & W.—Trade name for electric car heaters manufactured by Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill.

H & W.—Trade name for electric car heaters manufactured by the National Railway Appliance Co., 50 E. 42nd St., New York, N. Y.

HANDY. — Trade name for armature winder manufactured by the Armature Coil Equipment Co., 3202 Scranton Rd., Cleveland, Ohio.

HANDY.—Trade name for automotive lighting equipment manufactured by the Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill.

HANDY.—Trade name for automobile horn push button manufactured by the Handy Products Co., Erie Bldg., Cleveland, Ohio.

HANDY.—Trade name for commutator stones manufactured by the Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

HANDY.—Trade name for cord adjusters manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

HANDY.—Trade name for voltammeter manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

HANDY.—Trade name for electric cigar lighters manufactured by the Spielman Electric Co., 1931 Broadway, New York, N. Y.

HANDY & HARMAN.—59 Cedar St., New York, N. Y. Manufacturers of silver wire, anodes, contact and sparking points, platinum sheet and wire, etc. Business established 1867. President, Parker D. Handy; vice-president and general manager, Harry H. DeLoss; secretary, Cortlandt W. Handy; treasurer, J. L. Brush; sales manager, G. H. Niemeyer. Branch office, 31 Gold St., New York, N. Y.

HANDY PRODUCTS CO.—Erie Bldg., Cleveland, Ohio. Manufacturer of automobile horn push buttons and other motor car accessories.

HANDYFLUX.—Trade name for soldering paste manufactured by the Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

HANDYLAC.—Trade name for insulating varnish manufactured by the Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

HANDYVAR.—Trade name for insulating varnish manufactured by the Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

HANGER IRONS, TRANSFORMER.—Pieces of iron bar used in mounting transformers on poles. The tops are bent over so as to hang on and fit around the crossarm and holes are provided at the proper points, for bolting to the crossarm and on to the transformer.

HANGERS, ARC LAMP.—These devices combine a means for hanging or supporting an arc lamp with a pulley to permit lowering it for trimming and cleaning so as to obviate climbing up poles, posts or ladders. The upper part is usually a clamp of suitable type to secure to a mastarm, cross-span cable, bracket, pipe support or ceiling. To this is attached a pulley housing with guide for the lowering rope or chain. In nearly all cases there is also included a cutout auxiliary to the pulley. In the case of series circuits this cutout closes the circuit when the lamp is lowered; in multiple circuits it merely disconnects the lamp electrically; in all cases it makes the lamp safe to handle since it is entirely cut out of the circuit. Cutout hangers have the circuit wires ending at the cutout contacts in the pulley housing and when the lamp is lowered there are no dangling wires lowered with it. Cutout hangers are necessary on high-voltage series circuits. When the rope is pulled up the lamp is automatically reconnected into the circuit and supported by the housing independently of the hoisting rope. For cutout hangers especially suited for incandescent lamps see Hangers, incandescent lamp. For pulleys without the cutout feature see Pulleys, lamp lowering. Also see Cutouts, arc lamp.

Manufacturers:

Fletcher Mfg. Co., 302 E. 2nd St., Dayton, Ohio.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B Form 2 insulated arc lamp hanger has several new and desirable features. Insulated by high tension porcelain.—Adv.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Thompson Electric Co., The, 226 St. Clair Ave., N. E., Cleveland, Ohio. "Thompson."
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HANGERS, BOX.—These metal fittings are used to mount switch and outlet boxes in various classes of work. One device which consists of a perforated metal bar that is nailed across the joists, replaces the ordinary 2×4-in. block used in mounting boxes; another type is for securing outlet boxes in fire-resistive buildings where concrete floors are used; the supporting bar being imbedded in the concrete; both types not only may serve for mounting the box, but also for supporting a fixture stud, the fixture fitting being mounted in the bar. Another type, adapted for work in plastered walls and ceilings consists of two wings fastened to a nipple; the wings when folded are passed through the hole in the ceiling and then opened and locked by a key through the center of the nipple. A locknut on the nipple holds the box against the ceiling or wall.

Manufacturers:

Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Godfrey."
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Knauber's."
E. & B. Mfg. Co., The, 965 Woodward Ave., Detroit, Mich. "E. & B." (Switch box).
Economy Electric Specialty Co., 6937 S. Halsted St., Chicago, Ill. "Economy."
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Kruse Electric Co., Ft. Wayne, Ind.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."

HANGERS, CABLE AND MESSENGER.—Cable hangers are devices for attaching overhead cable to messenger strand or wire. One of the older forms which is still widely used consists of a steel wire hook to hang over the messenger and a loop of marlin cord to fasten to the cable. Other forms have a steel hook with various types of metal clips for fastening to the cable. On high-voltage cables, a split porcelain bushing or insulator sometimes forms part of the clamp that grips the cable, although with lead-covered cable it is usually desirable to have the sheath grounded, in which case the metal clip serves as a ground clamp. Those cable hangers that consist only of a clip or ring are listed separately. Messenger hangers are the de-

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vices by means of which the messenger strand is secured. They usually consist of a clamp, which is tightened by means of a bolt and secured to the pole or crossarm. (Also see Clips, cable, and Rings, cable.)

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Cameron Appliance Co., 48 Waters Ave., Everett, Mass. "Locke," "Cameron," "Yonkers," "Metropolitan."

Chase-Shawmut Co., The, Newburyport, Mass. "Boston."

Eureka Supply Co., Sewell, N. J.

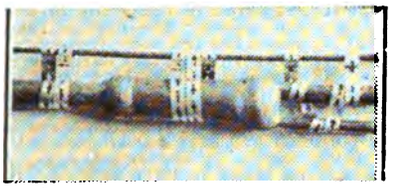
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.

Lanz & Sons, Mathew, Pittsburgh, Pa.

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.

NATIONAL PIPE & CABLE HANGER CO., 137 E. 43 St., New York, N. Y. The "National" is a real hanger and



"National" Cable Hanger

the most practical for hanging taps and splices. Put up in compact rolls with keys. Size ¾ in. by .025 in. For further description see "Hangers, Conduit and Pipe."—Adv.

OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."

Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.

Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Davidson."

Slater & Barnard, Ltd., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Nordyke."

Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."

HANGERS, CABLE, MANHOLE TYPE.—Cable hangers are much used in manholes for supporting cables from the sides of the manhole. There are several forms of such hangers, but nearly all are made to support one, two or three cables on a single hanger. They are sometimes adjustable in a vertical and horizontal plane, thus permitting the cable to be hung in place regardless of the angle of approach. This type requires an upright or support which is fastened by expansion bolts at top and bottom. Another form consists of a cast-iron interlocking hanger that requires only one bolt to fasten it to the wall at the top and each of the successive hangers are suspended from the one above. The hanger takes the form of a supporting shelf or bracket turned up at the end, and the cables may be laid in place on the hanger or supported on insulators provided for the purpose.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

HANGERS, CONDUIT AND PIPE.—Metal fittings for hanging conduit or pipe from ceilings or along walls. They are made in many forms and in the various sizes to fit trade sizes of pipe. Probably the simplest form is a pipe-enclosing ring with screw extension that can be screwed into wood ceiling beams, wood columns or wall boards. For mounting on trusses, I-beams and other steelwork, special hangers are made that in some cases consist of steel straps which can be bent over trussed beams and anchored without drilling a hole in the steelwork. In other hangers a double clamp is used around the conduit and this is bolted to the beam through a hole drilled for the purpose. For heavy conduit or power-house piping the hangers are made of heavy strap iron, sometimes adjustable, with means for bolting or clamping to ceiling beams, etc. Heavy piping along walls is usually supported by brackets. (Also see Brackets, steam and other pipe supporting; Clamps, beam.)

Manufacturers:

Acme Pipe Strap Co., 944-50 Harper Ave., Detroit, Mich.

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill. "Economy."

Beaton & Cadwell Mfg. Co., New Britain, Conn.

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Chicago Expansion Bolt Co., 324 W. Washington St., Chicago, Ill.

Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."

Fee & Mason, 81 Beekman St., New York, N. Y. "A. B. C."

Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."

Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

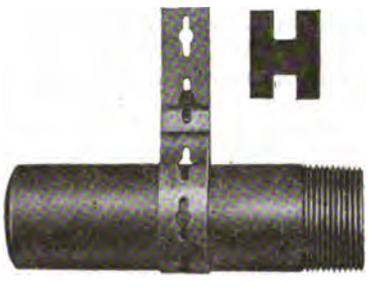
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.

ISERT CO., JOHN H., Louisville, Ky. Manufacturer of Isert hanger irons, perforated extension bars furnished in 10-ft. lengths. Holes ¾ inch on centers.—Adv.

Lovell & Co., F. H., Arlington, N. J.

MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display advertisement on page 1310.)

NATIONAL PIPE & CABLE HANGER CO., 137 E. 43 St., New York, N. Y. The "National" hanger is made from special, tempered, soft metal of wonderous strength, yet easily twisted or bent by hand. The only strap hanger handling pipe of assorted sizes. No tools needed in installing. Combines strength, endurance and neat appearance. Put up in compact rolls with keys.—Adv.



"National" Conduit Hanger

Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Oval-duct."

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. The adjustable hangers illustrated will fit any flange



from 2¾ ins. to 12 ins. Adjustable to varying plaster lines and will support any number of conduits from one to eight, which may run at any angle with the beam or far enough below the beam to permit a second line of conduits to be run above. Additional runs can be made without interfering with lines already in position. Not necessary to loosen clamp to meet any condition that may arise. Made of stamped steel.



"Close" pipe supports will hold the pipe or conduit close to wall or ceiling. Not necessary to offset conduit to enter knockout box. Three sizes: ½ in. for ½ in. pipe; ¾ in. for ¾ in. pipe; 1 in. for 1 in. pipe.—Adv.

U. S. Expansion Bolt Co., 139 Franklin St., New York, N. Y. "USE."

HANGERS, CORD.—Cord hangers are used for suspending a cord from some point other than the outlet box or receptacle. They usually consist of a clamp or hook which may be fastened to the conduit or ceiling. The device usually is arranged to insulate the cord from the support by use of porcelain bushings or spool insulators.

Manufacturers:

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

HANGERS, FIXTURE.—A term applied to certain devices and fittings for supporting lighting fixtures. They usually consist of a nipple fitting which fastens to the fixture stem and a clamping or fastening device for holding the nipple fitting to the supporting surface, outlet plate or box. By some manufacturers this or a similar fitting is called a dupod, tripod or crowfoot, depending on the number of feet it has for fastening to the outlet fitting. In some cases the fixture hickey is called a fixture hanger.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.

Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Godfrey."

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Adjustable and non-adjustable fixture hangers for many types of fixtures.—Adv.

Butler Electric Co., 3531 Cottage Grove Ave., Chicago, Ill. "Beco," "Cisco."

Economy Electric Specialty Co., 6937 S. Halsted St., Chicago, Ill. "Economy."

Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

Empire Engineering & Supply Co., 1 Dominick St., New York, N. Y.

Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa. "Tripod."

INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

Paine Co., The, 1742 W. Van Buren St., Chicago, Ill.

Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.

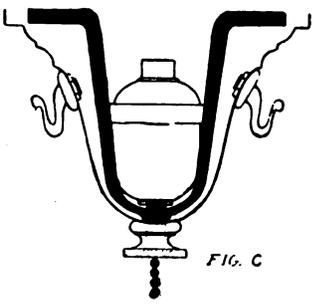
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

Polly Mfg. Co., Milwaukee, Wis.

Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."

UNIVERSAL MFG. CO., 2633 Randolph Street, Lincoln, Nebraska. Universal Bipod, a combination concealed switch holder and fixture hanger. Used on any



"Universal Bipod"

outlet with a 4¼ in. or deeper canopy. Write for folder showing various uses and advantages.—Adv.

WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio. "Red Spot."

White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y. "Clampall," "Jiffy," "Whitalks."

HANGERS, INCANDESCENT LAMP.—When incandescent lamps are rigidly mounted very high on streets or in trainsheds, erecting shops, rolling mills, etc., they are very difficult to reach and therefore not likely to be properly maintained. They do not need as much attention as arc lamps, but must not be neglected. Under even ordinary conditions dust and dirt collect very rapidly and greatly cut down the lighting efficiency; lamps are often found to give only 50% of the initial light if cleaning has been long neglected. To facilitate cleaning and lamp renewal, lamp hangers are made that permit the lamp to be easily lowered to the ground or floor. A suspension and a pulley are always included. In automatic-cutout hangers there is also a

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latching device and switch that automatically disconnects the lamp from the circuit when it is lowered and reconnects it again when pulled up to service position. They resemble arc-lamp automatic-cutout hangers, but are usually made for multiple circuits only.

Manufacturers:

Fletcher Mfg. Co., 302 E. 2nd St., Dayton, Ohio.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Thompson Electric Co., The, 226 St. Clair Ave., N. E., Cleveland, Ohio. "Thompson."

HANGERS, MISCELLANEOUS.—This classification is intended to include all such hangers for special purposes which are not separately listed elsewhere; for example. such hangers as are especially adapted to hanging transformer primary fuses or cutouts, pole-top switches, horn-gap arresters, choke coils, potheads, disconnecting switches, etc., to pole crossarms, poles or other supports.

Manufacturers:

Manufacturers' & Inventors' Electric Co., 29 Gold St., New York, N. Y. "Mandigrip."

HANGERS, SHAFTING.—These are supporting frames used to hang a shaft to a ceiling. They consist of an inverted A-shaped casting, the bearings for the shafting being fastened at the apex of the frame, the legs being bolted to the supporting surface. The bearings are usually two-piece and adjustable, to provide for proper alinement of the shaft. A metal cup is generally fastened to the under side of the bearings to catch oil dripping from the bearing. Although individual electric motor drive has to a large extent eliminated the need for shafting, group drive of a set of machines by means of a motor through shafting and belting is still employed in many plants, which necessitates use of suitable hangers for the shafting.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa.
Bond Foundry & Machine Co., Manheim, Lancaster Co, Pa. "Lytestrong."
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Brown Clutch Co., The, Sandusky, Ohio.
Brown Co., The A. & F., 79 Barclay St., New York, N. Y.
Challenge Co., Batavia, Ill. "Fitzgerald."
Dow, Inc., L. B., Keene, N. H.
Elmira Machinery & Transmission Co., Ltd., Elmira, Ont., Can.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National."
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y. "Howard."
Perkins & Son, Inc., B. F., 2 Crescent St., Holyoke, Mass.
Privibil Machine Co., P., 512-514 W. 41st St., New York, N. Y.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

HANGERS, TROLLEY WIRE.—A device used for supporting the trolley wire; it may be insulated or uninsulated. The common insulated form consists of a malleable iron shell casting into which a threaded stud is molded, the stud being insulated from the hanger shell. The stud in turn supports the trolley ear and the malleable shell casting is arranged in different forms for various types of support as, for instance, with outriggers for hooking on span wires; with slotted lugs or eye for attaching to mine timbers, bridges, barn structures, etc.; with bosses for attaching to expansion bolts; a form particularly adapted to mine use. For catenary construction see Catenary hangers.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio. "Black Diamond."
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B insulated hangers, for mines and electric railways, and O-B catenary hangers. Insulated lock hanger for railways, eliminates loose ear fit. A complete line of hangers, mechanical clamps and clinch ears.—Adv.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa (See display, adv. pages 1395-1402.)

HANGSTRATE.—Trade name for fixture hickeys manufactured by the Peerless Light Co., 663-671 W. Washington Blvd., Chicago, Ill.

HANNA.—Trade name for motor-driven foundry equipment manufactured by the Vulcan Engineering Sales Co., 1765 Elston Ave., Chicago, Ill.

HANOVIA CHEMICAL & MFG. CO.—Chestnut & New Jersey Railroad Ave., Newark, N. J. Manufacturer of electro-therapeutic apparatus, mercury vapor lamps, pyrometers, thermometers, etc.

HANSEN MFG. CO.—Princeton, Ind. Manufacturer of electric program clocks. Business established 1906. President, J. W. Hansen; vice-president, W. L. Hansen. Sales representatives, A. Flanagan Co., 521 S. Lafin St., Chicago, Ill.; Beckley-Cardy Co., 17 E. 23rd St., Chicago, Ill.; E. W. A. Rowles Co., 2345 S. LaSalle St., Chicago, Ill.; E. M. Welch Mfg. Co., Chicago, Ill.; Omaha School Supply Co., Omaha, Neb.

HANSEN MFG. CO., O. C.—Milwaukee, Wis. Manufacturer of linemen's gloves. Business established 1880. President and general manager, Walter Gerhardy; vice-president and treasurer, W. C. Bliedung; secretary, E. L. Unke; sales managers, Martin Selle, J. S. Thatcher.

HANSON & VAN WINKLE.—Newark, N. J. Manufacturers of generators and electroplating equipment.

HANSON CLUTCH & MACHINERY CO., THE.—Tiffin, Ohio. Manufacturer of clutches, pulleys, hangers and other power transmission equipment. Secretary and treasurer, M. B. Hanson.

HAPPY DAY.—Trade name for electric washing machines manufactured by the National Sewing Machine Co., Belvidere, Ill.

HAPPY HOME.—Trade name for electric dishwashers manufactured by the Happy Home Industries, Madison Bldg., Detroit, Mich.

HAPPY HOME INDUSTRIES.—Madison Bldg., Detroit, Mich. Manufacturer of motor-driven dishwashers.

HARBISON-WALKER REFRACTORIES CO.—Farmers Bank Bldg., Pittsburgh, Pa. Manufacturer of fire brick for electric boilers and other furnaces. Sales manager, J. J. Brooks, Jr.

HARCO.—Trade name for linemen's protective devices, gloves, etc., manufactured by F. A. Hardy & Co., 10 S. Wabash Ave., Chicago, Ill.

HARD-DRAWN COPPER WIRE.—Copper wire used for overhead transmission lines, trolley lines, etc., is required to have a greater mechanical strength and hardness than that used for interior wiring. This is obtained by the use of hard-drawn copper, which is hardened by being drawn three or four times without annealing and is not annealed after leaving the last die.

HARD FIBER.—See Fiber.

HARD FIBRE & INSULATION CORP.—96-104 Spring St., New York, N. Y. Manufacturer of fiber sheets, rods and tubing and insulating paper.

HARD RUBBER.—See Rubber, also Rubber (hard) rods, sheets, tubes, tubing, etc.

HARD SOLDER.—This is a solder which is composed of either zinc and copper or silver and copper. It fuses only at a red heat and is used in brazing processes, which see.

HARDENING FURNACES.—See Furnaces, electric, hardening.

HARDIE-TYNES MFG. CO.—Birmingham, Ala. Manufacturer of electric mine hoists, air compressors and steam engines.

HARDWARE, POLE LINE.—See Pole line hardware, miscellaneous.

HARDY & CO., F. A.—Chicago, Ill. Manufacturer of linemen's protective devices, first-aid equipment, etc. Business established 1884. President, John H. Hardin; vice-president, E. E. Swadener; secretary, E. S. Craven; treasurer, E. B. Morse; sales manager, C. A. Kingsbury. Main office, 10 S. Wabash Ave., Chicago, Ill. Branch offices, Atlanta, Ga.; San Francisco, Cal.; Dallas, Tex.; Denver, Colo.; St. Paul, Minn.

HARGRAVE.—Trade name for linemen's tools manufactured by the Cincinnati Tool Co., Norwood, Cincinnati, Ohio.

HARGREAVES-BIRD CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution, using cathodes of copper gauze, anodes of carbon or graphite, with a vertical asbestos diaphragm.

HARLEY CO., THE.—Page Blvd., Springfield, Mass. Manufacturer of metal castings and electric railway forgings. Business established 1907. President, H. Skinner; vice-president and general manager, Edwin Krause; assistant treasurer, H. Nichols; treasurer, F. J. Weschler; sales manager, H. B. Newton.

HARMONIC ANALYSIS.—Any irregular but periodic wave can be analyzed into a series of sine waves that may be regarded as components that are superposed upon each other to produce the original wave. These component sine waves are called harmonics and the process of ascertaining them is called harmonic analysis. It is frequently employed in the study of alternating-current waves. The first or fundamental harmonic has the same frequency as the original wave; the second harmonic has twice this frequency; the third has triple the frequency; the fourth quadruple, etc. If the two half waves of any cycle are not symmetrical about the axis, the wave will have both odd and even harmonics; if they are alike, which is the usual case, the wave will be found to have only odd harmonics. Also see Alternating wave form.

HARMONIC ANALYZER.—An instrument used in the harmonic analysis of an alternating current. It generally is capable of being tuned to any certain note or frequency. One form consists of an electromagnet with a steel ribbon armature which is attached to a metallic frame. The armature may be tuned to the proper tension by means of a thumb screw.

HARMONIC CURRENT OR ELECTROMOTIVE FORCE.—A current or electromotive force, the variations of which follow the law of harmonics or a sine curve. This variation gives a curve or wave which is similar to the path of a point on the rim of a wheel when rolled through one revolution on a flat plane. There may be several harmonic currents or electromotive forces constituting a complex alternating current or voltage wave.

HARMONIC MOTION.—Simple harmonic motion is the projection on a straight line of uniform circular motion. It is similar to the motion of a point in a vibrating string and approximately the same as the vibration of any sounding body, from which fact the name was derived.

HARMONICS.—The component sine waves which combined give the composite or actual wave are called harmonics. The first harmonic is commonly called the fundamental. The others are those whose frequencies are multiples of the fundamental frequency.

HARMONY.—Trade name for electric washing machines manufactured by the Clark, Cadle, Harmon Corp., 1139 University Ave., Rochester, N. Y.

HARPER ORIPHONE CO.—Boston Mass. Manufacturer of hearing devices for the deaf. Business established 1902 President and treasurer, C. W. Harper. Main office, 936 Old South Bldg., Boston, Mass. Branch office, 305 5th Ave., New York, N. Y.

HARPER SCREW WORKS, F. C.—29 S. Clinton St., Chicago, Ill. Manufacturer of nuts, screw and screw machine products. Sales manager, B. A. Dunning.

HARPOON.—Trade name for guy anchors manufactured by the Crouse-Hinds Co., Wolf & 7th Sts., Syracuse, N. Y.

HARPS, TROLLEY.—A U-shaped piece with stem usually cast of malleable iron, which carries the trolley wheel and its axle, and forms the means by which the trolley wheel is attached to the pole. It

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has sometimes been called the trolley fork.

Manufacturers:

Bayonet Trolley Harp Co., 404 Mitchell -Bldg., Springfield, Ohio. "Bayonet."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill.
Holland Trolley Supply Co., The, 1623 E. 43rd St., Cleveland, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Star Brass Works, The, Kalamazoo, Mich.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HARRIGAN, THOMAS M.—Woodstock Vt. Manufacturer of pull chain links.

HARRINGTON.—Trade name for mechanical stoker manufactured by the James A. Brady Foundry Co., 45th & Western Blvd., Chicago, Ill.

HARRIS & CO., ARTHUR.—212 Curtis St., Chicago, Ill. Manufacturers of feed water heaters and purifiers, copper sheets, tubing and castings. Business established 1884.

HARRIS OIL CO., A. W.—Providence R. I. Manufacturer of lubricating oils and greases. President, George F. Heywood; secretary, Francis X. Steffy; treasurer, Arthur D. Greene. Main office, 326 S. Water St., Providence, R. I. Branch office, 143 N. Wabash Ave., Chicago, Ill.

HARRISON.—Trade name for table and boudoir lamps manufactured by the Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y.

HARRISON FIXTURE WORKS.—59 Harrison St., Brooklyn, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1893. General manager, J. Baldinger. Sales representatives, Everts & Zurer, 200 5th Ave., New York, N. Y.; A. C. Riddle, Los Angeles, Cal.

HARSHAW, FULLER & GOODWIN CO.—Philadelphia, Pa. Manufacturer of battery and other chemicals. Main office, Philadelphia, Pa. Branch offices, Chicago, Ill.; New York, N. Y.; Cleveland, Ohio.

HART.—Trade name for switches manufactured by the Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

HART & CO.—124 N. Main St., Fostoria, Ohio. Manufacturers of carbon brushes and commutator lubricating compounds. Business established 1901. President, treasurer and general manager, J. S. Maurer; vice-president and sales manager, W. F. Maurer; secretary, N. N. Maurer.

HART & HEGEMAN MFG. CO.—Hartford, Conn. Manufacturer of switches, wiring devices, etc. Business established 1890. President, Shiras Morris; sales manager, H. L. Everest. Main office, 342 Capitol Ave., Hartford, Conn. Branch office, 623 W. Jackson Blvd., Chicago, Ill. Exclusive distributor for the H. T. Paiste Co., Philadelphia, Pa. Sales representatives, Albert Mann, 326 Congress St., Boston, Mass.; A. F. Wilson, 505 5th Ave., New York, N. Y.; C. H. Broward, Atlanta, Ga.; R. S. Wakefield, 222 Interurban Bldg., Dallas, Tex.; Garnett Young & Co., 612 Howard St., San Francisco, Cal.

HART MFG. CO.—Hartford, Conn. Manufacturer of switches. Main office, 230 Hamilton St., Hartford, Conn. Branch offices, New York, N. Y.; San Francisco, Cal.; Boston, Mass.; Chicago, Ill.; Detroit, Mich.; Denver, Colo.; Toronto, Ont., Can.

HART MFG. CO., R. A.—Battle Creek, Mich. Manufacturer of revolution counters. R. E. Hart, manager.

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HARTER MFG. CO.—522 S. Clinton St., Chicago, Ill. Manufacturer of lighting fixtures and units. Business established 1910. President and treasurer, G. A. Harter: vice-president, Ernest Saunders; secretary and general manager, E. Laymon; sales manager, D. E. Worrell. Sales representatives, Rumsey Electric Co., Philadelphia, Pa.; Bittman & Batte, San Francisco, Cal.

HARTFORD FAIENCE CO., THE.—Hamilton St., Hartford, Conn. Manufacturer of special electrical porcelain. Business established 1894. President, C. E. Whitney; secretary, treasurer and general manager, Fred L. Bishop.

HARTFORD MACHINE SCREW CO.—Hartford, Conn. Manufacturer of electric pumps, spark plugs, screws and screw machine products. Business established 1876. President, P. B. Gale; vice-presidents, J. F. Cooley, F. S. Thompson, H. E. Penfield; secretary, H. W. Beardsley; treasurer, J. J. Nolan; general manager, J. F. Cooley; sales manager, H. E. Penfield. Main office and factory, 476 Capitol Ave., Hartford, Conn. Branch offices, 870 Woodward Ave., Detroit, Mich.; 409 Broome St., New York, N. Y.; 320 Market St., San Francisco, Cal.; 618 E. Main St., Richmond, Va. Sales representatives, J. M. Jackson, 320 Market St., San Francisco, Cal.; Taylor Bros., 618 E. Main St., Richmond, Va.

HARTFORD TIME SWITCH CO.—71-73 Murray St., New York, N. Y. Factory, Hartford, Conn. Sole agent, A. Hall Berry, 71-73 Murray St., New York, N. Y.

HARTMAN ELECTRICAL MFG. CO. THE.—Mansfield, Ohio. Manufacturer of electrical controlling devices. President and treasurer, R. W. Hartman; vice-president and general manager, C. T. Anderson; secretary, F. O. Hartman.

HARTMAN-MALCOM CO.—847 N. Troy St., Chicago, Ill. Manufacturer of portable electric lamps. President and treasurer, J. M. Hanson; vice-president, J. A. Wilson; secretary, A. L. Hanson.

HARTUNG, CHARLES F.—802 Higgins Bldg., Los Angeles, Cal. Manufacturer of battery and testing clips.

HARVARD.—Trade name for lamp guard manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

HARWOOD.—Trade name for adjustable lighting fixtures manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

HARVARD ELECTRIC CO.—525 W. Van Buren St., Chicago, Ill. Manufacturer of lightning arresters, conduit fittings, wiring devices, metal castings, stampings, etc. Business established 1893. President and general manager, Fredric Greer. Sales representative, John J. Waldman, 136 Liberty St., New York, N. Y.

HASCO.—Trade name for poles, crossarms, brackets, pins, lamp bases and other wood specialties for electrical purposes manufactured by H. A. Stiles & Co., 97 Oliver St., Boston, Mass.

HASKINS CO., R. G.—27 S. Desplaines St., Chicago, Ill. Manufacturer of electric drills, bench and portable grinders, and other portable electric machinery. Business established 1912. President and sales manager, R. G. Haskins; vice-president and general manager, C. C. Kendrick; secretary and treasurer, E. M. Kenison. Sales representatives, R. Morley, 426 Broom St., New York, N. Y.; Manufacturers Sales Co., 2 Goebel St., Detroit, Mich.; Fred J. Naubauer, 362 Colonial Arcade, Cleveland, Ohio.

HASLETT SPIRAL CHUTE CO., THE.—Philadelphia, Pa. Manufacturer of power-driven conveyors. P. E. Lenfestey, general manager. Main office, 510 N. 61st St., Philadelphia, Pa. Branch offices, 228 Pine St., San Francisco, Cal.; 523 Calvert Bldg., Baltimore, Md.; 110 W. 34th St., New York, N. Y.

HASSE PROCESS.—An early process for the electrolytic refining of zinc, abandoned because the old-style distillation process was simpler and cheaper.

HASSELL IRON WORKS CO.—Colorado Springs, Colo. Manufacturer of oil engines. Business established 1890. President and general manager, W. W. Hassell; secretary and treasurer, C. B. Alling; sales manager, Reeve Burton.

HAT-BLOCKING OUTFITS.—These consist of a small motor with extended shaft upon which a wooden block used in shaping the hat is placed. With the hat in place the block is revolved rapidly and cloths, brushes and shaping irons are applied to the headgear. Motors of the fan motor type are used. The same or a similar outfit can also be used for cleaning straw or other hats (see Cleaners, hat, motor-driven).

HAT CLEANERS.—See Cleaners, hat, motor-driven.

HAT IRONS.—See Irons, electric, hat.

HATFIELD.—Trade name for motor-driven razor blade sharpeners manufactured by the Hyfield Mfg. Co., 21 Walker St., New York, N. Y.

HATFIELD ELECTRIC CO.—Indianapolis, Ind. Manufacturer of switchboards, panelboards and battery-charging panels. President and general manager, T. B. Hatfield; vice-president, David Lurvey; sales manager, T. F. Hatfield. Main office and factory, 102 S. Meridian St., Indianapolis, Ind. Branch office, 440 S. Dearborn St., Chicago, Ill.

HATHEWAY MFG. CO., THE.—Bostwick Ave., Bridgeport, Conn. Manufacturer of chains for pull sockets. Business established 1909. President, treasurer and general manager, W. E. Hatheway; vice-president, J. T. Hatheway; secretary, W. E. Thomson.

HAUCK MFG. CO.—Brooklyn, N. Y. Manufacturer of oil burning equipment. Business established 1900. Acting president, J. B. Moore; secretary, T. A. McCarthy; treasurer, A. H. Stein. Main office, 126 10th St., Brooklyn, N. Y. Branch offices, Baltimore, Md.; Buffalo, N. Y.; Boston, Mass.; Cleveland, Ohio; Milwaukee, Wis.; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; 537 S. Dearborn St., Chicago, Ill.

HAUER, INC., J. B.—96-100 Bayard St., Brooklyn, N. Y. Manufacturer of beam clamps and sheet steel cabinets for electrical purposes.

HAUGHTON ELEVATOR & MACHINE CO., THE.—Toledo, Ohio. Manufacturer of portable elevators. Business established 1865. President, I. N. Haughton; vice-president and treasurer, G. L. McKesson; secretary, H. H. Converse. Main office and factory, Toledo, Ohio. Branch offices, Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Akron, Ohio; 51 E. 42nd St., New York, N. Y.

HAUSBURG, E. O.—49 Maiden Lane, New York, N. Y. Manufacturer of watchmen's electric clocks.

HAVANA.—Trade name for illuminating glassware manufactured by the Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.

HAVEN.—Trade name for wire grips manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

HAVENS.—Trade name for wire grips manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

HAVOLINE.—Trade name for lubricating oils and greases produced by the Indian Refining Co., 244 Madison Ave., New York, N. Y.

HAWK.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

HAYDEN & DERBY MFG. CO.—New York, N. Y. Manufacturers of injectors and ejectors. Main office, 119 W. 40th St., New York, N. Y. Branch office, 27 N. Jefferson St., Chicago, Ill.

HAYDEN PROCESS.—Also known as the series system of electrolytic copper refining. See Copper.

HAYES, CARL I.—Edgewood, R. I. Manufacturer of electric furnaces. Business established 1905. Sole owner, Carl I. Hayes.

HAYS CORP., JOSEPH W.—Michigan City, Ind. Manufacturer of boiler room instruments.

HAZARD MANUFACTURING CO.—Wilkes-Barre, Pa. Manufacturer of bare and insulated wires and cables. Business established 1848. President, H. H. Ashley; vice-president, William H. Conyngham; secretary and treasurer, A. C. Overpeck; general manager, M. H. Sigafoos; sales manager, George B. North. Main office and factory, 81 E. Ross St., Wilkes-Barre, Pa. Branch offices and warehouses, 552 W. Adams St., Chicago, Ill.; 1415 Wazee St., Denver, Colo. District offices, 533 Canal St., New York, N. Y.; 2213 First National Bank Bldg., Pittsburgh, Pa.

HAZING STUNTS, ELECTRIC.—The possibilities of electric shocking devices for practical jokes and stunts for initiations into fraternal organizations have been utilized in various special furniture and devices. The stunts usually involve the giving of an electric shock unexpectedly, the high-voltage device being controlled automatically or at the will of an operator.

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Chairs which shock their occupant, weights to be lifted which are made "alive" at the right moment and similar stunts are made, some of them self-contained or more commonly inconspicuously wired from an external source. They are, of course, made with insufficient capacity to more than slightly shock the initiate and thus serve as an innocent and amusing diversion in the exercises.

Manufacturers:

Newton, Charles L., 305 W. 15th St., New York, N. Y.

HB.—Trade name for battery-charging outfits, cabinets, air compressors, motors and grinders manufactured by Hobart Bros. Co., 113 Water St., Troy, Ohio.

H-B CORP.—962 Monadnock Block, Chicago, Ill. Manufacturer of motor-driven dishwashers. Business established 1920. President, E. L. Hobbs; secretary, treasurer and sales manager, B. H. Bornquist.

H-B CURVES.—Curves which indicate the relation between the magnetizing force (H) and the resulting magnetic flux density (B) in any magnetic substance. See Magnetization curves.

H-C.—Trade name for bells and wire connectors manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

H. D. F. PHOTO ARC.—Trade name for photoengravers' lamp manufactured by the New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y.

HEAD.—In hydraulics a term used to denote the difference of level between the surface of the water at two points. In a water-power plant the total available head, usually expressed in feet, is the difference in level between the surface of the headwater in the forebay and the tail-water. In pumping it is the height that the water or other liquid is to be raised.

HEAD GUYING.—A method of guying or reinforcing poles in an overhead distribution system in which the top of one pole is guyed to the bottom of the next at a point about 10 or 12 ft. above the ground. If the line is braced in each direction by a head guy the method is called double head guying.

HEADLAMP.—A term often used in place of headlight. See Headlight, electric.

HEADLIGHT CONTROLS AND DIMMERS.—See Controls, automobile headlight; Dimmers, automobile and car headlight.

HEADLIGHT, ELECTRIC.—Broadly speaking this term covers any kind of electric light for lighting ahead of a moving vehicle, but in its more common technical use the term is only applied to lamps equipped with some kind of projecting device, such as a lens or reflector or both for throwing the light forward. For example, the small side lights on an automobile, merely used for indicating the presence of the vehicle or lighting around its sides, are not called headlights, but lamps at the front of the vehicle equipped with reflectors for projecting a powerful beam forward, are called headlights. Electric headlights on automobiles, steam locomotives and fast interurban electric railway cars are commonly equipped with parabolic reflectors for throwing a strong, concentrated beam forward. On street cars used only on city streets, much less powerful headlights are commonly used.

The greater the speed of an automobile or train that travels on or across highways at night the greater is the need for a powerful headlight to illuminate ahead as far as possible to insure safety from collisions or other wrecks. On the other hand, the beam from automobile and railway headlights is so powerful as to constitute a serious menace to the safety of traffic in the opposite direction, and consequently means have been taken and legislation has been passed in many states forbidding the use of these headlights in such a way as to cause dangerous glare in the eyes of an opposing driver. One plan extensively used is to dim the lamps when near opposing traffic. Another is to tilt the beam low enough so that it will not rise into the eyes of opposing traffic. To accomplish this latter and at the same time spread the beam over the full width of the road in a more desirable way, extensive use has been made of automobile headlight lenses of various types. A number of meritorious and many worthless devices for avoiding headlight glare have been placed on the market. There was for many years much uncertainty as to what really constituted dangerous glare. Definite recommendations for specifications to be followed by automobile headlights have now been issued by the Illuminating Engineering Society and the Society of Automotive Engineers, committees of which have been working on this problem for several years. These specifications have been embodied in state legislation in several states. They are obtainable from the Illuminating Engineering Society, 29 West 39th St., New York City, N. Y.

HEADLIGHTS, ELECTRIC, AUTOMOBILE.—Electric headlights are rapidly replacing oil and acetylene headlights on automobiles. They are nearly always provided in pairs, one on each side of the vehicle front and about 42 ins. above the ground. The headlight includes an outer housing with glass door and bracket support, a parabolic reflector, socket and concentrated-filament incandescent lamp. The latter may be either a vacuum or gas-filled tungsten type of 15 or 21 cp. Sometimes a small auxiliary lamp is also mounted in the reflector, but out of focus; it is used when running on well lighted streets or where passing another driver to prevent glare of the powerful lamp confusing him. Special lenses are often used in place of plain glass in the door, and sometimes diffusing glass. Also see Headlight, electric.

Manufacturers:

Adams & Westlake Co., 319 W. Ontario St., Chicago, Ill. "Adlake."
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Lamp & Stamping Co., Ltd., Ford, Ont., Can. "Clasco."
Glazier Headlight Corp., 25-27 Otsego St., Rochester, N. Y. "Locomotive."
Gray & Davis, Inc., Boston, Mass.
Jaeger Co., H. J., 280 Park Ave., Weehawken, N. J.
K-D Lamp Co., The, 108-12 W. 3rd St., Cincinnati, Ohio. "K-D."
K-W Ignition Co., The, E. 30th St. & Chester Ave., Cleveland, Ohio. "K-W."
S & M Lamp Co., 118 W. 36th St., Los Angeles, Cal.
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Vesta Battery Corp., 2100 Indiana Ave., Chicago, Ill.

HEADLIGHTS, ELECTRIC, CAR AND TRAIN.—These are electric headlights for use on electric street cars and on electric rapid-transit trains that operate on special right-of-way, such as elevated and subway trains that have no street or road crossings at grade. In the case of street cars the speed is not very high and the street lighting usually serves to illuminate the track for some distance ahead; in the case of the trains referred to none but employees are supposed to walk along the track and then seldom. Consequently in both cases a headlight of moderate power will serve to indicate the approach of the car or train and illuminate the track for a short distance ahead. Such headlights are nearly always of the incandescent type equipped with a reflector and plain lens or bull's eye for concentrating the light in the forward direction. Glare is seldom troublesome.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Dayton Mfg. Co., The, Dayton, Ohio. "Dayton."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. Golden Glow electric railway car headlights are fitted with the well known Golden Glow greenish-glass reflectors—reflectors which last indefinitely and never tarnish. These reflectors alter the light given by the incandescent bulb by subtracting the high frequency rays, thus projecting a light of beautiful golden color—a light which is not so blinding and much more penetrating than brilliant white light. Golden Glow headlights are made with heavy sheet steel cases in various types to meet all requirements.—Adv.



Golden Glow Headlights

GENERAL ELECTRIC CO., Schenectady, N. Y. Electric headlights for low-speed city service, moderate-speed city and suburban service and high-speed interurban service. The incandescent headlights made by this Company combine the advantages of the focus type Mazda lamp and projecting mediums that control the light with accuracy. They are built to withstand the severe usage incidental to railway service. The G-E luminous arc headlights will meet the conditions of any road. They are made for 2-amp. and 4-amp. operation. The light source is an adaptation of the principle embodied in the G-E luminous arc lamps, thousands of which are giving satisfactory service. (Bulletins A-4061 and 46800.) See adv. pages 1203-1223.—Adv.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y. "Star."
Trolley Supply Co., The, Massillon, Ohio. "McLain."

HEADLIGHTS, ELECTRIC, LOCOMOTIVE.—Electric headlights are provided on locomotives of high-speed passenger trains, especially such as the various limited trains, also on fast mail and sometimes on through freight trains; they are always provided on electric locomotives. Arc lamps with parabolic reflectors have been used on the fastest and most important trains. They can illuminate the track for a stretch of one-half mile or more, depending on weather conditions. Incandescent lamps with special concentrated filament in a gas-filled bulb are coming into extensive use for locomotive service; their range or power has been gradually increased and with their simplicity has resulted in encroaching on the arc lamp for this service. On steam locomotives a special headlight generating set is often provided; for these see Generating sets, locomotive headlight. High-speed electric interurban railways also require high-power headlights; for these arc lamps are often used, but the incandescent type has replaced them to a considerable extent.

Manufacturers:

Buda Co., The, Harvey, Ill. "Buda-Ross."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Dayton Mfg. Co., The, Dayton, Ohio. "Dayton."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Golden Glow."
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of headlights for electric and steam locomotives and for all classes of electric railway service. See adv. pages 1203-1223.—Adv.
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill.
Loco Light Co., The, 139 S. East St., Indianapolis, Ind. "Loco Light."
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y. "Star," "Wabash."
Sunbeam Electric Mfg. Co., Evansville, Ind.
Trolley Supply Co., The, Massillon, Ohio.

HEADLIGHTS, ELECTRIC, MINE TYPE.—Electric mining locomotives require an exceptionally rugged headlight because of the severe service met with due to rough track and violent bumping of the locomotive. The glass front is protected by a rod or wire grid or is made of wire glass. The glass door has a felt or other soft gasket to exclude dust and cushion vibration. Parabolic polished-metal or mirrored glass reflectors are used, the latter with the lamp socket being flexibly mounted in the case to prevent violent vibration from breaking the reflector or lamp filament. The case may be of sheet steel or of cast iron and is heavily japanned or enameled; mounting brackets are also of sheet steel or of cast iron. Incandescent lamps with concentrated tungsten filaments and gas-filled bulbs are now used almost exclusive-

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ly; 115-volt lamps not exceeding 50 watts are found satisfactory, one or two resistor units being placed in series with the lamp to take up the difference to the line voltage, which latter may be 220 to 650 volts. Frequently a headlight is placed at each end of the locomotive and the lamps are connected in series, a resistor being provided to take up any additional voltage and another resistor being added when only one lamp is to be burned. Some headlights have a swiveling or turret base which can be turned through 180° to permit the light to shine in either direction; in this case the headlight is mounted on top of the locomotive.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E mine locomotive headlights are the result of years of experience in headlight design and thorough familiarity with every phase of mine operation. The castings are cast iron of liberal cross-section to prevent breakage and receive a heavy black japan finish to prevent rusting. The glass is protected by heavy cast iron bars, and a positive door fastener prevents the door jarring open. The focusing device is readily accessible through a hand hole in the top. Additional features are the spiral springs to take up the jar and shock, and a curved case to glance off falling objects. Equipped with a 94-watt Mazda lamp, it will "pick up" objects at 500 to 600 feet. (Booklet B-3431.) See adv. pages 1203-1223.—Adv.

HEADRACE.—A feeding canal used to conduct water from the source of supply to the water-power plant. Headraces may be of considerable length, in which case part of the available head is lost in producing the velocity of flow. They are also called raceways.

HEALD MACHINE CO., THE.—Worcester, Mass. Manufacturer of electric grinding machines and magnetic chucks. Business established 1880. President, Paul B. Morgan; treasurer and general manager, James N. Heald; sales manager, S. T. Massey. Main office and factory, 10 New Bond St., Worcester, Mass. Branch offices, 26 S. Jefferson St., Chicago, Ill.; 311 Provident Bank Bldg., Cincinnati, Ohio; 401 Marquette Bldg., Detroit, Mich.; 721 Engineers Bldg., Cleveland, Ohio; 839 Singer Bldg.; New York, N. Y.; 1308 Commonwealth Bldg., Philadelphia, Pa. Sales representatives, Eccles & Smith Co., 69 First St., San Francisco, Cal.; 241 Los Angeles St., Los Angeles, Cal.; 46 Front St., Portland, Ore.; 1312 Western Ave., Seattle, Wash.; Hendrie & Bolthoff Mfg. & Supply Co., 1621 17th St., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah.

HEAR-CLEAR.—Trade name for attachment for telephone receivers manufactured by Robert I. Erlichman, Inc., Widener Bldg., Philadelphia, Pa.

HEARING DEVICES FOR THE DEAF.—Portable telephone sets adapted to be worn by persons who are partly deaf. They consist of a sensitive transmitter worn on the dress or coat, a watchcase receiver held on the ear by a headband, and a set of dry cells carried in the pocket. These are very compact devices. There are also other forms in which the dry cells are placed in a small box, which serves also as a sounding box to pick up the sound waves. A receiver on an extension cord is held on the ear. When the box is properly tuned, it enables the wearer to hear the ordinary conversation of any one in the room. Other devices are also used sometimes in a church or auditorium. The pulpit or speaker's stand is equipped with a sensitive transmitter and receivers are located at the seats of those who need them.

Manufacturers:

American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."
Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. "Acousticon."
Doe Electrical Device Co., Kent, Ohio. (In preparation.)
Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Auristophone."
Globe Phone Mfg. Co., Reading, Mass. "Ear-Phone."
Harper Oriphone Co., 936 Old South Bldg., Boston, Mass. "Oriphone."
Magniphone Co., The, 29 E. Madison St., Chicago, Ill. "Magniphone."
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y. "Magic Earphone."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

HEARN & HARRISON.—418 Notre Dame St., West, Montreal, Que., Can. Manufacturers of medical batteries, barometers, thermometers, etc. Business established 1857.

HEART.—Trade name for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

HEARTH ELECTRODES.—Furnace electrodes built directly into the hearth of the furnace.

HEARTPHONE.—Trade name for an electric stethoscope manufactured by the Globe Phone Mfg. Co., Reading, Mass.

HEAT.—Heat is energy of motion of molecules and atoms, or possibly of electrons. In gases the motion of the molecules is chiefly motion of translation. The velocity depends on the molecular weight of the gas and upon the temperature. In solids the molecules have motion of vibration, but no translation. The heat produced by an electric current is supposed to be due to the impact of rapidly moving electrons upon the atoms which remain fixed in their position.

When the heat energy of a body increases, its temperature may rise or it may change its state from solid to liquid or from liquid to vapor.

Other forms of energy tend to change into heat through the agency of friction, electrical resistance, chemical reactions, etc. The heat produced is always proportional to the amount of energy which disappears. The conversion of heat into mechanical energy by means of heat engines is one of the most important branches of engineering.

HEAT COILS, TELEPHONE.—A heat coil, or sneak coil as it is sometimes called, is merely a device for opening or grounding a telephone circuit if moderate current passes through it for too long a time, i. e., current of such a strength as to endanger the apparatus if permitted to flow long enough to accumulate much heat in the coils of the telephone apparatus. Heat coils are usually located on the main distributing frame. While several forms of heat coils are used, they consist in general of a thin metallic tube wound with a noninductive nickel-silver wire of very slight ohmic resistance. Inside of the tube a small pin is held in position by a drop of solder fusible at a very low degree of temperature. When the current passing through the wire accumulates sufficient heat it causes the solder to melt, which releases the pin and allows a spring to come in contact with the ground plate. Heat coils are used in place of fuses or circuit breakers because the current values are so small. A modification of the type described permits the line to be opened in one direction or grounded in another.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

HEAT INSULATION, BRICK, CEMENT, ETC.—Brick and cement are very often used as heat insulators where the temperature is not exceedingly high and where it is desired to retain as much heat as possible, as in a large boiler furnace. Another instance of this is in high-temperature electric furnaces, in which a refractory lining is first built inside of the furnace and this backed up with a wall of heat-insulating brick or cement. When brick is used for this purpose it is usually of a highly siliceous nature and the insulating cement, blocks and powder generally contain a large percentage of silica also. For boiler furnaces they are used as a protection to the outer brickwork and give a longer life to the setting. Also see Covering, boiler and piping.

Manufacturers:

Celite Products Co., 1134 Van Nuys Bldg., Los Angeles, Cal. "Sil-O-Cel."
Franklin Mfg. Co., The, Franklin, Pa.
Hagan Corp., The, 401 Peoples Bank Bldg., Pittsburgh, Pa.

HEAT LIGHTNING.—A form of lightning noticed near the close of a hot day in summer. It is not accompanied by thunder. See also Lightning.

HEAT LOSSES OF ELECTRIC FURNACES.—The amounts of heat escaping by radiation, conduction and connection from electric furnaces and electrolytic furnaces determine very greatly the thermal efficiency of the furnace. They can be greatly diminished by using walls of poorer conducting material, thicker walls, or by jacketing the outside with a white metallic jacket, preferably polished where practicable.

HEAT REGULATORS.—See Regulators, temperature.

HEAT-TREATING OUTFITS, ELECTRICAL.—These heat-treating outfits usually consist of a small electric furnace and auxiliary apparatus, such as a liquid bath heater, pyrometers, and rheostats or other controlling devices. The furnaces are usually of the resistance coil type. Their most common uses are the determination of the critical temperatures of steel samples and heat-treating small quantities of steel tools or machine parts.

Manufacturers:

Ajax Electrothermic Corp., 636 E. State St., Trenton, N. J.
Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. The G-E electric muffle furnace for temperatures up to 850 degrees C., is especially valuable for heat-treating carbon steels in the tool room, baking decorations on china, etc., and for laboratory and experimental uses. The low current required to maintain operating temperature is a prominent feature. Capacities of 4 kw. and 1½ kw. giving two different heats. For operation on 110 and 220 volts. (Bulletin 69706.) Also electric oil tempering baths, self-contained outfits consisting of a tank of oil with heating units, control panel and sensitive thermometers. These are compact outfits, simple in construction, efficient and easy to operate. Heating units are well protected from mechanical injury. Control panels permit wide range of heats. Coils for rapid cooling are furnished if desired. (Bulletin 69700.) See adv. pages 1203-1223.—Adv.



G-E Muffle Furnace

Holcroft & Co., 555 Book Bldg., Detroit, Mich.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."

HEAT TREATMENT OF STEELS.—The behavior of steels under heat treatment has been the subject of much investigation. Simple steels are composed of iron and various compounds of iron and carbon and the mechanical properties of the steel depend upon which of these compounds are present and in what proportions. By heating and cooling the steel in various ways, the compounds are changed from one form to another and their proportions changed. To bring about these changes it is necessary that the steel be heated above a point called its critical temperature. When steel is heated to a high temperature, it is observed that, up to a certain point, the rise in the temperature of the steel is proportional to the heat absorbed. At this point the specimen will absorb a certain amount of heat with no rise in temperature and will then continue to rise in temperature as before. Upon cooling the reverse of this phenomenon is observed, that is, the cooling is uniform down to a certain point where there is a sudden release of heat, with a small rise in temperature, and then a continued uniform decrease. These singular phenomena occur at what are known as the critical temperatures of the steel, and these temperatures are called the decalescence and recalescence points, on heating and cooling, respectively, the latter point occurring at a slightly lower temperature. The critical temperature depends on the carbon content of the steel and varies from 650 degrees to 800 degrees C. for commercial steels.

For proper treatment of the steel it is necessary to know the critical temperature of the steel being treated. This determination is usually made with an electrical

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heat-treating outfit (see item above) using samples from the batch to be treated. The usual heat-treating processes are annealing, tempering, and hardening, which change the physical strength or hardness, and heat tinting to give a special color finish to the product.

In the mechanical and heat treatment of steel it is believed that there are set up in the material stresses which cause brittleness or weak points, and which must be removed to give the steel the proper characteristics for certain purposes. This is done by softening the steel by annealing; the steel is heated to a high temperature and then slowly cooled; both heating and cooling require accurate temperature control and are accomplished in furnaces of special design. The furnaces used burn coal, oil, or gas, or may be one of the several electrical types. To obtain the best results there must be accurate control of the time, temperature, and atmosphere in the furnace. In electric furnaces the control of these elements can be made fully automatic so that the skilled help ordinarily required can be dispensed with. For observing furnace temperatures electric pyrometers are used. In the automatic systems the pyrometer is equipped with contact devices for control of the furnace temperature. The cooling process is generally accomplished in the furnace. Annealing furnaces are sometimes built in a continuous car type, of which the middle portion only is heated. The material is placed in cars and gradually heats up until it reaches the midpoint of the furnace and as it recedes is allowed to gradually cool off, the speed of the cars being so regulated as to give the proper time for heating and cooling. The ordinary car type furnace is allowed to cool down without removing the material or it may be removed and cooled, buried under some material as ashes or lime. Small parts are occasionally air-cooled. (Also see Furnaces, electric, annealing.)

Tempering differs from annealing in that it does not soften the steel to so great an extent. The steel is heated in the same manner as for annealing, but the material, instead of being allowed to cool slowly, is quenched in a liquid bath, the temperature of which varies with the material and the effect desired on the properties of the steel. Tempering was formerly an important process in the manufacture of tools, but the use of self-hardening steels has diminished its use.

In the various hardening processes the steel is heated above its critical temperature and cooled suddenly in a bath, generally of oil, water, or brine. The effect on the metal is to make it very hard and brittle. The brittleness is usually reduced by annealing or tempering. Many machine parts, such as gears and crankshafts are hardened to give them the necessary wearing quality. The furnaces used are of the same general types as used for annealing and are generally automatic, the work being fed continuously through the furnace and quenching baths; See Furnaces, electric, hardening.

Heat treating for colors depends upon the formation, on the surface of the polished metal, of an oxidized film. Steels contain portions of their mass richer in phosphorus than other portions. The speed of the oxidation depends on the quantity of phosphorus present. As steel oxidizes it colors first yellow-brown, then red, and lastly blue or purple. If the steel is heated for a short time due to the effect of the phosphorus it will have acquired a surface of the various oxidation colors. The heating is generally done in a lead or cyanide bath.

HEAT UNITS.—The commonly accepted theory of the constitution of matter is that every substance consists of molecules which are in ceaseless motion. The energy of this motion is called the heat of the body. The more violent the motion the hotter the body. In accordance with this conception, heat is the energy of the motion of the molecules of substances. Since heat is energy, the units of heat are essentially energy units. Since the temperature of a substance is a function of the quantity of heat added or withdrawn from it, the units for measuring the quantity of heat are defined in terms of a unit change of temperature in a unit mass of water. The two common units are the calorie and the British thermal unit; see Calorie; British thermal unit; also Mechanical equivalent of heat.

HEATER CORD.—See Cord, flexible, portable heater.

HEATER OR STOVE WIRE.—See Wire, heater or stove.

HEATERS, AIR OR SPACE, OR RADIATORS, CIRCULATING LIQUID TYPE.—In the circulating liquid type of air heater the principle is that of a self-contained hot-water system in miniature. The liquid, which is usually either oil or water, passes over the heating unit which is located in the bottom of a radiator. As the liquid becomes heated it rises and the cool liquid takes its place. This gives a constant circulation as long as the heater is in operation. It has the advantage that it can store considerable heat and will give that off long after the heater has been disconnected. These radiators are often semi-portable, being equipped with ball-bearing casters. They resemble an ordinary steam or hot-water radiator, but are seldom made in very large sizes taking over 2 kw. They present a larger heating surface of lower temperature than other types of air or space heaters. This type is used principally as an auxiliary to the main heating system of a building at seasons when it is not advisable to operate it and in addition thereto at times of severe cold.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Edison," "Hotpoint."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturers of Hotpoint, Hughes and Edison electric appliances, ranges and ovens. Two types of water heaters, Circulation and Clampon. The heating unit of the circulation type of heater consists of four spiral coils of calorite wire imbedded in lengthwise grooves in the brass core of the unit. These are encased in $\frac{3}{8}$ in. thick seamless steel tubing $1\frac{1}{8}$ ins. in outside diameter, sealed by welding at one end. The length of the unit varies with the wattage. The 750 watt is $7\frac{7}{8}$ ins. long, and the 5000-watt unit is $24\frac{7}{8}$ ins. The terminal end of the unit is screwed into a cast iron head that houses the terminals, and upon which the large capacity single or three heat switch is mounted. The head is also provided with a seat into which the thermostat switch may be attached. The heater head has a 4-in. diameter flange, drilled for four $\frac{1}{4}$ in. bolts, thus providing for bolting to the special Tee when used as a circulation type heater, or for bolting to the tank if the unit is to be used as an immersion heater. This heater is liberal in design and of rugged construction. The Clampon type is made of sheathed wire and formed in such a manner that the unit can be clamped about the water tank or against the bottom of conainers such as water pans. Water heaters made by this company are furnished with switches with connections already made between the switches and heating units. No mica is used in these heaters. See display adv. pages 1292-3.—Adv.



"Hotpoint" Circulation Type Heater

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's.

Electro Steam Radiator Co., 18 W. Monroe St., Chicago, Ill.

Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.

Radi-All Co., The, Ironton, Ohio. "Radi-All."

Roper Corp., George D., Eclipse Gas Stove Division, 707 S. Main St., Rockford, Ill. "Eclipse."

Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

Ward Leonard Electric Co., Mt. Vernon, N. Y.

Weeks Mfg. Co., H. G., Hamilton, Ohio.

Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

HEATERS, AIR OR SPACE, OR RADIATORS, LUMINOUS TYPE.—Some heaters of this type have the heating elements enclosed in glass tubes, which besides radiating heat also emit considerable light. These are merely low-efficiency lamps and are intended to consume a large amount of current. Some of these heaters are open and intended to radiate heat in all directions, while others have a reflecting surface for directing the heat. Both are mounted in highly decorated metal frames.

Radiant heaters, which do not give as much light as the lamp type, but do emit a cheerful glow, are made in a number of styles and sizes. They are quite commonly made with a bowl-shaped or parabolic copper reflector, and the heating unit is mounted in the center in the form of a spool, cone, cartridge or similar shape. These heaters are very light in weight and may be attached to any lamp socket or receptacle. The reflector may be turned or adjusted to throw the heat in any desired direction. Some larger type units are made in different forms, having a heating unit that is spread out over a larger surface. The reflectors in these cases are often mounted on legs and provided with a handle so that they may be placed in any shaped like a section of a cylinder and are position.

All these various heaters are used in homes, offices, hospitals, etc., in heating up a room or portion of a room when the main heating plant is not in operation or does not furnish enough heat.

Manufacturers:

Adon Products, Inc., 516 5th Ave., New York, N. Y. "Supreme."

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" twin radiant electric heater, a dependable reflector heater for supplying auxiliary heat in the home or office. Heating elements removable and can be substituted for elements of different voltage if necessary. Reflectors are adjustable, throwing heat in desired direction. Supplied with 8-ft. cord with detachable plug. Antique copper finish. "American Beauty" quad radiant electric heater, same as heater described above, except it has four reflectors instead of two. "American Beauty" electric luminous radiators are ideal auxiliary heaters. Heat is generated in large frosted lamps which throw a warm, cheerful glow. Made in three lamp round type, also in three lamp reflector type. These heaters are portable and can easily be moved from one place to another. Furnished in brush brass finish.—Adv.

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances, ranges and ovens. Of the radiant type, portable design, base is so weighted that if heater is accidentally tipped over, it will right itself. Fitted with removable heating unit, made of pressed steel, mahogany finished; reflector has slight coat of copper, highly polished. Wire guards over heating element easily removable. Ebonized wood handle at back. See display adv. pages 1292-3.—Adv.



"Hotpoint" Hedlite Heater

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Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

ESTATE STOVE CO., THE, Hamilton, Ohio. Estate Sunburst, a highly efficient heater with a distinctive cone-shaped heating unit. (Catalog sent on request.)—Adv.

Fairfacts Co., 234 W. 14th St., New York, N. Y.

Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal." "Sunflower."

MAJESTIC ELECTRIC DEVELOPMENT CO., 656 Howard St., San Francisco, Cal., manufacturers of Majestic Electric Heaters. Made in nine styles.



"Majestic" Electric Heater

The Parabolic Reflectors are made of pure burnished copper which cannot peel. Dead air space insures back of "Majestic" being always cool. Wire guard easily removed and replaced. Majestic heaters deliver a grateful glow of sunlight heat in any direction desired without fumes or fire, without smoke or odor.—Adv.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y.

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Roper Corp., George D., Eclipse Gas Stove Division, 707 S. Main St., Rockford, Ill. "Eclipse."

Rutenber Electric Co., Marion, Ind. "Rutenber."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass. "Sunbowl."

STRAIT & RICHARDS, INC., Fabyan Place, Newark, N. J. The Electric "Gloiog." See Logs, Electrically Illuminated or Heated.—Adv.

UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Cozy Glow." (See display advertisement on pages 1395-1402.)

HEATERS, AIR OR SPACE, OR RADIATORS, NONLUMINOUS.—Heaters in which the hot element does not emit a glow or light. These are sometimes made in the form of portable radiators which are enclosed in a perforated metal casing. They do not as a rule project the heat in any one direction, except upward by convection, but also allow it to radiate in all directions. These radiators may be used as an auxiliary to some other heating unit or may be installed as the only heating device in a small room, theater ticket booth, valve or meter house, traveling-crane cab, lookout station on a ship, etc. There are other forms of space heaters that are very popular and may be used for a wide variety of purposes. These are generally very compact, rugged units completely enclosed in a metallic case. Because of their small size and rugged construction they may be placed in almost any position and very close to the object to be heated. They are used for the protection of water meters, valves, sewer traps, and for warming engines and motors in mines and underground service, keeping float switches operating, etc. There are many other applications to industrial processes, such as warming molded compounds before punching, heating fiber, drying the ink on paper coming from printing presses, etc.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" navy-type electric air heaters, for wall or floor use. Practically indestructible. Made from malleable iron castings and perforated steel casings and internal supports of cold rolled steel. Elements are sheathed type and properly supported, built strictly in accordance with Underwriters' requirements. Five sizes. Furnished with terminal connection only. All heaters are furnished with heat deflectors. "American Beauty" portable type electric air heaters have cast iron tops and are finished in black japan, with polished nickel trimmings. Equipped with combination terminal box ready for direct connection of line wires.—Adv.

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Century Mfg. Co., Inc., Elizabethtown, Pa.

Claxo Co., The, Iowa City, Iowa.

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

Cope & Son, Ltd., 150 Hastings St., W., Vancouver, B. C., Can. "Rex."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Space Heaters are manufactured in standard units of 500-watt capacity. Their success is due in large measure to the compact steel jacketed construction used. Each heater occupies practically the same space as a 2-ft. ruler. The dimensions are $\frac{7}{8}$" thick by 1½" wide by 2' long. Both the size and shape of C-H Space Heaters are convenient for installation in almost any location. The construction is such that there is nothing that can jar loose or crack. Each heater consists



C-H Electric Space Heater

of a ribbon of nickel-chromium resistor insulated with sheet mica and mounted on a steel strip. A steel jacket is then placed over the resistor and the unit is sealed under heavy hydraulic pressure. Heaters are manufactured for voltages between 100 and 125, and 210 and 250. They may be connected to any d-c. or a-c. light or power circuit of the proper voltage. Also see display adv. pages 1225-30.—Adv.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. A substantial electric air heater of



"Hotpoint" Air Heater

black enameled steel, mounted on cast iron, nickel plated base. Heater is provided with ebonized wood handle. To estimate size of heater needed, allow 1 to 2½ watts per cubic foot in moderate climates; 2¼ to 4 watts in extreme climates. Made in the following sizes:

Cat. No.	Size	Heat	Wattage
411A8	15x9x17½ ins.	1	1000
431A8	15x9x17½ ins.	3	1000
432A8	15x9x23½ ins.	3	2000
433A8	23x9x19½ ins.	3	3000
435A8	23x9x22¼ ins.	3	5000

Nos. 411A8, 431A8 and 432A8 are supplied with copper tube terminal lugs, other types with 12-in. lead wires. See display adv. pages 1292-3.—Adv.

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

Faraday Co., The, 746 Chapel St., New Haven, Conn. "Kookerette."

GENERAL ELECTRIC CO., Schenectady, N. Y. Heaters for electric ovens for wall, floor and either floor or wall mounting. Each consists of metallic resistor material carried on suitable insulating blocks and assembled in steel frames. The blocks are made of a compound which retains its insulating qualities at the high temperatures and will not crack or break. Made in capacities from 1.3 to 12.3 kw. for voltages up to 600 volts. Automatic control panels can also be furnished for controlling the heat in the oven. (Bulletin 48021A.) This Company makes also heating units for industrial heating devices other than electric ovens and an air heating unit for miscellaneous applications. See adv. pages 1203-1223.—Adv.

Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."

Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio. "Halectric."

Hersh Bros. Co., Allentown, Pa. ("Lehigh" combined with fan.)

Hicks, W. Wesley, 660 Market St., San Francisco, Cal. "Wesix."

Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill. "H & W."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Radi-All Co., The, Ironton, Ohio. "Radi-All."

Roper Corp., George D., Eclipse Gas Stove Division, 707 S. Main St., Rockford, Ill. "Eclipse."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

STRAIT & RICHARDS, INC., Fabyan Place, Newark, N. J.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. "Triplex." (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display advertisement on pages 1395-1402.)

Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

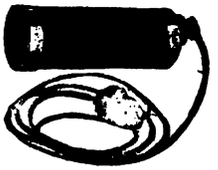
HEATERS, ELECTRIC, AUTOMOBILE—Heaters of this type are constructed for several uses. One type is designed for attachment to an ordinary lighting circuit by a plug and cord and is placed under the hood to keep the automobile engine and the water in the radiator warm in cold weather while the car is in the garage, as at night. Another type is designed to heat the interior of an enclosed car, current being taken from a storage battery. The latter as a rule only applies to enclosed electric vehicles, as with a gasoline automobile either the hot exhaust gases or water from the circulating system may be passed through a heater mounted on the floor. Another type of electric heater is used in winter to heat the gases before

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ignition; it may be installed between the manifold and carburetor and is supplied either from dry cells or the lighting and starting storage battery.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint." "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. (See display advertisement on page 1225-1230.)
Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.
EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill.



"Hotpoint" Auto Heater

A strongly made heater, widely used in cold weather, inside the hood of automobile, to help keep radiator and water jacket from freezing. Made of steel with black enameled body and nickel plated ends. Fitted with 100 or 200-watt heating units. A very economical heater, tested and approved by the National Board of Fire Underwriters. It is 7½ ins. in length, 3 ins. in diameter, and weighs 1 lb. See display adv. pages 1292-3.—Adv.

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Auto-Circulator."
Electric Intake Heater Co., 115 E. Cortlandt St., Jackson, Mich.
Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."
Faraday Co., The, 746 Chapel St., New Haven, Conn. "Faraday."
G. & G. Electric Heater Co., The, Lafayette, Ind. "G. & G."
McCord Mfg. Co., Inc., 2587 Grand Blvd., E., Detroit, Mich.
McJunkin, Paul, 15 E. 40th St., New York, N. Y.
Metal Specialties Mfg. Co., 338-53 N. Kedzie Ave., Chicago, Ill. "Presto."
National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C. "Calorel."
Rose Mfg. Co., 910 Arch St., Philadelphia, Pa. "Neverout."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Sharpe Electric Appliance Co., 502-8 Murphy Bldg., Detroit, Mich.
Suburban Lighting Co., Toledo, Ohio. "Love."
Thompson Mfg. Co., Des Moines, Iowa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, CAR.—Electric car heaters are used very extensively on electric interurban and suburban railways, street railways, elevated and subway systems, for heating the car bodies and vestibules. The heaters consist of resistor units which are usually assembled into metal casings to project the heat out into the car. A protective grid is placed on the outer side to protect the heaters and to prevent clothing coming in contact with them from being scorched. Heater units are placed at various points in the car to give good distribution of the heat; they are often mounted along the sides near the floor, sometimes also in the vestibule or near the doorway, these being usually vertical units. On many cars they are mounted just above the floor underneath the seats. Current is supplied to the heaters from the source of power that operates the car. An important adjunct sometimes used with electric heating equipments is the thermostat, by means of which the current is cut off when the car temperature reaches the desired amount and is applied automatically when the temperature falls below the fixed minimum. Thermostats save a large amount of energy as compared with manually controlled heaters, running as high as 50% under some conditions.

Nonelectrical heaters are still used for some electric cars. The hot-air type consists of a coal heater which raises the temperature of the air taken from the outside or inside of car, as may be desired, and sometimes, by means of an electric blower and ducts, distributes this heated air through the car. In the hot-water type, water contained in the piping system which is distributed along the sides of the car is heated in a coil in a coal-burnng stove and circulated through the system.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Consolidated Car Heating Co., 413 N. Pearl St., Albany, N. Y.
Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Electric Machine Co., The, 329 W. Ohio St., Indianapolis, Ind.
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill. "H. & W."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
National Railway Appliance Co., 50 E. 42nd St., New York, N. Y. "H & W."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Smith Heater Co., The Peter, 1725 Mt. Elliott Ave., Detroit, Mich.
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

HEATERS, ELECTRIC, CURLING-IRON.—Curling-iron heaters are designed to heat nonelectric curling irons of standard sizes and shapes. They are made in several shapes, usually having a small cylindrical opening into which the iron is placed and where it is surrounded by a heating element which quickly heats it to the proper temperature. The heater may be enclosed in a cylindrical polished metal casing or in an ornamental casing of some form. They are generally mounted on a slate or marble base with a felt bottom, and are attached to any wall receptacle or lamp socket by a cord and plug. One form is made so that the iron is placed on top of the heater and will accommodate an iron of any size or shape. These heaters have advantages over the ordinary flame methods of heating such curling irons, as they do away with the danger of an alcohol or other flame and are free from dirt or odor.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric curling iron heater, made in two styles. The triangle type takes curling tongs of any size or shape. Other type has hollow opening through which the tongs are inserted. Does away with danger from alcohol and other flames. Complete with 6-ft. cord permanently connected to heater and lamp socket attachment plug.—Adv.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Koken Companies, 2528 Texas Ave., St. Louis, Mo. "Koken."
Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, DISK.—One form of immersion type electric water heater, which see. Also see Stoves, disk.

HEATERS, ELECTRIC, FLASK.—Electrically operated heating units designed especially for heating flasks in chemical or other laboratory practice. They are sometimes made as attachments to hot plates having a shield that extends up around the flask to confine the heat to it. The heating unit is placed in the bottom of the heater and gives a sufficiently high temperature for flask heating, distilling, and ether and alcohol extractions.

Manufacturers:

Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.
Canadian General Electric Ct., Ltd., 212 King St., W., Toronto, Ont., Can.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J. "Multiple-Unit."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Schaar & Co., 556-558 W. Jackson Blvd., Chicago, Ill. "Universal."

HEATERS, ELECTRIC, GLUE.—See Glue pots, electrically heated.

HEATERS, ELECTRIC, LINOTYPE POT.—Linotype pot heaters are widely used in the composing rooms of printers to melt the type metal for typesetting machines, such as the linotype, intertype, monotype and linograph. Some of these heaters have a tank or crucible which holds 50 lbs. of metal at one time. The heating element is contained in a small crucible at the bottom of the other tank and permits the metal to flow out as soon as it is melted. In this way it is automatically led to the metal pot of the machine and maintained at the proper temperature. This eliminates the necessity of the operator watching this detail, and permits making better and more uniform slugs and fewer flaws.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chance Co., The, Centralia, Mo.
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See display adv. pages 1225-1230.—Adv.
Fort-ified Mfg. Co., 14th & Agnes Sts., Kansas City, Mo. "Fort-ified."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pit'sburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, SHAVING MUG.—A heating element in a specially constructed base of the shaving mug is used to heat the water. A cord and plug permit attachment to an ordinary lamp socket or receptacle. The outfit affords great convenience as the water may be heated in a few minutes.

Manufacturers:

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Edison," "Hotpoint."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Edison," "Hotpoint." (See display advertisement on pages 1292-1293.)
Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind.
Gibson Co., H. B., South Dayton, Ohio. "Thermovac."
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display advertisement on pages 1395-1402.)

HEATERS, ELECTRIC, WATER, BAYONET TYPE.—Electrically operated heating devices in the form of long slender units with threaded bushings at one end and designed to be inserted in tanks or other water circulating systems. Screw connections are used throughout, making water-tight joints, and the unit is sometimes enclosed in a special casing. In addition to their use as water heaters, they are often used in coffee urns, in vessels for melting tar, glue, paraffin, etc., and for generating small quantities of steam under low pressure, for sterilizing, etc. It is necessary to drill a hole in the container to install a heater of this type and they are always placed so that the unit is completely immersed in the liquid to be heated.

Manufacturers:

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

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CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis. C-H Pipe Outlet Type Heaters are inserted through the walls of the vessel below the minimum water level. The heater units consist of chromium wire with mica insulation, encased in copper casings, which are slipped into close fitting copper sheaths. The sheaths are mounted in a brass header which carries a terminal cover of drawn steel. The brass header and terminal cover are nickel-plated and polished. Different capacities are made, ranging from 500 to 4,500 watts. See display adv. pages 1225-1230.—Adv.



C-H Pipe Outlet Type Heater

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Newark Engineering & Tool Co., 476-482 18th Ave., Newark, N. J. "Nerco."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, WATER, BOILER-INSERT TYPE.—Water heating for kitchen boilers is often accomplished by inserting a heating unit in the boiler, and several styles of heaters are used for this purpose. Some of them are bayonet heaters, which are described above. Another form consists of a very long heating unit enclosed in a seamless copper tube which is inserted in the top of the boiler and extends to the bottom. It is always surrounded by the water being heated and affords quick transmission of heat. Still another form, which is installed in the bottom of the tank, has the heating element enclosed in a tubular shell. The water being heated passes through this shell and, as it gets hot, is conducted to the top of the boiler by a pipe, and in turn is replaced by cold water drawn in from the bottom. This arrangement facilitates getting hot water sooner after the current is turned on than if the heated water mingled freely with the other water in the tank as it rose to the top. These heaters are used mostly with the common kitchen boiler of the vertical type.

Manufacturers:

AETNA ELECTRIC APPLIANCE CO., 40 Court St., Boston, Mass. "Hotvent" water heaters are made in five standard types, general appearance as shown in cut below. All-brass; non-rusting; heating units easily removable without disturbing tank connections or draining heater. Heating unit is long-lived; has nichrome resistance wire completely embedded in lava; very efficient because entirely immersed in water; no dead air space. "Hotvent" heater takes cold water from bottom of tank and delivers hot water at top, thus making unnecessary to heat whole



"Hotvent" Water Heater

tank to draw a small quantity of hot water. Type C-6 uses 600 watts at 110 volts, has one heat; C-12, 1200 watts, 110-volts, one heat; C-24, 2400 watts, 110- or 220-volts, 3-heat on 110-volts; C-48, 4800 watts, 110- or 220-volts, 3-heat; C-72, 7200 watts, 110- or 220-volts, 3-heat. The 600 and 1200 watt sizes are generally used on storage systems in connection with a 30 or 40 gal. tank. The 2400, 4800 and 7200 watt sizes are generally used on intermittent systems, i. e., where the heater is operated as hot water is required. In general the tank should be large enough to contain the hot water produced during an hour's operation of the heater. Easy to install, economical to operate; for homes, clubs, boarding houses, offices, factories.—Adv.

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Coppersert."

Electric Sales Service Co., Berkeley, Cal. "Thermelectric."

Instantaneous Electric Heater Corp., Root Bldg., Buffalo, N. Y. "Vulcan."

Thermo Electric, Ltd., Brantford, Ont., Can. "Thermo."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, WATER, CIRCULATING TYPE.—Circulating type water heaters are used on systems where it is desirable to have the heater separate from the container. They are very often applied to boilers in a kitchen, where the boiler is normally connected to the kitchen range or to the furnace. When the main heating unit is not in operation or when there is not sufficient hot water, the circulating heater may be used independently. The electric heater is usually enclosed in a water-tight copper tube and is placed in a pipe loop around the boiler. When the water in the loop is heated it passes to the top where it either goes into the hot-water piping or is stored in the boiler. The cool water is drawn from the bottom of the boiler or tank to replace the heated water and thus a continuous circulation is set up. These heaters are also applied to large glue cookers, paste kettles, sterilizers and laboratory apparatus.

Manufacturers:

AETNA ELECTRIC APPLIANCE CO., 40 Court St., Boston, Mass. "Hotvent."

Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint." "Edison."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See display adv. pages 1225-1230.—Adv.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint." "Edison." (See display advertisement on pages 1292-1293.)

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash "Apfel's."

Hicks, W. Wesley, 660 Market St., San Francisco, Cal. "Wesix."

Hotwat Distributing Co., Title Insurance Bldg., Los Angeles, Cal. "Hotwat."

Instantaneous Electric Heater Corp., Root Bldg., Buffalo, N. Y. "Vulcan."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

Thermo Electric, Ltd., Brantford, Ont., Can. "Thermo."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATERS, ELECTRIC, WATER, INSTANTANEOUS OR FAUCET TYPE.—These devices consist of wire resistor coils within a porcelain body or cup through which the water flows when the faucet handle is turned. Operation of the faucet actuates a special switch, which turns the current on and off with the water, thus no more water is heated than is actually used. They are used principally at soda fountains and in restaurants, but have also been made for general lavatory use.

Manufacturers:

AETNA ELECTRIC APPLIANCE CO., 40 Court St., Boston, Mass. "Hotvent."

AQUA ELECTRIC HEATER CO., 250 W. 54th St., New York, N. Y. "Aqua." (See display advertisement on page 1290.)

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Hot-Flo Faucet Corp., 1400 Broadway, New York, N. Y. "Hot-Flo."

Hotwat Distributing Co., Title Insurance Bldg., Los Angeles, Cal. "Hotwat."

Instantaneous Electric Heater Corp., Root Bldg., Buffalo, N. Y. "Vulcan."

Mabey Electric & Mfg. Co., 968 Ft. Wayne Ave., Indianapolis, Ind. "Hot Quick."

Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."

National Electric Water Heater Corp., 42nd St., & Broadway, New York, N. Y. "Little Wonder," "Geyser."

National Stamping & Electric Works, 410 S. Clinton St., Chicago, Ill. "Superior," "Twin."

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

HEATERS, ELECTRIC, WATER OR OTHER LIQUID, IMMERSION TYPE.—These heaters consists of an insulated heating element within a metal cylinder or disk or within a closely coiled spiral metal tube, the cylinder, disk or tube being placed in the water to be heated. Some of the common forms are small sealed tubes or have a bulb at the end and are meant to be inserted in a glass of water, milk or other liquid. The disk type heaters are intended for immersion at the bottom of a pan or pot to boil water, or to melt paraffin or heat glue, etc.; the wires are enclosed in a tube which extends up above the level of the liquid. Some of the special forms are made for use in large urns and boilers, such as are used in a hotel or restaurant for making coffee or heating water. These are frequently permanently installed and have the connections coming through the sides of the tank. The advantages of the insertable immersion heater are that it may be used with any vessel and gives a direct application of the heat to the liquid.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

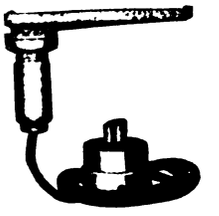
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Bottom Outlet Type Heaters are designed for application to urns or similar containers where they can be inserted from the top and terminals brought through a 1¼" hole



C-H Bottom Outlet Type Heater

cut in the bottom. The heater is of brass, about 3" by 6" by ½". Projecting at right angles from one end is a hollow extension, on which are locknuts and washers and through which runs the attaching cord. This construction makes a simple and durable heater from which any sediment, which

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may collect in the water, is easily cleaned. Heaters of this type are made in one size only with a maximum rating of 1,200 watts. If greater capacities are desired, two or more heaters may be used in the same vessel. See display adv. pages 1225-1230.—Adv.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind. "Elstat."

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. Immersion heaters for industrial applications ranging from 600 watts to 5 kw. capacity. See adv. pages 1203-1223.—Adv.

Instantaneous Electric Heater Corp., Root Bldg., Buffalo, N. Y. "Vulcan."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Lindstrom, Smith Co., 3213-3238 W. Lake St., Chicago, Ill. "White Cross."

Loetscher-Ryan Mfg. Co., Rock Island, Ill. "Ideal Minute."

Milwaukee Mfg. Co., 1316 Fond du Lac Ave., Milwaukee, Wis. "Electro-Boil."

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display advertisements on pages 1395-1402.)

HEATERS, ELECTRIC, WATER OR OTHER LIQUID, MISCELLANEOUS.—There are several types of electrical water heaters made which are not included under the headings above. Some of these are for use with boilers, and others are made in the form of small pots or boilers for table use, such as used for boiling eggs or heating broth, etc. Those applied to boilers are generally applied externally, and the heat is conducted to the liquid through the boiler walls, rather than by actual contact with the heating unit. One form of such heater is a flat rectangular plate that may be clamped on the bottom of the boiler. In another form the heating unit is flexible and is wrapped around the outside of the boiler at the bottom. Heaters of this type generally require that the boiler be covered with a thermal insulating coating, to confine the heat to the boiler. Other types of liquid heaters are also widely used in industrial plants, these being in many cases of special design to suit the requirements to be met as to temperature, character of the vessel, nature of service (intermittent or continuous), etc.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric water heater, made of heavy copper, finished in polished nickel with inner surface heavily tinned. Furnished complete with 6-ft. cord and having detachable porcelain plugs and attachment plug.—Adv.

AQUA ELECTRIC HEATER CO., 250 W. 54th St., New York, N. Y. "Aqua." (See display advertisement on page 1290.)

Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A & F."

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Calorex Corp., The, 10 W. 23rd St., New York, N. Y. "Hot-O-Mix."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Electric Boiler Corp., 491 Main St., Cambridge, Mass. "Electric Boilerette."

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

Gibson Co., H. B., South Dayton, N. Y. "Thermovac."

Hot-Flo Faucet Corp., 1400 Broadway, New York, N. Y. "Hot-Flo."

Instantaneous Electric Heater Corp., Root Bldg., Buffalo, N. Y. "Vulcan."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic." "Mesco."

National Electric Water Heater Corp., Times Bldg., New York, N. Y. "Little Wonder." "Geyser."

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Steelclad." (See display adv. pages 1395-1402.)

HEATING DEVICES, ELECTRIC, MISCELLANEOUS.—Electric heating devices are made in a large number of forms for industrial, laboratory and other applications. In addition to those listed under heaters, furnaces, ovens, warmers, etc., there are many forms used in manufacturing processes, in medical and surgical work, offices, homes, etc. One form is a flat heater, enclosed in a metal case, that may be clamped to a boiler or sterilizer in the home or office or may be applied to the heating of small ovens or drying rooms, for air heating, or for heating press heads, rolls and plates on printing presses, etc. A few of the machines and operations to which electric heaters are applied for manufacturing purposes are: Hat forms, presses, ironers, velouring stoves, etc.; candy pans, batch warmers, bon-bon heaters and decorating funnels; die heaters for celluloid and molded compound manufacture; glue cookers, felt burners, shoe warmers, relasting irons, treeing machines and many other similar applications.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Bacon Vulcanizer Mfg. Co., 4065 Hollis St., Oakland, Cal.

Boston Last Co., 44 Binford St., Boston, Mass. (Shoe factory) "Simplex."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Britton & Doyle, 205 Caxton Bldg., Cleveland, Ohio. (Sheet and press plate) "Doyle."

Calorex Corp., The, 10 W. 23rd St., New York, N. Y. "Hot-O-Mix."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

Cushman Co., The, 14 E'm St., Barre, Vt. (Magnetic heaters.)

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display advertisement on pages 1225-1230.)

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y. (Food truck).

Eastman Kodak Co., Rochester, N. Y. (Electric tacking iron.)

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

General Ceramics Co., 50 Church St., New York, N. Y. (Electric.)

GENERAL ELECTRIC CO., Schenectady, N. Y. A cartridge unit for concentrated or localized heating to provide a more efficient method than gas or steam. Furnished in standard sizes from 70 to 1,000 watts for operation on any commercial voltage from 100 to 250 volts. These units are extensively used in shoe manufacturing, cigarette, and paper box machinery, and for heating glue pots, soldering irons, small boilers, etc. (Bulletin 69704.) This Company manufactures also what is termed a helical coil unit which can be furnished in various forms best suited for the particular work it is intended to be used for. See adv. pages 1203-1223.—Adv.

Heidbrink Co., The, 420 S. 6th St., Minneapolis, Minn. "Heidbrink."

International Electric Co., Indianapolis, Ind. "International."

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. (Therapeutic.)

Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."

Manning, Bowman & Co., Meriden, Conn.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn. "R. E. C."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Santiseptic Mfg. Co., 26 Bay St., New Brighton, Staten Island, N. Y.

Service Station Supply Co., 30-32 Larned St., Detroit, Mich. (Electric hot knife.) "Hyrate."

Sprague Canning Machinery Co., 222 N. Wabash Ave., Chicago, Ill. (Sterilizers for canning factories.)

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. (Storage battery steamers.) "Sepco."

S. U. E. Co., 89 Beach St., Boston, Mass. "Unitize."

Superior Electric, Ltd., Pembroke, Ont., Can. "Superior."

Tecla Co., Inc., Detroit, Mich.

Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. "Triplex." (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

United Shoe Machinery Corp., 205 Lincoln St., Boston, Mass. (For shoe making machines).

Vit-O-Net Mfg. Co., 1225 N. Clark St., Chicago, Ill. "Vit-O-Net." (Pneumonia jackets.)

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y (Felt burning tool).

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATING ELEMENTS, MISCELLANEOUS.—Heating elements for use in various kinds of heaters frequently need to be replaced because of burnouts. Instead of sending to the manufacturer for the new unit to be installed, some manufacturers supply the miscellaneous heating elements so that a well equipped electrical repair shop can carry a stock of them and install them. This saves time and expense for the customer. Because of the large number of heaters made and the variations in different models of the same kind of heater, a great number of heating elements would be required. For this reason those repair shops that undertake such work as a rule carry only a small stock of elements for the most popular forms of heater.

Heating elements are also supplied by manufacturers with special facilities for their production to other manufacturers that make merely the casing, vessel or body of the heating device. Water heaters, air or space heaters, etc., are sometimes made by metal stamping concerns that are glad to purchase suitable heating elements for their needs.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Bacon Vulcanizer Mfg. Co., 4065 Hollis St., Oakland, Cal.

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Betz Co., Frank S., Hoffman St., Hammond, Ind.

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Electric Heat Unit Co., 1504 S. Grand Ave., St. Louis, Mo.

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

Hot-Flo Faucet Corp., 1400 Broadway, New York, N. Y.

International Electric Co., Indianapolis, Ind. "International."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

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National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C.
Phillips Electrical Co., Inc., 75 South Ave., Rochester, N. Y. (For hand shoe irons)
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.
Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
Tecla Co., Inc., Detroit, Mich.
Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. "Triplex." (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)
Weeks Mfg. Co., H. G., Hamilton, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HEATING, INDUSTRIAL. — See Industrial heating.

HEATING MACHINES, RIVET. — See Rivet heating machines, electric.

HEATING OF DYNAMOELECTRIC MACHINES.—One of the most common and troublesome faults in the operation of motors and generators is the excessive heating of the constituent parts of the machine, due either to a heavy overload or other electrical cause or to mechanical causes. It is this heating that determines the load any machine may safely carry without damaging the insulation. The temperature is detected by the use of a thermometer on some low-tension machines and by thermocouples imbedded in the machine in the larger high-tension generators. With small motors very often the first indication noticed is the odor of overheated paint, varnish or insulation and when this is noticed the machine should be stopped at once.

Even in normal operation all of the unavoidable losses in the machine are converted into heat, which raises the temperature of the conductors and their insulation, as well as the iron parts of the machine. Provision is usually made for self-cooling of the machine to dissipate this heat. In the case of compact, large-load-capacity machines special ventilation is required. See Generator cooling equipment.

HEATING OF ELECTROLYTE. — The warming up of an electrolyte by the energy set free within it by the passage of the electrolyzing current. The amount of this heat energy is equal to the total energy of the current minus the energy absorbed and disappearing in doing chemical work. This internally generated heat will maintain the electrolyte at a certain number of degrees above the surrounding temperature. In copper refining plants this may be 20° to 50° C., in aluminum pots 900° to 950° C. It may be regulated by varying the amperes passing and by varying the distance between the electrodes.

HEATING PADS, ELECTRIC.—Pads of cloth between the layers of which are flexible insulated heating elements, generally in the form of fine wire wound on an asbestos core and covered with asbestos. The pads are often provided with a switch for giving any one of three temperatures and one or more thermostats are placed in the electric circuit to prevent accidental overheating. These pads take the place of hot-water bottles, but are much more convenient and their flexibility permits them to conform to any part of the body. One type of these outfits is made nonflexible with an aluminum enclosing case shaped like a canteen. Electric pads are used in homes, hospitals and institutions, and may be applied directly to the body or used to warm up a bed on a sleeping porch or in a cold room.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric warming pad, replaces old fashioned, troublesome and cumbersome hot water bag. Consists of a flexible electric heating element with an outer cover of eiderdown which is removable. Arranged with three heats and regulated by means of a switch easily operated in the dark. Heat control regulated by two thermostats. Complete with 10-ft. cord, having three-heat switch and lamp socket attachment plug.—Adv.

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Comfort Electric Atomizer Co., The, 959 1st Ave., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. The round pad shown below is made of aluminum, is rust proof and may be used in either wet or dry pack. It is disc shaped, convex on one side and concave on the other. Fits to the body



"Hotpoint" Safety Heating Pads

curves. The other, a flexible heating pad, is made of steel units, so hinged together as to form a flexible jacket. Can be comfortably wrapped around an injured or aching limb. Any temperature between 100 and 200° F. may be obtained from both heating pads. They are so equipped that they may be regulated in the dark—under the bed coverings. They have a washable eiderdown cover, and come complete with cord, attachment plug and small contact plug. See display adv. pages 1292-3.—Adv

Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind. "Lectro-Warm."

GOODWILL ELECTRIC CO., THE, 59 E. Van Buren St., Chicago, Ill. The Goodwill electric pad (the automatic electric heating pad) has been devel-



Goodwill Automatic Electric Heating Pad

oped with a view to absolute safety, great accuracy, and extreme durability. Its temperature is controlled by a special adjustable thermostat in the center of the pad, the arms of this thermostat being wound with the same resistance wire that heats the pad. This insures perfect heat control, at all temperatures between 100 and 180° F. The helical construction of the pad makes it most durable, and it may be bent and twisted in any way without danger of injury. The Goodwill pad comes complete with blue eiderdown and white rubber covers, and 12 ft. cord with thru-switch. It is 10 in. in diameter and weighs 6 oz. The cost of operation is about 2 cts. a night. It is fully guaranteed for one year. It is approved and endorsed by the Good Housekeeping Institute and the New York Tribune Institute, and handled by the best dealers and jobbers. Prices, discounts and literature on application.—Adv.

Hainert & Son, F. H., Minneapolis, Minn. "Sta-Warm."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y.
Ingersoll Electric Appliance Co., 746 S. Wabash Ave., Chicago, Ill. "Electro-Flexo."

LANDERS, FRARY & CLARK, New Britain, Conn. Soft, flexible and conforms to the body. Three-heat cord switch, operates by slight pressure of the finger. Patented 4-thermostat con-



"Universal" Heating Pad

trol insures absolute maintenance of each degree of heat. Size of pad, 12 by 15 ins. Gray elderdown cover. Maximum heat, 60 watts. Complete with 10-ft. heater cord and plug.—Adv.

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manning, Bowman & Co., Meriden, Conn.
Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.
Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."
Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn. "Ever Ready."

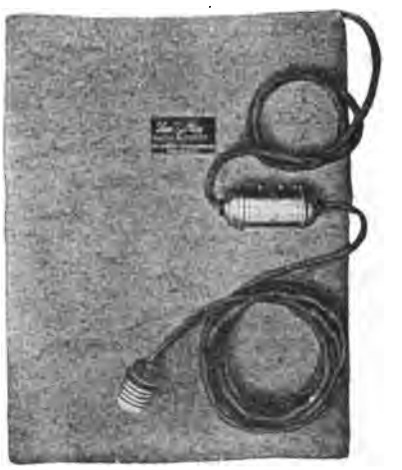
RUSSELL ELECTRIC CO., 140 W. Austin Avenue, Chicago, Ill. Manufacturer of Hold Heet pads, a reliable product of the highest quality. Guaranteed for two years. Moderate prices are made possible by enormous quantity production. Grey elderdown cover, size 12x15 ins. Three heat Cutler-Hammer switch, complete with ten feet of cord and washable slip. "The World's Best."—Adv.



"Hold Heet" Pad

Sanitarium Equipment Co., Battle Creek, Mich. "Thermophore."
Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y. "Sanotherm."
Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.
Slaughter & Co., William E., 1716 S. Michigan Ave., Chicago, Ill. "Parisian."
Standard Electrical Appliance Co., Beverly, N. J. "Seaco."
Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.

SUN-RAY MANUFACTURING CO., THE, Oshkosh, Wis. The Sun-Ray heating pad is of improved design, size 12 by 15 ins., finished in the finest elderdown. Replaces hot-water bottles and similar



Sun-Ray Heating Pad

devices. Heating element is formed by winding resistance wire on asbestos cord and covering with asbestos, which provides a flexible element of unusual

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strength, assuring permanent element protection, long life and the elimination of open circuits. The Sun-Ray is made for use on either A-C. or D-C. circuits, and for 25 to 40, 100 to 125 or 200 to 250 volts, as specified. The 25 to 40-volt pad is furnished for one heat; the 100 to 125-volt pad for either one or three heats; 200 to 250-volt pad has one heat; three heat pad uses 20 watts on low, 35 on medium and 55 on high heat. Is equipped with 10-ft. of reinforced portable cord and attachment plug, 3-heat switch and sanitary washable cover. Has automatic thermostatic control that maintains heat at 180-deg. F. Pad is so flexible it may be rolled into a ball or wrapped around a limb without danger of injuring heating element; soft and pliable; does not irritate the skin.—Adv.

Vit-O-Net Mfg. Co., 1225 N. Clark St., Chicago, Ill. "Vit-O-Net."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display advertisement on pages 1395-1402.)

Wirt Co., 5221 Greene St., Philadelphia, Pa.

HEATING SURFACE, BOILER.—Boiler heating surface is that part of a steam boiler exposed to the heat generated by the boiler furnace on one side and water or steam on the other side. The area of heating surface is used in expressing the boiler horsepower. This area is the number of square feet of boiler and tube surface exposed to the action of the flames and hot gases. Its value depends upon the number and length and diameter of the tubes or flues and upon the area of the boiler shell. Water-tube boilers are usually rated on the basis of one boiler hp. for each 10 sq. ft. of heating surface; Scotch marine boilers on 8 sq. ft., and horizontal return tubular boilers on 12 sq. ft.

HEATHER CO., THE R. C.—19-21 W. 36th St., New York, N. Y. Manufacturer of lighting fixtures.

HEATHERLITE.—Trade name for lighting fixtures manufactured by the R. C. Heather Co., 19-21 W. 36th St., New York, N. Y.

HEATOLITE.—Trade name for electrotherapeutic lamp manufactured by S. Robert Schwartz & Bro., 729-31 Broadway, New York, N. Y.

HEBENDAHL CO., J. P.—228-232 Broadway, Elizabethport, N. J. Manufacturer of electrical construction supplies.

HECO.—Trade name for electric automobile horns, ignition and generating apparatus manufactured by the Heinze Electric Co., Lowell, Mass.

HECTOR. — Trade name for belting manufactured by the Republic Rubber Corp., Youngstown, Ohio.

HEDLITE.—Trade name for electric radiator manufactured by the Edison Electric Appliance Co., Inc., 5660 W. Taylor St., Chicago, Ill.

HEEBNER & SONS. — Lansdale, Pa. Manufacturers of electrically operated peanut and grain threshers and feed and ensilage cutters. William D. Heebner, proprietor.

HEET SHEET.—Trade name for flanges, cylinder heads, etc., made by the Eureka Packing Co., 78 Murray St., New York, N. Y.

HEIDBRINK CO., THE.—420 S. 6th St., Minneapolis, Minn. Manufacturer of electric dental laboratory equipment. President, Dr. J. A. Heidbrink; vice-president and treasurer, B. J. Clark.

HEIL.—Trade name for foot ammeter for electroplating purposes made by the Coleman Lamp Co., 220-224 St. Francis Ave., Wichita, Kans.

HEIL CHEMICAL CO., HENRY.—St. Louis, Mo. Manufacturer of chemical balances, etc.

HEINE CHIMNEY CO.—123 W. Madison St., Chicago, Ill. Manufacturer of power plant chimneys. President, Heinrich Heine; secretary and treasurer, Eric Plagwitt.

HEINE SAFETY BOILER CO.—St. Louis, Mo. Manufacturer of boilers, feed water heaters, etc. Business established 1884. President and treasurer, C. R. D. Meier; vice-president, E. R. Fish; secretary, J. T. Brennan. Main office, 5316 Marcus Ave., St. Louis, Mo. Branch offices, 11 Broadway, New York, N. Y.; Pennsylvania Bldg., Philadelphia, Pa.; Park Bldg., Pittsburgh, Pa.; 50 Congress St., Boston, Mass.; 1st National Bank Bldg., Chicago, Ill.; Schofield Bldg., Cleveland, Ohio; Union Trust Bldg., Cincinnati, Ohio; Dime Bank Bldg., Detroit, Mich.; Godchaux Bldg., New Orleans, La.; Phoenixville, Pa.

HEINEMAN ELECTRIC CO.—5th St. & Girard Ave., Philadelphia, Pa. Manufacturer of knife switches and cutout boxes. Business established 1888. President, Bernard S. Berlin; secretary, Alfred G. Heinemann; sales manager, B. L. Howard.

HEINTZ & CO., JAMES C.—1319 Main Ave., Cleveland, Ohio. Manufacturers of automatic electric steam vulcanizers.

HEINZE ELECTRIC CO., THE.—Lowell, Mass. Manufacturer of automobile horns, ignition and generating apparatus. President, Joseph A. Legare; treasurer, C. Brooks Stevens; general manager, Butler Ames; sales manager, A. R. Bliss.

HEINZE-SPRINGFIELD. — Trade name for automobile starting systems manufactured by the Service Products Co., Greenawalt Bldg., Springfield, Ohio.

HEISSLER STORAGE BATTERY CO.—2506-10 Cottage Grove Ave., Chicago, Ill. Manufacturer of storage batteries. Business established 1909. President and general manager, E. R. Heissler.

HELFENSTEIN FURNACE.—A type of electric furnace which is entirely enclosed for more efficient control of the furnace gases.

HELICOID. — Trade name for piston packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

HELIOS. — Trade name for packing manufactured by the Crandall Packing Co., Palmyra, N. Y.

HELLER.—Trade name for showcases, display boards, etc., for electrical stores manufactured by Stevens & Co., 375 Broadway, New York, N. Y.

HELLER & CO., W. C.—Montpelier, Ohio. Manufacturers of display boards, fixtures, wall cases, etc., for electrical stores.

HELLER ELEVATOR CO., S.—250 Milwaukee St., Milwaukee, Wis. Manufacturer of electric passenger and freight elevators. Business established 1900. President and treasurer, S. Heller; vice-president, Leo Glueckstein; secretary and general manager, J. E. Freede. Sales representatives, H. Channon Co., Chicago, Ill.; Peter O'Brien, New Orleans, La.

HELMETS AND FACE MASKS OR SHIELDS, WELDERS'.—In the carbon arc welding process where both hands are required a helmet is necessary. There are many patented designs. The comfort of the operator should be considered. The carbon arc is a very hot one and is charged more highly with invisible rays than the metallic arc. This requires that the helmet be so fashioned that the operator's eyes as well as his entire face, neck and breast are well protected. The metallic arc process is a cooler process and only requires the use of one hand. In this work the operator usually prefers a screen or face mask which he holds ordinarily in his left hand. This screen is so made that it protects the sides of his face as well as his eyes. The screen permits him to quickly view his work after he breaks the arc.

For eye protection in the window sections of helmets and screens a special type of glass is manufactured in several degrees of color. This permits a selection not only for different classes of work, but for different vision on the part of the welder. Combinations of colored glass may be employed, but the combination should have the sanction of those well acquainted with the work before general adoption. It is to be remembered that the invisible ultra-violet and infra-red rays are emitted by the arc in the same manner as the visible rays, so goggles should be worn by those whose duties require them to inspect welders while at work. The arc should not be viewed closely without eye protection.

Manufacturers:

Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

Electric Arc Cutting & Welding Co., 152-158 Jelliff Ave., Newark, N. J. "Newarc."

Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill.

Ideal Face Shield Co., The, 468 N. Garfield Ave., Columbus, Ohio. "Ideal."

Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y.

HELMHOLTZ-THOMSON RULE.—That the energy absorbed in chemical work in electrolysis is derived from the electrical energy used, and determines, for any given amperes passing and chemical work done, the voltage disappearing in doing chemical work. Quantitatively, this is calculated by dividing the heat value of the chemical work expressed in gram-calories per chemical equivalent (in grams) of chemical change produced, by the constant 23,050. This constant is the energy value of 1 faraday falling in potential 1 volt, equal to 96,500 joules or 23,050 calories. See Thermochemical equivalent of the volt.

HELWIG MFG. CO.—St. Paul, Minn. Manufacturer of bolt and wire cutters and monkey wrenches.

HEMAFA.—Trade name for motor-driven cloth cutting machines manufactured by the Wildman Mfg. Co., Norristown, Pa.

HEMATITE.—An important ore of iron (Fe_2O_3) which has a red color when in the form of a powder. Hematite crystals are either steel blue or black. It is also known as specular iron.

HEMCO.—Trade name for plugs and sockets manufactured by the Hemco Electric Mfg. Co., Inc., 344 E. 40th St., New York, N. Y. (Exclusive distributor, George Richards & Co., 557 W. Monroe St., Chicago, Ill.)

HEMCO ELECTRIC MFG. CO., INC.—344 E. 40th St., New York, N. Y. Manufacturer of plugs, sockets and other electrical specialties. President, Benjamin P. McKinley; secretary, A. M. Berg. Exclusive distributor, George Richards & Co., 557 W. Monroe St., Chicago, Ill.

HEMCO TWIN-LITE.—Trade name for duplex socket manufactured by the Hemco Electric Mfg. Co., Inc., 344 E. 40th St., New York, N. Y. (Exclusive distributor, George Richards & Co., 557 W. Monroe St., Chicago, Ill.)

HEMINGRAY GLASS CO.—Muncie, Ind. Manufacturer of glass insulators. Business established 1848. President, P. W. McAbee; vice-president, A. C. Shinkle; secretary, W. E. Evans.

HEMIT.—Trade name for molded insulation manufactured by the Garfield Mfg. Co., Garfield, N. J.

HEMPFIELD FOUNDRIES CO.—35th & Charlotte Sts., Pittsburgh, Pa. Manufacturer of pipe fittings, pipes for power plants and valves. Business established 1912. President and general manager, H. M. Meixner; vice-president, William A. Bachman; secretary, R. L. Brinkley; treasurer, Charles R. Ball; sales manager, W. R. Neely.

HEMPY-COOPER MFG. CO.—418 Archibald St., Kansas City, Mo. Manufacturer of automobile voltammeters. Business established 1919. President, treasurer and general manager, Guy Cooper; vice-president, W. J. Hempy; secretary, J. O. Cooper.

HENDEE.—Trade name for secondary racks manufactured by the Line Material Co., South Milwaukee, Wis.

HENDERSON.—Trade name for boring machine manufactured by the Henderson Electric Co., Ampere, N. J.

HENDERSON ELECTRIC CO.—Ampere, N. J. Manufacturer of joist boring and conduit benders. Business established 1893. R. H. Henderson, proprietor.

HENDERSON-WILLIS WELDING & CUTTING CO.—2305-15 N. 11th St., St. Louis, Mo. Manufacturer of oxyacetylene welding and cutting outfits. President and treasurer, P. F. Willis; vice-president, E. M. Willis; secretary, K. E. Kruse.

HENDRICKSON CHANDELIER MFG. CO.—4032 11th Ave., S., Minneapolis, Minn. Manufacturer of lighting fixtures. E. O. Hendrickson, proprietor.

HENDRIE & BOLTHOFF MFG. & SUPPLY CO., THE.—Denver, Colo. Manufacturer of electric sirens for fire alarms, curfew and general signaling service. Business established 1861.

HENKEL & BEST CO.—122 S. Michigan Ave., Chicago, Ill. Manufacturer of lighting fixtures. President and general manager, Harry A. Best; vice-president, J. M. Gilchrist; secretary and sales manager, A. A. Henkel; treasurer, J. F. McPhearson.

HENRICH REFLECTOR CO., INC.—222 W. 35th St., New York, N. Y. Manufacturer of electric signs and lighting reflectors. Business established 1917. President and general manager, I. Levinson; sales manager, M. A. Elias.

HENRICI LAUNDRY MACHINERY CO.—61 W. Selden St., Mattapan, Boston, Mass. Manufacturer of electric laundry washing machines. Business established 1900. General manager, F. Henrici. Factory, Boston, Mass. Exclusive distributor, Troy Laundry Machinery Co., 133 Centre St., New York, N. Y.

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HENRY.—The henry is the practical unit of inductance. It is that inductance of a circuit in which the induced e. m. f. is one volt while the current, to whose variation the voltage is due, varies at the rate of one ampere per second. The henry is a comparatively large unit, hence the millihenry, which is 0.001 henry, is often used.

HENRY, JOSEPH.—An American physicist (born in Albany, N. Y., 1797, died in Washington, D. C., 1878) noted for his researches in electromagnetism. He was educated in the common schools of Albany and in the Albany Academy, where in 1826 he became instructor of mathematics and natural philosophy. He made his first public demonstration of his magnetic discoveries in exhibiting before the Albany Academy small electromagnets wound with silk-covered wire. These magnets had greater power than any that had yet been known, some being capable of lifting 3500 lbs. In 1831 Henry sent a current through a mile of fine copper wire around a room and caused an armature to be attracted and strike a bell, thus producing an audible signal, thereby establishing the principle later employed in telegraph practice. His electromagnetic investigations attracted much attention and led to his election as professor of natural philosophy in Princeton College, where he continued his studies and demonstrations. By his experiments he produced electrical apparatus which was later developed into telegraph relay and receiving magnets, while his demonstration of the conditions and range of induction from electric currents, as well as his discovery of oscillatory currents, paved the way for other developments in telegraphy.

In 1846 he was made secretary of the Smithsonian Institution at Washington; in 1849 he was elected president of the American Association for the Advancement of Science; in 1868 he was chosen president of the National Academy of Sciences, and in 1871 president of the Philosophical Society of Washington. As chairman of the United States Lighthouse Board he made important tests in marine signals and lights. He also investigated the acoustics of public buildings, meteorological changes of the atmosphere and methods of telegraphic transmission of meteorological observations from all points of the continent. The unit of inductance is named the henry in honor of his investigations of electromagnetic phenomena and induction.

HENRY'S LAWS.—When referring to gases dissolved in liquids, the fact that the quantity of gas dissolved is proportional to the pressure applied. Referring to mixtures of gases, the principle of partial pressures, which considers each ingredient of a gas mixture to occupy the volume of the mixture but at a pressure which is only part of the total pressure on the mixture, hence called a partial pressure. The sum of the partial pressures of the various gases in the mixture equals the total pressure on the mixture.

HEPBURN TELEPHONE MFG. CO., THE.—325 S. Dearborn St., Chicago, Ill. Manufacturer of intercommunicating telephones, rheostats, switches, push buttons, etc. Business established 1905. President and treasurer, Walter L. Davis; secretary, A. K. Davis.

HEPWORTH CO., S. S.—2 Rector St., New York, N. Y. Manufacturer of electric centrifugal machines. Business established 1893. President, H. E. Donnell; vice-president, J. B. Mackintosh; secretary, E. M. Mackintosh; treasurer, G. E. Donnell; general manager, C. A. Olcott.

HERALITE.—Trade name for glass sign letters manufactured by the Pressed Prism Plate Glass Co., 25 N. Dearborn St., Chicago, Ill.

HERBERT BOILER CO.—140 Root St. Chicago, Ill. Manufacturer of boilers. President, M. E. Herbert; secretary, W. H. Herbert.

HERBERTS ENGINEERING CO., INC.—500 5th Ave., New York, N. Y. Manufacturer of electrical advertising specialties. Business established 1916. President and general manager, H. J. Herberts; 1st vice-president and secretary, Alfred E. Wiener; 2nd vice-president, J. A. Firsching; treasurer, E. E. Ross.

HERBST, PAUL W.—180 N. Dearborn St., Chicago, Ill. Manufacturer of electricians' and linemen's tools.

HERCULES.—Trade name for expansion bolts and conduit waterproofing material manufactured by B. S. Barnard & Co., 31 Union Sq., New York, N. Y.

HERCULES.—Trade name for motor-driven pumps manufactured by the Barnes Mfg. Co., N. Main St., Mansfield, Ohio.

HERCULES.—Trade name for toy transformer manufactured by the Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

HERCULES.—Trade name for screw wrenches manufactured by the Bonney Vise & Tool Works, Inc., Allentown, Pa.

HERCULES.—Trade name for motor-driven hammers manufactured by the Champion Blower & Forge Co., Lancaster, Pa.

HERCULES.—Trade name for spark plugs manufactured by the Eclipse Mfg. Co., 424 N. Meridian St., Indianapolis, Ind.

HERCULES.—Trade name for motor-driven pulverizers manufactured by the Gruendler Patent Crusher & Pulverizer Co., 928 N. 1st St., St. Louis, Mo.

HERCULES.—Trade name for power transmission chains manufactured by the Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.

HERCULES.—Trade name for portable conduit and pipe bending machines manufactured by the Jones Tool Co., 1912 Van Buren Rd., Cleveland, Ohio.

HERCULES.—Trade name for galvanized wire strand and wire rope manufactured by the A. Leschen & Sons Rope Co., 5909 Kennerly Ave., St. Louis, Mo.

HERCULES.—Trade name for transformers manufactured by the Bertrand F. Miller Co., High & Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

HERCULES.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

HERCULES.—Trade name for tinners' shears manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

HERCULES.—Trade name for power transmission belting and piston packing manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

HERCULES.—Trade name for shears and rod cutters manufactured by W. F. & C. F. Tucker, 191 Franklin Ave., Hartford, Conn.

HERCULES.—Trade name for twist drills manufactured by the Whitman & Barnes Mfg. Co., Akron, Ohio.

HERCULES.—Trade name for gasoline engine manufactured by Woodin & Little, 33-41 Fremont St., San Francisco, Cal.

HERCULES CORP., THE.—Evansville, Ind. Manufacturer of gas engines. Business established 1902. W. H. McCurdy, president.

HERCULES MFG. CO.—2122 Northwestern Ave., Indianapolis, Ind. Manufacturer of ignition magneto generators. President and treasurer, C. G. McCutcheon; vice-president, Frank Remy; general manager, W. R. Poland.

HEROULT.—Trade name for electric furnaces manufactured by the United States Steel Corp., 71 Broadway, New York, N. Y.

HEROULT FURNACE.—An electric furnace of the combined arc-resistance type, used chiefly in the production of steel and steel alloys. The electrodes are all suspended above the bath.

HERR MFG. CO., JOHN.—44 N. 4th St., Philadelphia, Pa. Manufacturer of electric floor scrubbing, sanding, polishing, surfacing and grinding machines. Business established 1910. J. Herr, sole owner.

HERRINGTON.—Trade name for piston, valve and plunger packing made by the Imperial Packing Corp., 191 Greenwich St., New York, N. Y.

HERSH BROS. CO.—Allentown, Pa. Manufacturer of motor-driven ventilating fans, air washers, etc. General manager, G. Willis Hersh; sales manager, George W. Barr.

HERTNER ELECTRIC CO., THE.—1905 W. 114th St., Cleveland, Ohio. Manufacturer of motor-generators and battery-charging sets. President, D. C. Cookingham; vice-president and treasurer, J. H. Hertner; secretary, H. K. Cookingham.

HERTZ, HEINRICH.—A German physicist (born at Hamburg, 1857, and died at Bonn, 1894), who discovered electromagnetic waves which form the basis of radio telegraphy. He studied civil engineering, but forsook this profession for the study of mathematics and science, which he pursued at Munich and Berlin, becoming Helmholtz's assistant at Berlin University in 1880. In 1883 Hertz became lecturer on theoretical physics at Kiel and two years later he was called to the Polytechnic Institute at Karlsruhe as professor of physics; in 1889 he became professor of physics at the University of Bonn. His most important work was his experiments with radiant electricity by which he proved that electricity can be transmitted in electromagnetic waves with the same rapidity as light, these waves showing the phenomena of refraction, reflection, diffraction and polarization as light waves. These waves are often called Hertzian waves in his honor. His first paper describing his discoveries in electricity was published in 1887. English translations of his scientific papers were published by Prof. D. E. Jones.

HERTZIAN WAVES OR OSCILLATIONS.—Hertzian waves are electromagnetic waves given off by an electromagnet whose intensity is undergoing rapid periodic variations or by a rapidly varying or high-frequency alternating current. They are generally produced by an oscillatory discharge in a circuit, radio telegraphy being a practical application of this principle.

HERWIG ART SHADE & LAMP CO.—2140 N. Halsted St., Chicago, Ill. Manufacturer of lighting fixtures and lighting specialties. Business established 1908. President and treasurer, William D. Herwig.

HERZ.—Trade name for spark plugs and ignition timers manufactured by the Pro-Mo-Tor Fabricating Corp., 182 Locust Ave., New York, N. Y.

HERZOG MINIATURE LAMP CO., W. F.—51 Jackson Ave., Long Island City, N. Y. Manufacturer of miniature incandescent lamps. Sales representatives, Western Agencies Co., 12 E. 9th St., Los Angeles, Cal., 285 Mina St., San Francisco, Cal., 923 Pine St., Seattle, Wash.

HESS.—Trade name for fire alarm and burglar alarms apparatus and systems manufactured by the Metropolitan Electric Protective Co., 130 W. 26th St., New York, N. Y.

HESSBERGER FURNACE.—See Schoenherr-Hessberger furnace.

HETERODYNE RECEPTION, RADIO.—A method for receiving undamped radio telegraph signals. (See Radio telegraph receiving apparatus.)

HETEROGENEOUS DIELECTRIC.—A dielectric that has varying properties of insulation, conductivity or induction when measured in different directions.

HEURTLEY MAGNIFIER.—A submarine cable receiving system invented by Heurtley, by means of which the strength of incoming signal impulses is increased.

HEVI-DUTY.—Trade name for electric furnaces and hot plates manufactured by the Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J.

HEWITT & BROS., C. B.—16-24 Ferry St., New York, N. Y. Manufacturers of insulating papers. President, George F. Hewitt, Jr.; vice-presidents, Robert A. Alberts, William T. Bannister and Frederick L. Reeves; secretary, Frederick L. Reeves; treasurer, Frederick Ulrich.

HEXALITE, JR.—Trade name for lighting unit manufactured by the Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.

HEYWOOD BROS. & WAKEFIELD CO.—Boston, Mass. Manufacturer of car seats for passengers, conductors and motormen. Business established 1826. Incorporated 1897. President, C. H. Lang; vice-president, C. H. Hill; secretary, H. C. Perry; treasurer and general manager, F. L. Butler; sales manager, A. L. Lougee. Main office, 209 Washington St., Boston, Mass. Factory, Wakefield, Mass. Branch offices, 1415 Michigan Ave., Chicago, Ill.; 215 E. 6th St., Los Angeles, Cal.; 516 W. 34th St., New York, N. Y.; 149 10th St., Portland, Ore.; Monadnock Bldg., San Francisco, Cal.; 630 Louisiana Ave., Washington, D. C. Sales representatives, G. F. Cotter Supply Co., Southern Pacific Bldg., Houston, Tex.; Railway & Power Engineering Corp., Ltd., 133 Eastern Ave., Toronto, Ont., Can.

HEYWOOD-WAKEFIELD.—Trade name for car seats manufactured by the Heywood Bros. & Wakefield Co., 209 Washington St., Boston, Mass.

HG.—The form Hg is the chemical symbol for the metallic element mercury, whose Latin name is hydrargyrum.

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H-G MFG. CO., THE.—1215 Pine St., St. Louis, Mo. Manufacturer of fractional horsepower motors. Business established 1919. President, J. F. Galvin; vice-president, A. McR. Harrelson; secretary, Charles A. Neumann; treasurer, Silas Altorfer.

HIAWATHA.—Trade name for guy anchors manufactured by the Hallett Iron Works, Harvey, Ill.

HICKEY & SCHNEIDER, INC.—439-43 E. Jersey St., Elizabeth, N. J. Manufacturer of high-tension switching and protective line maintenance and construction equipment. Business established 1912. President and general manager, John Schneider; vice-president, William Hanzl; secretary, John Miller; treasurer, George E. Thum. Sales representative, H. C. Roberts Electric Supply Co., 1101-5 Race St., Philadelphia, Pa.

HICKEYS, CONDUIT.—See Benders, conduit and pipe, portable.

HICKEYS, FIXTURE.—The fixture hickey is a metal fitting for fastening the crowfoot or fixture stud to the fixture stem. It is essentially a short hollow piece, threaded inside or outside at both ends to provide a means of fastening to the stem and stud and has an opening cut on opposite sides to allow the fixture wires to enter the stem. Hickeys are made in various sizes and shapes, most being for straight electric fixtures and some for combination gas and electric fixtures. Some types are made of two pieces insulated from each other so as to insulate the fixture from the outlet box and eliminate need for a separate insulating joint.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Dunlap Co., John, Carnegie, Pa. "J-D."
Faries Mfg. Co., Decatur, Ill.
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
Liberty Machine Co., Wauwatosa, Wis.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
M. S. W. Mfg. Co., Inc., 1527-1529 Niagara St., Buffalo, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
Peerless Light Co., 663-671 W. Washington Blvd., Chicago, Ill. "Hangstrate."
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display advertisement on page 1308.)
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."

HICKOK ELECTRICAL INSTRUMENT CO., THE.—10514 Dupont Ave., Cleveland, Ohio. Manufacturer of electrical and testing instruments. Business established 1913. President, treasurer and general manager, R. D. Hickok; vice-president, C. F. Schultz; secretary, W. H. Eberle.

HICKORY.—Trade name for packings for pistons, valves, etc., manufactured by Randolph Brandt, 70 Cortlandt St., New York, N. Y.

HICKS, W. WESLEY.—San Francisco, Cal. Manufacturer of electric heating appliances. Business established 1918. Main office, 660 Market St., San Francisco, Cal. Branch office, Tacoma, Wash.

HIGGINS.—Trade name for ground clamps manufactured by the Model Products Co., 9th & Venango Sts., Philadelphia, Pa.

HIGGINS FURNACE.—An electric furnace designed especially for the fusion of bauxite for the production of artificial corundum.

HIGH DUTY.—Trade name for belt fasteners manufactured by the Flexible Steel Lacing Co., 4607-4631 Lexington St., Chicago, Ill.

HIGH-DUTY.—Trade name for valves manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

HIGH DUTY.—Trade name for magnetic pulleys made by the Magnetic Mfg. Co., 774 Windlake Ave., Milwaukee, Wis.

HIGH FREQUENCY.—High frequency is a term applied to an alternating current having a very high rate of alternation. There is no definite agreement as to what the lower limit for high frequency is. In commercial lighting and power circuits 133 cycles per second formerly used is now considered a relatively high frequency, since 60 cycles has been the upper limit for this service for many years. In telephony frequencies commonly used are much higher than this and anything above about 5000 cycles per second is considered high frequency. Radio frequency currents are generally all considered as high frequency and run from about 18,000 to about 3,000,000 cycles per second.

HIGH-FREQUENCY APPARATUS. MISCELLANEOUS ELECTROTHERAPEUTIC.—High-frequency electrical apparatus used for therapeutic purposes is made in a number of forms. While a few of the principal types of apparatus are described elsewhere in this book, there are special forms of machines used in the treatment of the body. Some of these are apparatus for converting ordinary lighting into high-frequency current by the use of special mechanical interrupters, electrolytic interrupters, special transformers, etc. There are also special sets consisting of motor-generators, electrolytic rectifiers, transformers, etc., that may be used for producing a great variety of currents of different frequencies, etc., and for giving vibratory motion, compressed air, and many other forms of energy used in treatment of the body. Also see Generators, high-frequency, electrotherapeutic; Violet-ray high-frequency apparatus, electrodes and attachments.

Manufacturers:

Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind. "Wood's."
BLEADON-DUN CO., 213 S. Peoria St., Chicago, Ill. "Baby Violetta," "Violetta." (See display advertisement on page 1295.)
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Easter Electric Co., The, 827 14th St., Denver, Colo.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Violet-Ray-O."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kapota Electric Machines Sales Co., Hyman, 25 W. 42nd St., New York, N. Y.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Master Electric Co., 113 S. Jefferson St., Chicago, Ill. "Sine-Flux." "De Luxe."
McINTOSH BATTERY & OPTICAL CO., 217-223 N. Desplaines St., Chicago, Ill. "Hogan" high-frequency apparatus, transformer type, affording high frequency currents of the most efficient character for auto-condensation, diathermy, electro-coagulation and all vacuum tube treatment.—Adv.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
RENULIFE ELECTRIC CO., Marquette Bldg., Detroit, Mich.
Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.
Tecla Co., Inc., Detroit, Mich.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Virazone Co., The, 1111 Absopure Bldg., Detroit, Mich.
Vulcan Electric Co., 239 S. Los Angeles St., Los Angeles, Cal. "Vulcan."
Wait & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis. "Vi-Ray-O."
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.

HIGH-FREQUENCY GENERATORS.—See Generators, high-frequency electrotherapeutic; also Generators, high-frequency radio.

HIGH-FREQUENCY TRANSFORMERS.—See Transformers, high-frequency; Transformers, radio.

HIGH-GRADE.—Trade name for generators, motors and motor-generators manufactured by the Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J.

HIGH POTENTIAL.—This term and its synonyms, "high tension" and "high voltage," are largely relative expressions designating circuits or apparatus designed for and operating at potentials higher than other circuits or apparatus with which they are related or being compared. For instance, a bell-ringing transformer has a high-potential winding of 110 volts and a low-potential winding of, say, 6 volts, yet the entire outfit is of low potential in comparison with the 2300/115-volt distributing transformer from which the bell-ringing transformer may be supplied, and the distributing transformer is of low potential in comparison with the transmission stepdown transformer of, say, 33,000/2300 volts from which it in turn receives its supply.

In spite of the widespread loose or relative nature of these expressions, there has usually been some effort to set a definite dividing line between low potential and high potential in general. This dividing line has steadily advanced with the progress of alternating-current developments, particularly in power transmission. At first the Edison 110 and 220-volt systems were considered to be low potential and any voltages above these, such as the 550-volt trolley lines and series arc systems of up to 5000 volts, were high potential. As a-c. power transmission came into use with voltages of 6600, 11,000, 22,000 and steadily rising values, all voltages over 5000 were regarded as extra-high potential by some authorities. There were wide differences of opinion, however, and are still on this point. At present, the 1920 edition of the National Electrical Code classifies potentials as follows: Low potential, 600 volts or less; high potential, 601 to 5000 volts; extra-high potential, over 5000 volts. These values are quite generally agreed to as the limits for the three classes of potentials, but by many electrical engineers are differently designated as follows: Low potential, 600 volts or less; medium potential, 601 to 5000 volts; high potential, over 5000 volts.

HIGH POWER.—Trade name for storage batteries manufactured by the Minimax Electric & Mfg. Co., Ltd., Maissonneuve, Montreal, Que., Can.

HIGH SPEED.—Trade name for arc lamp globes manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

HIGH-SPEED ENGINE CORP.—9-11 Clinton St., Newark, N. J. Manufacturer of steam engines. Business established 1920. President and general manager, Leonard M. Randolph; vice-president, Charles A. Wilson; secretary, Addison S. Sanborn; treasurer, Harry C. Gardner; sales manager, John H. Austin.

HIGH SPEED HAMMER CO., INC., THE.—313 Norton St., Rochester, N. Y. Manufacturer of electric drills and riveting machines.

HIGH TENSION.—This term is used when referring to circuits or apparatus designed for voltages exceeding 5,000. It is also used in a comparative sense in referring to any voltage of relatively high value. Also see High potential.

HIGH TENSION ELECTRICAL SPECIALTY CO.—Newton, Mass. Manufacturer of tree insulators.

HIGH-TENSION FUSES.—See Fuses, high-tension chemical; Fuses, high-tension oil-enclosed.

HIGH-TENSION FUSES, SWITCHES, TRANSFORMERS, INSULATORS.—See Fuses, high-tension, chemical, and High-tension, oil-filled; Switches, air-break, high-tension, pole top and outdoor substation; Switches, disconnecting, high-tension; Switches, oil, high-tension; Transformers, high-tension power, and high-tension testing; Insulators, porcelain pin type, high-tension, and porcelain, suspension.

HIGH TENSION SUPPLIES CO.—Wilmington, Del. Manufacturer of cartridge fuses and resistance materials. President, W. F. Hoey; vice-president and sales manager, W. B. Hoey; secretary and treasurer, D. T. Swing.

HIGH-TENSION SWITCHES.—See Switches, oil, high-tension motor-operated; Switches, oil, high-tension solenoid-operated; Switches, air-break, high-tension pole top and outdoor substation; Switches, disconnecting, high-tension.

HIGH-TENSION TRANSFORMERS.—See Transformers, high-tension power; Transformers, high-tension testing.

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HIGH VOLTAGE.—This term is used when referring to potentials exceeding 5,000 volts. It is also used in a comparative sense when referring to any relatively high voltage as compared to some other. Also see High potential.

HIGHLAND.—Trade name for soldering paste manufactured by the Highland Electro-Chemical Mfg. Co., Connellsville, Pa.

HIGHLAND ELECTRO-CHEMICAL MFG. CO.—Connellsville, Pa. Manufacturer of soldering paste, salts and sticks. Charles F. Wood, manager.

HIGHLANDER.—Trade name for revolving cylinder washing machines manufactured by the Rochester Washing Machine Corp., 87 Franklin St., Rochester, N. Y.

HIGHLANDS MFG. CO.—Muncie, Ind. Manufacturer of portable lamps, lighting fixtures and fixture fittings. Business established 1902. President, Thomas L. Ryan; vice-president, L. H. Ryan; secretary, S. M. Highlands; treasurer, C. E. Highlands.

HI-GLO SIGN CO.—Schmulbach Bldg., Wheeling, W. Va. Manufacturer of electric signs and displays. President, J. C. McKinley; vice-president and general manager, Dr. N. A. Haning; secretary, Edward L. Waddell; treasurer, H. B. Lockwood; sales manager, W. F. Hyde. Factory, Warwood, Wheeling, W. Va. Sales representatives, National Sign Co., Denver, Colo.; Myers Hi-Glo Electric Co., 1314 Wabash Ave., Chicago, Ill.; Staley, Crabb & Thomas, Indianapolis, Ind.; Steubenville Wiring Co., Steubenville, Ohio.

HI-HEET.—Trade name for molded insulations manufactured by the General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.

HILKE.—Trade name for motor-driven lumber stackers manufactured by the Seattle Machine Works, Lander St. & East Waterway, Seattle, Wash.

HILL CLUTCH CO., THE.—Cleveland, Ohio. Manufacturer of friction clutches, bearings, couplings, pulleys and other power transmitting equipment. Business established 1883. President, J. B. Perkins; secretary, Frank B. Carpenter; treasurer, Milo G. Firestone; sales manager, Hunter Morrison. Main office and factory, W. 65th St. & Breakwater Ave., Cleveland, Ohio. Branch office, 50 Church St., New York, N. Y.

HILL PUMP VALVE CO.—4601 Belmont Ave., Chicago, Ill. Manufacturer of miscellaneous valves. President and treasurer, E. H. Heller; vice-president, H. G. Heller; secretary and general manager, N. Leverone.

HILLIARD CLUTCH & MACHINERY CO., THE.—102 W. 4th St., Elmira, N. Y. Manufacturer of friction clutches and friction clutch couplings. President, J. M. Connelly; vice-president, J. S. Fassett; secretary, F. E. Robbins; treasurer, A. M. Bovier; general manager, V. R. Bruce.

HILLS-McCANNA CO.—2025 Elston Ave., Chicago, Ill. Manufacturer of lubricating devices. Business established 1898. President and sales manager, Albert H. Noyes; vice-president, Thomas A. Delaney; secretary and treasurer, Albert H. Smith.

HILO.—Trade name for telephone bracket manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

HILO.—Trade name for enamel varnishes, japans, black baking rubber finish, magnet wire enamel, etc., made by the Hilo Varnish Corp., Brooklyn, N. Y., and Chicago, Ill.

HI-LO.—Trade name for electric automobile horn manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

HILO VARNISH CORP.—Brooklyn, N. Y. Manufacturer of insulating varnishes, enamels and japans. Business established 1863. President, John H. Schumann; vice-presidents, Al G. Schumann and John H. Mills; secretary, Carl J. Schumann; treasurer, Frank M. Schumann; assistant treasurer, H. Uehlinger. Main office, 1 Gerry St., Brooklyn, N. Y. Branch office, 2420 Washburne Ave., Chicago, Ill.

HINDE & DAUCH PAPER CO., THE.—311 W. Water St., Sandusky, Ohio. Manufacturer of corrugated fiber shipping boxes and cartons.

HINDLE, CHARLES F.—45 Spring St., Ossining, N. Y. Manufacturer of electrocardigraphic equipment. Business established 1914.

HINDLEY.—Trade name for steam engines manufactured by the Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.

HINE ELIMINATOR.—Trade name for steam separator manufactured by James L. Robertson & Sons, 78-80 Murray St., New York, N. Y.

HINMAN MILKING MACHINE CO.—Oneida, N. Y. Manufacturer of electric milking machines.

HINSDILL ELECTRIC CO.—Troy, N. Y. Manufacturer of storage batteries and adjustable lighting fixtures. Charles A. Hinsdill, president. Main office, 225 River St., Troy, N. Y. Branch office, 334 Central Ave., Albany, N. Y.

HIPACO.—Trade name for pressboard manufactured by C. B. Hewitt & Bros., 16-24 Ferry St., New York, N. Y.

HIPCO.—Trade name for dry batteries manufactured by the Hipwell Mfg. Co., Pittsburgh, Pa.

HIPCOSCOPE.—Trade name for flashlights manufactured by the Hipwell Mfg. Co., Pittsburgh, Pa.

HI-PO WATERROOF BATTERY CORP.—South Norwalk, Conn. Manufacturer of dry batteries. President, E. Putney; vice-president and general manager, H. E. Warncke; secretary and treasurer, H. L. Hall.

HI-POWER.—Trade name for photographic and photoengraving lamps manufactured by J. H. Wagenhorst & Co., 704 Dollar Bank Bldg., Youngstown, Ohio.

HIPWELL MFG. CO.—Pittsburgh, Pa. Manufacturer of flashlights and flashlight batteries.

HIRSCHY CO., THE.—259 S. 1st Ave., S., Duluth, Minn. Manufacturer of electric washing machines. Business established 1917. President, treasurer and general manager, H. C. Hirschy; secretary, C. M. Rice.

HISEY-WOLF MACHINE CO., THE.—Colerain & Marshall Aves., Cincinnati, Ohio. Manufacturer of portable electric machine tools.

HI-SPEED.—Trade name for screw drivers manufactured by the M-B Tool Co., Danielson, Conn.

HI-TEN.—Trade name for pole-line hardware manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

HI-TENSIT.—Trade name for molded insulation manufactured by the Boonton Rubber Mfg. Co., Boonton, N. J.

HI TEST.—Trade name for electricians' rubber gloves manufactured by the Goodyear Rubber Co., 787-789 Broadway, New York, N. Y.

HI-TEST.—Trade name for linemen's rubber gloves manufactured by the Faultless Rubber Co., Ashland, Ohio.

HI-TEST.—Trade name for linemen's rubber gloves manufactured by the Wilson Rubber Co., 1216 Garfield Ave., S. W., Canton, Ohio.

HI-UP.—Trade name for dry batteries manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

HIVOLT RAY.—Trade name for violet-ray high-frequency coil manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

HI-VOLTAGE.—Trade name for linemen's rubber gloves manufactured by the Faultless Rubber Co., Ashland, Ohio.

HI-VOLTAGE.—Trade name for air-break switches, horn-gap fuses, choke coils and glass-tube fuses, manufactured by the Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio.

HI-VOLTAGE EQUIPMENT CO.—3305 Croton Ave., Cleveland, Ohio. Manufacturer of high-tension switching and protective equipment for outdoor installations. Business established 1920. President and general manager, L. C. Hart; secretary and treasurer, W. L. Jack.

H-K TOY & NOVELTY CO., THE.—Indianapolis, Ind. Manufacturer of toys, motors and other novelties.

HM.—Trade name for electric rivet heaters made by the Humil Corp., 101 Park Ave., New York, N. Y.

H. M. & L. M.—Trade name for lubricating oil manufactured by the Fred G. Clark Co., 1087 W. 11th St., Cleveland, Ohio.

H. M. S.—Trade name for spark plugs and screw machine products manufactured by the Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.

HOAGLAND-THAYER, INC.—300 Washington St., Newark, N. J. Manufacturer of electric industrial trucks. President, Alger M. Hoagland; secretary and treasurer, George D. Thayer. Factory, Madison, N. J.

HOBART BROS. CO.—113 Water St., Troy, Ohio. Manufacturer of battery-charging outfits, air compressors, motors and grinders. Business established 1893. President, C. C. Hobart; vice-president, C. C. Hobart, Sr.; secretary and sales manager, W. H. Hobart; treasurer and general manager, E. A. Hobart. Exclusive distributor, Battery Service & Sales, Hamilton, Ont., Can.

HOBBS CO., CLINTON E.—30-35 Pearl St., Boston, Mass. Manufacturer of electric hoists, chains and jacks. Business established 1913. President and secretary, Russell Hobbs; treasurer and general manager, Clinton E. Hobbs; sales manager, Carl B. Gury.

HOBBS STORAGE BATTERY CO.—Los Angeles, Cal. Manufacturer of starting, lighting and ignition storage batteries. Business established 1917. President and general manager, S. I. Wailes; vice-president and treasurer, A. W. Bumiller; secretary, E. P. Fay. Main office and factory, 1231 Olive St., Los Angeles, Cal. Sales representatives, R. H. Turner, 2004 Commerce St., Dallas, Tex.; R. H. Starrett, 1002 E. Denny Way, Seattle, Wash.; Fred Bellows, 28 8th St., San Francisco, Cal.

HOBRECHT CO., J. C.—1012 6th St., Sacramento, Cal. Manufacturer of lighting fixtures.

HOCKING GLASS CO.—Lancaster, Ohio. Manufacturer of illuminating glassware.

HODELL.—Trade name for chains manufactured by the Chain Products Co., 3924 Cooper Ave., Cleveland, Ohio.

HODGES STUCCO MACHINE CO., THE.—3618 Colerain Ave., Cincinnati, Ohio. Manufacturer of electric stucco machines. Business established 1919. President, John T. Rowell; secretary and treasurer, William H. Morris.

HODGKINS CO., J. F.—Box 447, Gardiner, Me. Manufacturer of trolley wheels, trolley bushings and motor bearings. Business established 1891. President and general manager, J. F. Hodgkins; secretary and treasurer, E. F. Hodgkins.

HODGMAN RUBBER CO.—Tuckahoe, N. Y. Manufacturer of linemen's gloves, boots and other rubber products. Business established 1838. President, G. B. Hodgman; vice-president, F. A. Hodgman; secretary and general manager, A. W. Warren; treasurer, S. T. Hodgman. Main office and factory, Tuckahoe, N. Y. Branch offices, 52 Chauncy St., Boston, Mass.; 1708 Republic Bldg., Chicago, Ill.

HOEPFNER PROCESSES.—Early attempts in the electrolytic production of various metals from the ores; special processes were developed for copper, zinc and nickel.

HOEVEL MFG. CORP.—Jersey City, N. J. Manufacturer of sand-blast machines. Business established 1911. President, G. H. Koven; vice-president and treasurer, L. O. Koven; secretary and general manager, H. F. Hoevel. Main office and factory, Jersey City, N. J. Branch office, 503 American Trust Bldg., Cleveland, Ohio.

HOFMANN, ALFRED.—150-152 Hudson Ave., Union Hill, N. J. Manufacturer of lamp making machinery and incandescent lamp filaments.

HOFFELD & CO., R.—61-69 Carroll St., Buffalo, N. Y. Manufacturers of felt and leather washers. Partnership, H. R. Hoffeld and William Maier.

HOFFMAN-CORR MFG. CO.—Philadelphia, Pa. Manufacturer of electrical tapes, braids, twines and ropes. Business established 1892. General manager, George F. Hoffman. Main office, 312 Market St., Philadelphia, Pa. Factories, Philadelphia, Pa., and Oxford, Ala. Branch office, 318 Lafayette St., New York, N. Y.

HOFFT CO., THE M. A.—Lemcke Bldg., Indianapolis, Ind. Manufacturer of mechanical stokers. M. A. Hofft, president.

HOGAN.—Trade name for high-frequency electrotherapeutic apparatus manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

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HOGAN SILENT.—Trade name for X-ray transformer manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

HOGAN-SPENCER-WHITLEY CO.—1052 W. 12th St., Erie, Pa. Manufacturer of electric washing machines. Business established 1919. President, J. R. Spencer; vice-president, J. J. Hogan; secretary and treasurer, R. R. Whitley.

HOIST CONTROLLERS.—See Controllers, mine and other heavy-duty hoist; also Controllers, miscellaneous hoist.

HOISTS, ELECTRIC, BUILDER'S AND CONTRACTOR'S.—Electric hoists of this type are specially designed for use in building construction where, because of fire hazard, smoke, danger of freezing in winter or other reasons, the steam hoisting engine is objectionable. They are used to operate concrete elevators and to raise brick, tile and other materials to the various working levels. The hoisting ropes are wound about the drums of the machine. The machine is usually on the ground level, the ropes being passed over pulleys supported above the working level. The hoist generally consists of a d-c. series or compound motor, or a polyphase slip-ring induction motor, with gear drive, drum-type controller, a braking device, and one or two winding drums, all compactly mounted on a single base. However, there are a number of more complex machines capable of satisfying the variety of demands made upon hoisting machinery in the erection of large steel structures.

Manufacturers:

American Hoist & Derrick Co., St. Paul, Minn.
Bedford Foundry & Machine Co., Bedford, Ind.
Brown Clutch Co., The, Sandusky, Ohio. "Little Giant," "Morgan."
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Carlin Machine Co., John H., Sandusky and Lacock Sts., Pittsburgh, Pa.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Clyde Iron Works, 27th Ave., W. and Michigan St., Duluth, Minn. (Exclusive distributor, Clyde Iron Works Sales Co.)
Denver Engineering Works Co., The, 30th and Blake Sts., Denver, Colo.
Erie Hoist Co., The, 1908 Holland St., Erie, Pa. "Erie."
Finch Mfg. Co., 9th Ave. & W. Linden St., Scranton, Pa.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
GREEN EQUIPMENT CORP., 53 W. Jackson Blvd., Chicago, Ill.
Grote Mfg. Co., F., 3rd Ave., Evansville, Ind.
Lakeside Bridge & Steel Co., North Milwaukee, Wis.
Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Marsh Engineering Works, Ltd., Belleville, Ont., Can.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Orr & Sembower, Inc., Reading, Pa.
Reading Chain & Block Corp., 2140 Adams St., Reading, Pa. "Reading."
Sasgen Derrick Co., The, 3101-3129 Grand Ave., Chicago, Ill.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill. "Thomas."
Vulcan Iron Works, 730 S. Main St., Wilkes-Barre, Pa.

HOISTS, ELECTRIC, CHAIN.—The chain hoist and its modifications are the types often used on certain traveling cranes, monorails, and various portable hoists. It is essentially a motor-operated block and tackle. The chain or rope is wound about a pulley which is either direct-connected or geared to an electric motor. The motors are generally equipped with drum type controllers and various braking devices. The controls are operated from the floor by pendent cords. The hoisting ropes are either single or double-strand type and made of chain or wire rope. The single-strand type, having no block, has the hook fastened directly to the chain. The hoists are provided with a hook so that they may be supported from any convenient point.

Manufacturers:

Brown Clutch Co., The, Sandusky, Ohio. "Morgan."
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dake Engine Co., Grand Haven, Mich.
Detroit Hoist & Machine Co., Morrow & Marston St., Detroit, Mich. "Detroit."
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Red Line."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Moore Co., The Franklin, Winsted, Conn.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Roeper Crane & Hoist Works, 1730 N. 10th St., Reading, Pa.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Yale & Towne Mfg. Co., Stamford, Conn. "Yale."

HOISTS, ELECTRIC, COAL AND ASH.—Electric hoists are used for handling coal and ash in many of the large and medium-sized power plants. Where the coal is delivered by barge, schooner or railroad car it is often unloaded by the use of a grab-bucket digger and hoist. A coal tower is provided generally with a 1 or 1.5-ton digger, and the coal is unloaded and hoisted high enough in the tower to pass by gravity through the crushers, weighing scales and finally to the conveyor. In smaller plants very often a monorail hoist is used for picking up the coal either at the car or barge and conveying it to the storage space or picking it up at the storage yard and conveying it to the bunkers. These are usually motor-driven with an operator's cab suspended alongside the hoist.

Ash handling often consists of removing the ash from the pits and transferring to a skip hoist or other hoist which is used to lift them up into storage hoppers or pockets, from which they are spouted into cars, trucks or barges for removal from the plant. Monorail hoists are also used for ash handling in some plants. For ash hoists for sidewalk use see Hoists, electric, miscellaneous and special.

Manufacturers:

American Engineering Co., Aramingo Ave. & Cumberland St., Philadelphia, Pa. "A-E-CO."
Bartlett & Snow Co., The C. O., Cleveland, Ohio.
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Burke Furnace Co., 320 E. North Water St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Carlin Machine Co., John H., Sandusky & Lacock Sts., Pittsburgh, Pa.
Denver Engineering Works Co., The, 30th & Blake Sts., Denver, Colo.
Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich. "Detroit."
Ernst, Charles K., 999-1007 E. Ferry St., Buffalo, N. Y.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
Gillis & Geoghegan, 537-539 W. Broadway, New York, N. Y. "G & G."
Guarantee Construction Co., 140 Cedar St., New York, N. Y.
Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
LINK BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Mead-Morrison Mfg Co., 125 Prescott St., East Boston, Mass.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
Mundy Hoisting Engine Co., J. S., 722 Frelinghuysen Ave., Newark, N. J.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Orton & Steinbrenner Co., The, 608 S. Dearborn St., Chicago, Ill.
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.
Robins Conveying Belt Co., 13 Park Row, New York, N. Y.
Schramm & Son, Inc., Chris D., West Chester, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement no pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Washburn & Granger, Inc., 50 Church St., New York, N. Y. "Dean."

HOISTS, ELECTRIC, DECK AND DOCK.—Cargo handling hoists are frequently light-weight, portable, machines similar to builder's hoists. When in use they are fastened rigidly to the deck or dock by hooks or, when on rails, by track clamps. Instead of the usual lever control they are sometimes operated by electrical remote control. In this case the master controller is light in weight and is carried by the operator to his position beside the hatch. In this way only a single operator is required and he has a full view and complete control of the load being handled.

Manufacturers:

Albro-Clem Elevator Co., Erie Ave. & D St., Philadelphia, Pa. "Albro-Clem."
American Engineering Co., Aramingo Ave. & Cumberland St., Philadelphia, Pa. "A-E-CO."
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Carlin Machine Co., John H., Sandusky & Lacock Sts., Pittsburgh, Pa.
Erie Hoist Co., The, 1908 Holland St., Erie, Pa. "Erie."
Flory Mfg. Co., S., Bangor, Pa. "Flory."
Gillis & Geoghegan, 537-539 W. Broadway, New York, N. Y. "G & G."
Lakeside Bridge & Steel Co., North Milwaukee, Wis.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Marsh Engineering Works, Ltd., Belleville, Ont., Can.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Mundy Hoisting Engine Co., J. S., 722 Frelinghuysen Ave., Newark, N. J.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Schram & Son, Inc., Chris D., West Chester, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill. "Thomas."

HOISTS, ELECTRIC, DERRICK.—Derrick hoists are similar to the ordinary builder's hoists except that they are provided with bull wheels for swinging. In some types the bull wheel is stationary and the swinging is accomplished by a swinging winch. Several types embody minor modifications, such as a two-speed clutch or control mechanism constructed in imitation of steam control so men familiar only with engine hoists may be used to operate them.

Manufacturers:

American Hoist & Derrick Co., St. Paul, Minn.
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."

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Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Carlin Machine Co., John E., Sandusky & Lacock Sts., Pittsburgh, Pa.
Denver Engineering Works Co., The, 30th & Blake Sts., Denver, Colo.
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Marsh Engineering Works, Ltd., Belleville, Ont., Can.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Mundy Hoisting Engine Co., J. S., 722 Frelinghuysen Ave., Newark, N. J.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Orr & Sembower, Inc., Reading, Pa.
Schramm & Son, Inc., Chris D., West Chester, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill. "Thomas."

HOISTS, ELECTRIC, MINE.—Heavy-duty mine hoists, due to the character of their work, are heavily constructed, powerful hoisting machines, frequently called hoisting engines, even when driven by electric motors. For deep mines it is necessary that these machines operate at very high speeds, sometimes as high as 1000 ft. per minute, as the mine depth may exceed 2000 ft. The hoists generally used are of the drum type, either cylindrical, conical, or a combination of the two. Usually two drums operating in balance are used for each hoist. With this method the loads of two similar cages are approximately balanced, one empty cage being lowered in one section of the shaft while the loaded cage is being hoisted in another. These hoists must be very accurately controlled and sometimes special electrical control systems are used. The hoists may be driven by induction motors, in which case the control is obtained by a variable resistance in the motor circuit, usually a large water rheostat. They may be driven by a direct-current motor receiving power through a motor-generator set, control being obtained by variation of the generator voltage. This method is sometimes modified by the addition of a flywheel and a regulator. The regulator is connected in the motor-generator circuit and when the line current exceeds a predetermined value it causes the motor to slow down and allows the flywheel to assist in driving the generator. Besides the deep vertical-shaft hoists there are several special mine hoists particularly adapted to the wide variety of demands met with in the numerous classes of mines. Among such types are the inclined-shaft hoist, the skip hoist, a special hoist designed to clamp on a standard drill column, and other types that are similar to ordinary elevator hoists, and are used for hoisting, hauling and miscellaneous purposes.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Box Iron Works Co., William A., Blake & 33rd Sts., Denver, Colo.
Brown Clutch Co., The, Sandusky, Ohio "Morgan."
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Carlin Machine Co., John H., Sandusky & Lacock Sts., Pittsburgh, Pa.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Denver Engineering Works Co., The, 30th & Blake Sts., Denver, Colo.
Finch Mfg. Co., 9th Ave. & W. Linden St., Scranton, Pa.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
GREEN EQUIPMENT CORP., 53 W. Jackson Blvd., Chicago, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Marsh Engineering Works, Ltd., Belleville, Ont., Can.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Mundy Hoisting Engine Co., J. S., 722 Frelinghuysen Ave., Newark, N. J.
Nordberg Mfg. Co., Milwaukee, Wis
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Orr & Sembower, Inc., Reading, Pa.
Riverside Iron Works, 410 Riverside Blvd., N. E., Calgary, Alta., Can.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill. "Thomas."
Vulcan Iron Works, 730 S. Main St., Wilkes-Barre, Pa.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "Winze."

HOISTS, ELECTRIC, MISCELLANEOUS AND SPECIAL.—For lifting material from a basement to a sidewalk or street level electric hoists are very desirable for speed and convenience of handling; however, where a permanent hoist would obstruct the walk or be unsightly it is necessary that the hoist be constructed to disappear beneath the walk when not in use. For this purpose hoists mounted on the top of a telescoping pipe are employed. They are placed in the hoistway and when not in use are telescoped beneath the sidewalk or street level. In warehouses where large quantities of material, such as bags of sugar, wool, or cotton are piled, their handling is greatly facilitated by an electric hoist. These warehouse hoists are generally portable and constructed similarly to the deck or dock type. Other special and miscellaneous types of electric hoists are used for a variety of purposes not included in other classifications listed herewith.

Manufacturers:

Box & Co., Inc., Alfred, Philadelphia, Pa.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Byers Machine Co., The John F., Ravenna, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich. "Detroit."
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
Gillis & Geoghegan, 537-539 W. Broadway, New York, N. Y. (Telescopic.) "G & G."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Reading Chain & Block Corp., 2140 Adams St., Reading, Pa. "Reading."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Whiting Corporation, Harvey, Ill.
Yale & Towne Mfg. Co., Stamford, Conn. "Yale."

HOISTS, ELECTRIC, MONORAIL.—The monorail hoists are a special form of traveling crane, the travel being restricted to a single trolley. They may be classified, according to their method of propulsion along the trolley, into three divisions as follows: Plain trolley, in which the attendant pushes on the load to propel it along the trolley; hand-geared trolley, which is provided with a sprocketed wheel and hand chain for traveling; motor-driven trolley, controlled either by pendent cords or from an operator's trailing cage. The hoist differs from the chain hoist only in that the hook that is provided for support has been replaced by the trolley wheels and the mechanism for propelling it along the trolley has been added. They usually receive their power from trolley wires mounted on the rail. In foundries, machine shops, steel and iron works, tire and rubber plants, and other factories monorail hoists have found numerous applications. Also see Hoists, electric, coal and ash.

Manufacturers:

Box & Co., Inc., Alfred, Philadelphia, Pa.
Brown Hoisting Machinery Co., The, Cleveland, Ohio. "Brownhoist."
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Quebec, Can.
Cleveland Crane & Engineering Co., The, Wickliffe, Ohio.
Columbia Hoist & Crane Co., Borden & Van Pelt Aves., Long Island City, N. Y.
Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich. "Detroit."
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
LINK-BELT CO., Philadelphia, Chicago, Indianapolis. Link-belt electric hoists are built in various sizes and capacities, and are either floor or cage operated. One man and a Link-Belt hoist can handle material and pieces that would ordinarily require a crew of men. They are built with plain trolley, hand-geared trolley, motor-driven trolley, and without a trolley, which makes it a stationary hoist, or suitable for suspension from an existing trolley. The Link-Belt fully enclosed drum type controllers are standard equipment. Very small head room is required; all parts are fully enclosed, but readily accessible. Renewable bronze bushings used throughout, automatic oil bath, large reservoirs for lubricating gears and bearings, few working parts reduce maintenance expense. Interchangeability of repair parts, first class workmanship and superior material for purpose intended, are some of its features.—Adv.
Maris Bros., 56th St. & Grays Ave., Philadelphia, Pa.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Moore Co., The Franklin, Winsted, Conn.
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Reading Chain & Block Corp., 2140 Adams St., Reading, Pa. "Reading."
Roeper Crane & Hoist Works, 1730 N. 10th St., Reading, Pa.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague Electric



Type S-1 Hoist, Capacity ¼ to 1 ton.

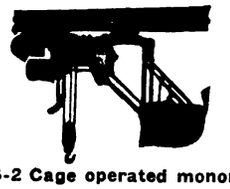


Type W Hoist, Capacity 1 to 6 ton.

Hoists are built in capacities from ¼ to 6 ton and in two general types. Type "S" (Spur gear) and Type "W" (Worm

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gear). They are furnished with either d-c. or polyphase a-c. motors. Our catalog tells how all our hoists are: simple, protected, economical, safe, durable, reliable, accessible, substantial, fool-proof. They are suitable for unloading uses such as in foundry machine shops, ice plants, press rooms, warehouses, boiler rooms, on docks, in all kinds of factories and for all outdoor



Type S-2 Cage operated monorail hoist.

uses exposed to the elements. They are also used for handling bales of cotton, rolls of paper, cakes of ice, ammunition, automobiles, etc. Sprague products, see adv. pages 1306-7.—Adv. Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

HOISTS, ELECTRIC, PORTABLE.—These machines are self-contained hoists usually including a motor, a winding drum, chain or wire rope and hook. They can be carried by one or two men and suspended from any point in a shop where a beam or similar support can be found. They are largely used for hoisting heavy castings onto machine tools, such as lathes, planers, etc., or onto trucks or cars for movement about the shop. The term portable hoist is also frequently applied to certain builders' and derrick hoists, deck and dock hoists, mine hoists, and chain hoists which are not built for permanent installation, but are semiportable, being mounted on trucks or skids so that they may be moved about from place to place.

Manufacturers:

American Hoist & Derrick Co., St. Paul, Minn.
Baker R & L Co., The, Cleveland, Ohio.
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Box & Co., Inc., Alfred, Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Mead-Morrison Co., Ltd., 285 Beaver Hall Hill, Montreal, Que., Can.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Detroit Hoist & Machine Co., Morrow & Marston Sts., Detroit, Mich. "Detroit."
Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.
Erie Hoist Co., The, 1908 Holland St., Erie, Pa. "Erie."
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me. "Maine."
Maris Bros., 56th St. & Grays Ave., Philadelphia, Pa.
Mead-Morrison Mfg. Co., 125 Prescott St., East Boston, Mass.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. "Milwaukee."
Morris Crane & Hoist Co., Ltd., The Herbert, Niagara Falls, Can. "Morris."
Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."
Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."
Otis Elevator Co., 260 11th Ave., New York, N. Y.
Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis. "P. & H."
Reading Chain & Block Corp., 2140 Adams St., Reading, Pa. "Reading."
Sasgen Derrick Co., The, 3101-3129 Grand Ave., Chicago, Ill.
Schramm & Son, Inc., Chris D., West Chester, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, Ill. "Thomas."

HOISTS, ELECTRIC, TELPHER.—See Telpherage systems, electric conveying.

HOLCOMB & HOKE MFG. CO.—Indianapolis, Ind. Manufacturer of electric corn poppers and peanut roasters. President, J. I. Holcomb; treasurer, Fred Hoke. Main office, Indianapolis, Ind. Branch offices, 8 S. Dearborn St., Chicago, Ill.; Detroit, Mich.; Philadelphia, Pa.; New York, N. Y.; St. Louis, Mo.; Minneapolis, Minn.; Boston, Mass.

HOLCROFT & CO.—555 Book Bldg., Detroit, Mich. Manufacturers of electric furnaces and heat treating outfits. President, Charles T. Holcroft; vice-president, Walter Holcroft; secretary and treasurer, Ruel T. Cadwell; sales manager, H. L. Ritts.

HOLD FAST.—Trade name for porcelain knobs manufactured by the Adamant Porcelain Co., East Liverpool, Ohio.

HOLE SHOOTER.—Trade name for portable electric drill manufactured by the A. H. Petersen Mfg. Co., 1614 Fratney St., Milwaukee, Wis.

HOLDEN & WHITE, INC.—Chicago, Ill. Manufacturer of electric car heaters, ventilators, and other railway specialties. President, R. R. Holden; secretary, Charles C. Castle; treasurer, O. E. Quinton; sales manager, W. C. Lincoln. Main office, 343 S. Dearborn St., Chicago, Ill. Branch office, 50 E. 42nd St., New York, N. Y. Sales representatives, 50 E. 42nd St., New York, N. Y.

HOLE'S LIGHTHOUSE.—6911 Jeffery Ave., Chicago, Ill. Manufacturer of luminous pendants.

HOLDERS, BATTERY.—Battery holders are used to make the circuit connections for a set of dry battery cells without the use of binding posts, and at the same time to hold the cells securely in place and support them in such manner that their terminals will be practically free from dust and moisture encountered in open shelf mounting. The cells for use with these holders are usually of No. 6 size and have a screw top similar to an incandescent lamp base but of larger diameter. The holder consists of a suitable screw shell which completes the connection for the negative or zinc terminal, a central contact spring which makes contact with the central carbon terminal, and a hard rubber block or strip on which these are mounted. The blocks are used where sectional construction is desired so that the connections may be changed from series to parallel or the reverse. When strips are used they are arranged for either series or parallel connections and several strips may be used to give the desired results. Battery holders are sometimes mounted in cabinets and they are also provided for wall or ceiling mounting or for suspending from the lower side of a shelf.

Manufacturers:

Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill. "Besco."
Ferry Mfg. Co., 2113 S. 4th St., St. Louis, Mo.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo. "Guaranteed."
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Stanley & Patterson, 34 Hubert St., New York, N. Y.

HOLDERS, BRACKET.—See Fixture fittings and parts.

HOLDERS, BRUSH, COMMUTATOR AND SLIP RING.—A brush holder is a device for holding a brush on the commutator or slip rings of an electric generator or motor. The holder permits the brush to move more or less radially and holds it in contact with the commutator or ring by a spring pressure of about 1½ or 2 lbs. per sq. in. There are a number of different methods of producing the proper tension, some of the common ones being: A spiral spring on an adjusting screw rod, which bears directly on a brush free to move radially in a guide strap; a form in which the whole brush holder is controlled by a spring and is movable about the mounting stud and in which the brush is rigidly clamped; the reaction type in which the brush is held against an inclined surface and maintained in its proper place by spring pressure on a long arm and by the reaction of the armature on the brush. In many types the holder forms a part of the electrical circuit and in others it is insulated and all of the current is carried through the brush pigtails to a flexible lead connected to the machine terminals. The brush holder is usually mounted on the brush-holder stud and, in the case of commutator brushes, the latter is mounted on what is known as the brush yoke, which consists of a rocker arm, ring, quadrant or other adjustable support for maintaining all the brush studs or holders in their proper relative position while the entire set can be moved through a smaller or larger arc along the commutator.

Manufacturers:

Baylis Co., The, Nelson St., Bloomfield, N. J. (Reaction type.)
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Coit St., Irvington, N. J.
Dominion Carbon Brush Co., 38 Duke St., Toronto, Ont., Can.
Eureka Co., The, North East, Pa.
Gooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
Holland Trolley Supply Co., The, 1623 E. 43rd St., Cleveland, Ohio.
Parker White Metal & Machine Co., South Erie, Pa.
Perfection Supply Co., 98 Park Pl., New York, N. Y. "Perfection."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stimple & Ward Co., 520 Sandusky St., Pittsburgh, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HOLDERS, BRUSH, INSULATING PAINT AND VARNISH.—These brush holders are used to avoid cleaning the brush each time it is used. They hold the brush immersed in the paint or varnish and usually also serve to cover the can or pail to prevent the varnish from drying.

Manufacturer:

BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.

HOLDERS, CORD.—A term applied to devices employed to support a cord, generally to take up slack in the cord so as to prevent any one or anything from being entangled in the cord. It may be a simple coiled spring to which the cord is fastened or a small reel to which a spiral spring is fastened, the tension in the spring being just sufficient to support the cord. Cord holders are frequently used for the cords of electric pressing irons (flatirons), for which they not only keep the cord out of the way and off the ironing board but protect it from the hard wear it gets when left to trail back and forth on the board.

Manufacturers:

CROUSE-HINDS CO., Wolf & 7th Sts., North, Syracuse, N. Y. "Condulet."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.

HOLDERS, LAMP.—A clamping device for holding a lamp for temporary attachment to shelves or to any convenient means of support. The term is also sometimes applied to a lamp guard with a handle for holding the lamp. In England lamp sockets are called lamp holders. This term has not a very definite meaning in the American electrical trade, and hence should not be used when other more definite terms can be found. (Also see Guards, lamp; Lamps, clamp; Lamps, hand.)

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

HOLDERS, SHADE, GLOBE, AND REFLECTOR.—Devices for fastening or holding a shade, globe or reflector to a lamp socket or to the fixture. The common sizes are for shades and reflectors having 2¼ and 3¼-inch diameter necks. A 1⅝-in. holder has also been used to some extent. The 3¼-in. holder will take a globe which will pass through its neck a 60-watt lamp. The commonest larger globe-holder sizes are 4, 6, 8 and 10-in. The following holder designations originated with one manufacturer, but are now quite commonly used in the electrical trade:

Form T holder, for shades and reflectors with 1⅝ in. diameter neck.—Form O holder, for shades and reflectors with 2¼-in. diameter neck, the neck of the reflector being held just above the end of the socket; this is the oldest and most common form of 2¼-in. holder.—Form H holder, for 2¼-in. diameter neck reflectors and shades, the neck of the reflector being held ⅞ inch further away from the bead of the socket than in the Form O. (In the United States

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shades and shade holders have been so standardized that the light-center distances in lamps, that is, the distance from the base to the light center of the filament, are made to conform either to the Form O or the Form H shade-holder positions, where the reflectors are scientifically designed for specified sizes of lamps.)—Form A holder, a 3¼-in. holder with which the reflector is supported 1¼ ins. further from the bead of the socket than with the common old standard 3¼-in. holders.—Standard 3¼-in. holders, used mainly for globes, the neck of the globe being supported about even with the mouth of the socket.

Aside from the foregoing grouping as to sizes, shade and globe holders may be classified in various ways as to their construction. The oldest types of shade holders employ a split collar that is clamped around the socket shell just above the bead provided for this purpose. A threaded solid collar is now much used; it screws onto a threaded bead and makes a more convenient, firmer and neater arrangement. In place of the three screws most commonly used to engage the turned over edge of the shade, globe or reflector neck, there are now widely used spring wire or other clamping arrangements that are more convenient and give a better support. Shade holders that also serve to cover the socket are more commonly called socket covers (sometimes husks), and are listed under Covers, socket.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y. "American."
American Pin Co., The, Waterbury, Conn. "Ampinco."
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Uno."
Art Metal Mfg. Co., The, Cleveland, Ohio. "Amco."
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Special types to fit all conditions.—Adv.
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "New Wrinkle."
Chicago Electric Products Co., 2730 Lincoln Ave., Chicago, Ill. "Universal 3 in 1."
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "Victor."
Dayton Mfg. Co., The, Dayton, Ohio. "Flex."
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Dunlap Co., John, Carnegie, Pa. "Cleaneazy."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Mefco."
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display advertisement on page 1405.)
New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn. "Simplex," "Plumwood."
STANDARD ELECTRIC & MFG. CO., 308 First Ave., E., Cedar Rapids, Iowa. "Steico."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V.V."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

HOLDERS, SOLDERING IRON.—A hook and rest for holding a soldering copper (iron) in position to be heated by a blow torch or bunsen flame. These holders are made to fasten to the torch or to stand on the work bench. This term is also applied to holders on which the iron may be rested to avoid burning the work bench or to keep the iron clean.

HOLDERS, TELEPHONE.—See Brackets, desk telephone.

HOLDERS, WELDING ELECTRODE.—Holders for both metal and carbon welding electrodes are similar in design and construction, differing only in the clamping device. They both consist of an insulating handle, a means of supporting the welding cable, and a conducting metallic clamp for gripping the electrode. A split clamp is usually employed and it is tightened by turning the insulated handle. Clamps for carbon electrodes generally are much larger and heavier than for metal, as the current used is greater. The greater current generally makes it necessary to place a shield on the holder to protect the welder's hand from the heat, but these shields are not so necessary on the metal electrode holder.

Manufacturers:

Electric Arc Cutting & Welding Co., 152-158 Jeliff Ave., Newark, N. J. "Newarc."
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y. "Grip-O."
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

HOLDFAST.—Trade name for lamp guards, changers, shades and adjustable fixture joints manufactured by W. N. Matthews & Brother, Inc., 2912 Easton Ave., St. Louis, Mo.

HOLD-HEET.—Trade name for electric cooking and heating appliances manufactured by the Russell Electric Co., 140 W. Austin Ave., Chicago, Ill.

HOLDTITE.—Trade name for friction tape manufactured by the United States Rubber Co., 1790 Broadway, New York, N. Y.

HOLLAND.—Trade name for motor-driven churns made by the Holland Mfg. Co., 131 N. Wells St., Chicago, Ill.

HOLLAND MFG. CO.—131 N. Wells St., Chicago, Ill. Manufacturer of motor-driven churns. Business established 1919. Proprietor, George W. Bliss.

HOLLAND TROLLEY SUPPLY CO., THE.—1623 E. 43rd St., Cleveland, Ohio. Manufacturer of trolley line equipment.

HOLLERITH.—Trade name for motor-driven tabulating machines manufactured by the Tabulating Machine Co., 50 Broad St., New York, N. Y.

HOLLERITH.—Trade name for electric tabulating and sorting machines manufactured by the International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can.

HOLLIS, R. E.—551 N. Parkside Ave., Chicago, Ill. Manufacturer of electric dishwashers. Business established 1920. President, R. E. Hollis.

HOLLOW-HANDLE TOOL SETS.—A hollow handle with a chuck for holding screw-driver blades and drills of various sizes, the tools being carried within the handle which may be opened and the proper tool taken out as needed. They are supplied with a wide variety of tools, the outfit being well adapted to repair and troublemen's kits.

Manufacturers:

Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Robinson Co., M. W., 296 Broadway, New York, N. Y. "Buell," "Rollis."

HOLLOWSPUN.—Trade name for concrete poles manufactured by the Massey Concrete Products Corp., 122 S. Michigan Ave., Chicago, Ill.

HOLMES.—Trade name for tree insulators made by the High Tension Electrical Specialty Co., Newton, Mass.

HOLMES.—Trade name for electric burglar alarm systems manufactured by the Rhode Island Electric Protective Co., 32 Custom House St., Providence, R. I.

HOLOGRAPH.—Trade name for oxy-acetylene cutting and welding outfits manufactured by the Davis-Bournonville Co., Jersey City, N. J.

HOLOPHANE GLASS CO., INC.—340 Madison Ave., New York, N. Y. Manufacturer of illuminating glassware. General manager, H. H. Thompson; sales manager, Charles Franck. Factory, Newark, Ohio.

HOLT FARM LIGHT CO.—Toledo, Ohio. Manufacturer of farm lighting and power plants. Business established as the Automatic Light Co. in 1916. President and sales manager, L. W. Holt; vice-president, S. H. Humphrey; secretary and treasurer, H. K. Greenman.

HOLTZ ELECTROSTATIC MACHINE.—A machine invented by Wilhelm Holtz in 1865 for producing high-potential electricity by continuous electrostatic induction. It consists of two upright circular plates of glass having their faces separated by a small air space. One plate, usually the larger of the two, is fixed. It has two openings or apertures to which are glued strips of paper which act as armatures. The smaller plate is rotated at a fairly high speed and metallic combs or brushes collect the electricity formed by induction from the armatures. It is useful for laboratory and demonstration purposes only and, as with all electrostatic machines, has been replaced by generators. Also see Electrostatic machines.

HOLTZER-CABOT ELECTRIC CO., THE.—Boston, Mass. Manufacturer of motors, generators, motor-generators, electrical signaling apparatus, telephones and telephone accessories, etc. Business established 1875. President, C. W. Holtzer; vice-president, E. R. Harding; secretary and treasurer, W. S. Kemp; sales manager (Motors), W. E. Haseltine; sales manager (Sundries), T. W. Ness. Main office, 125 Amory St., Boston, Mass. Factories, Boston, Mass., and Chicago, Ill. Branch offices, 6161 S. State St., Chicago, Ill.; 101 Park Ave., New York, N. Y.; 1104 Union Trust Bldg., Baltimore, Md.; Philadelphia, Pa.; Detroit, Mich.; Minneapolis, Minn.; St. Louis, Mo. Sales representatives, Bittman & Battee, Inc., San Francisco, Cal.

HOLWICK, B. C.—Canton, Ohio. Manufacturer of electric coffee grinders and meat choppers.

HOLZ & CO., LTD.—18 Madison Ave., New York, N. Y. Manufacturer of cathodes, magnets and magnetic testing apparatus.

HOME.—Trade name for medical batteries manufactured by J. H. Bunnell & Co., 32 Park Pl., New York, N. Y.

HOME.—Trade name for electrotherapeutic apparatus manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

HOME BATTERY.—Trade name for electrotherapeutic apparatus manufactured by Adon Products, Inc., 516 5th Ave., New York, N. Y.

HOME LAUNDRY.—Trade name for electric washing machine manufactured by the Haag Bros. Co., Peoria, Ill.

HOME LIGHT CO. OF AMERICA.—2120 Harrison Ave., New York, N. Y. Manufacturer of portable electric lamps.

HOME MODEL.—Trade name for electric washing machines manufactured by the Miller Mfg. Co., Meyersdale, Pa.

HOME STATION AND BATTERY, TELEGRAPH.—In a telegraph system the station from which a telegraph message is sent is called the home station. The battery at this station is also referred to as the home battery.

HOME UTILITIES CO.—320-326 N. May St., Chicago, Ill. Manufacturer of electric washing machines. Business established 1918. President and treasurer, J. J. Negrescou; vice-president, J. Barcal; secretary, J. Tlapa.

HOMELITE.—Trade name for farm lighting plant manufactured by the Simms Magneto Corp., East Orange, N. J.

HOMER COMMUTATOR CO., THE.—4748 Hough Ave., N. E., Cleveland, Ohio.

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Manufacturer of commutators. President, J. R. Kraus; vice-president and treasurer, Fred J. Baird; secretary and general manager, C. B. Keck.

HOMESTEAD VALVE MFG. CO.—134 6th Ave., Homestead, Pa. Manufacturer of valves. Business established 1892. President, J. E. Roth; vice-president, B. F. Schuchman; secretary and treasurer, W. R. Schuchman; sales manager, S. Fink.

HOMMEL & CO., LUDWIG.—Pittsburgh, Pa. Manufacturers of industrial lighting units and microscopic illuminators. Business established 1906. President, Ludwig Hommel; vice-president, Charles A. Swartz; secretary and treasurer, J. R. Newman. Main office and factory, 530-534 Fernando St., Pittsburgh, Pa. Branch office, Electric Bldg., Cleveland, Ohio.

HOMMEL-LITE.—Trade name for industrial lighting units and reflectors manufactured by Ludwig Hommel & Co., 530-534 Fernando St., Pittsburgh, Pa.

HOMOGENEOUS CONDUCTOR AND DIELECTRIC.—A conductor that has uniform conducting power in all directions, or a dielectric that is an equally good insulator or nonconductor in all directions.

HONEY COMB.—Trade name for tuning coils manufactured by the De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y., and Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

HONEYWELL HEATING SPECIALTIES CO.—Wabash, Ind. Manufacturer of temperature regulators and thermostats. Business established 1916. President and general manager, M. C. Honeywell; vice-president, O. L. Honeywell; secretary and treasurer, W. L. Huff.

HOO HOO.—Trade name for babbitt metal manufactured by the More-Jones Brass & Metal Co., 3132-44 N. Broadway. St. Louis, Mo.

HOODETTE.—Trade name for show case lighting reflector manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

HOODS, OUTLET.—Iron fittings for attachment to service boxes and through which wires are brought out and into conduit threaded and turned into the fitting. Made in straight-way, right and left-handed, and back-connected patterns.

Manufacturers:

CROUSE-HINDS CO., Wolf & 7th Sts., North, Syracuse, N. Y. "Condulet."

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.

HOODS, STREET.—See Streethoods.

HOOK'ER TO YER BULB.—Trade name for radio tuners manufactured by Tresco, 1201 Kahl Bldg., Davenport, Iowa.

HOOK SWITCH.—In a telephone set, the switch operated by the yoke upon which the receiver is hung. See Switches, telephone, hook, etc.

HOOKER ELECTROCHEMICAL CO.—25 Pine St., New York, N. Y. Manufacturer of chemicals.

HOOKS, CABLE RACK.—See Racks and hooks, cable.

HOOKS, CARRYING OR LUG.—These hooks are used for carrying poles used in line construction, two men being at each end of the pole. The tool is a bar to which is fastened a pair of tong-like hooks which grasp the pole when the hook bar is lifted, being simply a device to allow two men one at each end of the bar to obtain a convenient hold on the pole. They are also used for handling ties and heavy timbers.

Manufacturers:

Dicke Tool Co., The, Downers Grove, Ill.

HERBST, PAUL W., Chicago, Ill. We make all standard patterns. See display advertisement on page 1258.—Adv.

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display advertisement on page 1253.)

HOOKS, CHANDELIER AND FIXTURE.—See Fixture fittings and parts.

HOOKS, GUY.—These are hooks used for supporting guy wires. They are usually made of one piece of iron forged to form a hook and spike to be driven into the pole or supporting wall.

Manufacturers:

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display advertisement on page 1254.)

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

Lanz & Sons, Mathew, Pittsburgh, Pa.

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Marchand."

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

HOOKS, INSULATING.—Pigtail hooks with screw ends or equivalent, covered with an insulating sleeving or enamel coating designed for supporting telephone or other signal wires on walls, ceilings, bracket arms, poles, etc. Also a two-piece hook, a hook piece and a nipple insulated from each other, used in supporting fans, fixtures, etc.

Manufacturers:

Faries Mfg. Co., Decatur, Ill.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

HOOKS, PIPE AND CONDUIT.—Hooks for fastening pipe or conduit to walls of any kind. The hooks used for hanging pipe are usually made of galvanized or wrought iron in various shapes, round, square, sickle-shaped, or a hinged band form and are designed to be driven or set in the wall during construction. The conduit hooks are usually made of iron bent into a simple hook form. They are sometimes fastened in the wall by an expansion bolt.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.

Chicago Expansion Bolt Co., 324 W. Washington St., Chicago, Ill.

McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.

HOOPES.—Trade name for laboratory standard Wheatstone bridges manufactured by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

HOOSIER.—Trade name for electric pumps and automatic controllers made by the Flint & Walling Mfg. Co., Kendallville, Ind.

HOOSIER.—Trade name for electric drills and boring machines manufactured by the Hoosier Drilling Machine Co., Goshen, Ind.

HOOSIER DRILLING MACHINE CO.—E. Madison St., Goshen, Ind. Manufacturer of motor-driven drilling and boring machines. President, B. F. Deahl; vice-president, C. R. Newell; secretary, C. C Newell; treasurer, William Mutschler.

HOOVEN, OWENS, RENTSCHLER CO., THE.—Hamilton, Ohio. Manufacturer of gas and steam engines. Business established 1845. President, G. A. Rentschler, Sr., vice-president, W. B. Mayo; secretary, treasurer and general manager, Gordon S. Rentschler; sales manager, G. A. Hepke. Main office and factory, Hamilton, Ohio. Branch offices, 430 Central Savings & Trust Bldg., Akron, Ohio; 1508 Candler Bldg., Atlanta, Ga.; 141 Milk St., Boston, Mass.; 1127 Marquette Bldg., Chicago, Ill.; 425 Chronicle Bldg., Houston, Tex.; 39-41 Cortlandt St., New York, N. Y.; 2128 Land Title Bldg., Philadelphia, Pa.; 1601 Arrott Bldg., Pittsburgh, Pa.; 1105 Chemical Bldg., St. Louis, Mo. Sales representatives, W. H. Taylor Engineering Co., Allentown, Pa.; Stearns-Rogers Mfg. Co., Denver, Colo.; San Antonio Machine & Supply Co., San Antonio, Tex.; Charles C. Moore & Co., San Francisco, Cal.; R. B. Whiteacre & Co., St. Paul, Minn.

HOOVEN SERVICE, INC.—New York, N. Y. Manufacturer of electrically operated typewriters. Business established 1916. President and treasurer, Paul M. Hooven; secretary, M. T. Hooven; sales manager, Raymond Crane. Main office, 117 W. 46th St., New York, N. Y. Factory, Hamilton, Ohio. Branch offices, Washington, D. C.; Philadelphia, Pa.; Atlanta, Ga.; Pittsburgh, Pa.; Cincinnati, Ohio; Chicago, Ill.; Detroit, Mich.; San Francisco, Cal.; Montreal, Que., Can.

HOOVER SUCTION SWEEPER CO., THE.—North Canton, Ohio. Manufacturer of electric vacuum cleaners. President and treasurer, W. H. Hoover; vice-president, H. W. Hoover; secretary, H. C. Price. Main office, North Canton, Ohio. Factories, North Canton, Ohio, and Hamilton, Ont., Can. Branch offices, Philadelphia, Pa.; Pittsburgh, Pa.; Washington, D. C.; Kansas City, Mo.; San Francisco, Cal.; Charlotte, N. C.; Oklahoma City, Okla.; St. Louis, Mo.; Canton, Ohio; Cleveland, Ohio; Dallas, Tex.; Chicago, Ill.; Boston, Mass.; New York, N. Y.; Hamilton, Ont., Can.

HOPE FORGE & MACHINE CO., THE.—Mount Vernon, Ohio. Manufacturer of gas engines and motor-driven air compressors.

HOPE WEBBING CO.—Providence, R. I. Manufacturer of insulating tapes, sleevings, etc. Business established 1883. President, Joseph B. McIntyre; vice-president, Charles A. Horton; secretary, A. A. Tucker; treasurer, C. C. Marshall; general manager, C. A. Horton; sales manager, C. P. Roundy. Main office, Providence, R. I. Factory, Pawtucket, R. I. Branch offices, 381 4th Ave., New York, N. Y.; 608 S. Dearborn St., Chicago, Ill. Sales representatives, Clapp & LaMoree, Los Angeles, Cal.; Consumers Rubber Co., Cleveland, Ohio; Mitchell-Rand Mfg. Co., New York, N. Y.; T. C. White Electrical Supply Co., St. Louis, Mo.

HOPEWELL INSULATION & MFG. CO., INC.—Hopewell, Va. Manufacturer of insulators, telephone mouthpieces, receivers and mufflers, insulator pins, pliers, sockets, molded insulation, etc. Business established 1920. President and general manager, S. S. Sonneborn; vice-president, E. A. Spengeman; secretary, Christopher Branda.

HOPPERS, COAL AND ASH, POWER PLANT.—These hoppers are funnel-shaped compartments generally, in which coal or ash are kept a relatively short time, the former for feeding to the furnaces, and the latter into cars or trucks. Hoppers differ from bunkers in that they are smaller and are used chiefly for feeding the material into the furnace or other receptacle, while bunkers are used for storage as well. In power plants they may be either fixed or movable, depending on their function. The coal for the furnaces is placed in the fixed hoppers which feed it to the grates in spouts or closed pipes. Hoppers for this purpose are generally made of sheet steel and are sometimes reinforced with renewable wearing plates at points where the abrasion is most severe. Ash hoppers are also of fixed or stationary construction. They are generally made of steel and lined with brick or concrete or else made entirely of reinforced concrete. Ash hoppers are often cylindrical with a funnel bottom.

Movable hoppers are used in connection with weighing apparatus. These hoppers, carried on knife-edge supports, are used to operate standard beam scales. The coal is received from the crusher in a continuous flow in one hopper, while another hopper is being weighed and tripped, and then the coal is diverted into the other hopper, while the first is being weighed. Automatic scales which include hoppers are also used in some cases.

Track hoppers are another form used in power plants where the coal is delivered by rail. The cars are run in on a track over the hopper, the track being supported on I-beams usually. When bottom or side-dump cars are used, the coal may be dumped directly into the hopper, or in other cases shoveled into them. From the hopper the coal is generally dropped into a bucket or other conveyor that takes it to the bunkers over the boilers.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display advertisement on page 1257.)

Beaumont Co., Inc., R. H., 315-19 Arch St., Philadelphia, Pa.

Conveyors' Corp. of America, 326 W. Madison St., Chicago, Ill.

Green Engineering Co., East Chicago, Ind.

LINK-BELT CO., 329 W. 39th St., Chicago, Ill.

HOPPES MFG. CO., THE.—Belmont & Larch Sts., Springfield, Ohio. Manufacturer of feed water heaters, meters and purifiers, oil and steam separators, etc. President, J. J. Hoppes; vice-president, J. F. Ware; secretary and treasurer, G. Coblentz.

HORIZONTAL CANDLEPOWER.—The luminous intensity, measured in candle-

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power, emitted by a lamp in the direction of a horizontal line passing through the luminous center of the lamp. Since the candlepower may vary in different horizontal directions, it is customary to determine the average or mean horizontal candlepower, which is found by measuring the horizontal intensity when the lamp is rotated on its vertical axis. The abbreviation for mean horizontal candlepower is mhc.

HORIZONTAL COMPONENT OF EARTH'S MAGNETISM.—The intensity of the earth's magnetic force which acts in a horizontal direction. This component is measured in gausses.

HORIZONTAL ILLUMINATION.—The illumination that falls on a horizontal plane as measured in foot-candles or other illumination units. This is the illumination value most commonly stated and gives a fair idea of the suitability of the lighting provided for reading, writing, drafting and other close visual work on flat horizontal surfaces. For some purposes the vertical illumination is much more important than the horizontal, however, as for an art gallery or wall sign; in such cases a high horizontal illumination with low vertical illumination would be worthless. For most purposes both these illuminations are important, varying in their relative importance somewhat with the purpose in view. Also see Illumination.

HORN & BRANNEN MFG. CO.—427-433 N. Broad St., Philadelphia, Pa. Manufacturer of lighting fixtures.

HORN FIBER.—See Fiber.

HORN POSTING SIGN SYSTEM, W. J.—20 N. 5th St., Springfield, Ill. Manufacturer of electric signs. President and general manager, W. J. Horn; vice-president, W. F. Kessberger; secretary and treasurer, W. E. Coleman.

HORNGAP ARRESTERS.—See Arresters, lightning, horngap.

HORNGAP SWITCHES.—See Switches, air break, high-tension pole top and outdoor substation.

HORNS, ELECTRIC, AUTOMOBILE.—Horns for use in signaling on automobiles are of several types. One type is operated by a small battery motor concealed within the drum of the horn. The motor has a ratchet flywheel on its shaft. The passing of the ratchet over a small pin causes the pin to tap a diaphragm similar to those used in the telephone and the result is a shriek. A second type operates on the principle of the electric bell, the vibrating armature striking the diaphragm pin. Electric horns are the most common types of automobile horns now in use. They are usually made for 6 or 12 volts fed from the ignition, lighting and starting battery.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Samson," "Samson Jr.," "Victor."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. on pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crescent Mfg. Co., 129 Reade St., New York, N. Y. "Crescent."
E. A. Laboratories, Inc., Myrtle Ave. & Spencer St., Brooklyn, N. Y. "E. A.", "Newtone."
FITZGERALD MFG. CO., THE, Torrington, Conn. "Clero."
Heinze Electric Co., Lowell, Mass. "Heco."
KLAXON CO., Newark, N. J.
North East Electric Co., Rochester, N. Y. "North East."
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Hi-Lo."
Schwarze Electric Co., E. Church St., Adrian, Mich.
Sireno Co., The, 18-20 Rose St., New York, N. Y. "Sireno."
Sparks-Withington Co., The, Jackson, Mich. "Sparton."
Stewart-Warner Speedometer Corp., 1828 Diversey Pkwy., Chicago, Ill. "Stewart."

HORNS, ELECTRIC, FACTORY.—Most of the electric horns used in factories are constructed so that a motor turns a ratchet within the horn drum and causes a pin or button to vibrate a diaphragm. Horns having a buzzer tone often have the diaphragm actuated by the vibrating armature of an electromagnet in a manner similar to an electric bell. They give a loud and penetrating tone and are much used for starting, stopping and other signals in noisy factories and large industrial plants.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin industrial signals have a peculiar penetrating tone pitch which makes them a most effective form of audible signal for industrial use. The fastest code signaling is readily obtained. They cost less than a good bell and maintenance cost is lower. Made for a-c. or d-c. circuit at any voltage up to 250 and for outdoor or indoor use.—Adv.



Industrial Signal

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "R. S. K."
HOLTZER-CABOT ELECTRIC CO., The, 125 Amory St., Boston, Mass. "Reacto."
KLAXON CO., Newark, N. J.
Russell Electric Co., Danbury, Conn. "A. C.", "Saxon."
Schwarze Electric Co., E. Church St., Adrian, Mich.
Sireno Co., The, 18-20 Rose St., New York, N. Y. "Sireno."

HORNS, ELECTRIC, FIRE-ALARM AND MISCELLANEOUS.—Horns of this sort are constructed and operated in a manner similar to factory electric horns, their use, however, being confined chiefly to alarms of fire. They are largely used in electrically controlled fire-alarm systems in large industrial plants and institutions, and to some extent in small towns for burglar and fire alarms, also for telltale warnings on tanks or pressure systems, and miscellaneous call signal purposes wherever a loud and penetrating signal is desired.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The Benjamin fire signals are excellent devices for municipal or industrial fire signals. They have great volume of tone and are instantly responsive to electric current impulse.—Adv.



Fire Signal

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "R. S. K."
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Armory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Russell Electric Co., Danbury, Conn. "Rapid Fire," "Russell-Hammer"
SAMSON ELECTRIC CO, Canton, Mass.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Sireno Co., The, 18-20 Rose St., New York, N. Y. "Sireno."

HORRY FURNACE.—An electric furnace for the production of calcium carbide, in which the carbide is obtained continuously in block form. The furnace is built up around a horizontal rotating drum and between two end disks, the fourth side of the box being made up of segments which can be bolted to the edges of the two disks. Above one side of this ring-shaped container is a vertical electrode compartment and feed hopper. As the carbide collects under the electrodes the furnace is rotated about the axis of the horizontal drum, carrying the carbide down under the drum and up on the other side, where the outer segments are taken off and the carbide removed, the segments being put back in place again as rapidly as there is room for one below the feed hopper.

HORSE CLIPPERS.—See Clippers, horse, motor-driven.

HORSE HEAD.—Trade name for zinc strips, plates and slabs made by the New Jersey Zinc Co., 160 Front St., New York, N. Y.

HORSEPOWER.—The common unit of mechanical power. A horsepower is the rate of doing 550 foot-pounds of work per second, or 33,000 foot-pounds per minute. One horsepower is approximately equal to 746 watts.

HORSEPOWER-HOUR.—A horsepower-hour is a unit of mechanical work or energy often used. It is the work done in one hour when the power or rate of doing work is uniformly one horsepower. A horsepower-hour is thus equal to 198,000 foot-pound-seconds, or 2,685,600 joules, or 0.746 kilowatt-hour. The preferred abbreviation is hp-hr.

HORSESHOE MAGNET.—This is a permanent magnet in a form resembling a horseshoe so as to bring the poles comparatively close together. An iron "keeper" or armature is usually placed against both poles when the magnet is not in use as this helps retain the magnet's strength. Electromagnets are also made in horseshoe form in many cases.

HORTON MFG. CO.—Fort Wayne, Ind. Manufacturer of electric washing and ironing machines. Business establishd 1871. President and general manager, J. C. Peters; vice-president, A. H. Peters; secretary, W. F. Peters; treasurer, F. C. Peters; sales manager (Washing Machine Dept.), F. C. Peters; sales manager (Ironing Machine Dept.), A. C. Richard.

HOSE, ARMORED FLEXIBLE, FOR STEAM AND COMPRESSED AIR.—Flexible metal hose is largely used where a very strong hose is desired, either because of high pressure or to prevent wear which occurs when the hose must be subjected to abuse, such as kinking, dragging over rough floors, or being run over by trucks, etc. The construction of such hose is suited to its purpose. For the highest pressures it has a metal inner body or "core," which is a helix wound from one continuous flat strip of metal. Around this core is a layer of rubber to prevent leakage, then a layer of woven wire, asbestos or cotton, and finally the outside layer, a winding of wire to protect the hose from external injury. For less rigid requirements the hose has fewer layers, such as a layer of rubber covered by a layer of wound wire. For carrying acid they are made with a core of acid-resisting metal.

Manufacturers:

Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. "Fle-X-Met."
Pennsylvania Flexible Metallic Tubing Co., Broad & Race Sts., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display advertisement on pages 1306-1307.)
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

HOSKINS MFG. CO.—Detroit, Mich. Manufacturer of electric furnaces, pyrometers and resistance materials. President, Hiram Walker, Jr.; vice-president, W. W. Talman; secretary and treasurer, T. A. Langan; general manager, A. L. Marsh; sales manager, W. D. Little. Main office and factory, Lawton & Buchanan Sts., Detroit, Mich. Branch offices, Grand Central Terminal, New York, N. Y.; Tremont Bldg., Boston, Mass.; Oliver Bldg., Pittsburgh, Pa. Sloan Bldg., Cleveland, Ohio; Otis Bldg., Chicago, Ill.

HOSPITAL ANNUNCIATORS.—See Annunciators, hospital.

HOSPITAL, NURSES' AND DOCTORS' CALL SYSTEMS.—See signaling systems, hospital, nurses' and doctors'.

HOSPITAL OPERATING-ROOM FIXTURES.—See Fixtures, lighting, operating room and other hospital.

HOSPITAL SUPPLY CO., THE.—157 E. 23rd St., New York, N. Y. Manufacturer of electric sterilizers, incubators, centrifuges, resuscitating apparatus and other surgical supplies and hospital equipment. Business established 1905. President, L. L. Watters; sales manager, A. Graupe.

HOT BLAST.—Trade name for blow torches and brazers manufactured by the Turner Brass Works, Sycamore, Ill.

HOT CLOSETS.—See Warmers, plate or dish; Warmers, food or roll.

HOT-FLO.—Trade name for electric water heaters manufactured by the Hot-Flo Faucet Corp., 1400 Broadway, New York, N. Y.

HOT-FLO FAUCET CORP.—1400 Broadway, New York, N. Y. Manufacturer of

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electric water heaters. Business established 1918. President, Arthur Frantzen; secretary, Henry Frantzen; general manager, Leo. E. Ostro. Factory, Hartford, Conn.

HOT-FLOW.—Trade name for water softening and filtration apparatus manufactured by the International Filter Co., 1st National Bank Bldg., Chicago, Ill.

HOT-O-MIX.—Trade name for electric heaters for beverage mixers manufactured by the Calorex Corp., 10 W. 23rd St., New York, N. Y.

HOT PLATES.—See Plates, hot, household and portable: Plates, hot, miscellaneous.

HOT QUICK.—Trade name for electric water heater manufactured by the Mabey Electric & Mfg. Co., 968 Ft. Wayne Ave., Indianapolis, Ind.

HOT-STUFF.—Trade name for refractories for boiler furnace linings, etc. manufactured by the Bird-Archer Co., 90 West St., New York, N. Y.

HOT WELL.—When a steam engine or turbine is operated condensing, the condensed steam is collected in the bottom of the condenser or in a separate well, known as the "hot well." From here it is usually pumped by the "hot well pump" to the feed-water heater or returned directly to the boiler without further heating. Its temperature is generally from 110° F. to 130° F.

HOT-WIRE INSTRUMENTS.—See under Instruments, electrical measuring.

HOTEL ANNUNCIATORS.—See Annunciators, hotel.

HOTPOINT.—Trade name for electric heating, cooking and labor-saving appliances manufactured by the Edison Electric Appliance Co., Inc., 5660 W. Taylor St., Chicago, Ill., and Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont, Can.

HOTTEST SPOT TEMPERATURES.—The operation of electrical machinery is in general limited by the temperatures of which the insulation and other parts may operate continuously. To obtain the maximum temperature attained in the windings at any spot, called the "hottest spot temperature," a correction is applied to the observed temperature. In windings this correction is 15° C., except with bare windings, such as edgewise strip conductor or a cast copper winding where 5° C. is used. Commutators, collector rings, bare metallic surfaces, etc., do not have any correction applied. Various insulating materials have their allowable "hottest spot temperatures" specified.

HOTVENT.—Trade name for electric water heaters manufactured by the Aetna Electric Appliance Co., 40 Court St., Boston, Mass.

HOTWAT DISTRIBUTING CO.—Title Insurance Bldg., Los Angeles, Cal. Manufacturer of electric water heaters.

HOUSE BRACKETS. — See Brackets, house service.

HOUSE NUMBERS. — See Numbers, house, illuminated.

HOUSE PUMPS.—See Pumps, house, electric.

HOUSE WIRING.—See Wiring of dwellings.

HOUSEHOLD.—Trade name for electrotherapeutic apparatus manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

HOUSEHOLD APPLICATIONS OF ELECTRICITY.—The applications of electricity in the home were few up to some 15 years ago. Since that time, and especially within the last five to ten years, they have grown rapidly in number until they are now quite common in a steadily growing percentage of households so that residence electrical equipment and service constitutes one of the chief sources of income of the manufacturing, jobbing, retailing, contracting, central-station and telephone branches of the electrical industry.

Electricity received its first application in the home when the electric bell was introduced over 40 years ago. Buzzers and annunciators for servant's calls were also employed at this early date in some of the larger homes.

Among the early applications of electricity in the home was the telephone, which was introduced about 1880. From then until about 1895 residence telephone service spread rather slowly due largely to the need for technical development and to confining the service to business houses where it was quickly demanded as a necessity. When the original telephone patents expired a large number of independent companies sprang up and these companies together with the original Bell companies produced a number of improvements in the equipment and operation of telephone systems which greatly increased their use. The first homes in which telephones were installed were mostly those of physicians and business men. Their use increased slowly until within the last 20 years when low-rate party-line service gave it a marked impetus and they have now become quite common in a large percentage of homes. Many apartment buildings and large residences also have private or interior telephone systems connected with the public exchanges.

Lighting. Edison's invention of the incandescent lamp made possible electric lighting of interiors. The first central stations were built in 1882 and within a few years electric lighting, which was first used in stores and business houses, was introduced in residences. The early lamps were of the carbon-filament type which at first were not very efficient and long-lived and could not actively compete with the cheaper gas and oil lighting despite their superior cleanliness and convenience, except in the more pretentious homes where cost was not the predominating factor. As the lamps were improved home lighting progressed steadily but still relatively slowly until about a dozen years ago. About that time the first durable tungsten lamps were brought out. These lamps, though at first feared by the central stations because they thought their lighting income would be greatly diminished due to the much higher lamp efficiency, were soon discovered to be one of the best developments to further residence lighting which could have been found. Their higher efficiency and the better color quality of their light soon gave gas lighting real competition. Improved methods of house wiring also had been developed and both gave a great impetus to electric lighting so that it was not many years before electric lighting was found in the majority of homes in our larger cities.

Heating and Cooking. Residence service had always been a compartively expensive kind of business for central stations, since the installation cost was high for the income derived. The lighting load in residences gave a very poor load-factor. Central-station men, therefore, began to look around for some means of creating a residence day load to improve this condition. About 12 years ago the first popular electric heating appliances were developed and the central stations saw in them a day load which would do much to improve the load-factor and materially increase the total energy consumption of their residence customers. Some of the earlier heating appliances had mechanical defects which caused them to burn out rapidly. The development of new resistance wire and other improvements eliminated these defects and heating appliances rapidly spread in use.

The first of these appliances to attain considerable popularity was the electric flatiron. It was received with great favor both by the housewives and by electrical men. At the present time from 70% to 80% of all residence customers of the central-station companies in the larger cities use this appliance and have come to look upon it as a necessity. Among the other early electric heating appliances were toasters, coffee percolators, tea urns, disk stoves, chafing dishes and curling irons, which though they have never been so much in demand as the iron are all extensively used. Electric radiators of the luminous bulb type were also introduced at an early date. Nonluminous radiators or room warmers were placed on the market later and used in the household to a limited extent, but it was not until the last 8 or 10 years that the luminous heating-coil radiators made this appliance really popular as an auxiliary heater for bathrooms, nurseries, etc., and as a general service heater in southern homes especially. Other heating devices, such as cookers, heating pads, blankets, foot warmers, egg boilers, milk warmers, small water heaters, shaving mugs, hair driers, etc., have been found thoroughly practical, efficient and very convenient, even though they have not attained as widespread use as flatirons or the common table devices.

The electric cooking range is a development of the last 8 or 10 years and is very extensively used in the West, where hydroelectric power is available at relatively cheap rates and also to some extent in other parts of the country where special cooking rates are offered to stimulate this very attractive electrical load. Ranges have been perfected for some years so that every cooking operation can be performed on them efficiently and they produce exceptionally savory dishes.

As an auxiliary to the electric range the electric water heater for heating all the water needed in the household for bathing, lavatory, cooking and washing purposes has met with considerable favor, particularly where special cooking and heating rates are in use. These water heaters are generally used with a kitchen storage tank (or so-called "range boiler"), which is covered with heat insulation. The heater can be run at low wattage for almost the entire day, since the heat in the water is kept from radiating.

Power Applications. Vacuum cleaners and washing machines were among the first development in motor-driven household appliances, but on account of their relatively high first cost were slower in coming into extensive use than the smaller appliances. During the recent war the scarcity and high wages of servants led many housewives to dispense with them and to utilize these two electric labor-saving appliances, which made it possible for the housewife or other members of the family to do the work of housemaids or laundresses with little exertion and at an extremely low cost. This gave the sale of washing machines and cleaners a great impetus and they rank now as the two commonest and most used power appliances to be found in the home.

Household fans, though they have been in use for many years, have not enjoyed as wide a sale for residence service, except in the southern states, due chiefly to their short seasonal period of usefulness in the northern climes. Electric sewing machines and detachable sewing-machine motors have made slower progress in household use, because dressmaking and general sewing is not done at home so extensively as in former times, but they are steadily replacing the foot-power machines still used in the home. Ironing machines or electrically driven mangles are used in many large households, most being gas-heated, though some electrically. Electric phonographs, massage vibrators, egg beaters, cake mixers and other motor-driven appliances are also used to a less extent. Electric dishwashers have been found a great labor-saving means of doing this disagreeable daily task and are of special value in large residences. Electric power tables are a great convenience in the kitchen since they permit one motor, with simple attachments, to be used for driving an egg beater, knife sharpener, tableware polisher, ice-cream freezer, etc. The electric refrigerator has been introduced with success into many homes, since it eliminates the ice problem and requires little attention; on account of their relatively high initial cost such refrigeraors have been used in the larger residences chiefly.

The wide-spread interest in radio telegraphy and radio telephony has produced a great number of amateurs who operate a station in their homes. This application of electricity, though not of such general utility as the other applications mentioned, is of some importance due to the number of such stations and the power they consume.

Present Status and Prospects. All of the various household applications enumerated and others not specifically mentioned have made their way and are extending their use almost entirely by merit. To only a limited extent have electrical devices been introduced into the home because of being fashionable or because certain neighbors or friends had them. If electricity in the household had come to be merely fashion, it would rest on a precarious basis and might lose its vogue as the whims of style change. But wherever it has been introduced it has been quickly appreciated as a most potent means for making the home a more comfortable and cheerful place of abode for all members of the family. For the housewife especially it has proved a great boon by helping solve her most arduous duties, performing the most irksome tasks and conserving her strength, eliminating drudgery and, in short, taking "work" out of housework. Electric service in the household has established itself as a permanent development. Although at first re-

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garded as a luxury, it has become a necessity and no modern home is complete without it.

This stability of the household uses of electricity and their ever widening scope means much to the electrical industry. The manufacture and sale of electrical household appliances and supplies has greatly extended the business of those branches of the industry concerned with it. Residences constitute by far the largest number of buildings in any community. Their wiring, the supply of electrical equipment therefor and the supply of electric service, while already a considerable proportion of the total business, in all likelihood will increase to much larger proportions.

Central-station companies in the last few years have recognized that by stimulating residence business, especially by promoting the greater use of various electrical appliances, the load-factor and diversity-factor of this former poorly paying service is substantially increased. No city has as yet reached the saturation point of electric service among its residences. In the older cities there are a great many lines to which buildings, as yet unwired, could be connected in the future. In almost every household the daily uses of electricity can be increased, especially when electric cooking has replaced gas cooking and the older methods formerly in use. Since the recent war a number of central-station companies have taken up the active promotion of residence service so as to increase the load on lines already built and thus offset the higher operating costs by the greater net income from residence service. In some cases this has been the means of avoiding the increases in rates that were necessary in so many other companies. By further growth of the residence service it is very likely that the profitableness of this class of business will be so enhanced as to permit central-station companies to reduce rates voluntarily and thus bring about still further development in this line.

HOUSEHOLD APPLIANCES, WATTAGE AND OPERATING COST OF.—It is often desirable to know the power consumption or cost of operation of electrical household appliances. Possible purchasers of such appliances frequently fall into the error of believing that the cost of operation of an appliance would make its use prohibitive and this false impression retards their purchase. Electrical dealers should be prepared to inform their patrons authoritatively on this matter, but in many cases have not the data at hand to do so.

It was primarily to show the cost of the energy used by such appliances that the following table was compiled. Practically all heating and motor-driven devices in household use will be found listed in this table. As some devices vary considerably in wattage according to size and capacity, their wattage has been given in two columns, the more common wattage in the first and the lowest and highest wattages in use in the second. Where two sizes are both very commonly used both wattages will be found listed in the first column. Motor-driven appliances are sometimes marked with a rating in horsepower and for such devices the tables show both the horsepower rating and the approximate equivalent of that rating in watts. The table does not give wattages for ordinary lamps used in household fixtures. In all cases the wattage can be readily found by looking at the lamp bulb. A small label shows both the voltage and wattage of every lamp. If a number of lamps are used on the fixture the sum of the individual wattages of the different lamps should be taken, unless it is not intended to use all of the lamps at one time.

The cost per hour of operating any of the appliances may be computed by multiplying the rating of the appliance in kilowatts and the kilowatt-hour electricity rate in any locality. In localities where a sliding or variable rate is used it will be necessary to estimate the average rate or mean cost per kilowatt-hour. As the table gives the rating in watts this rating must be divided by 1000 to give the rating in kilowatts when making the cost computations. The cost per minute will, of course, be the cost per hour divided by 60. The method of computing is illustrated in the following examples:

Example 1. To compute the cost of operating a vacuum cleaner in a locality where the average energy cost is 8 cents per kilowatt-hour:

Cost of operation per hour-wattage in kilowatts×cost of current per kilowatt-hour. Wattage from table=120, or 120/1000=0.12 kilowatt. Cost of operation per hour= 0.12×8 cents=0.96 or practically 1 cent. This is the cost of operating the motor continuously for one hour. However, in general use cleaners are usually run intermittently and the acual cost per hour's use would be slightly less.

Example 2. To compute the cost of operating a curling iron where the energy cost is 10 cents per kilowatt-hour:

The wattage of this appliance from table=25 or in kilowatts=0.025. Cost of operation per hour=0.025×10 cents=0.25, or only ¼ cent per hour.

WATTAGES OF HOUSEHOLD APPLIANCES.

TABLE 1—HEATING DEVICES.

Appliance	Wattage commonly used	Wattage lowest and highest
Bath, electric light		2000-5000
Blanket	120 or 170	120- 340
Comb	45	
Cooker, fireless,		
(1 compartment)	660	
(2 compartment)	1320	
Curling iron	25	15- 40
Curling iron and comb	25	
Dish, chafing	450	420- 600
Egg boiler	250 or 440	
Faucet, water heating	600	
Frying pan	640	
Griddle	450	
Grill	600	550- 660
Heater, luminous bulb radiator	250 per socket	
Heater, luminous coil radiator	660	500- 660
Heater, luminous fire place	480	480-2000
Heater, curling iron	90	
Heater shaving mug	420 or 500	
Heater, water, bayonet	250	250- 400
Heating pad	40, 50, 60	40- 60
Humidifier, air	470	
Ironing machine, electric heat	2160	
Iron, household	550	350- 600
Iron, traveler's	330	275- 575
Logs, fireplace		2000-5000
Ovens, portable		*650-1500
Percolator	420	400- 475
Plate, hot	550	500- 650
Range, burners on top		*1000-5500
Range, oven		*1760-3300
Samovar	420	
Stove, disk or table	450	400- 600
Tea kettle	420	360- 420
Teapot	400	400- 440
Toaster	400	400- 500
Urn, coffee	420	400- 475
Urn, tea	420	400- 475
Waffle iron	600	
Warmer, milk, immersion	250	
Warmer, milk nursing bottle	200	
Warmer, plate and dish	400	
	800	400-1760
Water kettle	420	
Waver, hair	45	

*Maximum wattage with all coils on.

TABLE 2—MOTOR DEVICES.

Appliance	Wattage commonly used	Wattage lowest & highest
Cream whipper	60	
Dishwasher	240	⅛ hp. or 125 w. ¼ hp. or 240 w.
Drier, hair	390	
Egg beater	60	
Fan, 8-inch	30	25- 35
10-inch	35	30- 45
12-inch	50	45- 60
Ironing machine, gas-heated	160	95-235
Motor, sewing machine and utility	40	
Phonograph	55	
Piano player	⅛ hp. or 125 w. ¼ hp. or 240 w.	
Refrigerator	¼ hp. or 240 w.	1/6 hp. or 165 w. 1/3 hp. or 320 w.
Sewing machine	40	
Toys, electric		5 -50
Vacuum cleaner	120	80-250
Vibrator	30	20- 50
Washing machine	¼ hp. or 240 w.	⅛ hp. or 125 w. ½ hp. or 480 w.

HOUSEHOLD ELECTRIC FREEZER.—Trade name for motor-driven ice cream freezer manufactured by Thomas Mills & Brother, 1301-1311 N. 8th St., Philadelphia, Pa.

HOUSER ELEVATOR CO.—Syracuse, N. Y. Manufacturer of electric elevators.

HOUSES, METERING AND SWITCHING.—See Switch houses, outdoor.

HOUSES, POLE CABLE TERMINAL.—Cable terminal houses are used in telephone line distribution where an underground or aerial cable terminates and the lines are run in separate smaller branching cables or as insulated twisted pairs (aerial conduit) or as individual wires on insulators in open wiring. The terminal houses differ from other pole cable terminals in that they consist of a wooden enclosing cabinet or housing, with the necessary terminal board, while in the smaller terminals the board is enclosed in a galvanized iron can. The terminal board in either case has a protecting cover for the terminal cable and the lines are fanned out and connected to screw terminals on the back of the board. The terminal projects through the board and the extension lines are connected to these from the front of the board. The whole housing is suspended from crossarms and there is usually a pole seat mounted below it for the convenience of men working on the connections.

Manufacturer:

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

HOUSINGS, TRANSFORMER BUSHING.—See bushing housings, transformer.

HOUSTON, STANWOOD & GAMBLE CO.—Cincinnati, Ohio. Manufacturer of steam engines, motor-driven lathes, fire-tube boilers and other boiler room equipment.

HOVERS, ELECTRIC—See Brooders and hovers, electric.

HOVORKA, JOHN D.—2509 W. 12th St., Chicago, Ill. Manufacturer of lighting fixtures. John D. Hovorka, sole owner.

HOWARD.—Trade name for shaft hangers manufactured by Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.

HOWARD CLOCK CO., THE E.—Boston, Mass. Manufacturer of electric clocks. President, R. M. Saltonstall; secretary, Murray Cheever; treasurer, E. A. Bigelow. Main office, 373 Washington St., Boston, Mass. Branch offices, 309 Broadway, New York, N. Y.; 31 N. State St., Chicago, Ill.

HOWARD MINIATURE LAMP CO.—East Orange, N. J. Manufacturer of miniature incandescent lamps.

HOW CO.—Trade name for incandescent lamps manufactured by the Howland Mfg. Co., 60 Franklin St., Malden, Mass.

HOWDEN CO. of AMERICA, INC., JAMES.—Wellsville, N. Y. Manufacturer of gas and steam engines. President, J. Howden Hume; vice-president, F. S. B. Heward. Main office, Wellsville, N. Y. Branch, 277 Broadway, New York, N. Y.

HOWE LAMP & MFG. CO.—115-123 E. Ontario St., Chicago, Ill. Manufacturer of automobile spotlights, ignition timers and vehicle lamps. Business established 1915. President and general manager, E. F. Bessey; vice-president, and sales manager, B. G. Cochrane; secretary and treasurer, Samuel Levy.

HOWE SCALE CO., THE.—Rutland, Vt. Manufacturer of coal scales and coal handling machinery. President, Carl B. Hinsman; vice-president and secretary, Leon G. Bagley; treasurer, Edward V. Ross. Main office and factory, Rutland, Vt. Branch offices and warehouses, Boston, Mass.; Pittsburgh, Pa.; Philadelphia, Pa.; Cleveland, Ohio; Cincinnati, Ohio; Minneapolis, Minn.; St. Louis, Mo.; Kansas City, Mo.; New Orleans, La.; Dallas, Tex.; Atlanta, Ga.; San Francisco, Cal.; Portland, Ore.; 341 Broadway, New York, N. Y.; 1222 S. Wabash Ave., Chicago, Ill.

HOWELL ELECTRIC MOTORS CO.—Howell, Mich. Manufacturer of induction motors. President, H. N. Spencer; vice-president, R. B. McPherson; secretary and treasurer, W. M. Spencer; sales manager, C. F. Norton. Main office and factory, Howell, Mich. Branch offices, 327 S. LaSalle St., Chicago, Ill.; Philadelphia, Pa.; Detroit, Mich.; Grand Rapids, Mich.; San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.; St. Louis, Mo.; Toledo, Ohio;

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Cleveland, Ohio; Buffalo, N. Y.; Dallas, Tex.; Saginaw, Mich.; Pittsburgh, Pa.; Atlanta, Ga.; Richmond, Va.; Boston, Mass.; Charlotte, N. C.; Montreal, Que., Can.; 149 Broadway, New York, N. Y.

HOWLAND MFG. CO., THE.—60 Franklin St., Malden, Mass. Manufacturer of incandescent lamps.

HOWLER.—A device for producing an alternating current which will make a telephone receiver howl. It is used to attract the attention of a subscriber who has left his receiver off the hook, though it is not very successful if the ear cap of the receiver stands flat on a solid desk. The term is also applied to a receiver with a horn attached for the purpose of signaling instead of a bell. It is thus used in railway composite telephones.

HOYT.—Trade name for electrical pocket instruments manufactured by the Hoyt Electrical Instrument Works, Penacook, N. H.

HOYT ELECTRICAL INSTRUMENT WORKS.—Penacook, N. H. Manufacturer of electrical pocket instruments. Exclusive distributors, Burton-Rogers Co., 755 Boylston St., Boston, Mass.

HP.—Abbreviation for horsepower. The form H. P. is often used, but hp. is preferable because horsepower is now more commonly written as a single word.

HP-HR.—Abbreviation for horsepower-hour.

H. S. B. W.—COCHRANE CORP.—Philadelphia, Pa. Manufacturer of feed water heaters, steam and oil separators and other power plant specialties. Business established 1863 as Harrison Safety Boiler Works. Incorporated 1920. President, J. S. L. Wharton; vice-president and treasurer; W. S. Hallowell; vice-president, secretary and general manager, J. C. Jones; sales manager, H. E. Gibson. Main office and factory, 17th St. & Allegheny Ave., Philadelphia, Pa. Branch office, Oliver Bldg., Boston, Mass. Sales representative, F. E. Idell, 50 Church St., New York, N. Y.; Dravo-Doyle Co., Pittsburgh, Pa., Cleveland, Ohio; A. Sorge, Jr. & Co., Monadnock Block, Chicago, Ill.; W. L. Flower Co., Cupples Block, St. Louis, Mo.; F. H. Mason, Moffat Bldg., Detroit, Mich.; H. P. Thompson, Mercantile Library Bldg., Cincinnati, Ohio; Charles C. Moore & Co., San Francisco, Los Angeles, Cal.; Salt Lake City, Utah; Seattle, Wash.; Tucson, Ariz.; J. E. Weinhold, Realty Bldg., Charlotte, N. C.; Arthur Scrivenor, Mutual Bldg., Richmond, Va.; J. W. Shuman, Corn Exchange Bldg., Minneapolis, Minn.; H. A. Paine, 1302 Nance St., Houston, Tex.; W. F. Trenary, Jr., Birmingham, Ala.; Walter Castanedo, Commercial Bank Bldg., New Orleans, La.; I. C. DeHaven, State Life Bldg., Indianapolis, Ind.; Canadian Allis-Chalmers, Ltd., King & Simcoe Sts., Toronto, Ont., Vancouver, B. C.; Calgary, Alta.; Winnipeg, Man.; Montreal, Que.; Halifax, N. S., Can.; Thermal Efficiency Co., 1416 Main St., Kansas City, Mo.; J. U. Jones, Western Indemnity Bldg., Dallas, Tex.; Mine & Smelter Supply Co., Denver, Colo.; Roland B. Hall, Jr., 3rd National Bank Bldg., Atlanta, Ga.

H_2O—Trade name for leather belting manufactured by the Schwartz Belting Co., 74-76 Murray St., New York, N. Y.

HUB DOME.—Trade name for bells and buzzers manufactured by Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

HUB ELECTRIC CO.—2225 W. Grand Ave., Chicago, Ill. Manufacturer of electric door openers, panelboards, switchboards and theatrical lighting effects. President, S. L. Decker; secretary, A. M. Knauber; treasurer, R. C. Biedemann; sales manager, K. G. Rennie.

HUB GUARD OR PLATE.—A heavy metal plate attached to a wooden line pole near the ground to prevent damage to the wood from accidental bumps by wagons. Also called hub plate or butt protector. See Plates, pole, hub, etc.

HUBBARD.—Trade name for pole line hardware manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

HUBBARD & CO.—Pittsburgh, Pa. Manufacturer of line construction specialties and pole line hardware. Business established 1843. President, John W. Hubbard; vice-president, C. P. Seyler; treasurer, S. A. Rankin; manager, C. L. Peirce, Jr.; sales manager (Electrical Materials Dept.), R. M. Kerschner. Main office, 6301 Butler St., Pittsburgh, Pa. Factories, Pittsburgh, Pa., and Chicago, Ill. Branch offices, 50 Church St., New York, N. Y.; 54th Ave. & Roosevelt Rd., Cicero, Ill.

HUBBARD'S SONS, NORMAN.—265-267 Water St., Brooklyn, N. Y. Manufacturers of electric vacuum pumps and impregnating apparatus. E. L. Hubbard, owner.

HUBBELL, INC., HARVEY.—Bridgeport, Conn. Manufacturer of sockets, switches, receptacles, current taps and other electrical specialties. Business established 1905. President, treasurer and general manager, Harvey Hubbell; secretary, G. S. Hadley; sales manager, Harry K. Bliven. Main office, Bridgeport, Conn. Factories, Bridgeport, Conn., and Toronto, Ont., Can. Branch office carrying stock, 348 W. Washington St., Chicago, Ill. District office, 30 E. 42nd St., New York, N. Y. Sales representatives, Garnett Young & Co., 612 Howard St., San Francisco, Cal.; Seattle, Wash.; Portland, Ore.; Los Angeles, Cal.; B. K. Sweeney, 231 15th St., Denver, Colo.; H. O. Biglin, 43 Fairlie St., Atlanta, Ga.

HUBER.—Trade name for hand operated stokers manufactured by the Conn & Emrich Co., Holliday & Saratoga Sts., Baltimore, Md.

HUDSON BRASS WORKS.—16 Nassau St., Brooklyn, N. Y. Manufacturers of fixture fittings and parts. President, Abraham Cooper; vice-president and secretary, Theodore Guterman.

HUENERGARDT CO.—19th & Vine Sts., Lincoln, Neb. Manufacturer of electric washing machines.

HUFF ELECTROSTIC SEPARATOR CO.—Box 66, Arlington, Mass. Manufacturer of graphite, electrostatic separating equipment and other mining machinery. Business established 1905. President, treasurer and general manager, H. B. Johnson; vice-president and secretary, William E. McKee. Main office and factory, Arlington, Mass. Branch office and warehouse, 230 W. 13th St., New York, N. Y.

HUGHES.—Trade name for electric ranges, ovens and hot plates manufactured by the Edison Electric Appliance Co., Inc., 5660 W. Taylor St., Chicago, Ill., and Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can.

HUGHES.—Trade name for power plant gas producers manufactured by the Wellman-Seaver-Morgan Co., 7000 Central Ave., Cleveland, Ohio.

HUGRO MFG. CO.—Warsaw, Ind. Manufacturer of electric washing machines and vacuum cleaners. President, treasurer and general manager, W. L. Groth; vice-president and sales manager, William Remmert; secretary, Dwight Harrison. Factories, Warsaw, Ind.; St. Louis, Mo.

HULL & CO., S. W.—3729 Prospect Ave., Cleveland, Ohio. Manufacturers of steel poles and towers. Business established 1917. President, S. W. Hull; vice-president E. C. Smith; secretary, F. Bolton; treasurer, E. C. Grimley; general manager, J. M. Babcock; sales manager, Frank G. Lee.

HUMANITY.—Trade name for electric washing machine manufactured by the Central Mfg. Co., 2525 Montgomery St., St. Louis, Mo.

HUMBIRD LUMBER CO.—Sandpoint, Idaho. Producer of cedar poles. Sales representative, Weyerhaeuser Sales Co., Sandpoint, Idaho.

HUMBOLDT MFG. CO.—2014 Nebraska Ave., Chicago, Ill. Manufacturer of electric stirrers and other laboratory apparatus.

HUMIDIFIERS, AIR, ELECTRIC.—A type, for mines, tested by the Bureau of Mines at its Pittsburgh station consists of a hollow wheel on an electric motor shaft, the periphery of the wheel being provided with small spray nozzles. Water entering at the hub is thrown into the air in a fine spray as the wheel revolves. Another, a self-contained type consists of a motor-driven blower, and an electrically heated device for producing the vapor. It is designed for use in the home, in hospitals and offices. Various special humidifiers are made for use in textile mills, printing press rooms and other industrial applications where it is important to maintain the humidity within certain limits. If the air is too dry, especially in winter, much trouble is experienced from threads and sheets sticking together due to accumulation of static electricity formed by friction.

Manufacturers:

Atmospheric Conditioning Corp., 920 Lafayette Bldg., Philadelphia, Pa. "Webster."

Carrier Air Conditioning Co. of America, 490 Broadway, Buffalo, N. Y.

Claxo Co., The, Iowa City, Iowa.

Normalair Co., Winston Salem, N. C.

Onward Mfg. Co., Menasha, Wis. "Onward."

Tecla Co., Inc., Detroit, Mich.

HUMIDIFIERS, CIGAR, ELECTRIC.—These are made in various forms small enough to install in a cigar store showcase. Some are merely electric water heaters, while others consist of a small fan blowing air upon the surface of a dish of water, generally combined with a flashing device and lamp to give the humidifier some advertising value as well.

Manufacturers:

Drake Mfg. Co., Milwaukee, Wis. "Drake."

Sanifacient Humidor Co., 310 W. Randolph St., Chicago, Ill.

HUMIDITY.—Moisture or dampness; a moderate degree of wetness perceptible to the touch or eye. It is of special importance when present in the atmosphere and often affects electrical phenomena, especially electrostatic. The relative humidity is the ratio of the vapor actually present in the atmosphere as compared to the greatest amount the air could possibly contain at that temperature. Relative humidity is measured by a hygrometer, which see.

HUMIL CORP., THE.—101 Park Ave., New York, N. Y. Manufacturer of electric rivet heaters. Business established 1919. President, treasurer and general manager, George G. Milne; secretary, William M. Symmes; sales manager, John P. Sunderland. Sales representatives, H. Lee Reynolds Co., First National Bank Bldg., Pittsburgh, Pa.; International Equipment Co., Ltd., Montreal, Quebec, Can.

HUM-MER.—Trade name for electric vibrating screens and magnetic separators manufactured by the W. S. Tyler Co., Cleveland, Ohio.

HUMMER.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

HUMPHREY.—Trade name for lighting fixture manufactured by the General Gas Light Co., Kalamazoo, Mich.

HUMPHREY, H. W.—Unionville, Conn. Manufacturer of fiber and metal washers.

HUMPHRYES MFG. CO., THE.—Mansfield, Ohio. Manufacturer of electric water system and other pumps. Business established 1870. President and general manager, W. G. Moore; secretary and treasurer, O. M. Gates.

HUNGERFORD BRASS & COPPER CO., U. T.—New York, N. Y. Manufacturer of brass, bronze and nickel silver rolls, sheets, wire, rods, etc. President, U. T. Hungerford; secretary, Bernard Ris; treasurer, J. R. Van Brunt. Main office, 80 Lafayette St., New York, N. Y. Branch offices and warehouses, 93-95 Broad St., Boston, Mass.; Lombard & South Sts., Baltimore, Md.; 510 Arch St., Philadelphia, Pa.. District office, Postal Telegraph Bldg., San Francisco, Cal.

HUNT.—Trade name for conveyors manufactured by the Robins Conveying Belt Co., 13 Park Row, New York, N. Y.

HUNT CO., INC., C. W.—West New Brighton, N. Y. Manufacturer of electric hoists, trucks, steam engines, etc. Business established 1872. President and general manager, S. S. Hathaway; vice-president, S. S. Volck; secretary, George S. Humphrey; treasurer, C. S. Van Winkle; sales manager, George K. Jenckes. Main office and factory, West New Brighton, N. Y. Branch offices, Chicago, Ill.; Boston, Mass.; New York, N. Y.; Washington, D. C.

HUNT MFG. CO., EDWARD J.—207 Market St., Newark, N. J. Manufacturer of oil driers and purifiers. Business established 1910. Owner, Edward J. Hunt. Factory, Harrison, N. J. Sales representative, Northern Electric Co., Ltd., Montreal, Que., Can.

HUNTER.—Trade name for electric routing machine made by American Router & Mfg. Co., P. O. Box 621, Pittsburgh, Pa.

HUNTER FAN & MOTOR CO.—Fulton, N. Y. Manufacturer of electric fans. Business established 1886. President and secretary, S. W. Wiltsie; treasurer, C. R. Lee; general manager, J. C. Hunter; sales manager, Arthur Organ. Branch office and warehouse, 46 W. 46th St., New York, N. Y.

HUNTING.—Pulsations in speed, generally periodic, or oscillations about a desired mean position. The word is very

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frequently applied to the periodic changes in speed above and below an average value which occur at times with a-c. generators, synchronous motors and synchronous converters. It is also used to designate the occasional oscillations of the governors of prime movers which causes them to pulsate in speed.

Hunting is often reduced or prevented by a damping action which retards the changes. In governors this can be done by increasing the frictional resistance to motion. In dynamoelectric machines, it is commonly done by putting grids which form closed electric circuits in the pole faces. Currents are induced in these circuits as a result of the pulsations in speed and these currents oppose the motions which produce them and thus damp the pulsations.

HUNTINGTON.—Trade name for track gages manufactured by the Aldon Co., 3338 W. Ravenswood Ave., Chicago, Ill.

HUNTINGTON.—Trade name for track gages manufactured by the Buda Co., Harvey, Ill.

HUNTINGTON.—Trade name for grinding wheel dressers manufactured by the Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa.

HUNTINGTON.—Trade name for grinding wheel dressers manufactured by the Desmond-Stephan Mfg. Co., Urbana, Ohio.

HUNTINGTON.—Trade name for grinding wheel dressers manufactured by the North Wales Machine Co., Inc., Elm Ave. & Center St., North Wales, Pa.

HUPP-YEATS ELECTRIC CAR CO.—Detroit, Mich. Manufacturer of electric vehicles.

HURLEY MACHINE CO.—Chicago, Ill. Manufacturer of electric labor-saving devices. Business established 1906. President and general manager, Neil C. Hurley; vice-presidents, A. J. Fisher and Tom J. Casey; secretary and treasurer, J. A. McCoy; sales manager, Tom J. Casey. Main office, 24 E. Jackson Blvd., Chicago, Ill. Factories, Cicero, Chicago and Waukegan, Ill. Branch offices, 147 E. 42nd St., New York, N. Y.; 124 Post St., San Francisco, Cal.; 822 S. Broadway, Los Angeles, Cal.; 319 N. 10th St., St. Louis, Mo.; 209 Tremont St., Boston, Mass.; 817 Walnut St., Kansas City, Mo.; Durant Bldg., Flint, Mich.; 413 Yonge St., Toronto, Ont., Can.

HURRICANE.—Trade name for electric fans manufactured by the Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J.

HUSE & SON, LTD., JOSEPH.—80 North St., Boston, Mass. Manufacturer of raw mica.

HUSKEE.—Trade name for electric portable drills and valve grinders manufactured by the Stenman Electric Valve Grinder Co., 42 Southbridge St., Worcester, Mass.

HUSKS, SOCKET.—See Covers or husks, socket.

HUYETTE CO., THE PAUL B.—5 S. 18th St., Philadelphia, Pa. Manufacturer of boiler water level gages. President, Paul B. Huyette; vice-president and treasurer, Walter C. Edge; secretary, P. Wood.

H W W.—Trade name for testing clamps manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

HYATT.—Trade name for water filters manufactured by the New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.

HYBINETE PROCESS.—The electrolytic process used in Norway and in Canada for producing refined nickel. The nickel-copper matte is roasted and then leached in dilute sulphuric acid to remove the bulk of the copper. The residue is cast into anodes and electrolyzed in sulphuric acid solution, depositing pure nickel on iron cathodes from which it is stripped and either cut up or remelted. The anodes are enclosed in diaphragms. The copper which goes into solution from the anodes and would tend to deposit before or with the nickel is previously removed from the solution by circulating it through separate tanks containing scrap nickel anodes, the copper being precipitated out and replaced by nickel in the solution.

HYDEVILLE SLATE WORKS.—Hydeville, Vt. Manufacturers of slate for electrical purposes.

HYDRATE THEORY.—The conception that salts going into aqueous solution combine with the water. Broadly, this applies to any other solvent, and has developed into the solvate theory, which see, in which it is extended in detail to cover not only combinations of the dissolved salt's molecules with the solvent, but also combinations of parts of those molecules with the solvent, called hydrated or solvated ions.

HYDRATED IONS.—In the developing ionization theory of solutions, the supposed combination of assumed ions with a certain amount of water. In the solvate theory, this conception has developed into regarding these combinations as existing in dilute solutions, but as being real chemical compounds of parts of the dissolved molecules with the solvent. They thus form a new class of chemical compounds, and are not ions in any proper sense.

HYDRAULIC ENGINEERING.—That branch of civil engineering which concerns itself chiefly with the design and construction of water courses, such as aqueducts, canals, water tunnels, flumes, irrigation works, water-power developments and related structures, including reservoirs, dams, spillways, control gates, etc.

HYDRAULIC ENGINEERING WORKS.—708 Fulton St., Chicago, Ill. Manufacturer of miscellaneous valves. President, C. T. Rockcastle; secretary and treasurer, U. J. Rockcastle.

HYDRAULIC PRESS MFG. CO., THE.—Mount Gilead, Ohio. Manufacturer of electric and steam pumps and presses. Business established 1877. President, Dr. Walter G. Tucker; vice-president and general manager, Frank B. McMillen; secretary, W. C. Bachelor; treasurer, Foster Copeland. Main office, 334 Lincoln Ave., Mount Gilead, Ohio. Branch offices, 39 Cortlandt St., New York, N. Y.; 370 Rockefeller Bldg., Cleveland, Ohio; 1502 Kresge Bldg., Detroit, Mich.; 316A Mutual Life Bldg., Buffalo, N. Y.; 3003 E. 27th St., Kansas City, Mo. Sales representatives, Berger & Carter Co., 365 Market St., San Francisco, Cal.; 92 1st St., Portland, Ore.; 414 E. 3rd St., Los Angeles, Cal.; 407 L. C. Smith Bldg., Seattle, Wash.

HYDRAULICS.—That branch of physics which treats of water or other liquids in motion, especially their physical action in pipes, canals, rivers, and other water courses. Also see Hydraulic engineering.

HYDRO.—Trade name for gas meters and vacuum gages manufactured by the Bacharach Industrial Instrument Co., 422 1st Ave., Pittsburgh, Pa.

HYDROCARBONS.—Chemical compounds containing only hydrogen and carbon. The simplest hydrocarbons are gases at ordinary temperatures; with increase in molecular weight they change to the liquid and finally to the solid state. In general they are neutral, insoluble in water and combustible. Methane, ethylene, acetylene, benzene, trimethylene, pinene and paraffin are important classes of hydrocarbons. The number of such compounds actually discovered is very large and their possible number is practically infinite. With their combinations with other elements they constitute what is called organic chemistry.

HYDROCHLORIC ACID.—Hydrochloric acid (HCl), commonly called muriatic acid, is a colorless gas very soluble in water. The acid as used commercially is a strong solution in water. The pure acid solution is colorless, but the commercial muriatic acid is commonly a yellowish solution. It is extensively used in "pickling," cleaning metals preparatory to a plating, galvanizing or enameling process.

Manufacturers:

COOPER & CO., CHARLES, 194 Worth St., New York, N. Y.
General Chemical Co., 25 Broad St., New York, N. Y.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Hooker Electrochemical Co., 25 Pine St., New York, N. Y.
Mallinckrodt Chemical Works, St. Louis, Mo.

HYDROELECTRIC POWER DEVELOPMENT.—The utilization of potential energy of water antedates history. There are indications that simple and crude water wheels were used in connection with water supply aqueducts and irrigation works even before the first century A. D. One of the first recorded applications of water power was made about 1581, when pumps driven by water wheels were used to supply the city of London with water. The earliest use of water power in the United States was the old tidal mill near Boston constructed in 1631. Other small developments followed and the presence of water power determined largely the location of the early settlements, but no developments of larger proportions were attempted until about the end of the 18th century. Introduction of the hydraulic turbine about the middle of the 19th century made possible higher efficiencies and larger developments of power, and this unit superseded the water wheel except for irrigation purposes and the smaller flour and saw mills. Even in the larger textile mills the utilization of the water power was restricted by the limitations of mechanical power transmission from the hydraulic unit to the driven machines.

It was not until near the close of the last century that hydroelectric power development was begun and thus removed the limitations referred to. One of the first electric central stations, that installed at Appleton, Wis., in 1882, was driven by water power. Other plants of this kind went into service in Vermont, Quebec and other parts of the United States and Canada, but the real beginning of hydroelectric power generation and transmission was not until 1889. In that year two single-phase 10,000-volt transmission systems were placed in service, one at Oregon City, transmitting 13 miles to Portland, Ore., and the other at Pomona, Cal., transmitting 29 miles to San Bernardino. The power was used for lighting and railways. In 1891 an experimental three-phase transmission system was completed in Germany, which transmitted over a distance of 109 miles from Lauffen to Frankfort at 25,000 volts.

About this time the first great development for transmission of electricity for general power purposes was started at Niagara Falls, N. Y. The Niagara Falls Hydraulic & Mfg. Co. built the first plant. Water was taken from the upper Niagara River and conducted by means of a crosscity canal to the lower bluff on the American side and distributed by steel pipes to the plants located at the foot of this bluff. The Niagara Falls Power Co. constructed the second plant, in which a small canal conducts water to the vertical shafts which connect with a tail-water tunnel running below the city of Niagara Falls and discharging into the river just below the suspension bridge.

During the recent World War, all the American power companies at Niagara Falls were consolidated under the name of the Niagara Falls Power Co., the consolidation making possible the use of all the water available under the treaty with Great Britain, by the construction of a new plant. This new plant built under the stress of war-time conditions, embodies the latest advances in hydraulic and electrical development. Three units were installed, designed to have a combined output of 100,000 hp. The units have each demonstrated their ability to operate continuously at 40,000 hp., which makes them the largest hydroelectric units in the world. Although the official efficiency tests have not as yet been completed, it is apparent from those already made that the hydraulic efficiency will equal or slightly exceed 93% and that the efficiency from forebay to switchboard will be over 90%.

Other large hydroelectric systems which represent the best practices known are the Tallulah River, Ga., Big Creek Cal. and Keokuk, Iowa, on the Mississippi. The Tallulah plant operates six 10,000-kw units at a 600-foot head, and transmits power at 110,000 volts. The Big Creek development has an ultimate capacity of 140,000 kw. and operates two plants. The first plant has a head of 1900 ft. and the tail water is then conducted to plant No. 2, which operates at a head of 1780 feet. Transmission is at a voltage of 150,000 and the maximum distance is 240 miles. The Keokuk dam and plant is the largest single water-power plant in the world. Its ultimate capacity is 225,000 kw.: 10,000-hp. turbines operating under a head of 32 feet are connected to 7500-kv-a. generators.

Some notable features in connection with hydroelectric development are in connection with the size of the units and the maximum heads utilized, etc. The largest single-discharge turbine in the world, 42,000 hp., is located in California. The highest head plants are to be constructed in California, where two plants are to operate at a head of 2500 ft. The highest dam in the world is 346¼ ft., and is installed in Idaho. The greatest storage of water in America and second in the world is in New Mexico, having a storage space of 2,638,868 acre-ft. The longest high-voltage transmission line, now operating at 87,000 and 55,000 volts is, from Mono County,

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California, to Yuma, Arizona, a distance of 539 miles.

HYDROELECTRIC POWER FACTS AND FIGURES.—Hydroelectric plants are those which generate electrical energy exclusively or chiefly by means of water power, as contrasted with those plants which use other sources of primary power. In view of the fact that these plants use little or no fuel and generally invest huge sums in water-power development, and transmit their current long distances over high-tension lines, they clearly stand in a class by themselves among other central stations.

Water wheels and turbines form a very important part of the primary power equipment of American central electric stations. They have not shown the increase in relative importance as compared to other prime movers during the past few years, which might have been expected had conditions been normal. There has been a fuller utilization of existing hydroelectric plants rather than much installation of new ones.

The growth of American hydroelectric power for central stations and electric railways is as follows: 1902, 1,748 units—488,125 hp; 1907, 2,710 units—1,446,218 hp; 1912, 3,325 units—2,948,538 hp; 1917, 3,695 units—4,917,522 hp. and 1920 (estimated) 6,481,000 hp. In 1917, 3,192 generators were driven by water-power, with a total kilowatt capacity of 8,228,265, an average rating of 1,010 kw. The generators driven by all other prime movers were 12,406 in number with capacities of 8,840,789 kw., an average of 712 kw. per generator.

The distribution of water power between commercial and municipal central stations, electric railways, and electrified divisions of steam railways is given in the following table. It also shows the proportion of water power to the total mechanical horsepower in per cent.

Class Horsepower Rating in Thousands	1920	1917	1912	1907
Commercial	5,500.0	4,076.8	2,338.9	1,318.7
Municipal	251.0	200.4	130.3	80.3
Electric railways	713.2	628.0	471.3	92.0
Electrified steam railways	16.8	12.8	8.0	5.2
Total	6,481.0	4,917.5	2,948.5	1,446.2
Percent of total hp...	28.8	28.7	26.4	21.8

In 1917 there were 1,079 plants reporting some water power and 259 which had water wheels and turbines totaling 1,000 hp. or more. Many stations report other types of primary power machines used as auxiliaries when water power is insufficient. There are 548 plants which use water power only. The actual increase in hydroelectric stations represented by the 259 large plants, from 1912 to 1917 was only 34. In 1917, these plants, representing 4% of the total number of plants, were valued at $1,396,619,224 or 45.6% of the total valuation. This was an increase of 51.3% since 1912 compared to a 40.7% increase for all central stations. The horsepower of prime movers increased 84.7% and the generator capacity 99.8% in the same period, with a corresponding growth for all stations of 71.8% and 74.1%, respectively. The income from sale of energy increased from $66,852,631 in 1912 to $149,224,378 in 1917, a gain of 123.2% as compared to the 74.8% increase of all central stations. The number of kilowatt-hours generated in 1917 by hydroelectric stations was 54.7% of the total for all central stations or 13,924,464,619 kw.-hr., an increase of 138.2% since 1912. In 1920, 16,500,000,000 kw-hr. were generated in hydroelectric plants, which was approximately 36% of the total of 46,000,000,000 kw-hr. This was an increase of 18.4% since 1917. Hydroelectric systems have 2.6 separate generating stations per system as compared with 1.1 for all stations. They serve 9.6 municipalities per station, while for all generating stations the average is 2.2. The average value of plant and equipment is $5,392,352, about nine times as great as the average of all stations.

The economies resulting from the decreased amount of labor needed in connection with water-power generation are shown by the fact that while all generating stations show an average of 19.4 employees, the hydroelectric stations in spite of their far greater output and capacity per plant employ but five times as many men, or 98.8 per plant. This is further illustrated by the fact that the large hydroelectric plants sell 797,572 kw-hr. per employee compared to 366,289 for steam plants. The average investment per kilowatt capacity of generators is $353 for hydroelectric stations and $312 for all other stations. The expenses per kw-hr. sold vary from 0.555 to 7.16 cents for water-power plants and from 1.387 to 10.08 cents for steam plants. Of this expense, the largest proportion in the water-power plants is the interest payment, amounting to 44.9%, in one group of large capacity stations. The amount paid in dividends per kw-hr. sold seems to bear no relation to the size of the station, though for hydroelectric plants it appears to grow less as the stations become larger. The highest dividend rate paid for these stations is 1.8%, with only 0.6% for the largest stations. The steam plants show a maximum dividend of 3.8% for the largest stations. It does not, therefore, appear that at present hydroelectric stations are a particularly profitable investment.

The total hydroelectric developments by states show California leading with 738,977 hp; New York is second with 701,948 hp. and Montana third with 268,917 hp. California, New York, Montana, South Carolina and Michigan combined report a total of 2,138,156 hp., or almost 50% of the total for the United States.

A recent census taken by the Canadian Department of Interior, shows that practically every great center in Canada is now served with hydroelectric energy. The potential capacity is given at 20,000,000 hp., and 2,418,000 of this is now installed. The ultimate capacity of the plants now working and being constructed is 3,385,000 hp. Of the water power now employed 73% is generated in central stations and 91.4% of the central-station energy is generated by water power.

HYDROELECTRIC POWER. POTENTIAL AND PROBABLE FUTURE DEVELOPMENT.—A survey of about one-fourth of the country made by the Department of the Interior of the United States to determine the potential water power of the country, revised and published in 1915, indicates a minimum potential horsepower of 32,083,000 and a maximum of 63,490,000. This is assuming an over-all efficiency of utilization of about 90%, which is higher than most of the present installations but has been reached in the latest plants. With all of the storage possibilities developed and utilized it has been roughly estimated that approximately 200,000,000 hp. or more would be available. Of this amount over 72% is found in the Rocky Mountain and Pacific Coast states and 42% of the total is found in the latter three states, Washington, Oregon and California.

The maximum horsepower per square mile available in the states having most power possibilities is as follows: Washington 125.0, Oregon 68.4, Idaho 60.4, California 49.4, West Virginia 43.5, New York 34.3, Montana 28.0, Connecticut 27.6, Massachusetts 27.5, New Hampshire 26.3, Maine 24.4, South Carolina 21.8, Virginia 20.6, Alabama 18.1, Tennessee 18.1, Vermont 17.6, Utah 15.5, Colorado 15.3, Arizona 14.0, Wyoming 13.3, New Jersey 12.8, Wisconsin 11.1, Maryland 10.8, Pennsylvania 10.7, North Carolina 10.7, Georgia 10.6, and Rhode Island 10.4.

If our water power were developed to its highest possible utilization, it would naturally be accompanied by the abandonment of the fuel-using generating equipment in a large number of central stations now in operation, together with the junking of a large part of the boiler and engine equipment now used in manufacturing establishments. It is estimated that there would be a saving in fuel which at present prices would amount to from $1,000,000,000 to $2,000,000,000 annually. There would be a further yearly saving of at least hundreds of millions of dollars which are now paid as wages to the workers in fuel-burning power plants that would be shut down and to many miners and coal handlers whose services would no longer be necessary with a general electrification of industry and railroading.

It appears that the gains which would result from a conservation of the fuel supply and a full utilization of the natural water resources would be public rather than private. At present the high cost of material, labor and of capital needed for water-power development purposes is rather effectively offsetting the high cost of fuel used in the old establishments. The development under private control will be gradual until such time as the economic gains will outweigh the costs of a change. With lower interest rates, lower prices for materials and labor and a greater certainty of return on investments, the movement in this direction will doubtless be more rapid.

The present power survey of the congested industrial district between Boston and Washington being conducted under the supervision of the United States Geological Survey gives promise of showing how water power and fuel-generated power can best be co-ordinated into a gigantic electrical power system using both sources for the best possible economy. By location of power stations at the most advantageously selected water-power sites and at coal mines all the power will be generated most efficiently and transmitted at very high tension over an extensive interconnected network of power lines feeding into a main power trunk or bus, from which branches will be tapped off to the cities, industrial centers and electrified railroad systems. The 220,000-volt 1100-mile power bus proposed for California is such a power trunk, but confined almost entirely to the interchange of power between hydroelectric systems alone and the supply of intervening and adjoining districts.

It can hardly be assumed that water power will eventually entirely supersede steam power or that all of the potential water power will ever be developed, since in many cases this would involve prohibitive expense. At present five of the nine groups of states have installed a greater primary power than the estimated potential water power in their respective groups. It must not be forgotten that the distance over which electric power can profitably be transmitted, which is now definitely established as exceeding 250 miles is still strictly limited by engineering and financial difficulties, but is gradually being increased by the application of higher transmission voltages. Consequently the United States must rely on coal and other fuels and other possible sources of primary power than water power, until such time as the enormous water-power resources concentrated in some of the states can be developed and transmitted economically into the states not blessed with this invaluable natural resource. In the meantime important improvements in the practical development and reliable utilization of other sources of power, such as use of the direct heat of the sun, the power of the winds, waves and tides, may relieve the power situation in many regions so that the use of fuels may ultimately be restricted to those districts that possess none of these various natural resources, all being tied together by electrical transmission lines and interchanging power as the conditions make necessary.

HYDROELECTRIZATION.—The therapeutic use of water and electricity combined, sometimes called hydroelectrotherapeutics. It is usually applied in the form of a bath furnished with suitable moderate-voltage electrodes, one fastened to the tub and the other applied to the body of the bather.

HYDROELECTROTHERAPEUTICS. — See Hydroelectrization.

HYDROGEN.—An odorless, invisible gas; the lightest known substance. Symbol H; at. wt. 1.008; sp. gr. (air = 1) 0.0695. Liquefies at 13 atmospheres pressure at —253° C. It burns readily, forming steam or water, and is highly explosive if the mixture with air is not rich enough in hydrogen for ordinary combustion. Burned with pure oxygen it gives a very hot flame, utilized in the oxy-hydrogen blowpipe. Other uses are in filling balloons, converting oil into fat and in certain other chemical operations. It is obtained in large quantities in electrolytic alkali processes, being given off by the action of the alkali metal on water to form caustic alkali. It is also produced electrolytically, together with oxygen, by the electrolysis of water, which has been acidulated or made conducting by the use of a little sulphuric acid or caustic soda or potash. See Hydrogen generators, electrolytic.

HYDROGEN GENERATORS, ELECTROLYTIC.—Electrolytic generators for the production of hydrogen generally operate on the principle of the electrolysis of water, which also gives oxygen. To increase the conductivity of the water a little sulphuric acid, caustic soda or caustic potash is added, but these serve only to conduct the current and are not decomposed. The generators are really a form of electrolytic cell or electrolyzer, and are often called such. They are generally made of lead for the acidic electrolyte, or

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of iron for the alkaline electrolyte. They are made in various forms, such as the Schoop, the Schmidt, the Garuti, and the Schuckert electrolyzers, which see. The electrodes are of the same material as the cell, and may be in the form of wire, plates, etc. With lead anodes lead peroxide is formed.

Manufacturers:

Burdett Mfg. Co., 309 St. Johns Ct., Chicago, Ill.
Carbo-Hydrogen Co. of America.. Benedum-Trees Bldg., Pittsburgh, Pa.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
National Electro Products, Ltd., 87 Church St., Toronto, Ont., Can.

HYDROGEN ION.—The primary condition in which an electrolyzing current tends to liberate hydrogen from an electrolyte, at the surface of contact of the electrolyte and the cathode.

HYDROGRAPH.—A graphical diagram which shows the daily variation in the flow of water in a stream at the point of observation during any period.

HYDROLYSIS.—The tendency of dissolved materials in aqueous solution to react with the water and form other products. Example: aluminum sulphate in solution has an acid reaction, supposed to be due to the reaction with water forming a certain amount of sulphuric acid and dissolved (colloidal) aluminum oxide. It is really a special case of chemical equilibrium, between the dissolved salt and water on one side and the corresponding acid and metallic oxide on the other.

HYDROMETER SYRINGES.—In many cases it is impossible to float the hydrometer in the container of the electrolyte or other solution, as in automobile ignition, electric vehicle, or other compact and portable storage batteries. For such work the hydrometer is enclosed in a larger glass tube which is provided with a rubber bulb at the upper end and small rubber tube or tip at the lower end. By means of the bulb enough solution may be drawn into the barrel of the large tube to float the hydrometer and permit taking a reading of the density. The hydrometer syringe finds extended application with storage batteries, being used as an acid syringe as well as to aid in taking hydrometer readings.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
Edelmann & Co., E., 2638-56 N. Crawford Ave., Chicago, Ill. "Break-Not," "Jumbo."
General Scientific Equipment Co., North Philadelphia, Pa. "Genco."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Munning & Co., A. P., Church St., Matawan, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
Workrite Mfg. Co., The, 5606 Euclid Ave., Cleveland, Ohio. "WorkRite."

HYDROMETERS.—These are devices for indicating the relative densities or specific gravities of liquids or solutions. They consist of a long glass stem near the lower end of which is an enlargement to keep the instrument afloat. This lower end terminates in a bulb which is filled with shot or some other heavy material to keep the instrument upright. The density of the solution is indicated by the depth to which the stem sinks in the solution. The scale may be graduated in relative densities, with water as the standard, or in arbitrary graduations called degrees, such as the Baume scale; the latter is not used as much as formerly. The specific gravity of acid storage-battery electrolytes is always determined by a hydrometer; it ranges from 1.150 to 1.300, depending on the kind of battery (amount of electrolyte used) and the state of charge. It rises during charge and falls during discharge. Also see Specific gravity.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Freas Glass Works, Inc., Francis L., 146 E. 9th Ave., Conshohocken, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
General Scientific Equipment Co., North Philadelphia, Pa.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Hearn & Harrison, 418 Notre Dame St., West, Montreal, Que., Can.
Luthy Products Corp., 1170 Broadway, New York, N. Y.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E M."
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus".
Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y. "Nauticо."
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico"
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y. "Reliance."
TAYLOR INSTRUMENT COMPANIES 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Workrite Mfg. Co., The, 5606 Euclid Ave., Cleveland, Ohio. "WorkRite."

HYDROPAK.—Trade name for packing for plunger pumps made by the Imperial Packing Corp., 191 Greenwich St., New York, N. Y.

HYDRO-PROOF.—Trade name for rubber tape manufactured by the Elkhart Rubber Works, Elkhart, Ind.

HYDROSINE.—Trade name for electric light baths manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

HYDROPHONE.—One name for an instrument including a microphone telephone transmitter for detecting sounds in or under water. See Detector, submarine; also Telephonic detectors for submarines.

HYDROSTATICS.—That branch of physics which relates to the pressure and equilibrium of liquids (or incompressible fluids, such as water, mercury, etc.), applying the principles of statics, or that branch of mechanics which relates to materials held at rest by balanced forces acting on them.

HYDROXYL ION.—The part of a dissolved hydrate salt which an electrolyzing current tends to liberate at the anode. Sometimes loosely applied to the pre-existing combination of an (OH) radical of a dissolved hydrate with the solvent, the solvated (OH) radical, before electrolysis is applied. In the latter case, its general formula is (OH) (Solvent)$_y$, where y indicates a varying and generally unknown number of molecules of the solvent.

HYFIELD MFG. CO., THE.—21 Walker St., New York, N. Y. Manufacturer of motor-driven razor blade sharpeners, dishwashers, screw drivers, electrical tape, etc. President, Charles E. Strong; vice-president, A. L. Hatfield; secretary, L. E Strong.

HYGRADE.—Trade name for incandescent lamps manufactured by the Hygrade Lamp Co., 60 Boston St., Salem, Mass.

HYGRADE LAMP CO.—60 Boston St., Salem, Mass. Manufacturer of incandescent lamps. Business established 1901. President and sales manager, E. J. Poor; secretary, W. E. Poor; treasurer and general manager, F. A. Poor. Sales representatives, Omer Cox, San Francisco, Cal.; C. J. Waddell, Peoria, Ill.; F. S. Hardy & Co., Boston, Mass.; W. R. Ostrander & Co., New York, N. Y.; Charles R. Ablett Co., 544 Prudential Bldg., Buffalo, N. Y.; W. Bingham Co., Cleveland, Ohio; Bostwick-Braun Co., Toledo, Ohio; Lampton, Crane & Ramey Co., Louisville, Ky.; King Hardware Co., Atlanta, Ga.; Holt Electric Utilities Co., Jacksonville, Fla.; Stauffer, Eshleman & Co., Ltd., New Orleans, La.; Barden Electric & Machinery Co., Houston, Tex.; W. S. Nott Co., Minneapolis, Minn.

HYGRADE LIGHTING FIXTURE CORP.—38 Park St., Brooklyn, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1918. President, Samuel Shapiro; secretary, Morris Berman; treasurer and general manager, Samuel Cominsky; sales manager, J. B. Bruenn.

HYGROMETERS.—These are instruments for indicating relative humidity. One form consists of a bundle of human hair from which the oil has been extracted. As the humidity increases, the hair absorbs moisture and, as it does so, expands. This expansion is made to move a pointer over a graduated scale.

Another form, usually termed the sling psychrometer, consists of two thermometers fixed side by side upon a board. One is an ordinary thermometer, while the other has a piece of wet muslin surrounding the bulb. The instrument is whirled in the air, and the water evaporates from the muslin, the rate of evaporation varying with the humidity. Since evaporation proceeds with the absorption of heat, the wet-bulb thermometer will indicate a lower temperature, and this temperature is a function of the humidity. By observing the difference of temperature, the humidity is then determined by means of a series of tables, which may be obtained from the Weather Bureau. Another form of this instrument in common use has the dry and wet-bulb thermometers mounted side by side on a stationary frame or board. The wick surrounding the wet bulb dips into a small vessel of water and remains permanently wet to a degree depending on the relative humidity of the air.

A knowledge of the prevailing humidity is necessary in certain electrical measurements, such as those made with spark gaps.

Manufacturers:

Foxboro Co., Inc., The, Foxboro, Mass.
General Scientific Equipment Co., North Philadelphia, Pa.
Green, Henry J., 1191 Bedford Ave., Brooklyn, N. Y.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y. "Nauticо."
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago; Ill.

HYKON MFG. CO., THE.—Alliance, Ohio. Manufacturer of boring machines. President, Harry J. Dick; secretary and treasurer, Edward T. Conrad.

HYLITE.—Trade name for fixture fittings, metal spinnings and stampings manufactured by Henry Hyman & Co., Inc., 476 Broadway, New York, N. Y.

HYLO.—Trade name for double-filament incandescent lamps manufactured by the Economical Electric Lamp Division, National Lamp Works of General Electric Co., 25 W. Broadway, New York, N. Y.

HYMAN & CO., INC., HENRY.—New York, N. Y. Manufacturers of fixture fittings and parts, metal spinnings and

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stampings. Main office, 476 Broadway, New York, N. Y. Branch offices, San Francisco, Cal.; 36 W. Randolph St., Chicago, Ill.

HYPOCHLORITES.—The salts of hypochlorous acid, HClO. They are formed by electrolysis of alkali chlorides if the products formed at the anode and cathode are allowed to mix, that is, they are formed by the action of chlorine on alkali hydrates. (See Alkali, electrolytic.) Cells for producing hypochlorite usually have bipolar electrodes, so that mixture of the products takes place readily without waste of space. The electrolyte is usually circulated to promote the interaction, and is recirculated until the desired concentration is attained. Types of these cells are the Kellner, Haas-Oettel, and Schuckert. The last-named uses graphite plate cathodes and platinum-iridium foil anodes.

HYPOSULPHITES.—Can be made by the electrolytic reduction of $NaHSO_3$ at low temperature.

HY-RAD.—Trade name for radio transmitters manufactured by the Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.

HYRATE.—Trade name for storage battery testers, battery grippers, electric battery oven and hot knife manufactured by the Service Station Supply Co., 30-32 Larned St., Detroit, Mich.

HYRATE CADMO.—Trade name for special voltmeter for cadmium testing of storage batteries manufactured by the Service Station Supply Co., 30-32 E. Larned St., Detroit, Mich.

HYSTERESIS.—An examination of a typical B-H, or magnetization, curve will show that the increase flux density is not directly proportional to the magnetizing force. At first the flux density increases more slowly; at higher values of H, it increases more rapidly, and at still higher values the rate again is slower, and finally any further increase in magnetizing force produces only slight increase in flux density.

When the magnetizing force is decreased, the reduction in flux density does not follow the curve for increasing values, but it decreases less rapidly. This lagging of the flux density behind the magnetizing force is called "hysteresis," from a Greek word which means lagging behind.

HYSTERESIS COEFFICIENT.—That constant by which the 1.6 power of the flux density must be multiplied to give the hysteresis loss per cu. cm. per cycle. It depends upon the magnetic properties of the substance. (See Hysteresis loss.)

HYSTERESIS, DIELECTRIC.—See Dielectric hysteresis.

HYSTERESIS LOOP.—If the magnetization be taken through a cycle from a certain value of flux density to an equal value of flux density in the opposite direction and then back to the value at starting, the magnetization curves will form a closed loop. This is known as the hysteresis loop and its area is proportional to the energy spent in magnetizing unit volume of the iron. The hysteresis loop gives valuable information concerning the losses in transformer and other iron which is subject to cycles of magnetization.

HYSTERESIS LOSS.—Whenever the flux in a ferromagnetic substance is caused to vary, the variation of flux is always accompanied by the development of heat in the substance. This heat is due to two causes. (1) Some energy is required to magnetize and demagnetize the substance. This energy is converted into heat by the frictional resistance of the molecules and is known as hysteresis loss. The hysteresis loss per cu. cm. of the substance may be calculated by the following formula, which is due to Steinmetz: $W = \eta B^{1.6}$ ergs per cycle, where η (the coefficient of hysteresis) has values from 0.001 to 0.002 for annealed soft steel. (2) Some energy is spent in inducing currents that circulate in the ferromagnetic substance which always is an electrical conductor. Such currents are called "eddy currents," which see.

HYTEMPITE.—Trade name for refractories manufactured by the Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y.

HY-TEN-SL.—Trade name for bronze of very high tensile strength manufactured by the American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa.

HYTEST.—Trade name for rubber-covered wires and cables manufactured by the Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y.

HYTONE.—Trade name for radio transmitters manufactured by the Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

HYVIS.—Trade name for lubricating oil manufactured by the Fred G. Clark Co., 1087 W. 11th St., Cleveland, Ohio.

HYVOLTAGE.—Trade name for insulated screw drivers manufactured by the Hyfield Mfg. Co., 21 Walker St., New York, N. Y.

I

I.—Chemical symbol for the element iodine. Also the symbol for an electric current; the form I is used to designate the continuous value or effective value of an alternating current and the form i for the instantaneous value.

IACO.—Trade name for motor-driven blowers manufactured by the Improved Appliance Co., 413 Kent Ave., Brooklyn, N. Y.

I. & C.—Trade name for micrometer gages and gage standards manufactured by Ibsen & Co., 404 Keefe Ave., Milwaukee, Wis.

I-BEAM.—A rolled steel beam or joist having a cross-section resembling the capital letter I. They are used extensively in power plant, building, bridge, traveling crane and other construction work, as they are very economical of material in relation to their strength.

IBSCO.—Trade name for battery steamers and stills manufactured by the Illinois Battery Steamer Co., 607 Spencer St., Peoria, Ill.

IBSEN & CO.—404 Keefe Ave., Milwaukee, Wis. Manufacturers of micrometer gages and gage standards. Business established 1913. H. B. Ibsen, proprietor.

I-C.—Trade name for controlling devices manufactured by the Industrial Controller Co., 886 Greenbush St., Milwaukee, Wis.

ICE BREAKERS, MOTOR-DRIVEN.—In hotels, creameries, confectionery and similar places where large quantities of crushed ice are used the cakes of ice are broken up by a motor-driven machine, known as an ice breaker. The usual form of the machine is a motor-driven drum fitted with cutting teeth or saw blades, the drum being mounted within a hopper. The cake ice is fed against the revolving drum and cut up into pieces of the desired size.

Manufacturers:

Allman Gas Engine Co., 461 Canal St., New York, N. Y. "Champion."

H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Creasey."

ICE-CREAM FREEZERS.—See Freezers, ice-cream, motor-driven.

ICE MACHINES.—See Refrigerating and ice-making machines, motor-driven heavy-duty.

ICE PROTECTION IN WATER-POWER PLANTS.—The formation of ice and provision for its removal is one of the important factors in hydraulic power-plant design. Frazil ice, i. e., finely divided ice held in suspension, is very difficult to remove and passes through the pipes into the turbines and clogs them. Anchor ice, which forms on the bottom of a channel is also troublesome. A larger forebay or settling basin is usually required to permit the frazil ice to float to the top and freeze solid. A solid layer of ice is a protection against the two other forms, but at the same time results in a loss of head.

ICELANDER.—Trade name for ice-making machines manufactured by the Armstrong Machinery Co., 3201-3219 E. Riverside Ave., Spokane, Wash.

IDEAL.—Trade name for medical batteries manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

IDEAL.—Trade name for electric floor sanders manufactured by the Boettcher Pattern Co., 440 N. Peoria St., Chicago, Ill.

IDEAL.—Trade name for refillable fuses manufactured by A. F. Daum, Pittsburgh, Pa.

IDEAL.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

IDEAL.—Trade name for oxyacetylene cutting and welding equipment manufactured by the General Welding Co., 355-57 14th St., Hoboken, N. J.

IDEAL.—Trade name for flour mill machinery manufactured by the B. F. Gump Co., 431 S. Clinton St., Chicago, Ill.

IDEAL.—Trade name for electric washing machine manufactured by the Haag Bros. Co., Peoria, Ill.

IDEAL.—Trade name for bells and gongs manufactured by the R. Haas Electric & Mfg. Co., 305 E. Monroe St., Springfield, Ill.

IDEAL.—Trade name for electric glue warmers manufactured by the Halverson Co., Union Ave. at E. Oak St., Portland, Ore.

IDEAL.—Trade name for battery connectors, terminals, etc., manufactured by the Ideal Clamp Mfg. Co., Inc., 200 Bradford St., Brooklyn, N. Y.

IDEAL.—Trade name for commutator stones manufactured by the Ideal Commutator Dresser Co., 3329-31 Sheffield Ave., Chicago, Ill.

IDEAL.—Trade name for motors, generators and motor-generators manufactured by the Ideal Electric & Mfg. Co., E. 5th & Elm Sts., Mansfield, Ohio.

IDEAL.—Trade name for welders' shields and helmets manufactured by the Ideal Face Shield Co., 468 N. Garfield Ave., Columbus, Ohio.

IDEAL.—Trade name for fire alarms manufactured by the Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J.

IDEAL.—Trade name for pipe thread cutting dies manufactured by the Ideal Tool & Mfg. Co., Beaver Falls, Pa.

IDEAL.—Trade name for tree trimmers manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

IDEAL.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

IDEAL.—Trade name for fan motors manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

IDEAL.—Trade name for lighting reflector manufactured by Frank W. Morse, 291 Congress St., Boston, Mass.

IDEAL.—Trade name for electric tools manufactured by the Neil & Smith Electric Tool Co., 813-815 Broadway, Cincinnati, Ohio.

IDEAL.—Trade name for electric irons manufactured by the Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

IDEAL.—Trade name for automatic fire detectors and fire alarm systems manufactured by the Relc Equipment Corp., 5 Beekman St., New York, N. Y.

IDEAL.—Trade name for electrical porcelain products manufactured by the Star Porcelain Co., Trenton, N. J.

IDEAL.—Trade name for ceiling outlet plates made by the Sterling Mfg. Co., 1014 Chestnut St., Erie, Pa.

IDEAL.—Trade name for trolley catchers manufactured by the Trolley Supply Co., Massillon, Ohio.

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IDEAL CLAMP MFG. CO., INC.—200 Bradford St., Brooklyn, N. Y. Manufacturer of battery connectors, terminals, etc. President and treasurer, Philip Rauch; vice-president, Frances Rauch; secretary, Jacob Rauch.

IDEAL COMMUTATOR DRESSER CO.—3229-31 Sheffield Ave., Chicago, Ill. Manufacturer of commutator stones. J. Walter Becker, general manager.

IDEAL ELECTRIC & MFG. CO., THE.—Mansfield, Ohio. Manufacturer of a-c. and d-c. power apparatus. Business established 1901. President and treasurer, C. H. Voegele; vice-president, John Krause; secretary and general manager, S. Glenn Vinson; sales manager, L. S. Meeker, Jr. Main office, 153 E. 5th St., Mansfield, Ohio. Branch offices, 1420 Majestic Bldg., Milwaukee, Wis.; 50 Church St., New York, N. Y.; 602 Swetland Bldg., Cleveland, Ohio; 802 Plymouth Bldg., Minneapolis, Minn.; 1131 Race St., Philadelphia, Pa.; 637 Michigan Trust Bldg., Grand Rapids, Mich.; 701 Fisher Bldg., Chicago, Ill.; 1004 House Bldg., Pittsburgh, Pa. Sales representatives, Haralson Sales Co., Birmingham, Ala.; DeMarco Engineering Co., Chattanooga, Tenn.; Morse Engineering Co., St. Louis, Mo.; Southern Jobbers' Supply Co., Inc., New Orleans, La.; Denver Metal & Machinery Co., Denver, Colo.; G. L. Vinson & Co., Raleigh, N. C.; Alexander & Garsed, Charlotte, N. C.; Dillon Electric Co., Canton, Ohio; C. B. Rodgers, Tiffin, Ohio; Baker-Joslyn Co., San Francisco, Cal.; E. I. Van Doren, Troy, N. Y.; Broderick Electric Co., East St. Louis, Ill.; National Engineer & Electric Co., Baltimore, Md.; Ferranti M & T Co., Montreal, Que., Toronto, Ont., Can.

IDEAL ELECTRIC MFG. CO., INC.—718-720 Cherry St., Philadelphia, Pa. Manufacturer of switches and outlet boxes. Business established 1920. President and general manager, B. F. Clark; secretary and treasurer, J. Pearl.

IDEAL FACE SHIELD CO., THE.—468 N. Garfield Ave., Columbus, Ohio. Manufacturer of welders' helmets and shields. President, F. J. Williams; secretary and treasurer, E. L. Work; general manager, F. A. Armstrong.

IDEAL FIRE DETECTOR CO.—161-163 W. Clay Ave., Roselle Park, N. J. Manufacturer of fire alarms. Business established 1912. President, George H. E. Berthold; vice-president, William B. Parkhurst; secretary, Robert C. Kayser; treasurer and general manager, Charles H. Kayser. Sales representatives, Relc Equipment Corp., 5 Beekman St., New York, N. Y.; Interstate Finance Corp., Easton, Pa.

IDEAL GAS & ELECTRIC FIXTURE CO.—433 Broadway, New York, N. Y. Manufacturer of lighting fixtures. Business established 1903. President, W. T. Hendrickson; secretary, P. B. Ferrando; treasurer and general manager, Henry Ferrando.

IDEAL HEAT.—Trade name for electric irons manufactured by the Loetscher-Ryan Mfg. Co., Rock Island, Ill.

IDEAL LAMP SHADE CO.—5503 N. Clark St., Chicago, Ill. Manufacturer of silk shades. Partnership, B. Matlea and M. Heuser.

IDEAL MINUTE.—Trade name for electric water heaters manufactured by the Loetscher-Ryan Mfg. Co., Rock Island, Ill.

IDEAL TOOL & MFG. CO.—Beaver Falls, Pa. Manufacturer of screws, cutting dies, tools and machinery. Business established 1904. President, F. N. Beegle; vice-president, George Davidson; general manager, R. S. Arnold.

IDF.—Abbreviation for intermediate distributing frame. See Frames, telephone distributing.

IDLER.—In gear trains or geared mechanisms, a toothed wheel occupying an intermediate position in the train to communicate motion from the driving gear to the follower without any change in speed ratio and without giving a reversal of rotation.

I. E. S.—Abbreviation for Illuminating Engineering Society.

IGNITERS, ELECTRIC BLASTING.—A term applied to a special form of blasting cap. It is used for exploding successive blasts of high and low explosives by electric firing.

Manufacturer:

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

IGNITERS, INTERNAL-COMBUSTION ENGINE.—The explosive charge in internal-combustion engines is ignited by an electric spark produced in various ways. The two methods in common use are the "make-and-break" and "jump-spark" systems. The make-and-break system has mounted in the end of the cylinder two contacts through which a high-tension current flows. At the proper moment the contacts are separated mechanically and an arc or spark is made at the contacts, igniting the charge in the cylinder. The jump-spark system commonly used in automotive and small stationary engines has two insulated contacts, separated by a very short distance, mounted in a plug in the end of the cylinder. By a timing arrangement the plug containing the contacts is included in a high-tension circuit and a spark which ignites the gas jumps across the contact. The sparking contact device used in the make-and-break method is called an "igniter." It is used almost exclusively on stationary engines. The jump-spark igniting device is called a "spark plug" and is listed separately under Plugs, spark (which see). A self-inductance coil and ignition batteries or a magneto generator is used for supplying the high-tension current for the sparking igniter.

Manufacturers:

Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

IGNI-TEST.—Trade name for automobile testers manufactured by the Testall Electric Mfg. Co., 339 Moore Bldg., San Antonio, Tex.

IGNITION ACCESSORIES, MISCELLANEOUS.—Ignition systems on automobiles and other internal combustion engines provide a very large field for the use of accessories of various kinds to improve troublesome conditions. Consequently several devices have been placed on the market which are not regularly furnished as part of complete systems. Among these are spark intensifiers, which are used on some automobiles to provide a series gap thus giving a higher spark intensity within the cylinder. Master vibrators are also furnished as auxiliary apparatus to convert a multiple vibrator system into one more nearly synchronous. Special types of high tension magnetos are also furnished. Automatic regulators are also used on battery systems to secure the same length of break at all but the very slowest speeds.

IGNITION BATTERIES.—See Batteries, primary, dry, ignition, telephone, etc.; Batteries, storage, automobile ignition, lighting and starting.

IGNITION COILS, PLUGS, TIMERS AND WIRE.—See Coils, ignition or spark; Plugs, spark; Timers, ignition or spark; Distributers, automotive ignition; Wire, automobile ignition.

IGNITION OUTFITS, COMPLETE, AUTOMOTIVE.—The equipment for producing the spark which ignites the charge in internal-combustion engines is called an ignition outfit. It includes a source of energy, a means of producing a high-tension current and a distributing or timing device for causing the spark to occur at the right moment in each cylinder. The source of energy may be a battery or when the engine is running a magneto, or both may be used interchangeably. For controlling the time and sequence of sparking a distributer or timer is used. As the contact which closes and opens the circuit with each spark discharge must operate with speed and precision a special device called a contactor is employed in many ignition systems. The high-tension current is produced by a battery and induction coil, a low-tension magneto and self-induction or spark coil, or a high-tension magneto may be employed. The complete outfit also includes wiring, switches, etc. The details of the outfits depend somewhat on the kind of automotive machine for which ignition is provided, as the requirements for the ordinary gasoline automobile, heavy-duty trucks, farm tractor, motorcycle, motorboat, airplane and other self-propelled conveyance differ in many respects.

Manufacturers:

A-C Electrical Mfg. Co., Dayton, Ohio. "Dayton."
All-Spark Ignition Co., Inc., 13 Water St., New York, N. Y. "Alsop-All-Spark."
American Bosch Magneto Corp., Springfield, Mass. "Bosch."
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Duntley, J. W., 1004 Michigan Ave., Chicago, Ill. "Duntley." (Automobile.)
Eastern Parts Mfg. Co., Inc., 135 Spring St., New York, N. Y. "Pemko."
EDISON STORAGE BATTERY CO., Orange, N. J. (See advertisement on page 1313.)
Eisemann Magneto Corp., 32 53rd St., Brooklyn, N. Y.
Gray & Davis, Inc., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."
North East Electric Co., Rochester, N. Y. (Automobile) "North East."
Philbrin Corp., Kennett Square, Pa.
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
Remy Electric Co., Anderson, Ind.
Robson & Co., Charles, N. W. Cor. 8th & Washington Ave., Philadelphia, Pa.
SAMSON ELECTRIC CO., Canton, Mass.
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.
Webster Electric Co., Clark & De Koven Ave., Racine, Wis.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

IGNITOR.—Trade name for dry batteries manufactured by the National Carbon Co., Cleveland, Ohio.

I. HP.—An abbreviation for indicated horsepower.

ILG ELECTRIC VENTILATING CO.—Chicago, Ill. Manufacturer of electric ventilating equipment. Business established 1906. President, S. M. Weis; vice-president and sales manager, J. M. Frank; secretary, treasurer and general manager, R. A. Ilg. Main office and factory, Crawford Ave. & Diversey Blvd., Chicago, Ill. Branch office, 13 Park Row, New York, N. Y.; 327 Commercial Trust Bldg., Philadelphia, Pa.; Bessemer Bldg., Pittsburgh, Pa.; Owen Bldg., Detroit, Mich.; Schofield Bldg., Cleveland, Ohio; Mallers Bldg., Chicago, Ill. Sales representatives, Tompkins & Stoddard, Boston, Mass.; W. H. Beaven, Birmingham, Ala.; A. P. Becker, Albany, N. Y.; G. G. Schackleford, Buffalo, N. Y.; J. R. Purser, Charlotte, N. C.; C. R. Leing, Cincinnati, Ohio; C. C. Carson, Dallas, Tex.; F. H. Boyer, Des Moines, Iowa; L. F. Buchanan, Grand Rapids, Mich.; H. L. Bramgin, Indianapolis, Ind.; James E. King, Kansas City, Mo.; Teltz Engineering & Equipment Co., Los Angeles, Cal.; Fuel Engineering Co., Memphis, Tenn.; M. V. Eicholtz, Milwaukee, Wis.; H. S. Nesbitt Co., Minneapolis, Minn.; W. M. Jaeger, New Haven, Conn.; G. H. Alwine Co., Omaha, Neb.; H. F. Kircher Co., Peoria, Ill.; Harry L. Mead, Portland, Ore.; Lee Harrison Co., Richmond, Va.; J. P. Adolph, Rockford, Ill.; J. M. Foster, St. Louis, Mo.; Tiltz Engineering & Equipment Co., San Francisco, Cal.; Economy Appliance Co., Spokane, Wash.; E. R. Greeley, Syracuse, N. Y.; M. C. Griffen, Toledo, Ohio.

ILLINOIS.—Trade name for stokers manufactured by the Illinois Stoker Co., 104 W. 7th St., Alton, Ill.

ILLINOIS.—Trade name for variable condensers manufactured by George F. Johnson, 625 Black Ave., Springfield, Ill.

ILLINOIS.—Trade name for weatherproof wire manufactured by the Illinois Wire & Cable Co., Sycamore, Ill.

ILLINOIS BATTERY STEAMER CO.—607 Spencer St., Peoria, Ill. Manufacturer of battery steamers and stills. Business established 1919. President, Charles Knetzger; vice-president, Otto Rohman; secretary, Alex Rapp; treasurer, T. B. Wissing; general manager, Joseph Wissing. Sales representative, Bailey-Drake, Inc., 1120 S. Michigan Ave., Chicago, Ill.

ILLINOIS BRONZE POWDER CO.—170 W. Randolph St., Chicago, Ill. Manufacturer of bronze powders.

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ILLINOIS ELECTRIC PORCELAIN CO.—Macomb, Ill. Manufacturer of porcelain cleats, knobs, insulators and other porcelain products for electrical purposes. President and general manager, C. W. Kettron; secretary, Charles Hanan; treasurer, W. C. Sutton.

ILLINOIS ENGINEERING CO.—Chicago, Ill. Manufacturer of electric vacuum pumps and steam specialties. Business established 1900. President, R. L. Gifford; vice-president and general manager, F. Van Inwagen; secretary, J. C. Matchett. Main office and factory, Racine Ave. & 21st St., Chicago, Ill. Branch offices, New York, N. Y.; Los Angeles, Cal.; Harrisburg, Pa.; San Francisco, Cal.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. R. E. Gordon, El Paso, Ill.; executive secretary, Jay Mitchell, Springfield, Ill.

ILLINOIS MALLEABLE IRON CO.—1801-1825 Diversey Pkwy., Chicago, Ill. Manufacturer of metal castings, conduit fittings, etc. Business established 1884. President, H. E. Bullock; vice-president and treasurer, W. J. Akin; secretary, George J. Reeling; sales manager, J. R. Steneck.

ILLINOIS SMELTING & REFINING CO.—410 N. Peoria St., Chicago, Ill. Manufacturer of lead bars, wire, brass, copper and bronze, sheets, tubing and other metal products.

ILLINOIS STAMPING & MFG. CO.—542 W. Jackson Blvd., Chicago, Ill. Manufacturers of metal stampings. Partnership, F. J. Schylander and F. A. Diener.

ILLINOIS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—President, R. W. Poelma, 65 W. Harrison St., Chicago, Ill.

ILLINOIS STATE ELECTRIC ASSOCIATION.—President, B. J. Denman, Rock Island, Ill.; secretary-treasurer, R. V. Prather, DeWitt Smith Bldg., Springfield, Ill.

ILLINOIS STOKER CO.—Alton, Ill. Manufacturer of stokers. President, James Duncan; vice-president, W. M. Duncan; secretary, G. D. Duncan. Main office, 104 W. 7th St., Alton, Ill. Branch office, Cleveland, Ill. Sales representative, Ernest E. Lee Co., 115 S. Dearborn St, Chicago, Ill.

ILLINOIS WIRE & CABLE CO.—Sycamore, Ill. Manufacturer of weatherproof wire. Business established 1912. President, George E. Dutton; vice-president, H. V. Engh; secretary and treasurer, Arthur A. Mueller; general sales manager, Frank H. Freeman; sales manager, Sam J. Reno.

ILLUMINANT.—A source of light, natural or artificial and capable of providing illumination. In the case of artificial sources it consists of the essential elements of the source necessary to produce light, whereas "lamp" may include support, outer housing and often decoration.

ILLUMINATED BULLETIN BOARDS.—Large bulletin boards and wall signs are usually illuminated by means of lamps and reflectors mounted in front of the upper edge of the board, the reflectors being either of special angle, box or trough type shaped to throw the light uniformly over the surface. Floodlight projectors are sometimes used for large boards when they can be placed at a fair distance. Small boards can be effectively illuminated from behind by using a translucent glass surface for the board or putting the announcement or design on a translucent slide, sheet or curtain placed directly back of a clear glass front; this permits ready change of the announcement and is much used in theaters and depots. (For manufacturers of the latter type see Bulletin and program boards, internally illuminated.)

ILLUMINATED COLUMNS.—Ornamental columns or pedestals made of opal glass, alabaster or other translucent material, and made luminous by means of internal lamps. They are usually for decorative effect, but occasionally for advertising as in barber poles. See Barbers' poles, illuminated and revolving.

ILLUMINATED DIAL INSTRUMENTS AND GAGES.—To facilitate the reading of switchboard type ammeters, voltmeters, steam gages and other instruments, the dial is frequently made of translucent glass and illuminated from within by means of one or more small incandescent lamps. With clear black figures and a black pointer the reading can be seen accurately from a considerable distance. This scheme is used especially with flush type instruments and eliminates the need of a projecting lamp bracket for each instrument or group.

ILLUMINATED ELEVATOR THRESHOLD.—To minimize accidents the threshold of an elevator should be more intensely illuminated than the rest of the car floor. One way of doing this is by means of a lamp and reflector set low in the wall of the car and near the door so as to throw light on the threshold. Another is by means of a protected lamp set within the threshold, which has openings thus rendered luminous. (For manufacturers, see Elevator safety devices, electric.)

ILLUMINATED PENCIL OR PEN.—A novel form of vest-pocket flashlight shaped like and no larger than an ordinary fountain pen or pencil. (For manufacturers, see Flashlights, hand and pocket.)

ILLUMINATED STAIR LANDING.—Many accidents on stairways occur on reaching a landing, due to inability to discern the first and last steps of a flight. A lamp and reflector placed in a protected recess in the baseboard at the top and near the bottom step can be arranged to illuminate the landing effectively and thus decrease the liability of accidents. This scheme is especially useful in railway stations, theaters and other public buildings.

ILLUMINATED TRACING BOARD.—A box or frame with smooth translucent glass top and containing incandescent lamps is used to facilitate tracing an indistinct drawing or print by illuminating it from below. The box should be lined with asbestos or otherwise fireproofed.

ILLUMINATING ENGINEER.—One versed in the principles of light production and utilization, and skilled in their effective application; a master of the science and art of lighting; an expert in illuminating engineering. (See illuminating engineering.)

ILLUMINATING ENGINEERING.—That branch of engineering which devotes itself to the solution of lighting problems to conform to the physical, physiological and psychological requirements involved. It deals with both natural and artificial lighting, but principally the latter, and especially with the design of lamps, lamp accessories, and of lighting installations. In common with other branches of engineering it lays stress on efficiency, but nearly always it must be the visual or utilization efficiency and not merely the physical or production efficiency, while in some cases (as in esthetic lighting) the physical efficiency is greatly subordinated to the efficacy with which the desired visual and mental effects are produced.

ILLUMINATING ENGINEERING SOCIETY.—An American organization founded in 1906 "for the promotion of the science and art of illumination." Its membership now aggregates about 1200 and consists of illuminating engineers (active members) and others interested in the objects of the society (associate members and sustaining members). Formation of two new classes of membership (student and affiliated members) has just been authorized.

In its early years the society devoted itself principally to the study of the scientific principles of illumination and in recent years to the rather more elusive phases (such as esthetic lighting, psychological aspects of lighting, etc.) and to the widespread promulgation of the known principles of good lighting. In the fall of 1910 the society collaborated with the Johns Hopkins University in giving a course of special lectures at Baltimore on illuminating engineering, and again in the fall of 1916 it acted jointly with the University of Pennsylvania in giving a similar course of lectures at Philadelphia, each of which was largely attended. During the recent war the society, through special committees, co-operated with several government departments in the solution of important problems in military and naval lighting. A Factory Lighting Code was drafted by a committee of the society and has been used as the basis of state regulations on this subject in seven states. A School Lighting Code was also drawn up and a Code on Automobile Headlighting. Each of these has been used as the basis for legislation.

Officers for 1920-1921 are: President, Gen. George H. Harries, Chicago, Ill.; junior past-presidents, George A. Hoadley, Swarthmore, Pa.; Samuel E. Doane, Cleveland, Ohio; vice-presidents, William J. Clark, Mt. Vernon, N. Y.; George S. Crampton, Philadelphia, Pa., James J. Kirk, Chicago, Ill.; H. F. Wallace, Boston, Mass.; general secretary, Clarence L. Law, New York, N. Y.; treasurer, L. B. Marks, New York, N. Y.; directors, John C. D. Clark, Boston, Mass., Evan J. Edwards, Cleveland, Ohio, Preston S. Millar, New York, N. Y., Francis E. Cady, Cleveland, Ohio, E. C. Crittenden, Washington, D. C., Robert B. Ely, Bloomfield, N. J., Adolph Hertz, New York, N. Y.; Walton Forstall, Philadelphia, Pa., Frank S. Price, Boston, Mass. The general offices of the Society are at 29 West 39th St., New York City.

The Society has four sections, at Boston, New York, Philadelphia and Chicago, each of which meets monthly (except during the summer). Besides the sections a recent provision has been made for smaller branches of the Society known as chapters; the first having been recently established at San Francisco, the second at Cleveland and another being organized at Toronto, Canada. An annual convention is held usually in September or October in one of some ten cities. The Society publishes the "Transactions of the Illuminating Engineering Society" with nine issues a year.

Based on the successful work of the American society, similar societies have been organized in England, Germany and Japan.

ILLUMINATING GLASSWARE.—See Glassware, illuminating.

ILLUMINATION.—This word is used widely in the general sense of lighting, such as the illumination of a building exterior or of any interior room or particular portion thereof. In this sense it does not make any definite distinction between the source of the illumination and the resulting illumination produced.

In illuminating engineering the word illumination has a definite technical meaning, this being the density of the luminous flux over any particular surface, or the flux per unit of intercepting area. This is based on the conception of light as a flux of luminous energy radiating from a concentrated or point source. In popular language, luminous flux may be regarded as being measured by the number of rays of light emanating from the source, if rays of light had a definite unit value, such as is commonly held true of lines of force from a magnet. It is obvious that a powerful light source would issue a very large number of rays and that illumination on any surface would be measured by the number of unit rays falling upon a unit area of the surface. Since there is no such thing as a unit ray, the term light flux or luminous flux is used to represent the total amount of light emitted by the source and the lumen is considered to be the unit of this luminous flux.

Consequently the illumination may be measured in terms of the number of lumens striking unit area of the surface illuminated. The most common unit of illumination is the foot-candle, which equals one lumen incident per square foot of surface. Another unit is the lux, which equals one lumen incident per square meter; also the phot, which equals one lumen per square centimeter. The milliphot equals 0.001 phot, equals 0.929 foot-candle. Other relations between these units are as follows: one foot-candle equals 1.076 milliphot, equals 10.76 lux; one phot equals 10,000 lux, equals 1,000 milliphot.

It should be noted that illumination is the density of the light reaching any surface, but that this is not the same as the brightness of the surface. Brightness may be stated as being the relative brilliancy of the surface as it appears to the eye, and this is affected by its reflecting power and color as well as its illumination.

Illumination depends on the angle that the intercepting surface makes with the light rays. It is greatest when the surface is at right angles to the rays and least (practically zero) when it is parallel to the rays. Also see Horizontal illumination; Vertical illumination.

ILLUMINATOR.—Trade name for lighting unit manufactured by Lorin W. Young, Inc., 214 E. 40th St., New York, N. Y.

ILLUMINATORS, MICROSCOPE.—To study materials under a microscope the object may be highly illuminated by an electric illuminator specially designed for use on microscopes. The materials often present different appearance to the eye under light coming from different angles and the illuminators consequently may be adjustable to obtain these various angles. In the electrical industry they are largely used in the testing or research laboratory

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where sections of materials, such as metals, rubber, insulating materials, vitreous enamels, refractories and glass, are studied by visual observation or by photomicrographs.

Manufacturers:

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Hommel & Co., Ludwig, 530-534 Fernando St., Pittsburgh, Pa. "Silverman."

ILLUMINATORS, OVEN.—A protected lamp for illuminating the interior of a baking or other oven. It permits the baker to see just how the baking is proceeding without opening the door or disturbing the pans in which the baking is being done. Similarly, it enables the contents of other types of ovens to be examined without disturbance and facilitates the filling and emptying of the oven.

ILLUMINET.—Trade name for lighting unit manufactured by the Art Metal Mfg. Co., Cleveland, Ohio.

ILLUMINOMETER.—A term commonly applied to portable photometers used for measuring illumination intensities, usually on a special test plate placed at the level where the intensity is to be determined. The instrument may be entirely self-contained or require one or a few accessories. (See Photometers; also Foot-candle meters.)

ILLUSTRATOR.—Trade name for stereopticons manufactured by Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

I. L. R.—Trade name for lead produced by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

IMCO.—Trade name for insulating compounds, waxes, paints and other insulating materials, manufactured by the Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich.

IMICO.—Trade name for mica and mica products manufactured by the International Mica Co., 37th & Brandywine Sts., Philadelphia, Pa.

IMMERSION HEATERS.—A type of electric heater with the heating element contained in sealed disk or tube which can be immersed in the liquid to be heated, this being in any convenient vessel. See Heaters, electric, water and other liquid, miscellaneous; also Warmers, milk.

IMP.—Trade name for gasoline blow torches manufactured by the Carleton Co., 170 Summer St., Boston, Mass.

IMPEDANCE.—The impedance of a circuit is the factor by which the total current must be multiplied to give the impressed e. m. f., or it is the factor by which the impressed e. m. f. must be divided to give the current. The symbol for impedance is Z; $Z=\sqrt{R^2+(X_1-X_c)^2}$. See Ohm's law for a-c. circuits.

IMPEDANCE, CHARACTERISTIC, OF TELEPHONE AND TELEGRAPH LINES.—The characteristic impedance of a line is the ratio of the applied e. m. f. to the resulting steady-state current upon a line of infinite length and uniform structure or of periodic recurrent structure. When the ratio is taken at the point where the e. m. f. is applied this is called the sending-end impedance. The terms line impedance, surge impedance, iterative impedance, sending-end impedance, initial sending-end impedance, final sending-end impedance, natural impedance and free impedance have all been more or less indefinitely and indiscriminately used as synonyms of what is here defined as "characteristic impedance."

IMPEDANCE COIL.—A name sometimes given to a reactance coil or choke coil. See Coils, choke; Coils, reactance; Reactors, power limiting.

IMPEDANCE DROP.—The impedance drop in a-c. circuits corresponds to the resistance drop in d-c. circuits. It is the product of the effective current in the circuit by the impedance of the circuit.

IMPEDANCE, MUTUAL.—The mutual impedance for single-frequency alternating currents under any given condition, between a pair of terminals and a second pair of terminals in a network, is the negative ratio of the e. m. f. produced between either pair of terminals on open circuit to the current flowing between the other pair of terminals.

IMPEDANCE, SELF.—The self-impedance between a pair of terminals of a network under any given condition is the ratio of the e. m. f. applied across the terminals to the entering current.

IMPEDANCE, SENDING-END.—The sending-end impedance of a telephone or telegraph line is the ratio of the applied e. m. f. to the resulting steady-state current at the point where the e. m. f. is applied.

IMPEDANCE, SYNCHRONOUS.—The square root of the sum of the squares of the effective resistance and the synchronous reactance of armatures of synchronous machines. It is used in calculating the voltage regulation of a-c. generators and the performance of synchronous motors. It is preferably measured by taking, at any given excitation, the difference between the no-load saturation curve and the full-load saturation curve at zero power-factor. This difference in volts divided by the full-load amperes gives the synchronous impedance in ohms corresponding to the given excitation.

IMPERIAL.—Trade name for locomotive headlights, floodlight projectors and reflectors manufactured by the Crouse-Hinds Co., Wolf & 7th North Sts., Syracuse, N. Y.

IMPERIAL.—Trade name for black electrical slate, used for switch bases, panelboards and switchboards, produced by the Davis Slate & Mfg. Co., 610-618 E. 40th St., Chicago, Ill.

IMPERIAL.—Trade name for piston packing manufactured by the Boston Belting Co., 80 Elmwood St., Boston, Mass.

IMPERIAL.—Trade name for insulated wire manufactured by the Crescent Insulated Wire & Cable Co., Olden & Taylor Sts., Trenton, N. J.

IMPERIAL.—Trade name for oxy-acetylene, oxy-hydrogen and lead burning apparatus; name plates; portable lamps and lamp shades, manufactured by the Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill.

IMPERIAL.—Trade name for motors and generators manufactured by the Imperial Electric Co., Akron, Ohio.

IMPERIAL.—Trade name for motor-driven air compressors and tie tamping bars manufactured by the Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

IMPERIAL.—Trade name for commutator stones manufactured by the Martindale Electric Co., 11737 Detroit Ave., Cleveland, Ohio.

IMPERIAL.—Trade name for electric scales manufactured by the Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

IMPERIAL.—Trade name for d-c. current relays manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

IMPERIAL BRASS MFG. CO., THE.—Chicago, Ill. Manufacturer of portable lamps, lamp shades, oxyacetylene, oxy-hydrogen and lead burning apparatus. Main office, 1200 W. Harrison St., Chicago, Ill. Branch offices, 1476 Broadway, New York, N. Y.; Monadnock Bldg., San Francisco, Cal.

IMPERIAL ELECTRIC CO., THE.—Akron, Ohio. Manufacturer of motors and generators. Branch office, 253 Broadway, New York, N. Y.

IMPERIAL GLASS CO.—Bellaire, Ohio. Manufacturer of illuminating glassware.

IMPERIAL PACKING CORP.—191 Greenwich St., New York, N. Y. Manufacturer of packings for cylinders, pistons, valves, etc. Business established 1915. President, George I. Mandeville; vice-president and treasurer, Robert W. Purdy; secretary, E. M. Bond; general manager, H. Cypher; sales manager, C. R. FitzMaurice.

IMPERIAL PORCELAIN WORKS.—Trenton, N. J. Manufacturer of electrical porcelain.

IMPERVIOUS METAL CORP.—421 Wood St., Pittsburgh, Pa. Manufacturer of enamels, lacquers and insulating varnishes. Business established 1912. President, Charles E. Pope; vice-president and treasurer, Adam E. Daum; secretary, Hugh Prentice; sales manager, Frank G. Moller. Factory, Rochester, Pa.

IMPREGNATING APPARATUS.—Materials which must give high insulation, but are not of themselves good insulators, either from a tendency to absorb moisture or other reasons, are made to meet rigid insulation requirements by impregnation with insulating compounds. Armature, field and transformer coils, insulating pins, paper, fiber, cables, etc., are subjected to this treatment. The simplest method is to dry the material in an oven and then dip it into an impregnating liquid. This method is somewhat improved if the drying is done in a vacuum; however, for thorough impregnation more complex systems are used. They usually consist of two heated tanks and a pumping system; one tank contains the impregnating liquid, the other is for drying and impregnating. The work is placed in the latter tank and thoroughly dried in a vacuum. The vacuum is still maintained while sufficient liquid is sucked into the tank to completely cover the work. Then the vacuum pump is reversed, creating a pressure upon the liquid. Although the dried material will readily absorb the liquid, this pressure forces it into every pore and gives the material an insulation of more dependable quality.

Manufacturers:

Buffalo Foundry & Machine Co., 1541 Fillmore Ave., Buffalo, N. Y. "Buffovak."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Devine Co., J. P., 1372 Clinton St., Buffalo, N. Y.
Hubbard's Sons, Norman, 265-267 Water St., Brooklyn, N. Y.
Stokes Machine Co., F. J., 17th & Cambrai Sts., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

IMPREGNATING COMPOUNDS.—See Compounds, impregnating.

IMPRESSED ELECTROMOTIVE FORCE.—The e. m. f. applied to a circuit to create a current flow. This is distinguished from any other e. m. f., such as a counter e. m. f. that may be present in the circuit due to induction, either self or from outside influences.

IMPROVED.—Trade name for armature coil forming machine manufactured by the Armature Coil Equipment Co., 3203 Scranton Rd., Cleveland, Ohio.

IMPROVED.—Trade name for motor-driven blowers manufactured by the Improved Appliance Co., 413 Kent Ave., Brooklyn, N. Y.

IMPROVED.—Trade name for copper cable type of lightning rod made by Moore Bros. Lightning Rod Co., Maryville, Mo.

IMPROVED APPLIANCE CO.—413 Kent Ave., Brooklyn, N. Y. Manufacturer of motor-driven blowers. President, Henry L. Doherty; vice-president, Frank W. Frueauff; secretary, George A. Nelson; sales manager, Gilbert C. Shadwell.

IMPROVED 500.—Trade name for strain insulators manufactured by J. H. Parker & Son, Parkersburg, W. Va.

IMPROVED OHIO.—Trade name for die stocks made by the Borden Co., Warren, Ohio.

IMPROVED WILLIS.—Trade name for planimeter manufactured by James L. Robertson & Sons, 78-80 Murray St., New York, N. Y.

IMPULSE.—An impulse is a sudden brief change in current flow. It is used most largely in automatic telephony to operate switches. It may consist of a break and a make, or it may be a make and a break (the latter is called a "pulsation"). Speed and impulse ratio fix the ability of impulses to do work. They define the impulse. The speed varies from 8 to 12 per second at the subscriber's calling device; 14 impulses per second are used for testing switches. While hunting an idle trunk, a switch may make from 20 to 80 impulses per second, depending on the type of switch and its adjustment.

Very often a preliminary impulse or an unintentional impulse is made just before the subscriber dials the call number. It is thought to be caused by the subscriber fumbling the hook while removing the receiver. Another term used in referring to impulses is "impulse ratio." This is the ratio between the length of time that the current change lasts and the total period of the impulse (break to break, or make to make). In the case of "make" impulses (pulsations) the ratio is the time of current flow to total period.

Impulses are occasionally used for operating control equipment, especially for operating remotely located lighting circuits. Their use has also been proposed for controlling two-rate meters before and after the peak-load period, but seldom applied in actual practice.

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IMPULSE SPRINGS.—Any pair of springs in electrical apparatus which make or repeat electrical impulses, usually in an automatic telephone system. See Calling device.

IMPULSE TANK CO.—2820 N. Spring Ave., St. Louis, Mo. Manufacturer of pneumatic paint spraying brushes. William C. Carter, proprietor.

INCANDESCENCE.—Incandescence is that process of light production classed as high-temperature radiation, in which a solid or liquid produces light without altering its chemical nature in the process. Electric incandescence is the glowing of a body when heated to a high "white hot" temperature by an electric current passing through it. It is generally produced by passing a current of high intensity through a conductor having a relatively high resistance. Its widest application is in the incandescent lamp; see Lamps, incandescent.

INCANDESCENT LAMPS.—See Lamps, incandescent (ten types).

INCANDESCENT SUPPLY CO.—638 Liberty Ave., Pittsburgh, Pa. Manufacturer of lighting fixtures.

INCLINATION OF MAGNETIC NEEDLE.—A magnetic needle or compass, if free to turn about a horizontal axis, will turn so that the needle makes an angle with the horizontal plane. This angle is called the angle of dip, and is different in different latitudes. In the northern hemisphere the north-seeking pole is depressed and in the southern hemisphere it is the south-seeking pole. At the equator the dip is zero.

INCLINATORS, CARBOY.—See Carboy rockers or inclinators.

INCO.—Trade name for nickel anodes, cathodes, sheets, etc., manufactured by the International Nickel Co., 43 Exchange Pl., New York, N. Y.

INCO INSULITE.—Trade name for insulating asphalt, baking japans, compounds, paints, varnishes and other insulating materials manufactured by the International Paint Corp., 915 Olive St., St. Louis, Mo.

INCO PRODUCTS.—Trade name for graphite, japans and protective paints manufactured by the International Paint Corp., 915 Olive St., St. Louis, Mo.

INCOMPARABLE.—Trade name for soldering fluid manufactured by the Reade Mfg. Co., 135 Hoboken St., Jersey City, N. J.

INCUBATORS, BACTERIOLOGICAL, ELECTRIC.—These devices are electrically heated cabinets or ovens accurately controlled by thermostats. They are used by physicians, in special culture tests, such as blood tests, in bacteriological research, and in milk and other tests of food products. The larger laboratory types are generally large ovens provided with trays or shelves for holding the tubes, vessels, flasks, etc., containing the material under test. The accuracy of electrical control makes the electric incubator superior to other types.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Watters."
Thermo Electric Instrument Co., The, 8 Johnson St., Newark, N. J. "Freas," "Thelco."
Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md.

INCUBATORS, INFANT, ELECTRIC.—These incubators, used largely in maternity hospitals, have been the means of saving the lives of thousands of prematurely born, feeble and poorly nourished infants. The delicate care required for such an infant can only be obtained in a very accurately controlled device, such as these electric incubators. They consist essentially of a heated cabinet, the temperature being controlled automatically and accurately by a thermostatic heating element control, and are provided with a device for constantly supplying fresh air of a predetermined moisture content also under automatic control.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Watters."

INCUBATORS, POULTRY, ELECTRIC.—There are two general types of electric incubators commonly used, the lamp and the resistance-heating-element types. The incubators consist of a tray inclosed in a heat-insulating box, the eggs being placed on the tray and kept at a uniform temperature by a thermostatic control. The larger incubators are usually a cabinet type capable of holding from 100 to 500 eggs, and are used chiefly in hatcheries. Smaller incubators holding from 50 to 100 eggs are made largely for use by farmers or small-scale poultry raisers. These are portable and may be placed anywhere on the farm where it is convenient. By relieving the hens of hatching the eggs they conserve their energy for greater egg production.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Cyphers Incubator Co., Buffalo, N. Y. "Electrobater."
Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind. "Lectro-Hatch."
Liberty Mfg. Co., Inc., 3201-41 Carrollton Ave., New Orleans, La.
Lo-Glo Electric Incubator Co., Inc., 76 Greenwich St., New York, N. Y. "Lo-Glo."
Oakes Mfg. Co., The, Tipton, Ind. "Oakes Electric Hen."
Petaluma Electric Mfg. Co., 2-4 E. Washington St., Petaluma, Cal.
Reliable Incubator & Brooder Co., Quincy, Ill. "Reliable."

INDEPENDENCE.—Trade name for polishing wheels manufactured by the Eastern Felt Co., Winchester, Mass.

INDEPENDENT.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

INDEPENDENT LAMP & WIRE CO.—1737 Broadway, New York, N. Y. Manufacturer of incandescent lamps and wire. Business established 1908. President, Nathan Hofheimer; vice-presidents, Lester Hofheimer, R. K. Dana, A. J. Liebman; secretary, R. B. Dana; treasurer, R. K. Dana.

INDEPENDENT LAMP MANUFACTURERS' ASSOCIATION.—President, Nicholas Fabian, Continental Lamp Works, New York City; secretary, Charles B. Levy, American Auto Lamp Co., New York City.

INDEPENDENT PNEUMATIC TOOL CO.—Chicago, Ill. Manufacturer of electric drills and grinders. Business established 1905. President and general manager, John D. Hurley; vice-president and sales manager, Ralph S. Cooper; secretary, F. W. Buchanan; treasurer, E. G. Gustafson. Main office, 600 W. Jackson Blvd., Chicago, Ill. Factory, Aurora, Ill. Branch offices and warehouses, 1463 Broadway, New York, N. Y.; 61 Fremont St., San Francisco, Cal.; 1721 Jefferson County Bank Bldg., Birmingham, Ala.; 718 Bessemer Bldg., Pittsburgh, Pa.; 55 Garfield Bldg., Detroit, Mich.; 1103 Citizens Bldg., Cleveland, Ohio; 811 Denckla Bldg., Philadelphia, Pa.; 1230 Little Bldg., Boston, Mass.; 334 St. James St., Montreal, Que., Can.; 411 Olive St., St. Louis, Mo. District office, 32 Front St., W., Toronto, Ont., Can.

INDEPENDENT REFINING CO.—Oil City, Pa. Manufacturer of lubricating oils. Business established 1880.

INDEPENDENT TELEPHONE ASSOCIATION OF CALIFORNIA.—President, A. Wardman Whittier; secretary-treasurer, E. Erwin, Pomona, Cal.

INDEPENDENT TELEPHONE ASSOCIATION OF OKLAHOMA.—President, A. Gordon, Mangum, Okla.; secretary-treasurer, M. M. Flickinger, Kingfisher, Okla.

INDESTRUCTIBLE.—Trade name for insulated screw driver manufactured by the Cronk & Carrier Mfg. Co., 109 W. Water St., Elmira, N. Y.

INDESTRUCTIBLE.—Trade name for electric signs manufactured by the Indestructible Sign Co., 232½ N. High St., Columbus, Ohio.

INDESTRUCTIBLE.—Trade name for tool handles manufactured by the J. L. Osgood Tool Co., 45 Pearl St., Buffalo, N. Y.

INDESTRUCTIBLE SIGN CO., THE.—232½ N. High St., Columbus, Ohio. Manufacturer of electric signs. Business established 1912. President and general manager, C. A. Divine; vice-president, J. J. Divine; secretary and treasurer, F. B. Moore; sales manager, L. H. O'Connor. Factory, Michigan City, Ind.

INDIAN.—Trade name for nail pullers and glass cutters manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

INDIAN REFINING CO.—244 Madison Ave., New York, N. Y. Producer of lubricating oils and greases.

INDIANA.—Trade name for household electric vibrator manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

INDIANA CREOSOTING CO.—Louisville, Ky. Producer of creosoted poles, posts, ties and underground conduit. Main office, 401 W. Main St., Louisville, Ky. Branch office, Bogalusa, La. Plants, Manville, N. J.; Paterson, N. J.; Rome, N. Y.; Toledo, Ohio; Indianapolis, Ind.; Bloomington, Ind.; Russell, Ky.; Marion, Ill.; Kansas City, Mo.; Springfield, Mo.; Hugo, Okla.; Shreveport, La.; Deridder, La.; Bogalusa, La.; Brunswick, Ga.; Trenton, Ont., Can.

INDIANA ELECTRIC LIGHT ASSOCIATION.—Secretary, Thomas Donohue, Lafayette, Ind.

INDIANA FAN CO.—40 E. South St., Indianapolis, Ind. Manufacturer of ventilating fans. Business established 1895. President, J. B. Dill; secretary and treasurer, H. D. Hamilton.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION.—President, Henry A. Barnhart, Rochester, Ind.; secretary, F. O. Cuppy, Lafayette, Ind.

INDIANA LEATHER STAMPING CO.—Williamsport, Pa. Manufacturer of leather nail heads and washers.

INDIANA RUBBER & INSULATED WIRE CO.—Jonesboro, Ind. Manufacturer of insulated wires and cables. Business established 1890. President, A. F. Seiberling; vice-president, N. Huber; secretary, Robert W. Seiberling; treasurer, S. H. Miller. Main office and factory, Jonesboro, Ind. Branch office, 210 S. Desplaines St., Chicago, Ill. Sales representative, Thomas & Betts Co., 63 Vesey St., New York, N. Y.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATION.—Secretary, George Skillman, Indianapolis, Ind.

INDIANA STEEL & WIRE CO.—Muncie, Ind. Manufacturer of telephone and telegraph wire, strand and rail bonds. Secretary and general manager, E. F. Kitselman; sales manager, Robert Miller.

INDIANA STEEL PRODUCTS CO.—Valparaiso, Ind. Manufacturer of permanent magnets. President, H. R. Curran; vice-president, J. Lowenstine; secretary and treasurer, Mandel Lowenstine. Main office and factory, Valparaiso, Ind. Branch office, 127 N. Peoria St., Chicago, Ill.

INDIANAPOLIS.—Trade name for portable electric welders manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

INDIANAPOLIS MFG. CO.—1030 E. Pratt St., Indianapolis, Ind. Manufacturer of wood separators for storage batteries. Business established 1913. President and treasurer, H. W. Nordyke; vice-president, J. E. Norris; secretary, G. Norris.

INDIANAPOLIS SWITCH & FROG CO.—Springfield, Ohio. Manufacturer of electric railway track equipment.

INDICATED HORSEPOWER.—The indicated horsepower of a steam engine is a measure of the power developed within the cylinder. It is calculated from indicator cards which show the steam pressure variations within the cylinder. See Indicators, engine.

INDICATOR, CALL, TELEPHONE.—A device used in a manual office to indicate visually to the operator the call number which an automatic subscriber desires. It enables the subscriber in a mixed system (automatic and manual) to dial all numbers regardless of whether they are on a manual or automatic exchange and makes it unnecessary to give a number orally.

INDICATORS, ELEVATOR FLOOR LEVEL, ELECTRIC.—In a panel on the main floor are set glass bulls' eyes, one for each floor, behind each of which is a miniature incandescent lamp. Each vertical row of lamps represents an elevator whose number appears at the top. As the car moves from floor to floor the proper lamp in the row flashes to show constantly the location of the car. A contact-maker for each car makes and breaks the circuit of

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each lamp as the car moves. This type of indicator is a great aid to the starter as it enables him to see how all the cars in a bank are distributed and permits him to dispatch the cars more effectively. It may be located at any suitable point and is not subject to the limitations of mechanical indicators.

Manufacturers:

Elevator Signal Co., 166 West St., New York, N. Y.
Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.

INDICATORS, ENGINE.—To obtain a record of the variation of the steam pressure in a steam engine cylinder a graphic pressure chart is made by means of a steam engine indicator. This instrument consists of a small piston to which a pencil is attached. This piston is connected by piping to a cock in the engine cylinder so that it moves vertically up and down against a spring, the movement being proportional to the pressure of the steam in the cylinder. The paper upon which the record, called an indicator diagram, is drawn is wrapped around a small drum or cylinder. This drum rotates about its axis, the rotation being produced by a reducing motion attached to the engine crosshead. When the engine is running the pencil moves up and down with the steam pressure at the same time that the drum rotates with the movement of the crosshead. The result is that the pencil traces a curve which represents the varying steam pressure at every point in the engine stroke and whose area is proportional to the horsepower developed in the engine cylinder. The power so determined is called the indicated horsepower of the engine and is greater than the brake horsepower, which is the useful power available at the pulley or engine shaft. The shape of the indicator diagram enables the engineer to make a careful study of the valve setting and other factors affecting the behavior of the steam end of the engine.

Manufacturers:

American Steam Gauge & Valve Co., 208 Camden St., Boston, Mass. "American."
Bacharach Industrial Instrument Co., 7000-6 Bennett St., Pittsburgh, Pa.
Crosby Steam Gage & Valve Co., Boston, Mass. ("Sargent" electrical attachment.)
Robertson & Sons, James L., 78-80 Murray St., New York, N. Y. "Robertson-Thompson."
Tecla Co., Inc., Detroit, Mich.
Trill Indicator Co., The, Corry, Pa.

INDICATORS, EXCESS DEMAND.—These devices are used instead of a meter in small installations where electric service is supplied on a flat-rate system based on not exceeding a certain maximum demand specified in the service contract. For small residence customers the cost of a meter and of reading it monthly constitutes a very large part of the total cost of rendering the service. A meter can be dispensed with by charging a definite flat rate monthly regardless of the actual total energy consumption, provided that the demand does not exceed that specified. To prevent exceeding this demand an indicator is installed. This usually consists of a solenoid in series with the load and provided with a plunger that is drawn up when the demand is greater than the prescribed amount, thus actuating a switch to open the circuit momentarily, upon which the plunger drops back. If the excess demand continues, the plunger is intermittently actuated and the lights rapidly flickered. To stop this annoying blinking the customer must reduce his demand to the proper amount. These devices are given various names, such as current limiter, excess indicator and sometimes (but erroneously) demand indicator. An indicating watt-meter is the only instrument that actually indicates the demand at any instant. A demand meter shows the maximum demand reached in any period: for these see Meters, demand.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y. "Pittsburgh."

INDICATORS, HELM AND OTHER MARINE.—These are indicating devices attached to the rudder stock of a vessel to indicate in the different navigating stations throughout the ship, the angle that the rudder makes with the hull, either port or starboard. There are also other indicators used for marine services, such as stack-temperature indicators, consisting of a system of pyrometers placed in the smokestack or stacks and giving a continuous indication of the stack temperature. There are also shaft-speed indicators, consisting of some form of a generator directly geared to the main engine or propeller shafts and wired to indicators located in the navigating stations of the ship. These are of importance in maneuvering of the vessel while in fleet formation and when passing through narrow channels, harbor entrances, etc.

Manufacturers:

American Speed Indicator Co., The, New London, Conn. "Kenney."

INDICATORS, LIGHTNING.—Lightning indicators are small instruments connected in the ground connection of lightning protective apparatus. They indicate when a discharge to ground has occurred. One form is a compact instrument soldered into the ground line, and having an indicating needle that is normally at zero but swings over to one side after a discharge has passed. It also provides a means of testing to determine the condition of the protective apparatus. Another is a paper or other fabric film that shows charring after a discharge has passed. These indicators are of value when studying the extent of lightning disturbances that must be guarded against and also in observing whether the protective devices installed are functioning.

Manufacturer:

Bajohr Lightning Conductor Co., Carl, 4055 Keokuk St., St. Louis, Mo.

INDICATORS, OPERATION AND MISCELLANEOUS.—These are electric indicators showing when machinery or apparatus is in operation by means of a special signal, such as lighting of a lamp, ringing a bell or putting a manual signal in position. In case of a motor-driven machine the indicator circuit is connected across the motor circuit, so that when the motor is started the indicator circuit is excited and the signal is operated. Such signals are of value in cautioning persons against interference with the circuit or calling attention to the fact that the machine is in service.

Various forms of pilot lamps are frequently used to indicate when an electric heating device is "on" or "off," this being usually by lighting a red lamp while the current is on. Circuits for electric flat-irons, stoves and other heating devices are frequently equipped with such pilot lamps to call attention, in case of the iron, to its being in service and to guard against leaving it without turning off the current so that the ironing board or the work being ironed may not be scorched.

Other indicators are used for various special purposes, such as calling a repairman when a machine is out of order, as is done in printing shops where there are numerous linotype or other typesetting machines. Pilot lamp indicators are also used to show when a line circuit has power on or off. For instance, when repair work is being done on a line it is well to have a special caution signal to prevent energizing the line until the work is completed and the line is clear.

Manufacturer:

Display Stage Lighting Co., 314 W. 44th St., New York, N. Y.

INDICATORS, PHASE-ROTATION.—Polyphase currents in coils properly spaced will produce rotating or revolving magnetic fields. The direction of motion of the magnetic field will depend upon the sequence of the currents in the coils. If this sequence is changed, the direction of rotation is changed. A device which indicates the sequence of currents is known as a phase-rotation indicator. These indicators are essentially the same as synchroscopes, but, being polyphase instruments, no split-phase device is used. All the windings are stationary and the revolving element consists of a pivoted light iron vane to which a pointer is attached.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

STATES CO., THE, 71 Francis Ave., Hartford, Conn. Device indicates by the brightness of a lamp the order of phase sequence in a polyphase circuit. Indispensable in connecting reactive meters, phase shifters and induction motors for correct rotation. Line gangs should carry them in order not to reverse motors when changing service construction.—Adv.



Phase Indicator

INDICATORS, SPEED OR REVOLUTION.—See Tachometers, also Speedometers.

INDICATORS, SWITCH.—Switch indicators are of several types depending upon the character of the switch. On the switchboards of large power stations it is customary to use red and green pilot lamps, to show when oil circuit breakers or other switches are closed or open. For railway switches indicators are used to show when the switch is open or closed. When the switch is moved to one side it makes electrical contact for a circuit that actuates a solenoid to move a signal disk into position and light a colored lamp. When the switch is moved to the other position the signal disk is released by the solenoid and the first lamp goes out or a lamp of different color is lighted in place of it. These signals clearly show the position of the switch both to the trainmen on the locomotive or car and to the tower operator, if an interlocking signal tower is in use.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Hall Switch & Signal Co., Garwood, N. J.
Tecla Co., Inc., Detroit, Mich.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

INDICATORS, SYNCHRONISM.—See Synchroscopes.

INDICATORS, VOLTAGE OR CURRENT.—Instruments used for testing purposes to determine the nature of the voltage or current present and its approximate value. They are usually fairly simple instruments, having in one type a window in which the indiction appears in the form of figures to show whether the source is a-c. or d-c. and 110 or 220 volts. Other instruments are also made for this purpose to give merely approximate indications.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
Berghman Co., 5428 Fulton St., Chicago, Ill. "Berghman."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic Determinator."
Roller-Smith Co., 233 Broadway, New York, N. Y. "C. O. D.," "Universal."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S & C"
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

INDIVIDUAL CONTAINER.—Trade name for ignition parts and commutator brushes for motors and generators manufactured by the Otter Mfg. Co., 243-245 W. 17th St., New York, N. Y.

INDIVIDUALITY.—Trade name for electric signs manufactured by the Greenwood Advertising Co., Knoxville, Tenn.

INDUCED CURRENT AND E. M. F.—An electric current produced in a circuit by conductors cutting magnetic lines of force or by induction. When the circuit and conductors are stationary, it is produced by a changing magnetic field. Electromotive forces are induced in a similar manner.

INDUCTANCE.—Inductance is the magnetic property of a circuit by virtue of which a fluctuating current will induce an e.m.f. If the e.m.f. is induced in the same circuit in which the current fluctuates, we have what is called self-inductance. If the e.m.f. is induced in an adjacent circuit, we have what is called mutual inductance. Unit inductance is that value of inductance in which unit e.m.f. is induced by unit change of current. In-

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ductance was formerly called "self-induction" and its unit was called the "coefficient of self-inductance." The practical unit of inductance is the henry. The symbol for inductance is L.

The direction of the induced e.m.f. always bears the same relation to the direction of the fluctuating magnetic flux. When the circuit is closed, the induced e.m.f. tends to produce a current in the direction such as to oppose the change in flux. This is derived from Lenz's law, which has been stated as follows: If a constant current flows in the primary circuit A, and if, by the motion of A, or of the secondary circuit B, a current is induced in B, the direction of this induced current will be such that, by its electromagnetic action on A, it tends to oppose the relative motion of the circuits.

INDUCTANCE ANALOGOUS TO INERTIA.—See Inertia, analogy of inductance to.

INDUCTANCE IN A-C CIRCUITS.—The magnetic field set up by the current flowing in a circuit carrying an alternating current reverses with each alternation of the current. This induces an electromotive force which reacts on the working pressure and causes a drop in the pressure at the receiving end of the circuit, in addition to that caused by the resistance. The drop in a-c. circuits is therefore more than for d-c. circuits under like conditions. The difference is of small practical consequence in circuits smaller than of No. 4 wires, but with larger conductors it may be 40% or more greater than the drop would be with direct current.

The effect of inductive reactance increases as the separation between wires is increased. With all wires of the circuit inside the same conduit it is negligibly small, but with open wiring and on pole lines the increased separation causes a materially increased line drop. If the wires of the circuit are carried in separate iron conduits the drop is greatly increased and with currents of over 100 amperes overheating may result.

INDUCTANCES, STANDARD.—Standard inductances are used extensively in radio communication and testing as a means of varying the wave length and for calibrating other inductances, especially the variable inductances often called variometers. They are usually insulated wire coils wound on open cores, generally having one layer of wire only. No magnetic material is used in constructing the core for which fiber, rubber, molded insulation, or wood is employed. The core usually consists merely of two rings one at each end joined together with small slats or bars. A small supporting framework is attached to the rings at each end. Multiple layer coils are also used to give higher inductances.

Manufacturer:

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.

INDUCTION APPARATUS, STATIONARY.—Stationary induction apparatus comprises several forms of apparatus which change electrical energy to electrical energy, through the medium of magnetic energy, without mechanical motion. The most familiar form of such apparatus is the transformer. Voltage regulators are also in this class, and reactors or as they are commonly called resistance coils or choke coils, which supply reactance or produce phase displacement.

INDUCTION COILS.—See Coils, induction (three types).

INDUCTION FURNACE.—A type of electric furnace operating on the principle of the electric transformer; the current is led into a primary coil, and the metal to be heated forms the secondary circuit which is short-circuited on itself.

INDUCTION IN TELEPHONE LINES.—A mutual influence or relationship between electrical conductors is often called induction or, when it becomes troublesome, "inductive interference." It is noticed by users of telephone lines when the lines run parallel to power lines or trolley lines for a distance, making the telephone line noisy. There are two kinds: Electromagnetic induction is due to the magnetism in the space surrounding a wire set up by the current flowing in the wire. A trolley-line feeder carries enough current to act on a telephone line in this way. Electrostatic induction is due to the electrical field surrounding a wire which is charged to a voltage. Series arc lines are the worst offenders against telephone lines in this respect. Cross talk is produced by both kinds of induction between telephone lines, but the electrostatic kind is more prominent. To overcome the effect of induction, i. e., to eliminate the disturbances caused by induction, the lines are usually transposed. This matter has been given a great deal of study in relation to power and telephone lines, especially in California. See Transposition.

INDUCTION INSTRUMENTS.—See under Instruments, electrical measuring.

INDUCTION MACHINE.—An electric machine in which primary and secondary windings rotate with respect to each other. Induction machines include induction generators, induction motors, certain frequency converters and certain rotary converters.

INDUCTION MOTORS.—See Motors, a-c., induction (three types).

INDUCTION REGULATORS.—See Regulators, feeder voltage.

INDUCTION STARTER.—Another name for autostarter, which see.

INDUCTION TELEGRAPHY.—A method of telegraphy used in telegraphing from moving trains. A system of conductors is installed parallel to the track and the impulses are produced in these stationary conductors by induction. It is really a branch of wireless or radio communication, but is very little used.

INDUCTIVE CIRCUIT.—An inductive circuit is one possessing inductance. The current in an a-c. inductive circuit lags the electromotive force by an angle ranging from a fraction of 1° up to 90°, depending upon the relative values of the inductance and resistance.

INDUCTIVE COUPLER.—An apparatus which joins portions of two radio-frequency circuits by magnetic forces. See Coupler, radio.

INDUCTIVE LOAD.—An inductive load is a load in which the current lags behind the voltage across the load.

INDUCTIVE REACTANCE.—The e.m.f. of self-inductance in a circuit depends upon the inductance of the circuit and the rate at which the current is changing. The factor by which the current must be multiplied to give the self-induced e.m.f. is the inductive reactance of the circuit. Numerically it is equal to the product of the inductance, frequency and 2π, or $X_1 = 2\pi f L$, where X_1 is the inductive reactance, f is the frequency, and L is the inductance.

INDUCTIVE REACTANCE VOLTAGE.—The inductive reactance voltage of a circuit is the product of the inductive reactance by the total current; or $E_1 = 2\pi f LI$. This voltage lags one-quarter of a period behind the current producing it. Also see Inductive reactance.

INDUSTRIAL.—Trade name for electric furnaces manufactured by the Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill.

INDUSTRIAL.—Trade name for electric cranes manufactured by the Industrial Works, Bay City, Mich.

INDUSTRIAL CONTROLLER CO.—Milwaukee, Wis. Manufacturer of controlling devices. Business established 1910. President, C. G. Welch; secretary and general manager, F. W. Magin; treasurer, H. L. Van Valkenburg. Main office and factory, 886 Greenbush St., Milwaukee, Wis. Branch offices and warehouses, Monadnock Block, Chicago, Ill.; 120 Broadway, New York, N. Y. District offices, Ford Bldg., Detroit, Mich.; Citizens Bldg., Cleveland, Ohio. Sales representatives, Walker Bros. & Haviland, Philadelphia, Pa.; Beedle Equipment Co., Cincinnati, Ohio; White & Converse, Minneapolis, Minn.; Arthur M. Funke, San Francisco, Cal.

INDUSTRIAL ELECTRIC FURNACE CO.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric furnaces. President, F. von Schlegell; secretary and treasurer, C. B. Fletcher.

INDUSTRIAL ELECTRIC HEATING.—The first service of the electric central-station industry was for lighting and for a time was looked upon by the central stations as their sole source of income. While this field grew rapidly the use of electricity for driving motors, or the power business, soon assumed such proportions as to attract their attention. Much was done to develop this load to its maximum by obtaining power contracts at special rates. Lighting also continued to receive attention, especially as applied to street lighting, electric signs and spectacular lighting.

With these fields thoroughly established progressive central stations scanned the horizon for the next worth-while load. This was found in the form of electric heating. This had found some application in households for flatirons, table appliances, radiators, and later for cooking ranges and water heaters. It was believed that electric heating had possibilities in the industrial field. With only about eight years of development this field has grown to be a large and important one and American central stations now have over 1,000,000 kw. of this class of business connected. It is still a field of which comparatively little is known by the public at large, but the active central stations, both large and small, have realized the importance of this phase of the industry and are taking steps to obtain as much as possible of this steady, profitable and constantly increasing load.

Utility and Advantages. The question may naturally arise, "What can be done with electric heat?" The answer is that there is no other form of heat that electricity cannot supplant for it will do everything that heat produced direct from fuels will do, and in many cases will do it better and nearly always with such decided advantages as increasing factory production, improving the quality of the product, saving time and space, eliminating unhealthy and unsafe working conditions, etc. From the standpoint of cost alone, in comparing the cost of heat direct from fuels with the cost of heat from electric current, its use is not always economical or practical, but it is generally found that the factors mentioned above or some others of equal importance may be capitalized, thereby resulting in industrial heating as a decidedly economical proposition.

The most prominent and by far the greatest asset of industrial electric heating is that of increasing the production of an entire plant or of one department solely by the use of electric heat. The factors responsible for this are the higher obtainable working temperatures, the evenness of heat distribution and absolute temperature control. The first allows a saving of time and floor space by performing the operation more quickly. The second permits a more uniform product with fewer rejections because all articles receive the same degree of heat, which is practically impossible with other methods of heating. The last allows a better product and an absolute duplication in every case. For these reasons electric heating is applied to advantage in many processes in which other methods of heating were used formerly, and it is also applied in hastening or otherwise improving many processes or operations which it was thought did not require the use of heat.

The healthfulness and safety of electric heat are items now recognized as being of far greater importance than was once the case. The reduction of fire risk and the cleaner working conditions that can be obtained, the elimination of explosion hazards, etc., are assets that can be capitalized by the manufacturer in the reduction of labor costs by reducing labor turnover, employing unskilled labor and obtaining greater production per man-hour.

Industrial Electric Heating as a Central-Station Load. From the viewpoint of the central station there are a number of reasons why this new business, industrial electric heating, is an ideal load. It has long hours of use or, in other words, its load-factor is good, generally better than all other classes of business because it has a more constant demand due to the necessity of maintaining uniform temperatures. Even at noon time when most of the connected motor load is not operated, the heating processes may be continued without attention or, if they should be stopped, some heat is nearly always maintained so that time is not lost in heating up the furnace, oven, or other appliance when the noon hour is over. Very often heating processes may be accomplished with very little attention and the off-peak hours, such as during the night, are utilized by the customer in order to get a better rate for the energy consumed. This is an advantage to the central station as it smooths out the load curve. It is also noticed that stations having an industrial heating load have a much better power-factor, as all resistance heating elements and almost all electric furnaces have unity power-factor.

The enormous field for industrial electric heating can be realized if consideration is given to the large number of industries and factories using electric power for motor

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purposes, and the considerable number which use very little or no motor power at all but can use heat in some form or another. In many instances of the latter class the heating load is nearly ten times the motor load of the plant. In the electric furnace field, the load for each furnace is usually high and very desirable. The field covers practically every factory in which steam heat or direct-combustion methods are used, plus the possibility of application to other problems to which no other means of heating can be applied. There are hundreds of standard heating appliances and thousands of others that are by no means standard but which can utilize electrical energy to great advantage.

Aside from electric furnaces, which are probably the most desirable load from the central-station standpoint, there are annealing, japanning and temper-drawing ovens and other appliances which are also highly desirable. A large japanning oven will consume about 250kw. A typical example of such an oven installed in an automobile manufacturing plant, showing the reduction in labor costs and increase in production, is given herewith. The oven was of the continuous conveyor type, 110 ft. long, consisting of a preheating chamber 30 ft. long and a main baking chamber 80 ft. long. The connected load was 260 kw. The temperature was automatically controlled. In this case the production was increased almost 100% and the percentage of rejections was reduced almost 100%. The oven supplanted two large gas ovens which were loaded by the truck method. The new oven reduced the labor cost by 16 men (approximately $80 per day). Floor space was also reduced 80% and the general condition of the japanning room greatly improved.

Annealing and temper-drawing ovens will consume about 10 kw., core-baking ovens for foundries about 12 kw., roofing joiners about 8 kw., photo-print driers about 12 kw., etc. Many of the other appliances listed below do not represent a large load individually, but are nearly always installed in sufficient number to make them desirable as central-station load builders. A list of some of the heating appliances and places where they are successfully applied is given below.

Applications. One of the most important classes of the electric heating load is that of electric furnaces. Nearly as new in its application as the realization of the importance of industrial electric heating, it has made great strides in development and has demonstrated its superiority over fuel-fired furnaces for many purposes. The increase of the electric furnace load has been particularly rapid in the last few years after its uses during the recent World War so clearly demonstrated its advantages. Many processes in the metal melting, founding, ore refining, steel and special-alloy producing and electrochemical industries are not only accomplished at a lower cost, but far superior products are obtained. Many articles such as artificial abrasives and graphite, calcium carbide and cyanamide, etc., that can be produced in no other way because of temperature limitations, have been made possible by the electric furnace. Electric furnaces are made in a number of forms and sizes. They are also used for annealing, brass and other alloy melting, hardening, steel refining and melting, and many other miscellaneous metallurgical, electrochemical and laboratory processes.

Electric ovens are used widely in industrial processes for such purposes as enameling, sherardizing, japanning, drying, hardening, heat treating, annealing, conditioning, temper drawing, bacteriological and other hospital and laboratory processes, armature and field-coil baking, coil impregnating and drying, testing, vulcanizing, etc.

Bakeries, restaurants, confectioners and food-product manufacturers utilize electric heating for the operation of bake ovens, batch warmers, broilers, candy warmers, chocolate warmers, bonbon and chocolate dipping tables, coffee urns, coffee roasters, cooking kettles, corn poppers, food warmers, drying pans and kettles, gelatine cookers, griddles and grills, macaroni driers, peanut roasters, popcorn machines, ranges for large-scale cooking, toasters, etc.

Printers, bookbinders, engravers and electrotypers have quite a few appliances that may be heated electrically. Among them are such devices as back rounders, burnishers, case coverers, creasing tools, embossing presses, engravers' stoves, wax tools, gilding-wheel heaters, gilding irons, gold-leaf presses, ink driers, linotype and monotype pot heaters, matrix driers, palette heaters, printing-press heaters, ink heaters, wax shipping tables, etc.

Shoe manufacturers, tailors, shirt, collar, hat and other wearing-apparel manufacturers, laundries, etc., are also extensive users of electric heating, although the individual appliances are not very large as a rule. Such articles are used as cloth and clothes driers, collar and cuff formers, corset irons, flanging bags, flatirons, French irons, glove forms, hosiery forms, hat irons, ironing machines, indentors, knurling irons, laundry irons, lining cemeters, pleating machines, relasters, shoe irons, shirt irons, starch cookers, stitchers, tailor irons, thread waxing machines, turn and welt heaters, velouring stoves, velvet irons, welters, etc.

Miscellaneous electric heaters and stoves, while larger in number than furnaces and ovens, do not consume as much energy individually. They are used for heating air in drying rooms, crane cabs, munition rooms, meter houses, etc., and as die heaters, disk stoves, hot plates, laboratory heaters, heat-treating outfits, car heaters, water stills, immersion heaters, and for heating such articles as flasks, oil, plating baths, sand, sealing wax, sulphur, test tubes, water, varnish, wax, extracts, celluloid etc.

There are also a number of other miscellaneous industrial electric heating applications a few of which are as follows: Box mold heaters, blueprint driers, branding irons, cauterizers, can capping tools, creasing tools, crimping machines, envelop driers, film driers, embossing presses, glue pots and glue cookers, gun-shrinking furnaces, metal-melting pots, oil-tempering baths, pipe-thawing outfits, pitch kettles, pyrographic machines, photo-print driers, putty warmers, rivet-heating machines, sherardizing machines, stain heaters, sterilizers, steamers, soldering irons, soldering furnaces and pots, vaporizers, vulcanizers, etc.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION.—Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INDUSTRIAL LIGHTING FIXTURES.—See Fixtures, lighting, industrial.

INDUSTRIAL PRODUCTS CO.—1001 Chestnut St., Philadelphia, Pa. Manufacturer of linemen's tool bags and belts. Business established 1919. President, E. Fred Shipman; secretary and treasurer, J. B. Prouse.

INDUSTRIAL TRACTORS.—See Tractors, electric.

INDUSTRIAL TRUCK CO., DIVISION OF COWAN TRUCK CO.—Holyoke, Mass. Manufacturer of storage battery trucks and tractors. Business established 1911. President, J. L. Wyckoff; secretary and general manager, George F. Jenks; treasurer, E. N. White; sales manager, K. N. Wood. Main office and factory, Holyoke, Mass. Branch offices, Grand Central Palace, New York, N. Y.; Dorchester, Mass.; 207 Fulton Bldg., Pittsburgh, Pa.; Wilkins Bldg., Washington, D. C.; 1500 Central National Bank Bldg., Milwaukee, Wis.; 512 Peters Bldg., Atlanta, Ga.; 1618 Fisher Bldg., Chicago, Ill.; 541 Cass St., Detroit, Mich.; 120 Glenholme St., Ontario, Ont., Can.; St. Paul Minn.; 601 Bulletin Bldg., Philadelphia, Pa.

INDUSTRIAL TRUCKS.—See Trucks, storage battery, baggage and industrial.

INDUSTRIAL WORKS.—Bay City, Mich. Manufacturer of electric cranes. President, W. L. Clements; secretary and treasurer, C. R. Wells; manager, E. B. Perry; sales manager, Benjamin Dixon. Main office and factory, Bay City, Mich. Branch offices, 50 Church St., New York, N. Y.; 1309 Widener Bldg., Philadelphia, Pa.; 1001 McCormick Bldg., Chicago, Ill.; 1344 Book Bldg., Detroit, Mich. Sales representatives, F. H. Hopkins & Co., Ltd., Victoria Sq., Montreal, Que., Can.; J. G. Miller, Commonwealth Trust Bldg., St. Louis, Mo.; C. B. Davis Engineering Co., Brown-Marx Bldg., Birmingham, Ala.; Norman B. Livermore & Co., Merchant's National Bank Bldg., San Francisco, Cal.; Northwestern Equipment Co., Northwestern Bank Bldg., Portland, Ore.; El Paso Bridge & Iron Co., El Paso, Tex.; Landes & Co., Salt Lake City, Utah.

INDUSTROLITE.—Trade name for factory lighting fixture manufactured by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

INERTIA, ANALOGY OF INDUCTANCE TO.—Inductance in electrical circuits is analogous to inertia associated with moving bodies in mechanical systems. Because of its inertia a moving body opposes any change in its momentum, but inertia does not affect a motion with constant velocity. Similarly inductance in an electrical circuit in which a current is flowing opposes any change in the magnetic flux thus produced. Thus inductance does not affect or oppose a constant current, but only opposes a change in the current, as with alternating or pulsating currents. It always tends to oppose the change.

INFRA-RED RAYS.—These constitute the portion of the spectrum beyond the red, consisting of waves too long to be visible, but not long enough to be detected by their electrical effects. They are generally studied by observing their heating effect.

INFUSORIAL EARTH.—See Kieselguhr.

INGERSOLL & BRO., ROBERT H.—Chicago, Ill. Manufacturers of luminous switch attachments. Main office, 37 S. Wabash Ave., Chicago, Ill. Branch offices, 30 Irving Pl., New York, N. Y.; 350 Freemont St., San Francisco, Cal.

INGERSOLL ELECTRIC APPLIANCE CO.—746 S. Wabash Ave., Chicago, Ill. Manufacturer of electric heating pads. Business established 1920. President, Dr. John Kercher; vice-president, Mrs. F. B. Allison; secretary and treasurer, T. H. Allison; general manager, C. B. Ingersoll.

INGERSOLL-RAND CO.—New York, N. Y. Manufacturer of electric and pneumatic foundry machinery. President, G. Doubleday; vice-presidents, W. R. Grace and J. H. Jowett; secretary, F. S. Overton; treasurer, R. D. Purcell; sales manager, L. D. Albin. Main office, 11 Broadway, New York, N. Y. Factories, Phillipsburg, N. J.; Easton, Pa.; Painted Post, N. Y.; Athens, Pa.; Littleton, Colo.; Sherbrooke, P. Q., Can. Branch offices, 1102 Candler Bldg., Atlanta, Ga.; American Trust Bldg., Birmingham, Ala.; 99 Chauncy St., Boston, Mass.; 303 Lewisohn Bldg., Butte, Mont.; 709 Fisher Bldg., Chicago, Ill.; Williamson Bldg., Cleveland, Ohio; 1017 Main St., Dallas, Tex.; 1718 California St., Denver, Colo.; 812 Ford Bldg., Detroit, Mich.; Providence Bldg., Duluth, Minn.; 121 San Francisco St., El Paso, Tex.; Post Office Bldg., Houghton, Mich.; Holston National Bank Bldg., Knoxville, Tenn.; 108 W. 2nd St., Los Angeles, Cal.; Hibernia Bank Bldg., New Orleans, La.; Commercial Trust Bldg., Philadelphia, Pa.; 706 Chamber of Commerce Bldg., Pittsburgh, Pa.; Dooly Block, Salt Lake City, Utah; Rialto Bldg., San Francisco, Cal.; 610 Spruce St., Scranton, Pa.; Colman Bldg., Seattle, Wash.; 300 N. Broadway, St. Louis, Mo.; Commercial Bank Bldg., Washington, D. C.

INGERSOLLITE.—Trade names for luminous switch attachments manufactured by Robert H. Ingersoll & Bro., 37 S. Wabash Ave., Chicago, Ill.

INJECTORS, POWER PLANT.—These devices are used for forcing the boiler feed water into the boiler against the boiler pressure. They are used chiefly on small boilers, largely in isolated power plants, and to some extent on larger boilers as an emergency feeder in connection with pumps. The principle of operation is essentially that a jet of steam is caused to strike the feed water in a specially shaped fitting, the combined action of the vacuum created by the condensed steam and the energy of the rapidly moving steam drawing the water through the feed-water inlet pipe and forcing it through a check valve, or similar device, into the boiler. This elementary principle is somewhat modified in practice where positive or automatic injectors are used. These injectors do not require such low feed-water temperature and are designed for higher boiler pressures than a simple single-tube injector.

Manufacturers:

American Injector Co., 175 14th Ave., Detroit, Mich. "U. S."
Beggs & Co., James, 36 Warren St., New York, N. Y.
Eynon-Evans Corp., 15th & Clearfield Sts., Philadelphia, Pa.
Griffiths & Son, James A., 1315-17 Buttonwood St., Philadelphia, Pa. "Champion", "Keystone."
Hancock Inspirator Co., The, 119 W. 40th St., New York, N. Y. "Hancock."
Hayden & Derby Mfg. Co., 119 W. 40th St., New York, N. Y. "Metropolitan."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Penberthy Injector Co., Ltd., Windsor, Ont., Can. "Penberthy."

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Powell Co., The William, Cincinnati, Ohio.
Randle Machinery Co., The, Powers St. & C. H. & D. R. R., Cincinnati, Ohio. "Leader."
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Sherwood", "Buffalo", "Buffalo Automatic."

INLAND STEEL CO.—Chicago, Ill. Manufacturer of track bolts, spikes, tie plates, etc. President, P. D. Block; vice-president, G. H. Jones; secretary, E. M. Adams. Main office, First National Bank Bldg., Chicago, Ill. Works, Indiana Harbor, Ind., and Chicago Heights, Ill. Branch offices, St. Louis, Mo.; St. Paul, Minn.; Milwaukee, Wis.; Detroit, Mich.

INNOVATE.—Trade name for cord adjusters manufactured by the McGill Mfg. Co., Valparaiso, Ind.

IN-PHASE COMPONENT.—See Active component.

INPUT.—The energy absorbed by or put into a machine or appliance during its operation, as distinguished from the output, or useful energy delivered by it. With electrical apparatus the input is usually measured and expressed in watts.

INSINGER CO.—4651 Stenton Ave., Philadelphia, Pa. Manufacturer of motor-driven dishwashers.

INSPIRATOR.—A type of injector having double tubes. See Injectors, power plant.

INSTANTANEOUS ELECTRIC HEATER CORP.—Buffalo, N. Y. Manufacturer of electric water heaters. Business established 1920. President and general manager, Robert McLelland; vice-president, John G. Herb; secretary, Allan E. Choate; treasurer, Norman H. Ingledew; sales manager, Fred C. Noice. Main office, Root Bldg., Buffalo, N. Y. Branch office, Jamestown, N. Y.

INSTANTANEOUS VALUE.—By instantaneous value of an alternating current is meant the value at a particular instant. In the expression $i=A \sin \omega t$, i represents the instantaneous current value. It evidently fluctuates from zero to I_m (positive maximum), back to zero, to $-I_m$ (negative maximum), and again back to zero. Similarly the instantaneous value of an alternating e. m. f. is designated by e.

INSTANTANEOUS WATER HEATERS.—See Heaters, electric, water, instantaneous or faucet type.

INSTITUTE OF RADIO ENGINEERS, THE.—An international organization founded in New York in May, 1912, by a consolidation of the then most influential societies in the radio engineering field. Its present membership is more than 2,000, and includes practically every radio engineer of standing in the world. The grades of membership are fellow, member, associate member and (for students) junior member. Among the membership are found inventors, authors, consulting and practicing engineers, professors of physics and engineering, executive officers of commercial organizations, officers and representatives of government bureaus, professional and amateur investigators, and professional and amateur operators. The qualifications for these various grades of members are closely similar to those adopted by the American Institute of Electrical Engineers, between which organization and the Institute of Radio Engineers there exists most cordial co-operation.

The object of the Institute of Radio Engineers is "the advancement of the theory and practice of radio engineering and the allied arts and sciences, and the maintenance of a high professional standing among its members." With this object in view, and in addition to the parent group in New York, there have been established Sections in Washington, D. C., Boston, Mass., San Francisco, Cal., Philadelphia, Pa., and Seattle, Wash. Sections are being established in several other cities in the United States and in foreign countries. The Institute of Radio Engineers is represented on the Executive Committee of the International Radio Telegraphic Union, acting in conjunction with the National Research Council. Monthly meetings are held by each of the Sections, and the papers published and distributed to the membership in the "Proceedings of the Institute of Radio Engineers."

The Institute has its Standardization Committee, which publishes, at suitable times, definitions of terms used in the radio art and such standardization rules as are appropriate. There is a Committee on Radio Regulation which considers all national and international radio legislation and prepares reports thereon which are transmitted to those interested. The annual meeting of the Institute generally takes place the first week in January. The present officers are: President, E. W. F. Alexanderson, New York, N. Y.; vice-president, Fulton Cutting; treasurer, Warren F. Hubley; secretary and editor of publications, Dr. Alfred N. Goldsmith, College of the City of New York, New York. These officers and the following managers constitute the board of directors of the Institute; managers, Edwin H. Armstrong, Admiral W. H. G. Bullard, E. H. Colpitts, Lloyd Espenshied, John V. L. Hogan, L. R. Krumm, Robert H. Marriott, Donald McNicol and Maj. Gen. George O. Squier.

INSTRUMENT BRACKETS.—See Brackets, instrument and meter.

INSTRUMENT CLOCK MOVEMENTS. See Clock movements for recording instruments, time switches, etc.

INSTRUMENT DIALS.—See Dials, electrical instruments.

INSTRUMENT GEARS.—See Gears and pinions, meter.

INSTRUMENT TRANSFORMER.—A transformer suitable for use with measuring instruments. Such transformers are of two kinds, those transforming the potential and those transforming the current to the values suitable for the instruments. For further details see Transformers, potential; Transformers, current.

INSTRUMENTS, BOILER ROOM, MISCELLANEOUS.—Various boiler-room instruments are installed in some plants to give special indications and records of what is taking place. A large number of other types of instruments that are more commonly used are described elsewhere, but this classification is simply for special instruments. Often these take the form of combinations of other instruments, such as special draft gages or recorders, which show the total effective draft, the furnace draft and the boiler draft. In other cases barometers are combined with the vacuum gages or recorders to give both indications simultaneously. Meters combining the CO_2 reading with the temperature of the products of combustion and recording them on one chart are also used.

The other instruments commonly used in boiler rooms are described and their manufacturers listed under the following classifications: Barometers; Flue-gas analysis instruments; Gages, draft; Gages, boiler water level; Gages, steam indicating; Gages, steam recording; Meters, air and gas; Meters, feed water; Meters, oil; Meters, steam flow; Meters, water; Pyrometers, electric; Recorders, combustion or CO_2; Regulators, boiler furnace draft; Scales, coal; Thermometers, flue gas.

Manufacturer:

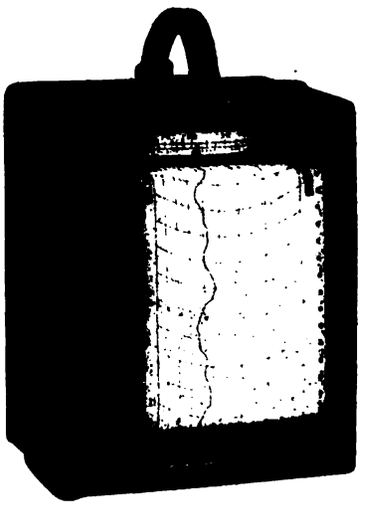
Uehling Instrument Co., Paterson, N. J.

INSTRUMENTS, ELECTRICAL, CURVE DRAWING, GRAPHIC RECORDING OR PRINTING, MISCELLANEOUS.—Electrically operated instruments which give a permanent record of the quantities they measure are used for a wide variety of purposes. Those which are most common (and are described elsewhere) are: ammeters, pyrometers, thermometers, voltmeters and wattmeters. In addition, instruments to permanently record the frequency, power-factor, reactive-factor, switching operations, etc., are often used in electrical generating stations. In the mechanical end of these stations, electrical recording instruments are sometimes used to record the water level at one or more points, or the steam, air or draft pressure in the boiler room. (Also see Recorders, production, electrically operated.)

In general there are two principles used to obtain the record. In one type the moving arm or indicator merely closes contacts which operate relays controlling the inking or recording device. In other forms, the moving arm carries an inking pen and gives the record directly. Similarly the mechanism for operating or moving the record chart is of two general types. In the most common a purely mechanical clockwork is utilized, which requires winding once a day or every eight days. The other form has an electrical self-winding device attached to the clock mechanism, which maintains a uniform tension on the spring. The record itself is either made on a circular chart, which usually requires replacing each day, or in the form of a continuous record on a long roll of paper.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display advertisement on page 1286.)
Bunnell & Co., J. H., 32 Park Place. New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind. The Esterline graphic meter is an instrument containing an accurate measuring element which, instead of being read periodically by the eye, writes a continuous record of its indications on a record chart which is propelled at a uniform rate by a clock movement. The instrument is arranged so that it can be made with meter elements of different types, so as to make recording ammeters, voltmeters, wattmeters, for use on both a-c. and d-c. circuits; power factor recorders, speed recorders, pressure recorders, and production recorders. The writing mechanism is completely carried and controlled by the metering element itself. Every motion of the measuring element is imparted directly to the writing pen without the use of auxiliary devices of any kind. The ink supply is contained in a stationary inkwell, from which it is drawn by capillary action to the writing pen. The ink is carried to the pen through an enclosed tube, avoiding exposure to the air, dust and dirt. In order to adapt the instrument to various uses, it is made in three types of cases, namely, portable, switchboard and wall. The portable instrument weighs 20 pounds, and can be taken and used almost anywhere. The meter cases are made of cast aluminum, making them light and unaffected by heat and moisture. The clock is mounted in an individual dust-proof case, and is assembled complete as a unit. The clocks are made so that the speed of the chart can be adjusted for chart speeds of ¾ ins., 1½ ins., 3 ins., 6 ins. and 12 ins. per hour; by a special feature incorporated in the clock at the time it is made, it can also be made to give the above hourly speeds, and also chart speeds of ¾ in., 1½ ins., 3 ins. and 6 ins. per minute. These instruments are used by central stations, industrial plants and engineers for recording and testing purposes. Portable meters are used for temporary installations and switchboard or wall instruments for permanent use. Bulletins and further information sent on request.—Adv.

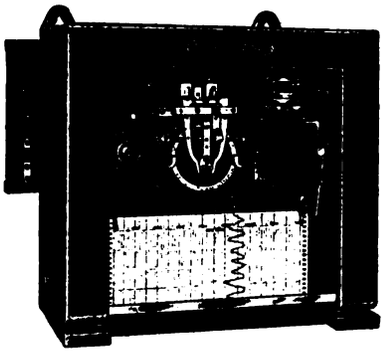


Esterline Graphic Meter

Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."

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LEEDS, & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Automatic Recording Potentiometers and Wheatstone Bridges. From 1 to 16 records on one chart. Charts are 10 in. wide, giving a clear, open, sensitive scale. Instruments can be



Graphic Recording Instrument

equipped to operate signals or alarms, or to operate relays to give automatic control. May be applied to voltage, resistance or conductivity measurements.—Adv.

Leupold, Voelpel & Co., 107 E. 70th St., N., Portland, Ore. (Long distance water stage recorder.) "Stevens."
Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y. (Electric ship's log.) "Nautico."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)

INSTRUMENTS, ELECTRICAL, LECTURE AND SPECIAL LABORATORY.—These are instruments made for special purposes. As lecture instruments they may be used either to demonstrate some principle, or to enable a large number of persons to observe conditions and take readings simultaneously. Many tests that are run in laboratories, especially for research work, require instruments that are not standard or that have never been used before. These instruments and much other auxiliary testing equipment are often made up to meet the special requirements of the test. In this manner hundreds of instruments have been made, many of which were special forms of standard instruments designed for very unusual ranges or extreme sensitivity, etc

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Megger" testing sets for testing insulation resistance, etc. (see Megohmmeters); "Frahm" vibrating-reed frequency meters, portable and switchboard type (see Frequency meters); "Jagabi" sliding contact tube rheostats for rapid regulation of electrical circuits (see Rheostats, special and miscel.); "Frahm" vibrating-reed tachometers; "Jagabi" Type C hand tachometers operating on the centrifugal principle. For last two instruments see Tachometers, indicating.—Adv.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md. (Bacteriological).
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

INSTRUMENTS, ELECTRICAL MEASURING.—Electrical measuring instruments may be divided into several classes, depending upon the basis of classification. If the distinguishing characteristic is the units in which the results are expressed measuring instruments may be classed as absolute or secondary. Again, the discriminating characteristic may be the delicacy of the instrument and its accuracy and precision of measurment; this basis gives two classes, known as laboratory and commercial. Subdivision of each of these four general classes may be made on the principle of operation; according to this basis we have electromagnetic, electrodynamic, electrostatic and thermal instruments. Finally, the discriminating characteristic may be the quantity measured; such a basis gives ammeters, voltmeters, wattmeters, magnetometers, ohmmeters permeameters, etc.

Absolute Instruments are those which are so designed and constructed that the results are expressed in absolute units. This means that the physical dimensions upon which the quantities measured depend must be known accurately so that the factor which connects the effect of the quantity measured with its numerical value can be calculated. The tangent galvanometer is an example. Absolute instruments are not adapted for general use.

Secondary Instruments are those whose scales have been determined or divided experimentally. Such instruments are calibrated in terms of the units of the quantity measured. The ordinary electrical instruments are examples.

Electromagnetic Instruments are those actuated or operated by the interaction between the magnetic field surrounding a current-carrying wire and the magnetic field due to an iron core, either permanent or temporary. Such instruments are of three classes: (1) movable-core type; (2) movable-coil permanent-magnet type (3) induction type.

Movable-Core Type Instruments are electromagnetic instruments whose deflection is produced by the action of magnetic forces on a pivoted iron core. The actuating force of such instruments is roughly proportional to the square of the numerical value of the quantity measured, although they are usually calibrated in terms of the first power of the quantity.

Movable-Coil Permanent-Magnet Type Instruments are constructed with a pivoted coil to which a pointer is attached and which is actuated by the magnetic force due to a current in the coil and a permanent magnet. Nearly all types of d-c. ammeters and voltmeters are excellent examples. The actuating force of such instruments is proportional to the first power of the quantity measured.

Induction Type Instruments are those whose actuating force is due to a revolving or shifting magnetic field. The magnetic field is produced by either single-phase or polyphase alternating currents in stationary coils and the reaction of this field with the field due to the induced currents causes a deflection or rotation of the movable element. They are used exclusively in the measurement of alternating electrical quantities.

Electrodynamic Instruments are those whose actuating force is due to the interaction of currents in coils without iron cores.

Electrostatic Instruments are those whose actuating force is due to the attraction or repulsion of static charges. Their action is independent of magnetic forces.

Thermal Instruments are of two types, one type employing the physical expansion of metals with increase in temperature, and the other the e. m. f. developed when the junction of dissimilar metals is heated. The former are known as hot-wire instruments, the latter as thermocouples, which see.

Hot-Wire Instruments. The rise of temperature in a current-carrying wire is a function of the resistance of the wire and square of the current strength. The rise in temperature is usually accompanied by a change in the resistance of the wire and a change in length. Either one of these effects of the current may be utilized to measure the current or e. m. f. to which the current is due. The common hot-wire instruments utilize the expansion of the current-carrying wire for actuating the pointer. This wire is kept at a fixed tension by a spring. As the wire elongates, the deflection of the spring rotates the staff to which the pointer is attached. As the heat developed is proportional to the square of the current, the deflection is proportional to the square of the current, and hence such instruments indicate effective values of current or voltage.

For a-c. measurements the hot-wire instruments possess certain theoretical advantages, namely, they are not influenced by variations in frequency, magnetic fields, and wave form. There are certain inherent practical difficulties, however, such as the uncertainty of the zero, large consumption of energy, errors due to changes in surrounding temperature, and to heating when left in the circuit, which limits their use on switchboards. Their particular field of usefulness is in high-frequency measurements and as "cross over" or transfer instruments between direct and alternating currents when calibrating a-c. meters. Such ammeters are seldom made of greater current capacity than 25 amperes.

Deflection or Indicating Instruments are those that indicate instantaneous values by means of a pointer moving over a scale.

Integrating Instruments are those that sum up the instantaneous values over an interval of time. Examples are ampere-hour meters and watt-hour meters.

Recording or Graphic Instruments are indicating instruments to the pointer of which is attached some device for recording the fluctuations of the instantaneous values on a chart that moves at uniform speed either longitudinally or circularly.

Instrument Control Systems. Most electrical and magnetic quantities are measured or compared by their electrostatic or magnetic forces. A force cannot be exerted unless there is an opposing force of like intensity, hence all indicating and recording instruments that are actuated by forces proportional to the quantities measured must be provided with some counter force whose intensity will vary with the actuating force. The controlling forces employed in electrical measuring instruments are:

(1) Resisting force of a spring; (2) the torsion of some filament; (3) the force of gravity; (4) the mechanical friction of a rotating fan; (5) eddy currents induced in a moving vane or disk.

The first three are commonly employed on deflection and graphic instruments, and the last two on instruments of the integrating type, such as watt-hour and ampere-hour meters.

Damping. By damping is meant the retardation of the motion of the movable element of an instrument so that it will come to rest quickly and indicate correctly. Moving-coil instruments are usually damped by the eddy currents induced in the frame of the movable coil. Electrostatic and several other types of instruments are damped by the friction of air in dashpots or against movable vanes.

Critical Damping. A deflection instrument is said to be critically damped when after deflection it returns to zero but does not pass it.

Dead-Beat is a term that characterizes a deflection instrument which deflects

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promptly to the proper value of the quantity being measured, but does not overshoot the mark.

INSTRUMENTS, ELECTRICAL, MISCELLANEOUS.— Electrical instruments are made to measure a number of quantities. Many of the standard instruments are described elsewhere. There are, however, many other miscellaneous instruments for making measurements of quantities that are usually ignored in practical work and for many special laboratory measurements. A few of these are given here. One is a bolometer, which is used to measure extremely small temperature changes. See Bolometer. Another instrument known as a barreter is used to measure small currents of high frequency. This is obtained by a bridge arrangement which utilizes the change in resistance in a high-temperature-coefficient wire. There are also special forms of galvanometers, such as thermogalvanometers for measuring small high-frequency currents. These utilize a thermocouple which has one end connected in the high-frequency circuit and the opposite end connected in a galvanometer circuit.

For measuring inductances, both large and small, there are a number of instruments. One type of these is known as oscillators, which include a bridge consisting of standard and variable inductances and resistances that are balanced. Some form of energy must be supplied and often the oscillator itself gives a very pure sine wave of high frequency. There are also a number of other instruments used for testing purposes. One form of these is the instruments for measuring the slip of induction motors, either giving a direct reading or indications from which it may be calculated. There are also many other special testing instruments made for research or other special laboratory work.

For the more common electrical instruments see Ammeters, Ampere-hour meters, Bridges, Compasses, Electrodynamometers, Electrometers, Electroscopes, Faradmeters, Foot-candle meters, Frequency meters, Galvanometers, Gas meters, electrically operated, Meters, watt-hour, Ohmmeters, Oscillographs, Photometers, Power-factor meters, Pyrometers, Voltammeters, Voltmeters, Wattmeters.

Manufacturers:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Mylef Sts., Hamilton, Ont., Can. "Westinghouse."
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
General Radio Co., 11 Windsor St., Cambridge, Mass. (Audibility Meter.)
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSTRUMENTS, PRECISION, OR LABORATORY STANDARD, MISCELLANEOUS.—The principal types of precision instruments used as laboratory standards are described elsewhere under ammeters, voltmeters and wattmeters. Other laboratory tests and measurements are required to be very exact and special instruments for other purposes are kept for this purpose and for use as comparative standards. For measurements of very small amounts of current or power, refined electrodynamometers are often used. These are generally of the reflecting type, the deflections being measured by means of a mirror with a lamp and scale. Also see Electrodynamometers. There are also special forms of potentiometers of the deflection type. In these instruments the greater part of the e.m.f. is measured by balancing against the potentiometer current, and the remainder is obtained by means of the average indication of a fluctuating galvanometer. Other measurements, such as inductance, capacitance, speed, heating effect, etc., are also made by using special precision instruments.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Green, Henry J., 1191 Bedford Ave., Brooklyn, N. Y.
Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."
Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. The L. & N. Portable Standardizing Set for direct-current calibrations and measurements comprises in a single unit all the measuring apparatus necessary for checking voltmeters, ammeters and millivoltmeters. It measures directly by the potentiometer method electromotive forces up to 150 millivolts, with .05 millivolt accuracy. Its range for voltage is 0 to 750 volts, and for current from 0 to 150 amps. With suitable volt boxes and shunts the range can be extended indefinitely. The set is immune from errors due to stray fields, contact resistances, lead resist-



Portable Standardizing Set

ances and temperature changes. It constitutes a primary standardizing outfit, since all measurements are referred directly to the e.m.f. of a standard cell. A novel feature of the instrument is its source of available low current which can be used for checking millivoltmeters or for scale checking large high range ammeters independently of their shunts.—Adv.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display advertisement on page 1286.)
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

INSTRUMENTS, RADIO. — Instruments used to measure the high-frequency currents and other desirable quantities encountered in radio telegraphy and radio telephony are generally different from ordinary measuring instruments. In measuring radio currents or voltages ordinary ammeters and voltmeters do not give accurate or satisfactory results because of the high frequency used. A special type of hot-wire ammeter has been developed for this purpose and in some cases will measure currents up to 300 amperes. It is essential that the value of current in the sending antenna be known. Voltage measurements are made by means of electrostatic voltmeters or by means of a spark-gap voltmeter. (See Voltmeters.)

Wavemeters are also important instruments used for this service. They are used to determine the wave length of the high-frequency circuits. They consist essentially of a circuit containing known inductance and capacitance, one or both of which can be varied until its circuit is in resonance with the one being measured. Other instruments known as decremeters are used to give the values of the decrement. This instrument is valuable, inasmuch as sharp tuning is impracticable when the incoming wave trains contain less than 13 complete oscillations before the amplitude has decreased to one-tenth.

Unfortunately, many of the pieces of apparatus used in radio work are referred to as instruments, although they do not indicate or measure any electrical quantities as do other electrical instruments, and many manufacturers of radio equipment which is commonly designated as instruments of various sorts do not make measuring instruments.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Chelsea Radio Co., 15 5th St., Chelsea, Mass.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."

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Parkin Mfg. Co., San Rafael, Cal.
Rádio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass. "Sorala."
Western Radio Electric Co., 550 S. Flower St., Los Angeles, Cal. "Wesrad."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.

INSTRUMENTS, TELEGRAPH. — The successful operation of telegraph lines which are working duplex or quadruplex requires careful balancing and testing. This requires the use of special instruments, often standard types, to measure the currents flowing to compare the artificial line with the working line, etc. This involves the use of galvanometers usually, or a center-reading ammeter. Ohmmeters or other resistance-measuring devices are also used. Special forms of bridges adapted particularly for use on telegraph and telephone lines, are made so that Murray and Varley loop tests may be easily made. Values of inductance, capacitance and leakance of the lines are generally determined, this being done by the ordinary instruments for that purpose by comparison methods.

In wire telegraphy, as in radio telegraphy, many parts of the equipment commonly referred to as instruments are in no sense electrical measuring instruments. These are described completely under Telegraph sets, which see.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
St. John, Thomas M., East Windham, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.

INSULA WELDA.—Trade name for industrial goggles manufactured by Strauss & Buegeleisen, 16 Hanover Pl., Brooklyn, N. Y.

INSULAC.—Trade name for insulating varnish manufactured by the Robertson Chemical Co., Cleveland, Ohio.

INSULADUCT.—Trade name for flexible fabric tubing manufactured by the L. & N. Co., Ltd., St. Johns, Que., Can.

INSULATE.—Trade name for molded insulation manufactured by the General Insulate Co., Brooklyn, N. Y.

INSULATED BOLTS, COUPLINGS (SHAFT), FORKS, HANDLES, NAILS, NUTS, RACKS, SCREW DRIVERS, SHOES (LINEMEN'S), STAPLES, TACKS, TURNBUCKLES.—See these specific headings.

INSULATING BUSHINGS, COMPOUNDS, FABRICS, (OILED), JOINTS (FIXTURE), LININGS (PULL CHAIN), LUMBER, MATTING, PAINTS, VARNISH.—See these specific headings. Also see cleats, felt, mica, oil, paper, supports, tape and tubes.

INSULATING MATERIALS CO.—5133 Wesson Ave., Detroit, Mich. Manufacturer of insulating compounds, paints, varnishes, etc. Business established 1910. President, J. G. Splane; vice-president, James Inglis; secretary, treasurer and general manager, W. S. Gates; sales manager, C. F. King.

INSULATING MATERIALS.—Insulating materials are classed as nonconductors of electricity and are those materials which are commonly used in making insulators or for various other insulating purposes. They are also commonly referred to as dielectrics, which see. They may be classed in several ways, one of which is according to their physical properties. This gives four general classes, solids, plastics, liquids and gases. Many of the materials in these classes are described and their insulating properties are given elsewhere in this book under the particular name of the material.

In the class of solids they are further divided into two groups, natural and fabricated. In the first group are some of the most important insulating materials, such as asbestos, soapstone, slate, marble, mica, lava, wood, gums and resins. The fabricated materials are also of extreme importance. They include glass, porcelain, molded compositions, synthetic resins, hard rubber, paper, fabrics, yarns, vitrified materials, etc. The molded composition is one class of insulating material that has developed very rapidly within the last few years. It makes possible insulators and other insulating articles in shapes and forms that were formerly impossible and it also gives important properties of heat resistance, strength and ruggedness that are unknown to many other insulating materials.

Plastics are of importance from an electrical standpoint, but not as much so as the solids. Such articles are included in this class as caoutchouc, asphalt, gutta percha, pitch, waxes, and other compounds. They are used considerably for impregnating other insulating materials.

Liquids are largely used as such and are also used where they solidify upon application. The most important liquid insulating materials are oils. There are three kinds used, mineral, animal and vegetable. Those that solidify on application are used in enamels, paint, japan, varnish and shellac.

Gases are not as important in the ordinary sense, aside from their use in condensers, etc. The more prominent insulating gases are atmospheric air, hydrogen, nitrogen and carbon dioxide.

INSULATING MATERIALS AND COMPOSITIONS, MISCELLANEOUS. — There are many native materials and artificial compositions other than those listed which are occasionally used for insulating purposes. Among the simpler materials that are used without chemical alteration in their preparation for use are quartz, magnesia, kieselguhr, talc or soapstone, special woods, fibers, etc. Aside from these there are numerous compounded preparations made in many cases to meet special requirements as to plasticity, temperature, dielectric strength, tensile and compressive strength, resistance to moisture, acids, etc. A great variety of ingredients are used in the preparation of such compounds, most of which are patented or trade secrets. These miscellaneous compounds are exclusive of the widely used molded insulations, impregnating and sealing compounds, shellacs, varnishes and paints, etc.

Manufacturers:

American Lava Corp., 1429 William St., Chattanooga, Tenn.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Benolite Co., Inc., 331 4th Ave., Pittsburgh, Pa.
Best Electric Corp., 476 Broadway, New York, N. Y.
Calman & Co., Emil, 100 William St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. See display advertisement on page 1320.)
Clay Electric Co., 3303 N. 12th St., Philadelphia, Pa.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Dielectric Mfg. Co., St. Louis, Mo. "Dielac."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
FORMICA INSULATION CO., THE, 4614 Spring Grove Ave., Cincinnati, Ohio. "Formica."
GARFIELD MFG. CO., Garfield, N. J.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. Materials developed from careful research and made primarily to meet the requirements of G-E products. These fabrics and compounds are offered to others for general electrical repair work. The compounds include varnishes, japans, oils, sealing compounds and paints. (Bulletin 48704). The fabrics include fibers and papers treated with varnishes, oils and japans, and asbestos tape and treated cloths. (Bulletin 48715). See adv. pages 1203-1223.—Adv.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hope Webbing Co., Providence, R. I. "Hope."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
Insulation Products Co., Richland St. & Annon Way, Pittsburgh, Pa.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display advertisement on page 1320.)
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. See "Varnish, Insulating"; also see display adv. page 1319 for all Irvington electrical products.—Adv.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y. "Niagrite," "Vulcabeston," "Electrobestos."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Mica Insulator Co., 68 Church St., New York, N. Y. "Micanite."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Res-Pro Insulating Co., Inc., Boston, Mass.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Ruberoid Co., 95 Madison Ave., New York, N. Y. P" & B."
Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. 'Sarco."
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
STORRS MICA CO., P. O. Box N, Owego, (Tioga Co.), N. Y. Block mica—Indian. Argentine, Brazilian, African.—Adv.
Tar Heel Mica Co., The, Plumtree, N. C.
Toch Bros., 320 5th Ave., New York, N. Y.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display advertisement on page 1305.)
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilmington Fibre Specialty Co., Wilmington, Del. "Fyberoid."

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INSULATION, EFFECT OF HEAT ON.—Insulating material used in electrical machinery becomes permanently damaged by excessive temperature, the damage increasing with the length of time that the excessive temperature is maintained and with the degree of excess temperature. After repeated operating at abnormally high temperatures the insulation finally breaks down. The shortening of life by operating at high temperatures is warranted in only a few special cases, as when it is desired to secure some particular result such as obtaining the greatest power within a limited space, as in motors for electrically operated torpedoes. To permit increasing the load on a machine without exceeding the safe temperature of the insulation, recourse is made to special or forced ventilation of the windings. This is quite commonly done in turbogenerators, large railway motors, rolling-mill motors, etc.

INSULATION, MOLDED, MISCELLANEOUS.—Molded insulating compounds are used very widely and for a variety of purposes. The ease with which they may be molded and the possibility of having metal inserts molded into them permits their use for a great many purposes, and the wide variety of uses also calls for a number of compounds. Bakelite and Condensite are perhaps the best known and most widely used; they are listed separately. There are a number of others, sold under various trade names, which are used for miscellaneous purposes. Among these are Aetna, Aico, Ambroin, Dielectrite, Electrose, Gohmak, Gummon, Hemit, Insulate, Kerite, Lavite, Rolite, Sternoid, Tegit, Vulcabeston and Vulcalose.

Manufacturers:

Alden-Napier Co., 54 Willow St., Springfield, Mass. "Na-ald."

AMERICAN INSULATOR CORP., New Freedom, Pa. The "Aico" cold-molding method of producing electrical and automotive insulated parts, while comparatively new, has been placed upon an efficient quantity-production basis and it may be used wherever a highly insulative or heat-resisting molded part is required. Parts with inserts, threads or knurled work are readily produced by the "Aico" cold-molding process. An engineering department is operated for the use of all consumers of molded insulation and an opportunity will be welcomed of discussing your molding problems and offering possible suggestions for more practical production designs with resultant reduction in molding cost.—Adv.

American Lava Corp., 1429 William St., Chattanooga, Tenn. (Lava.)

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."

Auburn Button Works, Inc., 40-46 Washington St., Auburn, N. Y.

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenmold."

Boonton Rubber Mfg. Co., Boonton, N. J. "Hi-Tensit."

Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.

CHICAGO MICA CO., Valparaiso, Ind. Electric motor insulation in all forms, commutator insulation, including molded rings, sleeves, bushings and segments, or furnished in plate form, sets especially designed for General Electric, Christensen and Westinghouse types of motors. For other Chicago Mica Co. products see display advertisement on page 1320.—Adv.

Compo-Site, Inc., 207-215 Astor St., Newark, N. J. "Compo-Site."

Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.

CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis. C-H Thermoplax and Pyroplax are used in the making of connector plugs, wiring devices, push buttons, arc shields, switch bases. The first is heat-resisting and the other fire-resisting. Inserts, trade marks, ratings may be formed into this material during moulding.—Adv.

Diamond Rubber Co., The, Akron, Ohio.

Diamond State Fibre Co., Bridgeport, Pa. "Condensite Celoron," "Disfico."

Dielectric Mfg. Co., St. Louis, Mo. "Petrite."

Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Duranoid Mfg. Co., The, 213-221 Chestnut St., Newark, N. J. "Duranoid-Condensite."

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. (See display adv. page 1289.)

Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."

GARFIELD MFG. CO., Garfield, N. J. "Gummon," "Tegit," "Hemit."

General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y. "Hi-Heet."

Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

Hygrade Lamp Co., 60 Boston St., Salem, Mass. "Hygrade."

Insulation Products Co., Richland St. & Annon Way, Pittsburgh, Pa.

INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "J-P Bakelite," "J-P Condensite," "Johns-Pratt," "Moulded Mica."

Mack Molding Co., Little Falls, N. J.

Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

Niagara Insul-Bake Specialty Co., Inc., 483 Delaware Ave., Albany, N. Y.

NORTHERN INDUSTRIAL CHEMICAL CO., 11 Elkin St., Boston, Mass. Manufacturers of moulded insulation for electrical specialties, automobile ignition, instruments, etc. Bakelite and Condensite moulded parts are strong and impervious and may be immersed in water, or subjected to atmospheric conditions for indefinite periods without materially changing in structure, finish, strength or form. The most intricate shapes may be moulded and metallic connections accurately moulded in place. High heat does not soften or warp this material.—Adv.

Parkin Mfg. Co., San Rafael, Cal.

Phonograph Appliance Co., 174 Wooster St., New York, N. Y.

Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."

Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."

Shaw Insulator Co., 5-7 Kirk Pl., Newark, N. J. "Shawlac."

Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.

WATERBURY BUTTON CO., THE, 935 So. Main St., Waterbury, Conn. Established 1812. Under the trade name "Kay Komp," this company is marketing a new molded insulation intended for weatherproof sockets, bushings, knobs, handles, push buttons, etc. This material has exceptional strength, finish and dielectric strength, and at the same time is extremely economical in first cost. Parts are made by contract from sample or blueprint in any desired quantity. (See entry also under "Eyelets, for electrical use" and display adv. page 1328.)—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATION OF CABLES.—See Cables, lead-sheathed, power types.

INSULATION PRODUCTS CO.—Richland St. & Annon Way, Pittsburgh, Pa. Manufacturer of insulating materials. K. S. Stevenson, general manager.

INSULATION, RAIL JOINT AND TRACK.—Rail joint or track insulation is provided at the junction or joint of two rails where it is necessary to sectionalize the rails for signaling purposes, etc. Fiber is generally used for this purpose. There are three places at a rail joint where this insulation is required. Where the two rails come together a gap is ordinarily left to permit expansion, but in an insulated joint this is filled by a heavy sheet of fiber cut to the approximate section of the rail. The fish plates which go on the sides of the rails to hold them in line are insulated from the rail by another sheet of insulation placed between them. Sometimes the rails are mounted on a steel tie plate instead of being spiked directly to the ties. In such cases the joint must be protected by another insulating sheet placed between the plate and the rail.

Manufacturers:

Campbell Fibre Co., Stanton, Del.

Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

Standard Fibre Co., 11 Miller St., Somerville, Mass.

WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

INSULATION RESISTANCE.—The insulation resistance of an insulated conductor is the electrical resistance offered by the insulating covering to an impressed voltage tending to produce a leakage of current through the insulation. It is usually expressed in megohms for a specified unit length of the insulation. In the case of wire or cables it is expressed in megohms per thousand feet, mile or kilometer, usually corrected to a temperature of 15.5° C. Insulation resistance is frequently measured by a megohmmeter, which see.

INSULATOR.—An insulator is a material used in electrical engineering which does not allow a continuous current to pass through it under the action of a continuous e.m.f. but allows only a brief transient current which charges it electrostatically. This charge or displacement of electricity produces a counter e.m.f. equal and opposite to the applied e.m.f. and the flow of current ceases. Insulators are commonly referred to as nonconductors and also dielectrics. See Dielectric.

While any material having these properties may be looked on as an insulator, the tendency has been for the term insulator to be restricted to a compact unit form of insulating material that in itself forms a definite part of a machine or electrical apparatus and in most cases is used to support and insulate a conducting member or wire from the framework on which the insulator is mounted. This gives rise to a number of separate and distinct articles for various conditions to be met, which are commonly known as insulators and are described under several subclassifications below.

INSULATOR BRACKETS, CLAMPS, PINS.—See Brackets, insulator; Clamps, insulator; Pins, insulator (six types).

INSULATORS, ARC LAMP.—These are insulators designed to be used on high voltage arc circuits to support the arc lamp and insulate it from the support. They are sometimes provided with an eye at the upper end to secure to a cord or messenger cable, or this end may be flat to clamp onto a chain or other support. The lower part of the insulator nearly always terminates in an eye to which the arc lamp is secured. The insulating part consists of a double petticoat porcelain bell which forms a good watershed. A metal cap to which the upper eye or clamp is fastened, fits over the porcelain bell and is securely fastened to it. The lower eye is on a rod which passes through the center of the bell.

Manufacturers:

Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."

Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn, N. Y. "Crescent."

MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, BATTERY AND ELECTROLYTIC.—These insulators are used to support tanks and jars for storage batteries and electrolytic cells, to prevent grounding. They are usually porcelain insulators similar in construction to pin-type insulators and sometimes have two or three petticoats for high-voltage batteries. They are much larger in diameter as compared to their height than ordinary pin-type insulators, this feature providing larger bearing surface. Very often a wooden tray or supporting framework is built under the cell and this tray rests on the insulators. Where storage batteries are used to provide a stationary rather high-voltage source of energy, glass jars

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are often used to enclose the individual cells. With a considerable number of plates in the jar it is quite heavy and therefore a uniform bearing surface must be provided. The glass jar bottoms are frequently not exactly even, so that it is necessary to rest the jars in a shallow tray filled with fine sand. The sand also serves the purpose of catching any moisture and electrolyte that may have spilled out. The tray is supported on the insulators having one at each corner. For large tanks they are occasionally placed at equal intervals under the long sides instead of at corners only.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

INSULATORS, CANOPY.—Fiber rings or slit fiber blocks for insulating metal canopies from the ceiling or wall. The rings are secured to the edge of the canopy by brads, rivets or a special hand punch. The slit of the fiber block slips on the canopy edge. Canopy insulators are usually required when fixtures are mounted on metal ceilings or walls or when these are of plaster on metal lath, and also when outlet boxes are used.

Manufacturers:

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilmington Fibre Specialty Co., Wilmington, Del. "Knu."

INSULATORS, CLAMP.—Clamp insulators are used for clamping a feeder or other cable to a cable shelf or platform or to a wall or to clamp it to the ceiling or the underside of a shelf. They consist of a cast-iron seat, properly drilled so that it may be held to the wall or platform by bolts, also a steel strap which passes around the insulator and a split porcelain bushing which fits around the cable. The approaches to the bushing are well rounded.

Manufacturers:

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, FEEDER.—Insulators used for distribution feeders are sometimes called feeder insulators. They are principally of the porcelain pin type, which see.

INSULATORS, FIBER.—Fiber is very extensively used as an insulating material. The most common uses of separate pieces of fiber for insulating purposes are in the form of cleats, bushings, washers or tubes, which see. This classification is for other uses, where individual pieces or articles made of fiber are needed, such as small spools used to fasten twisted pair in place by driving a nail through the spool when the two conductors have been placed around the spool. Special sectionalizing track-joint insulators made from sheet fiber are widely used in connection with railroad block-signaling systems using the track as conductors. Fiber is also used in making knobs, gaskets, switchbars, etc.

Manufacturers:

American Vulcanizing Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
BRANDYWINE FIBRE PRODUCTS CO., P. O. Box 122, Wilmington, Del.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Delaware Hard Fibre Co., Wilmington, Del. "D. H. Egyptian."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Eureka Supply Co., Sewell, N. J.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Knu-Canopy."
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned."
Spaulding & Sons Co., Inc., J., 300 Wheeler St., Tonawanda, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Fibre Co., 11 Miller St., Somerville, Mass.
Wilmington Fibre Specialty Co., Wilmington, Del.

INSULATORS, FIXTURE.—Couplings of insulating material placed between an electric light fixture and the gas piping or metal work to which the fixture is attached. They are made of molded insulating material as a rule with metal inserts at both ends. Insulating joints are often referred to as fixture insulators also; for these see Joints, fixture insulating.

Manufacturers:

Best Electric Corp., 476 Broadway, New York, N. Y.
BRANDYWINE FIBRE PRODUCTS CO., P. O. Box 122, Wilmington, Del.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

INSULATORS, GLASS.—Glass was the first material used for insulators and it is still found very satisfactory for the lower voltages. Above 6600 volts the size of the insulator is such that it tends to cause breakage with changes of temperature. The deep-groove double-petticoat insulator of the pin type is much used for distribution lines at voltages below 6600. It is rugged and reliable. Glass insulators are made in a large number of forms and are used very extensively for telephone and telegraph work, as well as for power distribution and transmission lines. For general insulating properties of this material see Glass.

Manufacturers:

Hemingray Glass Co., Muncie, Ind. "Hemingray."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Locke, Fred M., Victor, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, LAVA.—Lava insulators may be made in any of several forms. Bushings, tubes, washers, etc., are quite common forms, and they are also made as spools or bobbins for coils and resistance units. Another special form of insulator is a threaded tube used to wind resistance coils on, the threads retaining the wire in its proper place and permitting it to be wound close together, thus giving a compact coil. Lava insulators are used largely where it is necessary to employ a compact, strong insulator that can withstand considerable heating.

Manufacturers:

American Lava Corp., 1429 William St., Chattanooga, Tenn.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn, N. Y. "Lavarock."
Steward Mfg. Co., D. M., Chattanooga, Tenn. "Lavite."
Tennessee Burner Mfg. Co., Chattanooga, Tenn. "XL."

INSULATORS, MINE.—Mine insulators are generally made of either porcelain or glass. They are spool insulators made for mounting on malleable iron pins which are driven into the side walls. They are used for tying feeder cables and telephone and other signal circuits in place. Various sized grooves from ½ to 1 in. are made in the spools and they are from 2½ to 3½ ins. in diameter and 3 to 3½ ins. high.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
National Porcelain Co., Trenton, N. J.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B insulators, for transmission, distribution, feeder and trolley circuits.—Adv.
PARKER & SON, INC., J. H., Parkersburg, W. Va. Nos. 1 to 6 mine insulators are screw thread type, of various



Bemlow Mine Insulator

sizes. The Bemlow self-locking and self-draining type, for feeder wires in mines, is provided with a malleable iron pin and porcelain insulator.—Adv.
Pittsburg High Voltage Insulator Co., Derry, Pa. "Pittsburg."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, MISCELLANEOUS.—There are various special forms of insulators made that are not listed above or under Supports, busbar, etc. They are generally a special type or form of some other standard insulator. Strain insulators are one type that are very frequently modified in this manner to give some special feature. Often a manufacturer, especially of porcelain insulators, is called upon to furnish insulators for one of his customers and made to meet his individual requirements. This same type of insulator may exactly meet the requirements of some one else and thus the demand makes this type a stock pattern of that manufacturer. Many other types are also made up for special purposes, such as for going through a roof, for portable substations, etc.

Manufacturers:

AMERICAN INSULATOR CORP., New Freedom, Pa. "Aico."
Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display advertisement on page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."

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Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Findlay Electric Porcelain Co., The, Findlay, Ohio.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke, Fred M., Victor, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Ragotzky, C. A., 2252 N. 21st St., Philadelphia Pa. (Angle porcelain.)
Stupakoff Laboratories, The, 6617-6627 Hamilton Ave., Pittsburgh, Pa. (For high temperatures) "Usalite."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, MOLDED MICA.—Molded mica is very often used as an insulating material and is frequently made up as more or less standard articles that can be classed as insulators. These are used on heating appliances, sometimes on motors and generators, transformers, etc., or any place where the temperature is high and good insulating properties are required. The insulators are commonly flat blocks, cleats, tubes or bushings, etc., and there are also many other special shapes.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Micabond." (See display advertisement on page 1320.)
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
Meirowsky Bros., 11 McPherson Pl., Jersey City, N. J. "Royal."
Mica & Micanite Supplies Corp., 1465 Broadway, New York, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Munsell & Co., Eugene, 68 Church St., New York, N. Y. "Munsell's."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, OVERHEAD LINE, CLASSES OF.—Overhead lines are carried on insulators supported by pins, or on suspended strings of 4 to 10 units, known as suspension insulators. At dead ends and corners a strain insulator is used.

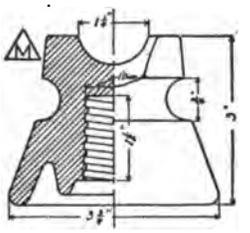
Pin type insulators are used at voltages below 50,000 and are usually made of porcelain except that glass is quite generally used for voltages below 6600. Suspension units are provided with galvanized steel terminals by which they are attached to the crossarm, to each other and to the line conductors; the terminals are cemented into the porcelain. Strain insulators are made in various forms, according to the voltage at which they are to be used.

Special types of insulators are made for secondary rack work, for house services, for lines through trees, for telephone and telegraph lines and for trolley lines. Insulators are rated according to dry and wet flashover test under specified conditions.

INSULATORS, PORCELAIN, PIN TYPE.—Porcelain insulators in the small sizes are made by both the wet and dry processes. They are used on low and medium-voltage lines, but are always used merely as a single or one-piece insulator. The high-tension type insulators are composed of two, three or four pieces cemented together; these are listed separately below. The smaller insulators are usually threaded on the inside to receive a one-inch pin. There are a number of forms made for different methods of tieing and for the various voltages and to give different arc-over voltages. The latter is accomplished by increasing the flare of the bell-shaped lower portion or "petticoat," or by having more than one concentric petticoat. These insulators are used somewhat for important telephone and telegraph line construction, but the largest use is for low-voltage power transmission and distribution lines. For properties of porcelain, see Porcelain.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. Pole line insulators for telephone and power line service up to



25,000 volts. We also manufacture a full line of standard porcelain products. Special designs made in accordance with specifications. For further information see page 1301.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke, Fred M., Victor, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
PARKER & SON, INC., J. H., Parkersburg, W. Va. Screw thread types of all sizes and shapes, for all service requirements.—Adv.
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Faradoid." (See display adv. pages 1395-1402.)

INSULATORS, PORCELAIN, PIN TYPE, HIGH-TENSION. — Porcelain insulators made by the wet process are found most reliable for voltages above 6600. They are made in two pieces generally for voltages up to about 20,000, and in three or four pieces for higher voltages up to about 70,000. The parts are burned separately and cemented together after being tested and inspected, thus insuring reliability and uniformity of product. Porcelain insulators are made in a number of sizes and shapes for the different voltages, ranging up to 18 ins. in diameter and about 14 ins. in height; two to four petticoats are provided to facilitate spilling of rain and to give a long dry arcover path. They are generally made to mount on a 1⅜ in. wooden pin. When arranged for mounting on steel pins a thimble threaded to fit the pin is cemented into the porcelain. Grooves are provided on top and side for the line wire and tie wire or clamp.

Manufacturers:

BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278).
Locke, Fred M., Victor, N. Y.
LOCKE INSULATOR CORP., Maryland Trust Bldg., Baltimore, Md. "Victor." Twenty six years' experience in the manufacture of wet process, high tension, electrical porcelain only and the result of actual operating conditions of the most important high-tension lines all over the world are incorporated in every one of our insulators.—Adv.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B modernized insulators have established an enviable record for reliability over a long period of years. Pin types are made from sizes for low voltage distribution up to insulators for operation at 88,000 volts.—Adv.
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburg."
Porcelain Insulator Corp., Lima, N. Y. "Pinco."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, PORCELAIN, SUSPENSION.—The suspension type insulator was developed when voltages were increased above 50,000, because of the excessive weight of pin type insulators for such voltages and the difficulty of securing proper mechanical strength in the pins. Its use makes possible wide clearances from the supporting structure and ample flashover values. Suspension insulators are made of porcelain by the wet process, and are made as separate disk units which are assembled in series strings, each unit having cemented into its top and bottom a galvanized steel connecting terminal. The top unit is suspended from the pole or tower crossarm and the conductor is secured to the bottom unit. The number of units used in a string for a given voltage is not standard, but depends on the climatic conditions and line construction, ranging up to nine or ten for 150,000 volts. The freedom of the string to swing under side strain necessitates proper allowance in the length of arms for such motion under wind pressure and at angles in the line. The diameter of the disk is from 6 to 10 ins. or more, according to the working voltage.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. An ideal insulator must be dielectrically and mechanically strong, impervious to moisture and at the same time inexpensive. It must not deteriorate under various climatic conditions but maintain its insulating properties while expansion and contraction of the various parts must take place without injury to the insulator as a whole. More than 10 years experience has demonstrated that the Hewlett Link Insulator meets these requirements. (Bulletin 49400). See adv. pages 1203-1223.—Adv.
Jeffery-Dewitt Insulator Co., 701 1st National Bank Bldg., Huntington, W. Va. "J-D."
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke, Fred M., Victor, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. O-B suspension insulators helped make modern high voltage transmission possible. In operation on practically all important systems, O-B insulators have a remarkable reputation.—Adv.

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Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburg."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, RACK.—Rack insulators are used to support and insulate cables and busbars in stations, subways, manholes, etc. There is usually a cast iron rack with some means of clamping split porcelain insulators which surround the cable or busbar. The clamping is accomplished in some cases by another casting which bolts to the original one. This type is generally used with round insulators. Another form has a series of wrought iron pins located in the base and the insulators are clamped between the pins by screwing on a nut at the top. This type may be built up in several tiers and each section may be removed or opened independently of the rest. There are a number of types of rack insulators, but they are nearly all modifications of these two principles. Another type called secondary racks are used where secondary mains are carried on vertical racks, in which case the insulator is made in the form of a spool, or other special shape. These insulators are provided by the manufacturer as a part of the rack or service bracket.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
Electrical Engineers Equipment Co., 35 S Desplaines St., Chicago, Ill. "Three E."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
PARKER & SON, INC., J. H., Parkersburg, W. Va. "Murdock."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, SECTIONALIZING.—A device used in trolley construction for insulating one section of the trolley wire from the adjacent section, so that one section may be "live" while the adjacent one is being worked upon, or to control feeder systems, etc. It is arranged so that the trolley wheel can pass from one section to another without interference. One form, particularly adapted to mine work, is provided with a movable metallic center controlled by a handle. When the center part is turned to the "open" position the two sections are insulated from each other, but when in the "closed" position the two sections are electrically connected and the metallic underrun permits the trolley wheel to pass without interruption to the flow of current, an important point where a mine locomotive is pulling a heavy load against a grade.

Manufacturers:

American Mine Door Co., The, Canton, Ohio. "Canton."
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B trolley section insulators, for railways and mines. Type M, for mines, is opened or closed without stopping. —Adv.
Pittsburg High Voltage Insulator Co., Derry, Pa. "Pittsburg."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

INSULATORS, SOCKET SHELL.—Linings of fiber or other insulating material placed between the outer shell of a socket and the interior current-carrying parts. These are more commonly called socket linings; see Linings, socket.

INSULATORS, SPAN WIRE.—Span wire insulators are used in overhead trolley construction for insulating the span wires. They are of the strain type so that they will stand the strain of the span wires without injury, and where uninsulated trolley hangers are used they may serve as the total insulation, although in the common construction where insulated trolley hangers are employed the span wire insulators serve as secondary insulation. For manufacturers see Insulators, strain, trolley.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A. St., Boston, Mass. "Aetna."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. O-B Dirigo composition, wood and porcelain span wire insulators.—Adv.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WHITE ELECTRICAL SUPPLY CO., T. C., 1122 Pine St., St. Louis, Mo.

INSULATORS, SPOOL TYPE.—Spool type insulators are generally made of porcelain, although glass is sometimes used. As their name implies, they are shaped like a spool, having a circular groove of about ½ to 1 in. in diameter or such size as to fit around a large wire or cable. They are used on tree insulators and swinging insulators to permit the cable or wire to slide or roll in the groove formed by placing two insulators close together. They are also used on insulated forks and some insulated turnbuckles. Some forms of mine insulators also use a form of spool insulator on a steel pin.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

INSULATORS, STRAIN, HIGH-TENSION.—Where insulation must be provided on a high-tension conductor that is under line tension, strain insulators are employed. They are also used in guy cables where it is desired to isolate them from ground potential. In guy cables and at voltages below 10,000 they usually consist of a porcelain piece pierced with holes at right angles to each other through which the cable or wire is threaded, putting the porcelain under compression. Suitable barriers separate the grounded end from the live line.

At voltages above 13,200 it is not possible to secure adequate insulation by this type except by putting a number in series. The insulator is therefore made with transverse corrugations and the strain is communicated by steel terminals cemented into the porcelain. For the terminals of long spans involving stresses in excess of 5000 lbs., strain insulators must be specially designed for the particular conditions.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Jeffery-Dewitt Insulator Co., 701 1st National Bank Bldg., Huntington, W. Va. "J-D."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke, Fred M., Victor, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. O-B high tension strain insulators for guy wires, radio work, long river crossings, etc. What is considered the longest span in the world (5010 ft.) uses an O-B strain insulator, operating at 150 Kv.—Adv.
PARKER & SON, INC., J. H., Parkersburg, W. Va. Puncture proof and non-absorbent insulators, made of best, wet process, high tension porcelain, are designed to permit greater arcing distances. Three styles known as the "Doublex" type, the "Muller," and the "Improved Span." These insulators will withstand a greater strain than any cable which will pass through them.—Adv.
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

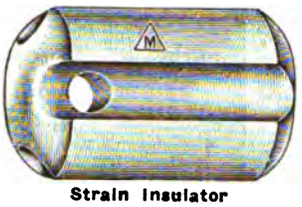
INSULATORS, STRAIN, MISCELLANEOUS.—Strain insulators are used to a large extent on many low and medium-voltage transmission and distribution systems and for communication circuits, such as telephone and telegraph lines. There are several forms of insulators used for the purpose of sustaining the strain of a long span or that occasioned at a corner or dead end. Where pin type porcelain insulators are used, a slightly special construction is used to give greater strength to the strain insulators. A popular form used in dead-ending feeders or cables, and for guy and messenger wires is made of porcelain by both the wet and dry methods. The insulators have two holes for the cable at right angles to each other and near opposite ends of the insulator. Grooves are provided in which the wires lie, and the body is designed to furnish a large creepage area. Larger strain insulators are also made in a number of forms. Wooden insulators, having a treated hickory rod accurately turned and with malleable iron caps swaged onto the ends, give very satisfactory results. The iron caps are made in the form of an eye, clevis, tapped hole, or adjustable clamp.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

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ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. We manufacture all of the regular types and sizes of strain



Strain Insulator

or span wire insulators. Also pole line insulators for telephone and power service. For further information, see page 1301.—Adv.

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

INSULATORS, STRAIN, TROLLEY.—Trolley strain insulators are used in overhead trolley construction for insulating span wires, guy wires, anchor wires, etc. They are made of composition, wood or porcelain, the porcelain being often favored because of its permanency but has the objection of liability to breakage

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. O-B Dirigo composition, porcelain and wood strain insulators.—Adv.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)
WHITE ELECTRICAL SUPPLY CO., T. C., 1122 Pine St., St. Louis, Mo.

INSULATORS, SWINGING.—Swinging insulators are hung from a loop and allowed to swing so as to adapt themselves to any strain. When this is possible the wire is not cramped. They are used in place of some forms of tree insulators, and permit the wire to slide in a groove formed by two porcelain spool insulators, which are held in place by a malleable iron yoke.

Manufacturers:

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

INSULATORS, SWITCHBOARD.—Switchboard insulators are arranged for mounting on the rear of switchboards by clamping or bolting to the framework, and serve the purpose of supporting, clamping and insulating large copper cables and busbars. The wide range of voltages for which they are used gives a variety of designs but they may be divided into two general classes, post type and cleat type. The former usually consists of a metallic base, with bolt holes or with a pipe clamp to fasten to the framework, a corrugated porcelain post (the length depending on the voltage) and a clamping device for holding the cable or one or more busbars. Where busbars are mounted remote from the board the insulators are called busbar supports; see Supports, busbar. The cleat type insulators are not used for voltages much over 10,000. They are also arranged for bolting to the framework. The base portion of the cleat is much higher than the top or clamping part and is rectangular in shape. When the two members are in position a circular tubelike surface, which is longer than the width of the insulator, usually surrounds the cable. Well rounded approaches are provided so that the insulator may be used without damaging an insulated cable.

Manufacturers:

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display advertisement on page 1260.)
GARFIELD MFG. CO., Garfield, N. J. "Hemit."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

INSULATORS, TELEPHONE AND TELEGRAPH.—Insulators used in telephone and telegraph line construction are usually petticoat insulators, cup-shaped, on which bare open wires are often carried. Usually they are made of glass, but sometimes porcelain insulators are used. The insulator screws onto a wooden or metal pin in a crossarm, or onto a wooden bracket. The petticoat is smaller and has less flare than on power insulators, as the voltage is low. It was formerly the practice in telephone line construction to use transposition insulators where the lines were transposed. These insulators differed in that they had two petticoats and two grooves for tying. They were used for dead-ending wires in a transposition, but are not used much now because better insulation is had by using ordinary insulators on a transposition bracket.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
Locke, Fred M., Victor, N. Y.
National Porcelain Co., Trenton, N. J.
PARAGON ELECTRIC CO., Old Colony Bldg., Chicago, Ill. "Paragon."
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.

INSULATORS, THIRD RAIL.—Third rail insulators are used to insulate and support the third or conductor rail in third-rail construction. The earlier forms consisted of wooden blocks, often treated with an insulated impregnating compound. These were superseded by designs using molded composition insulation, because of the splitting, rotting and rapid deterioration of the wood. Composition in turn has been almost entirely superseded by porcelain. In the porcelain insulators the body of the porcelain has been specially developed to give high mechanical strength to take care of the vibration, pounding and other mechanical stresses to which these insulators are often subjected in service.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Aetna."
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Electrose."
GARFIELD MFG. CO., Garfield, N. J.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Locke, Fred M., Victor, N. Y.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md. "Victor."
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. A complete line of porcelain and wood, third rail insulators regularly manufactured.—Adv.
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."
Standard Fibre Co., 11 Miller St., Somerville, Mass.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

INSULATORS, TREE.—In shaded streets it is not always possible to keep telephone and distribution wires clear of trees by trimming. Where the wires run near large limbs they cannot be attached without danger of breakage, unless the connection permits the limbs to sway. This may be done by the use of a tree insulator so designed as to separate the wire from the limb, but not to prevent longitudinal motion of the insulator. There are several forms of insulators which give this result. Some have two porcelain rollers, mounted on iron pins, through which the wire is allowed to slide. Another type merely has a hole with well rounded approaches, in which the wire is placed. Three insulators may be screwed to the tree, tied with a wire, or supported by a wire loop. When their use is not practical, a special steel-taped tree wire is found useful, the rubber insulation being protected from abrasion by the armor.

Manufacturers:

Cutter, Scott C., Oswego, Ill.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
High Tension Electrical Specialty Co., Newton, Mass. "Holmes."
Hopewell Insulation & Mfg. Co., Hopewell, Va.
HUSBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)
Locke, Fred M., Victor, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

INSULATORS, WALL.—These are usually high-tension insulators used to insulate a line conductor where it passes through a wall, as in a generating station or substation. As they are essentially a type of bushing, they are generally called high-tension entrance bushings. For manufacturers see Bushings, high-tension entrance.

INSULATORS, WIRE-SPLICE.—Wire-splice insulators are made of rubber and are used to insulate a fixture splice where there is not sufficient room to tape the joint readily or where it is desired to save time. They are merely a soft rubber tube with a shoulder at one end and closed at the other end. After the splice is soldered the insulator may be slipped right up over it, thus relieving the workman of the necessity of handling rubber tape. It also gives a very uniform covering over the splice.

Manufacturers:

Elasticap Co., The, 739 Garden St., Hoboken, N. J. "Elasticap."
Pittsburgh High Voltage Insulator Co., Derry, Pa. "Pittsburgh."

INSULBRIX.—Trade name for insulating brick manufactured by the Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y.

INSULECTRIC.—Trade name for insulated screw drivers manufactured by the M-B Tool Co., Danielson, Conn.

INSULITE.—Trade name for fish paper manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

INSURANCE SAFETY STANDARDS.—A sheet of electrical safety standards has been issued by the Safety Department of the Integrity Mutual Casualty Co., Chicago, Ill. These requirements are taken from the Industrial Compensation Rating

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Schedule adopted by the National Reference Committee on Schedule Rating. They are brief and cover, for equipment of more than 275 volts, such points as guarding, and use of rubber insulating mats. Above 750 volts, grounding of cases and frames is required.

INTEGRATING METERS.—See Meters, watt-hour (eight types.)

INTENSITY, LUMINOUS.—The luminous intensity of a point source of light is the solid angular density of the luminous flux emitted by the source in the direction considered, or it is the flux per unit solid angle from that source. The unit of luminous intensity is the standard candle.

INTENSITY OF MAGNETIZATION.—When a magnetic substance is introduced into a magnetic field, both the amount and distribution of the flux is changed. This change may be considered as due to a property of the magnetic substance by virtue of which it produces a magnetic field superposed upon the original field The intensity of magnetization may be considered the measure of the excess of the flux density produced by the magnetic substance measured in unit pole strength. It is usually expressed by the formula: $J=(B-H)/4\pi$. If m is the pole strength of the substance, the intensity of magnetization may also be defined as the pole strength per unit area, or $J=m/A$.

INTER-COMM-PHONE.—Trade name for intercommunicating telephones manufactured by the Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

INTERCOMMUNICATING SYSTEM, TELEPHONE.—This is a form of telephone exchange which has a cable running to each station. It contains a circuit for each telephone. Each station has a push button or key for every other station in the system, to connect with its line. A five-station system has at least five circuits in the cable and five push buttons at each station. It is useful for only very small exchanges, twelve lines or less, as in an apartment building or rather small factory. Its advantage lies in not requiring an operator.

INTERCOMMUNIPHONE.—Trade name for telephone selective calling systems manufactured by the S. H. Couch Co., Inc. Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

INTERFERENCE.—A disturbance of an electrical nature produced in a communication system by an extraneous source. Some of the causes are lightning, earth currents, power systems or transmission lines nearby, inductive interference or cross-talk from one adjacent telephone line on another, etc. Radio stations also cause interference with one another when transmitting signals of nearly the same wave length; they are also subject to atmospheric interference.

INTERIOR CONDUIT.—See Conduit, interior, rigid metallic; Conduit, interior, flexible steel; Tubing, flexible fabric or nonmetallic conduit.

INTERIOR LAMP & FIXTURE WORKS.—4888 N. Clark St., Chicago, Ill. Manufacturers of electric lamps, lighting fixtures and fixture parts. Business established 1920. Partnership of B. W. Tenney, J. W. Franke and W. B. Trabur.

INTERIOR TELEPHONES.—See Telephones, interior or intercommunicating.

INTERLOCKING RELAYS AND MAGNETS.—Interlocking relays and electromagnets are sometimes made with their armatures arranged so that when they operate a catch or lock will hold the armature in the closed position. A second electromagnet is generally used to release the lock. Some relays are self-locking in that a special holding coil wound on the core has its circuit completed and holds the armature after the operating coil has pulled it over to complete the contact.

INTERLOCKING SWITCH-TOWER SIGNALS.—See Signaling systems, railway block and interlocking.

INTERMEDIATE DISTRIBUTING FRAMES.—See Frames, distributing, telephone.

INTERNATIONAL.—Trade name for electric time recorders manufactured by the International Business Machines Co., Ltd., Royce St. & Campbell Ave., West, Toronto, Ont., Can.

INTERNATIONAL.—Trade name for electrical heating appliances manufactured by the International Electric Co., Indianapolis, Ind.

INTERNATIONAL.—Trade name for water softening and filtration apparatus manufactured by the International Filter Co., 1st National Bank Bldg., Chicago, Ill.

INTERNATIONAL.—Trade name for motor-driven floor scrubbing, surfacing and sanding machines manufactured by the International Floor Machine Co., 151 W. 36th St., New York, N. Y.

INTERNATIONAL.—Trade name for kerosene engines manufactured by the International Harvester Co., 606 S. Michigan Ave., Chicago, Ill.

INTERNATIONAL.—Trade name for coal scales manufactured by the International Scale Co., Canby Bldg., Dayton, Ohio.

INTERNATIONAL.—Trade name for electric clocks and time recording systems manufactured by the International Time Recording Co., 50 Broad St., New York, N. Y.

INTERNATIONAL BATTERY CO., INC.—453-455 Broome St., New York, N. Y. Manufacturer of medical and flashlight batteries and flashlight cases.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.—This Association was organized in 1895 and consists of municipal electricians, superintendents of city police and fire-alarm telegraph systems and electrical inspectors in municipal service. In the early days of the Association most attention was given to the discussion of fire-alarm and police signaling systems. Street lighting has been carefully considered and also municipal electrical inspection. The Association has a standardization committee which has compiled a number of standards in connection with electrical work of cities, especially fire and police-alarm systems.

The offiers of the Association are: President, R. C. Turner, Atlanta, Ga.; first vice-president, Dr. C. P. Steinmetz, Schenectady, N. Y.; second vice-president, William P. Briggs, New Bedford, Mass.; third vice-president, J. L. Caldwell, Colorado Springs, Colo.; fourth vice-president, D. R. Snider, Augusta, Ga.; secretary, Clarence R. George, Houston, Tex.; treasurer, William C. Crane, Erie, Pa. Executive committee, A. L. Duckett, Asheville, N. C., chairman; E. H. Benz, West New York, N. J.; G. P. Allen, Jacksonville, Fla.; William G. Dey, Louisville, Ky.; Claude Convers, San Antonio, Tex.; Chares K. Ahearn, Waterbury, Conn.; Walter Dilzell, New Orleans, La.; L. P. Sandiford, Savannah, Ga.; George L. Smith, Fort Wayne, Ind., and Frank K. Shinnen, Atlantic City, N. J.

The 1921 annual convention will be held at Colorado Springs, Colo., in the fall.

INTERNATIONAL AUTO-XRAY.—Trade name for physicians' and dentists' X-ray machines, manufactured by the International Devices Co., 326 Broadway, New York, N. Y.

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS.—An organization of electrical workers chartered by the American Federation of Labor in 1891. The title selected for the organization at that time was National Brotherhood of Electrical Workers, but this was changed to the present name when it was found that the organization had extended into Canada. The growth of the organization has been rapid and it has wielded an important influence in the electrical construction field.

While the organization is primarily a labor organization seeking to better working conditions and wages, it also offers advantages of trade education for its membership. Many of the local unions have established trade schools for apprentices whereby they may obtain a theoretical knowledge of their work as well as the practical. Many of the local unions also rotate or shift the apprentices from one employer to another so that they may obtain practical work of various kinds. The international officers of the Brotherhood are: President, James P. Noonan, Washington, D. C.; secretary, Charles P. Ford, Washington, D. C.

INTERNATIONAL BUSINESS MACHINES CO., LTD.—Royce St. & Campbell Ave., West Toronto, Ont., Can. Manufacturer of electric time recording systems and stamps, tabulating and sorting machines and computing scales. President, T. J. Watson; vice-president, J. E. Rogers; vice-president and general manager, Frank E. Mutton; secretary, J. S. Ogsbury; sales manager (Scale Division), George Bonnycastle; sales manager (Tabulating Division), L. E. Hubbard.

INTERNATIONAL CARBON PRODUCTS CO., INC.—320 W. 13th St., New York, N. Y. Manufacturer of graphite. Business established 1917. President, H. B. Johnson; secretary, Ralph Arnold; treasurer, Charles D. Burrage, Jr.; sales manager, J. F. Short.

INTERNATIONAL CLAY PRODUCTS CO.—31 Union Sq., New York, N. Y. Manufacturer of clay underground conduit. President, James H. Morris; vice-presidents, B. S. Barnard, John H. Fritzinger; secretary and treasurer, C. E. Rawlins.

INTERNATIONAL CREOSOTING & CONSTRUCTION CO.—Galveston, Tex. Manufacturer of ties, poles, crossarms and paving blocks. President, John Sealy; vice-president and general manager, R. J. Calder; secretary and treasurer, H. A. West; sales manager, E. E. Boehne. Main office, Galveston, Tex. Works, Beaumont, Texarkana, Galveston, Tex.

INTERNATIONAL DEVICES CO.—New York, N. Y. Manufacturer of motors, generators, radio and electrotherapeutic apparatus. Business established 1902. President, S. M. Kintner; secretary, J. B. Murphy; treasurer, H. S. Wilson; general manager, J. V. L. Hogan; sales manager, H. W. Dunk.

INTERNATIONAL ELECTRIC CO.—Indianapolis, Ind. Manufacturer of electrical heating appliances. President, C. W. Craig; vice-president and general manager, Young Moore; secretary and treasurer, Carl L. Rost.

INTERNATIONAL ELECTRIC CO., LTD.—97 Bleury St., Montreal, Que., Can. Manufacturer of motors. Business established 1904. President, P. De Serres; vice-president and general manager, J. A. Faguy; scretary and treasurer, S. Dudemaine; sales manager, A. Gagnier.

INTERNATIONAL ELECTRIC LAMP CO.—125-27 W. Lake St., Chicago, Ill. Manufacturer of incandescent lamps. President, D. J. Wagner; secretary, O. E. Fralick; treasurer, E. Arcola.

INTERNATIONAL ELECTRICAL UNITS.—Units adopted as legal units by the International Electrical Congress held in Chicago, Ill., in 1893. These standard units are the ampere, coulomb, farad, henry, joule, ohm, volt and watt. For a description of the units see these respective items. Also see Units, systems of.

INTERNATIONAL ENGINEERING WORKS, INC.—Waverly St., Framingham, Mass. Manufacturer of high pressure steam boilers. Business established 1867. President, J. J. Prindiville; vice-president, J. Philip Bird; treasurer and general manager, Fred W. Chipman. Sales representatives, W. B. Connor, Inc., 90 West St., New York, N. Y.; George H. Conner, 922-24 Sansom St., Philadelphia, Pa.; Isaac Hardeman, Charlotte, N. Car.

INTERNATIONAL EQUIPMENT CO.—352 Western Ave., Boston, Mass. Manufacturer of electric centrifuges, extractors and heavy-duty washing machines. President, A. Kendrick; treasurer, E. A. White; sales manager, R. W. Hoyt.

INTERNATIONAL FILTER CO.—1st National Bank Bldg., Chicago, Ill. Manufacturer of water purifying and filtration apparatus. President, treasurer and general manager, P. N. Engel; vice-president, Walter H. Green; secretary, M. B. Johnson; sales manager, O. A. De Celle. Branch office, Woolworth Bldg., New York, N. Y.

INTERNATIONAL FLOOR MACHINE CO.—151 W. 36th St., New York, N. Y. Manufacturer of motor-driven floor machines, rubbing machines and carpet washers. Business established 1911. Sales representatives, C. L. Allison Co., 1611 Sansom St., Philadelphia, Pa.; Frank B. Drew Co., 942 Phelan Bldg., San Francisco, Cal.

INTERNATIONAL HARVESTER CO.—606 S. Michigan Ave., Chicago, Ill. Manufacturer of agricultural machinery and internal combustion engines. President, Harold F. McCormick; vice-president, A. E. McKinstry; secretary and treasurer, George A. Ranney; general manager, Alex Legge; sales manager, J. F. Jones. Factories, Chicago and Milwaukee. Branch offices in 92 cities in U. S.

INTERNATIONAL INCANDESCENT LAMP WORKS, INC.—80-86 Bergenline Ave., Union Hill, N. J. Manufacturer of incandescent lamps. Business established 1916. President and general manager, Conrad Schickerling; secretary, A. W. Schaad; treasurer, F. J. Berenbroick; sales manager, Theodore M. Schroeder.

INTERNATIONAL INSULATING CORP.—25 W. 45th St., New York, N. Y. Manu-

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facturer of insulators and insulating materials. President, Otto Heineman; secretary, Jacob Schechter; treasurer and sales manager, Adolph Heineman; general manager, Mr. Griffin. Factory, Springfield, Mass.

INTERNATIONAL LAMP MFG. CO.—533 S. Wabash Ave., Chicago, Ill. Manufacturer of portable electric lamps. President, Charles Mitchell.

INTERNATIONAL MICA CO.—Philadelphia, Pa. Manufacturer of mica and mica products. President, L. H. Crabtree; vice-president, J. A. Crabtree; secretary, E. G. Kindig; treasurer, R. R. Roberts; general manager, E. G. Pancoast; sales manager, J. H. Greeley. Main office, 37th & Brandywine Sts., Philadelphia, Pa. Factories, West Philadelphia, Pa.; Tilton, N. H.; Ridgeway, Va.; Micaville, N. C. Branch offices, 106-110 W. Lake St., Chicago, Ill.; 523 Tribune Ave., Minneapolis, Minn.; 1623 E. 43rd St., Cleveland, Ohio. Sales representatives, Walter S. Gray, 942 Market St., San Francisco, Cal.; A. K. Kempton, Montreal, Que., Can.; Herman-Griffith, Sheldon Bldg., San Francisco, Cal.

INTERNATIONAL NICKEL CO.—43 Exchange Pl., New York, N. Y. Manufacturer of nickel and monel metal products. President, W. A. Bostwick; vice-president, R. C. Stanley; secretary and treasurer, J. L. Ashley; sales manager (Nickel), F. S. Jordan; sales manager (Monel Metal and Special Products), A. S. Creighton.

INTERNATIONAL ORA.—Trade name for vacuum type tungsten lamps manufactured by the International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J.

INTERNATIONAL OXYGEN CO.—Newark, N. J. Manufacturer of oxygen and hydrogen generators, brazing outfits, electrodes, etc. President, S. S. Heller; vice-president, Samuel Heller; secretary and general manager, L. W. Hench; treasurer, J. Heller. Main office, 796 Frelinghuysen, Newark, N. J. Factories, College Point, N. Y.; Verona, Pa.; Toledo, Ohio; Newark, N. J. Branch offices and warehouses, Verona, Pa.; Toledo, Ohio; College Point, N. Y. District offices, 30 N. La Salle St., Chicago, Ill.; 115 Broadway, New York, N. Y.

INTERNATIONAL PAINT CORP.—St. Louis, Mo. Manufacturer of insulating paints, varnishes, asphalt and other insulating materials. Business established 1909. President, Louis Nolte; vice-president, Edward H. Waddington; secretary, treasurer and general manager, Ell C. Bennett; sales manager, George B. Dunford. Main office, 915 Olive St., St. Louis, Mo. Factory, East St. Louis, Ill. Branch offices, Louisville, Ky., and Chicago, Ill.

INTERNATIONAL REGISTER CO., THE.—15 So. Throop St., Chicago, Ill. Manufacturer of railway fare registers and metal products. Business established (about) 1895. President and general manager, Arthur H. Woodward; vice-presidents, John Benham and Arthur H. Boettcher; secretary, L. Bagley Smith; treasurer, W. J. Volkins; sales manager, John Benham. Sales representatives, Charles N. Wood Co., Boston, Mass.; Union Electric Co., Pittsburgh, Pa.; Electric Service Supplies Co., Philadelphia, Pa.; 50 Church St., New York, N. Y.

INTERNATIONAL SCALE CO.—Canby Bldg., Dayton, Ohio. Manufacturer of coal scales. Subsidiary of Computing-Tabulating-Recording Co., 50 Broad St., New York, N. Y.

INTERNATIONAL STEEL TIE CO., THE.—16702 Waterloo Road, Cleveland, Ohio. Manufacturer of steel railway ties, track paving material and structural steel for transmission lines. Business established 1909. President and general manager W. P. Day; secretary, T. J. Clifford; treasurer, W. C. Mahon; sales manager, Fred H. Ogden.

INTERNATIONAL TAG CO.—Chicago, Ill. Manufacturer of shipping tags. President, A. L. Hamilton; vice-president, E. M. Kenning; secretary, E. L. Hamilton. Main office and factory, 319-329 N. Whipple St., Chicago, Ill. Branch offices, New York, N. Y.; Boston, Mass.; Philadelphia, Pa.; Cleveland, Ohio; Detroit, Mich.; St. Louis, Mo.; Los Angeles, Cal.

INTERNATIONAL TIME RECORDING CO.—50 Broad St., New York, N. Y. Manufacturer of electric clocks and time recording systems. Subsidiary of Computing-Tabulating-Recording Co., 50 Broad St., New York, N. Y. President and general manager, Thomas J. Watson; vice-president, George W. Fairchild; secretary and treasurer, James S. Ogsbury. Factories, Endicott, N. Y.; Toronto, Ont., Can.

INTERPOLE.—See Commutating pole.

INTERPOLE MOTORS.—See Motors, d-c., shunt and commutating pole.

INTERRUPTERS, INDUCTION COIL.—Interrupters for induction coils are divided into two distinct classes, mechanical and electrolytic. The simpler forms of mechanical interrupters are merely vibrating armatures carrying a contact point of platinum, tungsten, silver, etc., and making contact with a stationary contact point when the armature is not attracted. This type is largely used on small coils and medical batteries. There are also other forms of vibrating interrupters that permit considerable adjustment in frequency. These are used on spark coils and are described under Interrupters, spark coil, below. When the e. m. f. of the source exceeds about 20 to 30 volts, the contacts are usually arranged to be broken in oil or some other insulating liquid that will extinguish the arc.

For high-speed work mercury interrupters are used. These are generally motor-driven and can be adjusted to operate well on alternating current when driven by a synchronous motor. There are two types, one in which a reciprocating contact point is plunged into and withdrawn from a basin of mercury. The speed of this type is limited because the mercury tends to follow the contact when it leaves the surface. The other type is called a turbine type. In this a stream of mercury is made to play on a number of saw-like teeth, either by revolving the nozzle or the teeth. When the stream of mercury passes between the teeth the circuit is interrupted and when it strikes a tooth it is closed.

Electrolytic interrupters operate on an entirely different principle. They do not require condensers to eliminate the sparking at the contacts, as do the other types. They consist of a cathode, generally a lead plate, immersed in a dilute solution of sulphuric acid. The anode is a small platinum wire projecting into the electrolyte from a porcelain tube. The adjustment is obtained by moving the anode up and down to vary the amount of surface in action. When a certain current density at the anode has been reached, the gas released at this surface increases the resistance at that point to such an extent that the circuit is practically interrupted. As soon as the current density falls the resistance decreases and closes the circuit. These interrupters operate well in synchronism when connected in series or in parallel.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

INTERRUPTERS, SPARK-COIL.—Spark-coil interrupters are of the mechanical types referred to above under induction-coil interrupters. They are generally of substantial construction, with contact points that will interrupt the circuit many times without pitting or sticking. Condensers are nearly always bridged across the points to eliminate this possibility as far as possible and also to minimize the sparking at the interrupter. One of the most common types of interrupters for this service is a vibrating one that may be adjusted over quite a range of frequency. It has a vibrating hammer which has its tension regulated to the desired degree by a small coiled spring attached to a thumbscrew. When this hammer is attracted by the core of the coil, it moves over rapidly, against the tension of the spring, and in its travel it hits a small contact spring and opens the circuit and when it returns allows the spring to close again. This hammer action gives a very sudden interruption of the circuit. By varying the position of the contact screw, the back stop of the hammer and the spring tension almost any desired length of contact and number of interruptions may be obtained.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

INTERSTATE ELECTRIC CO.—356 Baronne St., New Orleans, La. Manufacturer of electric steering wheel warmers, plugs and fuses. Business established 1903. President and general manager, P. Stern; vice-presidents, F. K. Levy and F. B. Stern; secretary and treasurer, J. D. Lea; sales manager, F. K. Levy.

INTER-STATE MACHINE PRODUCTS CO., INC., THE.—Rochester, N. Y. Manufacturer of electric sirens. President, C. W. Leslie; vice-president, M. C. Armstrong; treasurer, John Buckley; secretary and general manager, F. C. Buckley.

INTER-STATE TOOL & MFG. CO., INC.—3418-21 Rutger St., St. Louis Mo., Manufacturer of air whistles for interurban trains, etc. Business established 1917. President, Harrison H. Reinecke; vice-president, Jacob A. Haupt; secretary and treasurer, George A. Abel.

INTERTALK.—Trade name for intercommunicating telephone apparatus manufactured by Stanley & Patterson, West & Hubert Sts., New York, N. Y.

INVINCIBLE.—Trade name for electric hair driers manufactured by the Camp Co., LaCrosse, Wis.

INVINCIBLE.—Trade name for split-phase motors manufactured by the Century Electric Co., 1827 Pine St., St. Louis, Mo.

INVINCIBLE.—Trade name for acid aprons manufactured by the Defiance Welding Co., 700 Phelps Ave., Defiance, Ohio.

INVINCIBLE.—Trade name for buffing wheels manufactured by A. P. Munning & Co., Church St., Mattawan, N. J.

INVINCIBLE.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

INVINCIBLE.—Trade name for electric vacuum cleaners manufactured by W. & J. Sloane, 5th Ave. & 47th St., New York, N. Y.

INVINCIBLE JUNIOR.—Trade name for electric vacuum cleaners manufactured by the Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.

INVINCIBLE JUNIOR TRUCK.—Trade name for electric stationary vacuum cleaners manufactured by the Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.

INVINCIBLE VACUUM CLEANER MFG. CO.—Dover, Ohio. Manufacturer of electric motors and vacuum cleaners. President, E. A. Nisbet; vice-president, S. L. Holmes; secretary and treasurer, H. E. Hauck. Sales representatives, W. & J. Sloane, 47th & 5th Ave., New York, N. Y.; C. W. Emery, 2036 N. 13th St., Philadelphia, Pa.; Fred Richardson, 630 Race St., Cincinnati, Ohio; Sterling & Welsh, 1225 Euclid Ave., Cleveland, Ohio; James Clark, Jr., Electric Co., 520 W. Main St., Louisville, Ky.; Craig Electric Co., 418 6th Ave., Pittsburgh, Pa.

I. O. C. SYSTEM.—Trade name for oxygen and hydrogen generators, brazing outfits, electrodes, etc., manufactured by the International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J.

IODOFORM.—CHI_3; can be made electrolytically using an electrolyte of potassium iodide (KI), sodium carbonate (Na_2CO_3), and acetone or alcohol, with platinum electrodes.

IONIC THEORY.—See Ionization; also Dissociation theory.

IONIZATION.—The assumed splitting up of dissolved materials into the parts which are subsequently liberated by electrolysis; in other words, the assumption that the ions pre-exist in an electrolyte before any electrolyzing current is applied. As thus stated, the conception has been discredited, and replaced by the idea of solvation (see Solvate theory, also Dissociation theory), or

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combination of parts of the dissolved molecules with the solvent. It is these new combinations, new classes of chemical compounds, which are resolved at the electrodes, by an electrolyzing current, into the ions and solvent.

IONIZATION APPARATUS, THERAPEUTIC.—See Electrolysis apparatus, dental and therapeutic.

IONIZATION OF GASES.—A gas is said to be ionized when it is dissociated or converted partially or wholly into ions, or in the case of electrical apparatus it is said to be ionized when it is rendered an electrical conductor owing to the formation of ions. Thus when an arc or other discharge is started the path of the discharge is ionied, and the resistance of the path is greatly reduced. Electron tubes having a small amount of residual gas in them may have the gas become ionized and this will have a marked effect on the behavior of the tube, as it permits larger currents to flow. In some cases this is desirable.

IONS.—Ions are electrically charged particles free to move about under the action of electric forces. The term is used particularly in connection with the conduction of electricity through gases and electrolytes.

In gases, ions are produced by removing one or more electrons from an atom, leaving it positively charged. The negatively charged electron may become attached to a molecule or to a group of molecules, which then becomes a negative ion. The positive atom may also become attached to a group of molecules. In an electric field the positive ions will move towards the negative terminal and the negative ions towards the positive terminal, thus serving as carriers for the electric current. Both ions may lose their charges by coming in contact with oppositely charged bodies, or by recombining with ions of opposite sign. The principal ionizing agents for gases are X-rays, radiations from radioactive substances, flames, hot metals and ultra-violet light.

In electrolytes, ions are the two parts into which the electrolyte tends to be divided by the passage of an electrolyzing current. The locus of their liberation or appearance is the surface of contact of the electrodes with the electrolyte. The term ions is sometimes loosely and erroneously applied to assumed pre-existing parts of molecules in the electrolyte before the electrolyzing current is applied. In so far as these are conceived as identical with the ions which the current tends to liberate, this use of the term is erroneous; if by it is meant the "solvated ions," or combinations of the ions proper with the solvent, the term may be admitted and used; it should, however, be qualified as "solvated ion."

IOWA INDEPENDENT TELEPHONE ASSOCIATION.—President, R. L. Parker, Traer, Iowa; secretary-treasurer, C. C. Deering, Des Moines, Iowa.

IOWA SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary, M. G. Linn, Des Moines, Iowa.

IOWA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Secretary, F. Bernick, Jr., Oskaloosa, Iowa.

IPCO.—Trade name for linemen's body and tool belt and safety strap and collapsible canvas tool bag and bucket manufactured by the Industrial Products Co., 1001 Chestnut St., Philadelphia, Pa.

I. P. MORRIS.—Trade name for hydraulic turbines and turbine governors manufactured by the William Cramp & Sons Ship & Engine Building Co., I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa.

I-RITE.—Trade name for electric pyrometers manufactured by the Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich.

IRON.—When pure, iron is a gray, comparatively soft metal. Its symbol is Fe; at. wt. 55.9; sp. gr. 7.8; m. p. 1530° C.; b. p. 2450 C. Pure iron is made by electrolysis of solutions of ferrous chloride ($FeCl_2$) or ferrous sulphate ($FeSO_4$). The electrolyte should be of a high concentration in ferrous iron. There is a tendency for hydrogen to be deposited with the iron, rendering it brittle and easily oxidized, and also for the deposit to break off in small flakes. Pure iron is little used, the chief use being for the construction of special electrical apparatus cores where it is valuable for its high magnetic permeability.

Pig iron or cast iron, the form in which iron is produced by the smelting of ore in blast furnaces, contains 3 to 4% carbon, 0.75 to 2% silicon, up to 1.5% phosphorus, up to 2% manganese, and smaller amounts of other elements. Wrought iron is made by purification of pig iron in an oxidizing hearth furnace, the process being called "puddling." Nearly all of the impurities are removed in a slag or in the gases, being converted to their oxides, but a small amount of slag is retained mechanically in the finished wrought iron. Steel (which see) is also made chiefly by purification of pig iron, with the retention or readdition of a small amount of carbon and frequently of other alloying elements in the amounts necessary to give a steel of the desired properties; these operations are carried out in open-hearth furnaces, Bessemer converters, crucible furnaces or electric furnaces.

Pig iron, in some localities where fuel is scarce and electric power is comparatively cheap (particularly in Sweden), is made in electric shaft furnaces, resembling blast furnaces in construction. The electrodes are inserted in the smelting zone through an arch, toward the bottom of the shaft. They are of carbon and are consumed quite rapidly, burning to carbon monoxide. In order to lessen this consumption, the cooled reducing gases issuing from the top of the furnace are led back through a pipe and blown in the furnace around the electrodes. Carbon (usually in the form of charcoal) is required in the furnace for reduction of the ore, but none for heating, so that a saving of about two-thirds of the fuel is effected by the electric smelting process. Electric pig iron is also made by remelting of scrap iron and steel in ordinary electric furnaces.

The world's production of pig iron in 1917 was 72,381,000 metric tons, of which the United States produced a little over half. Other leading producers are Great Britain and Germany, each with about 12 to 15% of the world's production.

IRON, INGOT, COMMERCIALLY PURE.—Pure ingot iron is used for rolling into sheets for core laminations and also to make metal parts of electrical machines which must be, due to their purpose, noncorrosive. Pure iron does not corrode as rapidly as the ordinary grades and is therefore particularly suitable for iron used in washing machines, marine motors and fittings, and other iron parts of machines and devices which are frequently exposed to corrosive water or gases.

Manufacturers:

Alloy Steel Products Corp., 123 Liberty St., New York, N. Y.
American Rolling Mill Co., The, Middletown, Ohio. "Armco."

IRON LOSSES.—The energy losses in the iron cores of transformers and of armatures of electrical machinery. They are due to hysteresis and eddy currents and result in heating of the core. See Eddy current loss, also Hysteresis loss.

IRON PRODUCTS CORP.—418 S. 2nd St., La Crosse, Wis. Manufacturer of lamp adapters and guy anchors. Business established 1920. President and general manager, C. R. Pieper; vice-president and treasurer, Harry Dahl; secretary, Otto Schlabach; sales manager, L. D. Peran.

IRON SEPARATORS.—See Separators, magnetic.

IRON, SHEET, FOR ELECTRICAL PURPOSES.—Pure sheet iron has many uses in the electrical field. Special soft iron laminations are used for the cores in transformers, motors, generators, magnetos, electromagnets and in various instruments. This classification covers such sheet iron as is suitable for manufacture into laminated cores. For the completely prepared laminations see Cores, electromagnet; Cores, field coil; Armature punchings.

Manufacturers:

Globe Iron Roofing & Corrugating Co., Cincinnati, Ohio.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Modern Tool, Die & Machine Co., 214 N. 4th St., Columbus, Ohio.
Newport Rolling Mill Co., Newport, Ky.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Stark Rolling Mill Co., The, Canton, Ohio. "Stark."

IRON-ALL.—Trade name for electric ironing machines manufactured by the Altorfer Bros. Co., Peoria, Ill.

IRON WIRE.—See Wire, iron line, telegraph and telephone; Wire, iron core, for induction coils, etc.

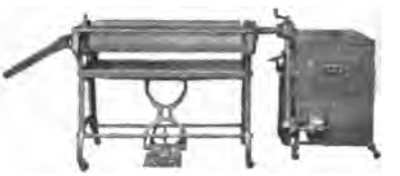
IRONCLAD.—Trade name for electric coal cutting and mining machines manufactured by the Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill.

IRONCLAD APPARATUS.—Electrical apparatus is often "clad in iron" or has a protective iron cover. The term is generally applied to electromagnets, drops, relays, etc., which have a tubular iron case on the outside of the winding and connected to the magnetic core at the bottom.

IRONING MACHINES, ELECTRIC, HOUSEHOLD.—These consist of a mangle of the usual type in which padded rolls are rotated by an electric motor. The rolls are heated by electric, gas, or gasoline heating elements usually placed within the rolls. By careful operation it is claimed that they may be used to iron almost all kinds of clothes. They are used mostly for so-called "flat work," however, such as sheets, towels, table cloths, napkins, handkerchiefs, etc., which can be ironed with far greater speed by such a machine than by hand. Electric heating of the rolls is not so common as gas heating, partly because it calls for a special heating circuit capable of carrying about 2000 watts. The usual household size ironing machine occupies about 25 by 40 to 45 ins. It uses a 1/6-hp. motor as a rule.

Manufacturers:

ALTORFER BROS. CO., Peoria, Ill. Two models: 1—The new A B C electric ironer; 2—The new A B C ironer, driven direct from washing machine (illustrated). The latter is the first complete home laundry unit. The ironer connects with any A B C washer by simply lifting wringer off post and putting ironer drive-assembly in its place. The new A B C electric ironer, foot-controlled, has a large pedal, easily



A B C Electric Laundress

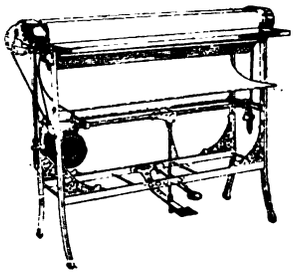
reached, and an 8-year-old child can put on tension or release it. The ironing shoe is 20% wider than most makes, and this permits a 10% faster roll speed. The roll is steel, electrically welded, and 45 ins. long. All moving parts are safely enclosed. The mechanism is packed in grease and runs in oil. The new A B C may be heated by gas, gasoline or electricity. Also see display advertisement on page 1297.—Adv.

American Ironing Machine Co., 166 N. Michigan Ave., Chicago, Ill. "Simplex."
Apex Appliance Co., 3223 W. 30th St., Chicago, Ill.
Barnett Foundry & Machine Co., Lyons Ave. & Coit St., Irvington, N. J. "Capitol."
Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill. "Chicago."
GOULD APPLIANCE CO., INC., 7 W. 42nd St., New York, N. Y. The "Gould" double-roll ironer embodies a double heating element, which makes possible the ironing of damp clothes. This damp ironing feature is brought about by the double roller pressing the clothes against a heated steel plate known as the "hot shoe." This shoe in the "Gould" ironer is flat, being under the double roll and directly above the gas burner, so the heat is concentrated

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in just the right place. The double rolls can be lifted from the hot shoe instantly, by foot control. A 1/6-hp. motor is employed to operate the machine. The amount of current consumed is small, the machine in fact



Gould Double Roll Ironer

being a lamp socket device. It is made in three sizes: 37 ins., 42 ins. and 46 ins. The control is simple and is worked by the foot only, leaving the hands free. Exactly the right pressure is applied for the lightest of lingeries to the heaviest of blankets. Space and weight economy are important features. —Adv.

HORTON MANUFACTURING CO., THE, Ft. Wayne, Ind.—The "Horton" ironing machine is being used extensively in homes and small institutions. It is so designed that the heat is uniformly distributed over the entire contact surface of the polished metal heated shoe and ironing roll. By pressure of the foot on the pedal, the padded roll is instantly



Horton Ironing Machine

locked against the ironing surface. It is as easily released in a similar manner. Its unique mechanical construction affords reliable service, operating smoothly, without vibration or noise. The Horton has a well finished appearance, and is attractive in many ways. —Adv.

Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."
Keystone Ironing Machinge Co., Knickerbocker Bldg., New York, N. Y. "Keystone."
Meyer Bros., 99-101 Queen St, E., Toronto, Ont., Can. "Canadian."
Oasis Mfg. Co., Peoria, Ill. "Oasis."
Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa. "Gainaday."
Raymond Co., The, Saugatuck, Conn.
Sieben Merchandising Co., Kansas City, Mo. "All-In-One."
Utensils Co., 303 E. Columbia St., Ft. Wayne, Ind. "Utenco."
Western Appliance Mfg. Co., 1405 L. C. Smith Bldg., Seattle, Wash. "Mercer."
Win-Her Washer Co., 814 Tuttle St., Des Moines, Iowa. "Win-Her."
Yates Co., William G., 2124 Stearns Rd., Cleveland, Ohio. "Cottage."

IRONING MACHINES, ELECTRIC, LAUNDRY.—These machines are built on the same general principle as the household types, but are intended for the heavier service of commercial, hotel and institutional laundries. The driving motor is usually ¼ or ⅓ hp. Electric heating is sometimes provided by means of ironclad heating elements that are nearly 5 ft. long in some machines. Gas or gasoline heating of the roll is frequently used. These machines do the work of several hand operators.

Manufacturers:

American Ironing Machine Co., 166 N. Michigan Ave., Chicago, Ill. "Simplex."
Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill. "Chicago."
GOULD APPLIANCE CO., INC., 7 W. 42nd St., New York, N. Y. "Gould."
Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."
Keystone Ironing Machine Co., Knickerbocker Bldg., New York, N. Y. "Keystone."
Mateer & Co., F. W., 226-232 W. Ontario St., Chicago, Ill.
National Laundry Machinery Co., 700 W. 22nd St., Chicago, Ill. "National Electric."
Raymond Co., The, Saugatuck, Conn.
Willey Co., Inc., The, 1222 Race St., Philadelphia, Pa.

IRONING MACHINES, SHOE-FACTORY AND OTHER INDUSTRIAL.—Specially designed machines having electrically heated surfaces for use in shoe factories or other industrial establishments in ironing operations, such as treeing, shoe knurling, etc. The term iron is used for devices where the heated surface comes in contact with the material by passing over or being pressed against it so that the iron flattens or forms it to a required shape. There are many such devices used in various clothing factories. Some of them are shirt irons, fluting irons, French irons, corset irons and velvet irons. Electric heating of these irons has won its extensive use entirely by its superior production, economy and improved quality of product.

Manufacturers:

Boston Last Co., 44 Binford St., Boston, Mass. "Simplex."
Freeman Co., The Louis G., 909-911 Sycamore St., Cincinnati, Ohio.
S. U. E. Co., 89 Beach St., Boston, Mass. "Unitize."
United Shoe Machinery Corp., 205 Lincoln St., Boston, Mass.

IRONITE.—Trade name for rubber insulated telephone drop wire manufactured by the Paragon Electric Co., Old Colony Bldg., Chicago, Ill.

IRONS, ELECTRIC, BRANDING.—See Branders and branding devices, electric.

IRONS ELECTRIC, CURLING. — See Curling Irons, electric.

IRONS, ELECTRIC, FLAT.—See Irons, electric, pressing.

IRONS, ELECTRIC, HAT.—For generations the journeyman hatter has used what is called a "hand shell" for ironing out felt hats. In the modern hat factory this hand shell is heated by electricity in a manner similar to the ordinary electric flatiron. The hat iron in some factories, besides being heated electrically, is revolved by electric drive.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

IRONS, ELECTRIC, PRESSING, HOUSEHOLD.—Flatirons in which the heating element is within the body of the iron and insulated from it. The irons are provided with a special heater cord having an attachment plug at one end and an ironconnecting plug at the other. They range in weight from 3 to 8 lbs., the usual size being 6 lbs. As they are designed for household use they are attractively finished, the metal parts usually nickel-plated and the wooden handle ebonized and polished. At the plug end attached to the iron a flexible wire sheathing or armor is usually employed to cover several inches of the cord so as to prevent the sharp bending back and forth and pulling of the cord which otherwise causes rapid wear and breaking or short-circuiting of the wires.

Some irons are provided with a snap switch on the handle to permit opening and closing of the circuit without removal of the plug; in most irons, however, the plug is so arranged that it can be readily withdrawn or moved out of electrical contact, thus permitting breaking the circuit when the iron is too hot or when use of the iron is to cease or be interrupted. Automatic thermostatic switching has also been provided with success to permit obtaining a definite temperature and not exceeding it. A stand for supporting the iron when not actually in use is often provided so as to prevent scorching the ironing board or the clothes, if the iron is left with current on; in some cases the iron is arranged with a heel to allow it to be turned up with the hot surface vertical and well removed from the board. Some device is desirable to make it easy for the operator when temporarily leaving the work, to make sure that the current is off or that the hot surface of the iron is not in contact with anything that might be scorched or ignited.

Electric flatirons are the most widely used electrical appliance in the household aside from lighting equipment. They are used mostly in the kitchen, where in but few cases special iron outlets are provided, so that the iron must be connected to the only fixture socket available. When this is a key or pull-chain socket of the ordinary type it is properly limited to 250 watts, whereas the household flatiron averages 500 to 550 watts; consequently, if such a socket is used to switch the iron on and off it will cause rapid wear of the socket contacts and put the socket out of commission. For this reason convenient switching or plugging facilities on the iron itself are desirable and users should be advised to close and open the circuit by means of them instead of at the socket.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric iron, the best iron made, weighs 6½ lbs., and is one of the simplest constructed irons on the market. Consists of an upper plate or hood with a handle support and handle, a heavy flat pressure plate, an inclosed heating element, and a base or ironing plate. The handles are electrically welded to the hood, making a very rigid assembly. The element consists of a mica form



"American Beauty" Iron

wound with nichrome ribbon of the highest grade, compactly enclosed in sheet steel case. The contact pins are round and of nickel silver, made so as to be easily removable. Always cool, the wood handle fits any hand and the iron is accurately balanced to the fraction of an ounce, and therefore does not tire the user. It is furnished complete with a stand and cord, having a detachable composition plug and attachment plug. The cord is especially made for this iron, and is of the most flexible character. "Little Beauty" electric iron, same as the "American Beauty" described above. Weight is 3 lb. instead of 6½. "American Quality" electric iron, second only in quality to the "American Beauty" described above. First class in every respect. Furnished complete with stand and cord, having detachable plug and attachment plug.—Adv.

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "American Ace."
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Brock Snyder Mfg. Co., The, Grimsby, Ont., Can. "Besco." (Exclusive distributor, Wentworth Electric Co., Lister Bldg., Hamilton, Ont., Can.)
Burt Co., W. T., New Cumberland, W. Va. "La Belle."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Flatiron Mfg. Co., Johnson City, N. Y. "Duo Point."

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Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Princess," "Domestic," "Sunbeam."

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Cope & Son, Ltd., 150 Hastings St., W. Vancouver, B. C., Can. "Rex."

Dover Mfg. Co., The, Dover, Ohio. "A-Best-O.," "Dover," "Domanco."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. The iron with the cantilever handle! This principle in the Hotpoint iron is exclusive, making it the easiest to iron with by lessening the usual strain of ironing. In addition, it has the attached stand, eliminating all necessity for lifting the iron. Its heating unit



"Hotpoint" Electric Iron

is in two sections, arranged V-shaped on the sole plate. The sections meet at the point of the iron, thus supplying most heat where most heat is needed—when the point is pushed forward into the damp goods. The heating unit is clamped between a heavy cast sole plate and pressure plate, insuring excellent heat retention. Top is pressed steel. Finish, polished nickel all over. Has cord and separable contact plug. The iron is furnished in three weights, 3, 5 and 6 lbs. See also Tailor Irons and Laundry Irons classified elsewhere. See display adv. pages 1292-3.—Adv.

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

Globe Stove & Range Co., The, Kokomo, Ind. "Globe."

Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."

INTERNATIONAL ELECTRIC CO., 218-222 S. McCrea St., Indianapolis, Ind. International "Baby" electric iron;



made in 1-lb. size only. A utility iron for light pressing laces, lingerie, etc. Also toy iron. Write for bulletin.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. Large heat storage capacity. Full nickel finish. Six styles



"Universal" Iron

of irons. Weight, 3 to 8 lbs. Reversible heat-proof spring stand. Six-foot heater cord. Curved handle brackets insure cool handle.—Adv.

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."

Loetscher-Ryan Mfg. Co., Rock Island, Ill. "Ideal Heat."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

Manning, Bowman & Co., Meriden, Conn.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill. "Progressive," "Ideal," "Standard."

Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y. "Victory," "Pittsburgh."

Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa.

Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y.

Reimers Mfg. Co., 513 W. 50th St., New York, N. Y. "Regulator."

Renfrew Electric Products, Ltd., Renfrew, Ont., Can. "Canadian Beauty."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Roma Mfg. Co., 228-230 N. Jefferson St., Chicago, Ill. "Roma."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Rutenber Electric Co., Marion, Ind. "Rutenber."

Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill. "Rogo," "Challenge," "Empress," "Majestic," "Milady's," "World's Best."

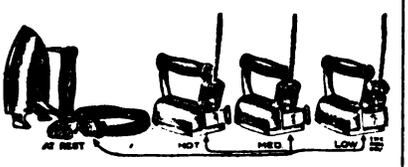
Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Steatite Electric Products Corp., Yorktown Heights, N. Y.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y.

WAAGE ELECTRIC CO., 12-14 S. Jefferson St., Chicago, Ill.—6 Reade St., New York, N. Y. "Waage Triple Heat" electric iron patented June 18, 1912. Gives three heats, regulated by plug; hot, for ironing table linens, etc.; medium, for general work, such as starched clothes, colored clothes, etc.; low heat, especially adapted to the ironing of fine fabrics, silks, etc. The



"Waage Triple Heat" Electric Iron

Waage is several irons in one; has a heat for every kind of ironing. Durably made and attractively finished; every part is interchangeable and designed for long service. Heating element is guaranteed. Two feet at rear of iron take the place of the old-style stand—also protect the plug. Terminal plug (patented) designed so contact clips will never lose their grip. Three other types; four-heat; single heat; and a 3-lb. iron for convenience when traveling, easily carried and always ready.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

IRONS, ELECTRIC, PRESSING, LAUNDRY.—These irons are built on the same general principle and closely resemble the household irons listed above. They are usually designed for heavier service, however, and range in weight from 6 to 8 lbs. They are very extensively used in commercial, hotel and club laundries for the finer work that cannot be handled as effectively on an ironing machine or mangle but which, on account of complicated ruffles or laces would require slowing up the operation and much handling in any case. Laundry irons are sometimes mounted on a stand or swinging arm to relieve the operator of lifting and holding the weight of the iron while moving the goods and also to reduce the time otherwise lost in setting the iron down when changing pieces.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "American Ace."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Dover Mfg. Co., The, Dover, Ohio. "Asbestos," "Dover."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor, St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. The iron is identical to the Hotpoint domestic



"Hotpoint" Laundry Iron

iron in general construction, differing only in size and having no attached stand. Fitted with the cantilever handle, which eliminates strain of ironing. Has two deck stand, suspension spring and cord. Also hinged plug cord protector. Requires special wiring. See Tailor and Domestic Irons. See display adv. pages 1292-3.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal." (See descriptive advertisement under Irons, electric, pressing, household.)

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Reimers Mfg. Co., 513 W. 50th St., New York, N. Y.

Roma Mfg. Co., 228-230 N. Jefferson St., Chicago, Ill. "Roma."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Steatite Electric Products Corp., Yorktown Heights, N. Y. "Stahot."

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

IRONS, ELECTRIC, PRESSING, TAILORS'.—These pressing irons are heated in a manner similar to the ordinary electric flatiron, but are much heavier, ranging from 12 to 24 lbs. and requiring in the larger sizes as high as 800 watts. Those used in large tailoring shops are commonly fastened to a swinging arm to give the operator greater speed and less fatigue in their use. An electrically heated steaming iron, which forces steam into the goods through the bottom of the iron, is also used for certain pressing work. These electric irons are very much more sanitary than the gas-heated ones still used in many "sweat shops," which are very uncomfortable and unhealthful for the operator, both on account of their heat and poisonous fumes.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric pressing iron; eight types, weighing 9, 12, 16, 20 and 24 lbs. The 9, 12, and 16, are for lighter pressing.

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and the 20 and 24-lb. irons for heavy and very heavy pressing. Complete with stand and 6-ft. cord, having detachable metal sheathed plug.—Adv.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Electrically-heated Tailors' Irons are carefully constructed for the work they must perform. The heating elements consist of nickel-chromium resistor ribbon wound on mica insulation.—Adv.

EDISON ELECTRIC APLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances, ranges and ovens. Made in the conventional goose



"Hotpoint" Tailor's Iron

shape. It has unit construction, similar to that used on all Hotpoint irons. The heating unit is clamped between a heavy cast soleplate and pressure plate, and insures excellent heat retention. Made of pressed steel and finished in polished nickel. Mounted on rear end of handle support is a rotary indicating snap switch, from which is obtained three heats—high, medium and low. See display adv. pages 1292-3.—Adv.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Reimers Mfg. Co., 513 W. 50th St., New York, N. Y.

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

U. S. Automatic Steam Iron Corp., 414-416 Broadway, New York, N. Y. "U. S."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

IRONS, ELECTRIC PRESSING, TRAVELERS'.—Pressing irons heated in a manner similar to the ordinary electric flatiron and differing only in being of lighter weight, about 3 lbs., and thus adapted for carrying in a traveling bag. These irons when designed to be used with various other heating attachments are generally somewhat heavier, but as they are primarily designed for a traveler's use with curling iron and other light heating attachments they are commonly referred to as travelers' irons. They have been found popular among women when going to a modern summer resort, which means one with electric service.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "American Ace."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Edison and Hughes electric appliances. Utility ironing set consists of a 3-lb. beveled edge iron, a pair of folding curling irons, and an inverting stand, all packed in a neat cloth covered box. The iron has two holes at the rear of it for inserting and heating the curling irons. With the inverting stand the iron can be turned into a small electric stove, a convenience of par-



"Hotpoint" Boudoir Set

ticular value to the traveler. The box is so constructed that when opened and laid flat it serves as an ironing board. All parts are finished in highly polished nickel. The boudoir set shown is another outfit identical to the utility ironing set, excepting that it comes in a colored cloth bag. See display adv. pages 1292-3.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal." (See descriptive advertisement under Irons, electric, pressing, household.)

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

Manning, Bowman & Co., Meriden, Conn.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa.

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

WAAGE ELECTRIC CO., 12-14 S. Jefferson St., Chicago, Ill., and 6 Reade St., New York, N. Y. See Irons, electric, pressing, household.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

IRONS, ELECTRIC, SOLDERING AND TIPPING.—Electric soldering and tipping irons are very extensively used for a wide range of work from very light to heavy soldering operations. They are used in the home, laboratory or small shop for light tinkering and occasional heavier miscellaneous uses, and are used in large numbers in factories of all kinds, and by telephone companies, central stations, electric railways and wherever soldering operations are performed. In many cases they are in constant service during the day and they have the advantage that only one iron is required for each operator, and no time is lost in reheating, as the iron maintains the proper temperature indefinitely.

There are quite a few different forms of irons, but the most common types consist of an insulated heating element which is either placed around a copper rod or tip or inserted in it in cartridge form. Nickel-chromium ribbon or some similar resistance material is generally used for the heating element and it is insulated with sheet mica. The heat should, as far as possible, be concentrated in the tip and the heating elements and tips are designed accordingly. The tips used with irons of this kind take a number of forms because of the large variety of uses to which they are applicable, some of the principal ones being straight beveled tips, angle points, cone tips, etc. They are also made in a number of weights and capacities. For use in the canning industry can capping and tipping irons are made. The capping iron is circular and of the same diameter as the can cap so that it solders it all at once. Tipping irons are frequently just a medium-weight straight-tip iron.

Another form of soldering iron which operates on a very low voltage (5 to 10 volts), consists of two high-resistance carbons which furnish a direct heat at the point of contact. The instant the iron is placed on the object to be soldered, the carbons glow with a white heat which immediately heats the work. As soon as the tool is removed from the work, the circuit is opened and the current ceases.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty' electric soldering irons, made in



"American Beauty" Soldering Iron

three sizes, light, medium, and medium heavy. The exterior of iron is perfectly smooth with no projecting screw heads. Is polished nickel with Circassian walnut finish wood handle, complete with 6-ft. cord and lamp socket attachment plug. Copper tips are of standard size drawn copper rod, ⅜, ½, and ⅝ in. in diameter. Tips may be withdrawn from core as it wears away, making it possible to utilize full length.—Adv.

Baco Electric Co., The, Bode, Iowa. "Baco Soderwand."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Clemens Electrical Corp., 725 Main St., Buffalo, N. Y.

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Cook Electric Co., 900-910 W. Van Buren St., Chicago, Ill. "Cook."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Electric Soldering Irons reduce soldering costs by saving time and speeding up soldering work. The heating unit is hermetically sealed within a steel case, so that it is absolutely impervious to acid, solder, or moisture. The core and casing are both of steel in order to insure uniform expansion and contraction, and provide



C-H Soldering Iron

maximum conduction of heat to the soldering tip. The copper tip is renewable and screws over the heater core, the extension of which is threaded. This construction carries the heat right into the copper tip where it is needed. Whenever the tip becomes battered or pitted through long use, it is easily renewed at slight expense. See display adv. pages 1225-1230.—Adv.

Dover Mfg. Co., The, Dover, Ohio. "Dover."

France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E electric soldering irons have been on the market a number of years and have given general



G. E. Soldering Iron

satisfaction. Made in various sizes, varying from 75 to 275 watts. (Bulletin B3571-A). This Company manufactures also a soldering iron furnace for heating large soldering iron coppers. See adv. pages 1203-1223.—Adv.

LANDERS, FRARY & CLARK, NEW Britain, Conn. "Universal."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

Martin-Copeland Co., 101 Sabin St., Providence, R. I.

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Sprague Canning Machinery Co., 222 N. Wabash Ave., Chicago, Ill.

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y.

WAAGE ELECTRIC CO., 12 S. Jefferson St., Chicago, Ill.

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IRONS, RIDGE.—Ridge irons are malleable iron straps, shaped to fit on the ridge or doubly beveled top of a wooden pole and support an insulator. They are drilled for bolting to the pole and spread out far enough to fasten to the pole top just below the bevel. They are flattened at the top and an insulator pin is mounted there in a vertical position so that a line may be run in this manner. The size of the stock used varies from ⅛x2½ ins. to ¼x2¾ ins., depending on whether a telephone or heavier line wire is to be carried on the pole top. Either a galvanized or painted finish may be had.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

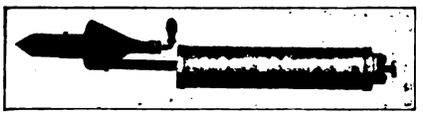
IRONS, SOLDERING, MISCELLANEOUS AND SPECIAL.—One special form of these irons has a grooved soldering tip or copper for soldering ears to the trolley wire; for other special work they are equipped with other special tips peculiarly adapted to soldering a certain piece or part. The term soldering iron is in some ways a misnomer, as the material of the tip is copper and consequently they are also commonly called soldering coppers. This classification also includes, beside special electrically heated irons, special gas and gasoline-heated irons and ordinary irons to be heated by a blow torch or other heating device, all of which are widely used by electricians and in electrical manufacturing and utility plants.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill. "Featherweight."

BELFRY & CRAIGHEAD, 1526 Tribune Bldg., Chicago, Ill. "Everhot" soldering iron, a light, self-contained, easily operated device with new type of burner that preheats gas; efficient on light or heavy work, and small size permits use in limited space. Uses only ½-pt. of gasoline fuel in 4 hrs.,



"Everhot" Soldering Iron

and any desired temperature can be maintained. Is well balanced, and has improved needle valve which eliminates trouble. Can be used as a blow-torch by removing soldering tip; special tips furnished for special purposes. Length, 16½ ins.; weight, 2 lbs. (See torches, gasoline and kerosene.)—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The C-H Soldering



C-H Soldering Fixture

Fixture was first developed to facilitate the soldering of cans, but numerous other uses have also been found for this device. The fixture consists of a pair of steel-clad, mica-insulated heating units, which are placed on either side of a piece of bar copper and gripped between two iron plates forming a housing for the heating units. The copper bar used is from 1" to 1½" wide and ¼" or ⅜" thick. The two heating units work independently of each other and may be removed or replaced separately. The fixture is designed for mounting on a bench. See display adv. pages 1225-1230.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Millers Falls Co., Millers Falls, Mass. "Millers Falls."

Pacific Metal Works, 153-159 1st St., San Francisco, Cal.

Products Corp., The, Maywood, Ill. "Ever-Hot."

SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y. (Can capping.)

IRONSIDES.—Trade name for power transmission belting manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

IRONTON ENGINE CO., THE.—Ironton, Ohio. Manufacturer of storage battery mine locomotives. Main office and factory, Ironton, Ohio. Branch offices, 584 Union Arcade Bldg., Pittsburgh, Pa.; 1350 Old Colony Bldg., Chicago, Ill.; 570 Gas & Electric Bldg., Denver, Colo.; 1108 Fayette National Bank Bldg., Lexington, Ky.; Fidelity Mutual Bldg., Philadelphia, Pa.; 808 Post St., Seattle, Wash.; Robson-Pritchard Bldg., Huntington, W. Va.

IRREVERSIBLE CELL.—An electrolytic cell which shows no back electromotive force; one which after electrolysis has been performed shows no disposition or ability to act as a primary cell and to generate an electromotive force in the opposite direction to the previously applied electrolyzing current.

IRVING IRON WORKS CO.—Long Island City, New York, N. Y. Manufacturer of car steps, fireproof shelving, safety treads, etc. Business established 1905. President, W. E. Irving; secretary and treasurer, C. A. Irving; general manager, P. L. Price; sales manager, W. H. Lown.

IRVINGTON.—Trade name for insulating varnish, cambric, etc., manufactured by the Irvington Varnish & Insulator Co., Irvington, N. J.

IRVINGTON VARNISH & INSULATOR CO.—Irvington, N. J. Manufacturer of insulating varnish, cambric, tape, etc. Business established 1905. President, O. Heinricks; vice-president and general manager, Oswald Dale; secretary and treasurer, D. F. Burnett.

IRV-O-SLOT.—Trade name for insulating materials manufactured by the Irvington Varnish & Insulator Co., Irvington, N. J.

ISCO.—Trade name for lighting fixtures manufactured by the Incandescent Supply Co., 638 Liberty Ave., Pittsburgh, Pa.

ISERT CO., JOHN H.—213 S. 9th St., Louisville, Ky. Manufacturer of cutout boxes and iron extension bars. President, John H. Isert; vice-president, M. L. Isert; secretary and treasurer, Truman Cooke.

ISKO CO., THE.—2525 Clybourn Ave., Chicago, Ill. Manufacturer of electric refrigerating machines. President and treasurer, P. L. Coonley; vice-president, W. R. Hill; secretary, S. H. Olmstead.

I-T.—Trade name for shipping tags manufactured by the International Tag Co., 319-320 N. Whipple St., Chicago, Ill.

ITALIO.—Trade name for decorative effect of illuminating glassware manufactured by the Eagle Mfg. Co., Wellsburg, W. Va.

I. T. C.—Trade name for storage battery trucks and tractors manufactured by the Industrial Truck Co., Division of Cowan Truck Co., Holyoke, Mass.

I-T-E.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa.

I² R LOSS.—The loss in an electrical conductor, circuit or machine due to its resistance. It is obtained by squaring the current value in amperes and multiplying by the resistance in ohms. The value obtained is in watts and represents power converted into heat. This loss is frequently referred to as the copper loss. See Copper loss.

ITS-IT.—Trade name for electric vulcanizer manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

IVADINE.—Trade name for dining room lighting unit manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

IVANHOE.—Trade name for metal reflectors and fittings manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO.—Cleveland, Ohio. Manufacturer of illuminating glassware, foot-candle meters, oscillographs, lighting fixtures, reflectors and fittings. General manager, W. F. Minor; sales manager, J. M. Smith. Main office and factory, 5716 Euclid Ave., Cleveland, Ohio. Branch offices carrying stock, 105 W. 40th St., New York, N. Y.; Boston, Mass.; 180 N. Wabash Ave., Chicago, Ill.; Philadelphia, Pa.

IVES MFG. CO., THE.—Bridgeport, Conn. Manufacturer of electrically operated miniature railways. President and treasurer, Harry C. Ives; secretary, Charles H. Silliman. Main office and factory, Bridgeport, Conn. Branch offices, 432 5th Ave. Bldg., New York, N. Y.

IVES MFG. CO., W. A.—Wallingford, Conn. Manufacturer of wood boring tools. President and treasurer, C. J. Benham; vice-president, C. M. Watson; secretary, S. M. Benham; general manager, E. T. McPherson. Main office and factory, Wallingford, Conn. Branch office and warehouse, 136 Pearl St., Boston, Mass. Sales representatives, M. C. Leibert Co., 66 W. Broadway, New York, N. Y.

IVIN LIGHTING FIXTURE CO.—159-161 Leonard St., New York, N. Y. Manufacturer of lighting fixtures.

IVINS' TUBE WORKS, ELLWOOD.—Philadelphia, Pa. Manufacturer of seamless aluminum and steel tubing. Sole owner, Ellwood Ivin. Main office and factory, Oak Lane, Philadelphia, Pa. Branch office, 1503 Mallers Bldg., Chicago, Ill.

IVRE.—Trade name for ivory tinted Regent glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

IWAN BROS.—1503 Prairie Ave., South Bend, Ind. Manufacturers of digging and tamping augers and bars. Business established 1877. Partnership, W. L. Iwan and J. H. Iwan. Sales representatives, Wm. Pickett Son & Co., 119 S. Jefferson St., Chicago, Ill.; W. W. Crandall Co., Nashville, Tenn.; E. C. Coffin Co., 503 Dooly Bldg., Salt Lake City, Utah; Omer Cox, San Francisco, Cal.

I. X. L.—Trade name for insulated wires manufactured by the Collyer Insulated Wire Co., 249 N. Main St., Pawtucket, R. I.

IXL.—Trade name for track drills manufactured by the Lowell Wrench Co., 54 Commercial St., Worcester, Mass.

IXL.—Trade name for cutting pliers manufactured by the O. P. Schriver Co., Cincinnati, Ohio.

IXL—Trade name for friction tape manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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JABLOCHKOFF CELL.—One of the early, unsuccessful attempts to convert the chemical energy of carbon directly into electrical energy by consuming it in a primary cell.

JACK-O LANTERN.—Trade name for portable lamp manufactured by the Luminous Unit Co. Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

JACK STRAPS.—See Straps, linemen's safety.

JACK SWITCHES.—See Switches, telegraph (button, table jack, etc.).

JACKS, ARMATURE.—A type of jack used for removing an armature from the motor or generator frame. As the armatures are very heavy some types of jacks are mounted on trucks, either flat-wheeled for general use or flange-wheeled for hauling over a track system. These jacks are sometimes termed armature lifts.

Manufacturers:

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa. "Barrett."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

JACKS, AUTOMOBILE.—The automobile jack is used to raise the automobile or electric vehicle or truck off the ground to remove wheels, change tires, etc., or for giving more working space beneath the car when making repairs on the motor or running gear. The ordinary general purpose jack has one lifting rod actuated by a screw or gear or rack. For working on cars in the repair shop another type of jack is sometimes found advantageous. This jack is a small lifting frame which raises the car by support from two points on the axle thereby giving greater stability to the car on the jack.

Manufacturers:

American Chain Co., Bridgeport, Conn. "Weed."

Arrow Grip Mfg. Co., Inc., Glens Falls, N. Y. "Arrow Grip."

Buckeye Jack Mfg. Co., The, Alliance, Ohio.

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa. "Barrett."

Joyce-Cridland Co., The, Linden Ave., Dayton, Ohio. "Joyce."

Marion Malleable Iron Works, The, Box 568, Marion, Ind. "Marion."

Millers Falls Co., Millers Falls, Mass. "Millers Falls."

Oliver Mfg. Co., 326 S. Desplaines St., Chicago, Ill. "Peerless," "Oliver-Samson."

St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKS, CABLE REEL.—To run lead cable or other heavy cable off the reel a strong pipe or rod is put through the center of the reel and the reel supported by this temporary shaft on jacks which raise the reel and act as bearing supports for the rod. There are a number of kinds of reel jacks, but all consist essentially of a broad base supporting a jack, usually of the screw type, the head of the jack being provided with a bearing for the rod supporting the reel.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Buckeye Jack Mfg. Co., The, Alliance, Ohio.

Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa.

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display advertisement on page 1254.)

HERBST, PAUL W., Chicago, Ill. We make standard and special patterns. See display advertisement on page 1258. —Adv.

Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Green Head."

Kelly Mfg. Co., L. J., 307 N. Pearl St., Albany, N. Y. "Kelly Improved."

Swett Iron Works, A. L., Medina, N. Y.

Templeton, Kenly & Co., Ltd., 1020 So. Central Ave., Chicago, Ill. "Simplex."

JACKS, CAR.—Simple and compact lifting machines capable of being carried and operated by one man and designed to easily lift or move comparatively large weights. Nearly always of the lever type, and frequently carried on cars as emergency equipment to be ready in cases of derailment, etc. These jacks are usually rated in tons lifting capacity.

Manufacturers:

Buckeye Jack Mfg. Co., The, Alliance, Ohio. "Buckeye."

Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can. "H. & E."

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa.

Joyce-Cridland Co., The, Linden Ave., Dayton, Ohio. "Joyce."

Millers Falls Co., Millers Falls, Mass. "Millers Falls."

St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.

Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKS, CAR-PIT.—Powerful and compact machines utilizing the principles of the lever, screw or hydraulic pump; often arranged for operation by man power. They are used for general lifting purposes in car pits and are designed usually for comparatively high lifts.

Manufacturers:

Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can. "H. & E."

Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa.

JACKS FOR PORTABLE TELEPHONES.—These jacks do not differ from ordinary telephone switchboard jacks in construction, but merely in their method of mounting and utility. They are used principally in stations along interurban, electric or other railway lines, or along high-tension transmission lines to permit the trainmen or patrolmen to call up headquarters. Instead of having a telephone installed that might be tampered with, each authorized person is provided with a small portable telephone and a plug, by means of which the connection is made through the jack to permit conversation. The jacks are usually mounted in a protected housing of some sort on the pole line, or may be placed in a station.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.

Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)

Monarch Telephone Mfg. Co., Fort Dodge, Iowa.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

JACKS, LOCOMOTIVE AND OTHER HEAVY-DUTY.—These jacks are very heavily built and are used for jacking up locomotives and very heavy machinery, such as motors, generators, transformers, etc. Some types are made with a ball-bearing screw, or with an automatic lowering device instead of the usual trip found on ordinary jacks using a rack lifting device.

Manufacturers:

Buda Co., The, Harvey, Ill.

Buckeye Jack Mfg. Co., The, Alliance, Ohio. "Buckeye."

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa. "Barrett."

Templeton, Kenly & Co., Ltd., 1020 So. Central Ave., Chicago, Ill. "Simplex."

JACKS, POLE.—The widening of highways or streets, and the straightening, grade readjustment and paving of streets and alleys sometimes makes it necessary to shift or raise a pole line several feet out of the existing line, while at the same time maintaining service over the line. One method of accomplishing this is to dig the new hole and then raise the pole out of the ground and skid it on a plank to the new hole. The pole is lifted out of the ground by a chain wrapped around the base, the chain being pulled upward by a pole jack. The pole jack is similar to the ordinary lift jack operating the lifting rod by a rack, but has a long rod to give a high lift and has a guide at the end of the rod over which the chain passes as the pole is pulled out of the ground. It is also used for straightening poles that have settled out of line.

Manufacturers:

Joyce-Cridland Co., The, Linden Ave., Dayton, Ohio. "Joyce."

LINE MATERIAL CO., South Milwaukee, Wis. (See display advertisement on page 1278.)

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKS, SHORING AND CONSTRUCTION.—A type of jack used largely for raising and temporarily supporting heavy machinery or supporting walls in reconstruction of foundations or buildings. It is used to support turbines, reciprocating engines, generators and motors while new foundations are placed under them without interrupting their service. It is also used in rebuilding and otherwise altering power plants and substations where it is of importance that the service of the station shall not be interrupted by the reconstruction work; for instance, in rebuilding walls, resetting boilers, stacks, pumps, tanks, etc.

Manufacturers:

Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa.

Hobbs Co., Clinton E., 30-35 Pearl St., Boston, Mass. "Green Head."

Joyce-Cridland Co., The, Linden Ave., Dayton, Ohio. "Joyce."

Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKS, TELEGRAPH SWITCHBOARD.—Two principal types of jacks are used on telegraph switchboards. One of these is very similar to an ordinary telephone switchboard jack, sometimes provided for making only two contacts, the tip and sleeve, and in other cases for completing three circuits, the tip, ring and sleeve. The other form of jack is older, but is very widely used. This is of the spring type and is used with a wedge-shaped plug having contacts on the nonparallel sides of the wedge. The contact springs of the jack are quite broad and strong enough to hold the plug in place when inserted.

Manufacturers:

Morkrum Co., 1410 Wrightwood Ave., Chicago, Ill.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

JACKS, TELEPHONE SWITCHBOARD.—A line terminal for quick connection and disconnection; also called spring jack. It usually has a tip spring to engage the tip of the plug, a ring spring to engage the ring of the plug, and a sleeve (tube) to en-

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gage the sleeve of the plug. Jacks are given several names depending upon their place in the circuit and their function. A few of the most important are described below.

Anciliary Jack and Lamp. In order to enable manual operators to help each other, the anciliary plan gives each subscriber line more than one answering jack and lamp. One is before the operator to whom it belongs for answering. The lamp cap is white. The others (called anciliary) are before other operators—their lamp caps are colored. Therefore, each operator has two kinds of jacks and lamps. She must answer the white lamps first, then if free she may answer the others and thus relieve the load on the other operators.

Answering Jack. The switchboard jack associated with a line lamp and attached to a subscriber line. When the subscriber on this line calls, the operator (seeing the line lamp lighted) plugs into the answering jack to answer the call.

Jack-per-Station. An arrangement of multiple jacks on a switchboard using one jack for each station on a party line. It is used to relieve the operator of the necessity of choosing ringing current to select the called station. For a four-party line there will be four jacks in each multiple section, hence four call numbers.

Multiple Jack. An arrangement of jacks installed in multiple in a multiple switchboard. See switchboard, telephone, multiple.

Test Jack. A jack used for testing purposes. Each automatic switch has a test jack to enable the switchman to operate the switch to reveal its condition.

Twin Jack. A pair of jacks mounted so as to take a twin plug.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display advertisement on page 1327.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

JACKS, TRACK.—A type of jack especially adapted to gripping railway track beneath the rail and lifting the track and ties several inches. It is also commonly used to move a track out of its original line several inches at a time by raising the track and ties and pushing the track off the jack in the direction in which the track is being moved.

Manufacturers:

Buckeye Jack Mfg. Co., The, Alliance, Ohio. "Buckeye."
Buda Co., The, Harvey, Ill.
Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa. "Barrett."
Swett Iron Works, A. L., Medina, N. Y.
Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKS, WRECKING.—Simple and powerful portable machines designed so that man power can lift or move very large weights. They are of several types: lever, screw, gear-driven or hydraulic pump, and usually of high rating in lifting capacity. For wrecking work an assortment of jacks having various lifting capacities and heights of lifts is desirable, especially when carried on a wrecking car.

Manufacturers:

Buda Co., The, Harvey, Ill.
Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can. "H. & E."
Duff Mfg. Co., The, Preble Ave. (North Side Station), Pittsburgh, Pa. "Barrett."
Joyce-Cridland Co., The, Linden Ave., Dayton, Ohio. "Joyce."
Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. "Simplex."

JACKSON.—Trade name for automatic chucking machines manufactured by the Long-Henkel Mfg. Co., S. W. Cor. 3rd & Buttonwood Sts., Reading, Pa.

JACKSON IRON WORKS, INC., BYRON.—San Francisco, Cal. Manufacturer of centrifugal and turbine pumps. Business established 1858. Main office, 410 Sharon Bldg., San Francisco, Cal. Factory, West Berkeley, Cal. Branch offices, Los Angeles, Visalia, San Jose, Cal.; Salt Lake City, Utah; Portland, Ore.; Bakersfield, Ore.

JACQUES CELL.—An attempt to convert the chemical energy of carbon directly into electrical energy by consuming the carbon in a primary cell.

JAEGER CO., H. J.—280 Park Ave., Weehawken, N. J. Manufacturer of automobile headlights, spotlights, lamps and nitrogen lamps. Business established 1912. President, Herman J. Jaeger; vice-president, L. A. De Rosa; secretary and sales manager, R. H. Herschman; treasurer, M. J. Jaeger; general manager, H. J. Jaeger. Sales representatives, C. H. Wallis Co., St. Louis, Mo.; Faucett-Huston Co., Chattanooga, Tenn.; Wright & Lacy, San Francisco, Cal.

JAEHNIG GAS FIXTURE CO., INC.—221-223 13th Ave., Newark, N. J. Manufacturer of lighting fixtures.

JAGABI.—Trade name for tubular rheostats and hand tachometers manufactured by James G. Biddle, 1211-13 Arch St., Philadelphia, Pa.

JAICE CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution, in which the circulation of the mercury cathode is maintained by the use of compressed air.

JAMES MFG. CO., D. O.—1120 W. Monroe St., Chicago, Ill. Manufacturer of gears. President and treasurer, D. O. James; vice-president, H. O. James; secretary, A. James; general manager, A. J. Scovil.

J & B.—Trade name for ignition coils, commutators, carbon brushes, bushing tools, and ignition timers manufactured by the J & B Mfg. Co., 65 Eagle St., Pittsfield, Mass.

J & B MFG. CO.—65 Eagle St., Pittsfield, Mass. Manufacturer of ignition coils and timers, commutators, carbon brushes, bushing tools, etc. Business established 1912. President, Edward B. Jacobson; vice-president and sales manager, Floyd A. Knight; secretary, treasurer and general manager, George H. Southerd, Jr.

JANETTE MFG. CO.—556 W. Monroe St., Chicago, Ill. Manufacturer of motors, motor-generators, electric grinders and air compressors. Business established 1910. President and treasurer, John T. Janette; vice-president, E. A. Monast; secretary, and general manager, A. E. Klunder. Sales representative, D. W. Smith, 149 Broadway, N. Y.

JANNEY.—Trade name for electrically operated flotation machinery manufactured by the Stimpson Equipment Co., Felt Bldg., Salt Lake City, Utah.

JANSEN CLOCK CO., F. W.—Chicago, Ill. Manufacturer of electric alarm clocks. President, treasurer and general manager, F. W. Jansen; vice-president, R. Jansen; secretary, M. Jansen. Main office, 215 W. Randolph St., Chicago, Ill. Branch office, 149 Church St., New York, N. Y.

JANTZ & LEIST ELECTRIC CO.—Western Ave. & York St., Cincinnati, Ohio. Manufacturer of electric motors and generators. Business established 1897. Partnership, O. W. Jantz and William Leist.

JAPANNING OVENS.—See Ovens, electric, enameling and japanning.

JAPANS, ASPHALTIC, ETC.—Japan is used to finish many metal products and serves both as a protection against corrosion and as a decorative covering. Many japans have an asphaltic base and are black in color; when dry they have a hard surface and good luster. Japans are made which dry in air and others require baking; those that are baked or require the longest time to dry generally give the most durable finish. Many electrical appliances and products have a japan finish, such as fans, telephones, bell and relay box covers, many electric vehicles, etc.

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York, N. Y.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio.
Dielectric Mfg. Co., St. Louis, Mo.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo 926" (rubber, baking). A dense black japan which gives a rich dull rubber-like finish. Covers well in a very thin coat; adheres tenaciously to brass and to die castings. It will stand drawing.—"Hilo 928" (dull rubber, baking). Gives a rich dull rubber finish. The film is tough, elastic and durable. For use on telephone instruments, automobile switch panels, wood handles, etc. It does not rub to a gloss.—"Hilo 934" (finishing, black, baking). This represents the highest grade of black baking japan. Contains no pigment; produces a hard, tough, durable and highly lustrous finish. It is particularly suited for use on small motor casings. Work finished with "934" can be machined without dulling the finish.—"Hilo 943" (black, baking). A clear japan containing no pigment; it bakes with a jet-black durable film. For use on work that can be baked at 350° F. or over. An excellent japan for core plates, heavy castings, conduit fittings, switch panel boxes, etc. Also see advertisement on page 1318.—Adv.
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Products." (See display advertisement on page 1320.)
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."

JAPANS, WATER.—Baking japan, as it is ordinarily used in industry, consists of a base and solvent. The solvents in common use are naptha, benzine, kerosene, turpentine and similar products. The use of such solvents entails a considerable fire risk, especially in the oven in which the japanned materials are baked. To eliminate this fire risk "water japan" was developed. This consists of an emulsion of japan base in water. There are two methods of applying this emulsion: the "electric dip" for small odd jobs and the "hot dip" for large quantities. In the first method the water japan is put in an iron tank which is connected to the negative terminal of a d-c. circuit; the metal to be coated is connected to the positive terminal of the circuit. Since the globules of base in the water carry negative charges, the base will be deposited on the positively charged metal, so that this is covered with a thin, adherent film of japan base free from solvent. In the second method the metal to be japanned is placed in wire baskets and heated in an oven to about 500° F.; it is then cooled to about 400° F., and quickly plunged into the cold water japan. The japan base leaves the water and collects in a firm film on the surface of the metal.

JARS, BATTERY, GLASS.—Battery jars must be acid and chemical resisting. Glass was one of the first materials which was found satisfactory for this use and was used on almost all the old types of primary cells. The jars were either cylindrical or of square cross-section with a circular top. Glass jars are also used for storage or secondary cells, but due to their weakness are used only in the smaller sizes and where the jars are not subject to vibration or shock, as in small lighting plants, fire-alarm systems, testing laboratories, small telephone or telegraph exchanges, etc. The storage-battery jars are usually rectangular in cross-section but rounded at all corners to avoid internal strains in the glass.

Manufacturers:

Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Gayner Glass Works, Salem, N. J.
Swanlite Co., 300 10th St., S., Minneapolis, Minn.

JARS, BATTERY, RUBBER.—This type of jar is used for all storage batteries for automotive machines. The vibration and shocks to which batteries for that purpose are subject makes the employment of a material such as hard rubber a necessity. The jars are usually rectangular in cross-section and have a pair of bridges molded across the base for supporting the battery plates. They are made in various sizes for

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use in electric trucks, electric passenger vehicles, industrial trucks, automobile starting, lighting and ignition systems, tractors, etc. Rubber jars are also used for storage cells employed in other portable service and occasionally for cells used in stationary work, as in small farm lighting plants.

Manufacturers:

Ashbrook Electric Co., 4111 Ravenswood Ave., Chicago, Ill. "Ashbrook."
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y. "Champion."
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Luzerne Rubber Co., The, Trenton, N. J.
Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.
Stokes Rubber Co., Joseph, Trenton, N. J.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. Storage battery jars, made of highest grade specially compounded rubber. The "Inco" brand jar is the standard for



Rubber Battery Jars

many types of batteries including automobile starting and lighting, and electric vehicle batteries. The "India" brand jar is exceptionally high grade,



Rubber Battery Jars

and constructed to meet Government specifications. It renders satisfactory service under the most exacting conditions. "62-B" brand jars are as solid and tough as it is possible to make hard rubber. Their construction will easily withstand any known battery service condition.—Adv.

JARS, HYDROMETER.—When a simple hydrometer is used that is not of the syringe type, it is necessary to pour the liquid to be tested into a tall, narrow glass jar, so that the observation may be easily made. Such jars usually have a slightly enlarged base to give them stability and are made of clear glass of a diameter about 1½ ins. and a height of 9 to 12 ins.

Manufacturers:

General Scientific Equipment Co., North Philadelphia, Pa.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Standard Scientific Co., 9 Barrow St., New York, N. Y.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."

JARS, LEYDEN.—See Leyden jars.

JASCO.—Trade name for farm lighting and power plants and motor-generators manufactured by Julius Andrae & Sons Co., Broadway & Michigan Sts., Milwaukee, Wis.

J C.—Trade name for telegraph repeaters manufactured by the Jester-Cooper Co., Houston, Texas.

J. C. P.—Trade name for conduit caps manufactured by the C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.

J. C. P. CAPLETS.—Trade name for conduit fittings manufactured by James C. Phelps, Springfield, Mass.

J-D.—Trade name for steel lighting reflectors manufactured by the John Dunlap Co., Carnegie, Pa.

J-D.—Trade name for porcelain suspension and post type insulators manufactured by the Jeffery-Dewitt Insulator Co., 701 1st National Bank Bldg., Huntington, W. Va.

JEANDRON, W. J.—New York, N. Y. Manufacturer of carbon brushes. Main office, 229 Fulton St., New York, N. Y. Branch office, 634 Wabash Bldg., Pittsburgh Pa.

JEANETTE SHADE & NOVELTY CO.—Jeanette, Pa. Manufacturer of illuminating glassware. President, Thomas R. Crock.

JEANNIN ELECTRIC CO., THE.—110 11th St., Toledo, Ohio. Manufacturer of repulsion-induction motors. Business established 1919. President, treasurer and general manager, C. H. Clement; vice-president, H. W. Jeannin; secretary, M. C. Seeley.

JEFFERSON.—Trade name for pipe unions manufactured by the Jefferson Union Co., Lexington, Mass.

JEFFERSON ELECTRIC MFG. CO.—426-430 S. Green St., Chicago, Ill. Manufacturer of automotive equipment electrical specialties. Business established 1915 President and general manager, J. A. Bennan; vice-president, F. L. Hemsteger; secretary and sales manager, A. R. Johnson; treasurer, J. C. Daley.

JEFFERSON GLASS CO., THE.—Follansbee, W. Va. Manufacturer of illuminating glassware, portable lamps, etc. Business established 1907. President and treasurer, C. H. Blumenauer; vice-president, C. B. Roberts; secretary and sales manager, L. O. Griffith; general manager, A. B. Megraw. Main office and factory, Follansbee, W. Va. Branch office, 5 Wabash Ave., Chicago, Ill. Sales representatives, Lighting Studios, 220 W. 42nd St., New York, N. Y.; Frederick Skelton, 200 5th Ave., New York, N. Y.; H. S. Bokke, 122 W. Baltimore St., Baltimore, Md.; S. E. Wiedemer, 5822 Central St., Kansas City, Mo.

JEFFERSON UNION CO.—Lexington, Mass. Manufacturer of pipe unions.

JEFFERY-DEWITT INSULATOR CO.—701 1st National Bank Bldg., Huntington, W. Va. Manufacturer of porcelain and strain insulators. Business established 1915. President, Dr. J. A. Jeffery; vice-president, B. A. Jeffery; secretary and treasurer, M. C. Dewitt; acting manager, W. D A. Peaslee.

JEFFREY MFG. CO.—Columbus, Ohio. Manufacturer of electric coal mining machinery, locomotives, elevating, conveying and crushing machines. Business established 1877. President, J. A. Jeffrey; vice-presidents, J. W. Jeffrey, S. B. Belden, R. H. Jeffrey; secretary and treasurer, C. W. Miller; general manager, Robert H. Jeffrey; sales manager (Mining Dept.), J. H. Flory; sales manager (Material Handling Dept.), J. G. Ogden. Main office and factory, 1st Ave. & 4th St., Columbus, Ohio. Branch offices, Brown-Marx Bldg., Birmingham, Ala.; 1858 McCormick Bldg., Chicago, Ill.; 421 U. S. National Bank Bldg., Denver, Colo.; Western Indemnity Bldg., Dallas, Tex.; Middlesboro, Ky.; M & M Bldg. Milwaukee, Wis.; 50 Dey St., New York, N. Y.; 437 Leader-News Bldg., Cleveland, Ohio; 516 Union National Bank Bldg., Scranton, Pa.; 1126 Real Estate Trust Bldg., Philadelphia, Pa.; Farmers Bank Bldg., Pittsburgh, Pa.; Marine Trust Bldg., Buffalo, N. Y.; Railway Exchange Bldg., St. Louis, Mo.; 456 Book Bldg., Detroit, Mich.; 439 Herman St., W., Los Angeles, Cal.; Montreal, Que., Can.

JENARCO.—Trade name for sheet packing manufactured by the Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.

JENKINS BROS.—Philadelphia, Pa. Manufacturers of valves, packing and rubber specialties. Business established 1864. President, Farnham Yardley; vice-president, Frank T. Swain; secretary, W. Byron Rufe; treasurer, A. Eugene Brady. Main office, 133 N. 7th St., Philadelphia, Pa. Branch offices, 80 White St., New York, N. Y.; 524 Atlantic Ave., Boston, Mass.; 300 W Lake St., Chicago, Ill.

JERSEY.—Trade name for motor-driven ice-cream freezers manufactured by the Taylor Bros. Churn & Mfg. Co., 2951 N. Market St., St. Louis, Mo.

JESTER-COOPER CO.—Houston, Tex. Manufacturer of telegraph repeaters. A. T. Jester, owner.

JET CONDENSER.—A type of condenser in which the exhaust steam meets a jet or spray of water and is condensed. See Condensers, exhaust steam.

JEWEL.—Trade name for polishing wheels manufactured by the Eastern Felt Co., Winchester, Mass.

JEWEL.—Trade name for grease cups manufactured by the Lukenheimer Co., Cincinnati, Ohio.

JEWEL ELECTRIC & MFG. CO.—546 N. Broadway, Chicago, Ill. Manufacturer of electric dishwashers and fountains.

JEWELL.—Trade name for electrical measuring instruments manufactured by the Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill.

JEWELL.—Trade name for water filters manufactured by the New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.

JEWELL BELTING CO.—Hartford, Conn. Manufacturer of power transmission belting. Business established 1770. Main office and factory, Hartford, Conn. Branch offices 2837 S. LaSalle St., Chicago, Ill.; 2 Rector St., New York, N. Y.

JEWELL CHROME, JEWELL DIVER, JEWELL KING PHILIP.—Trade names for power transmission belting manufactured by the Jewell Belting Co., Hartford, Conn.

JEWELL ELECTRIC CO., THE.—Munsey Bldg., Baltimore, Md. Manufacturer of electric control devices. Business established 1911. President, J. C. M. Lucas; treasurer, H. P. Lucas; general manager, C. Jewell.

JEWELL ELECTRICAL INSTRUMENT CO.—1650 Walnut St., Chicago, Ill. Manufacturer of electrical measuring instruments. Business established 1903. President, O. Simpson; secretary and treasurer, R. Simpson; sales manager, J. T. Keeney. Sales representatives, B. B. Baseler, 1716 Sansom St., Philadelphia, Pa.; H. C. Biglin, 29 Poplar St., Atlanta, Ga.; Electrical Specialty Co., 325 State St., Detroit, Mich.; C. B Fall Co. Railway Exchange Bldg., St. Louis, Mo.; C. F. Henderson, Call Bldg., San Francisco, Cal.; Howard & Geeseka, Plymouth Bldg., Minneapolis, Minn.; More Electric Co., Gas & Electric Bldg., Denver, Colo.; Nixon-Kimmel Co., 167 S. Wall St., Spokane, Wash.; Verne W. Shear Co., 1422 W. 29th St., Cleveland, Akron, Youngstown, Ohio; Burton R. Stare Co., 325 Yesler Way, Seattle, Wash.; O. E. Thomas Co., 406 American Bank Bldg., Los Angeles, Cal.; Superior Engineering Co., 332 3rd Ave., Pittsburgh, Pa.; J-R Engineering Sales Co., Hartford, Conn.; Filer-Smith Machinery Co., 703 Confederation Life Bldg., Winnipeg, Man., Can.; Frank T. Groome, 1710 Royal Bank Bldg., Toronto, Ont., Can.

JEWELS, INSTRUMENT. — Electrical measuring instruments usually have their movable elements mounted on jewel bearings. The sapphire is the jewel mostly used for this purpose. See Bearings, jewel, for instruments.

JEWELS, SPECTACULAR LIGHTING.—These jewels are highly polished cut glass and cut into many prismatic forms. When they are studded in walls, plates, etc., they are sometimes given a paste backing to increase the reflection from their faces. They are used in special exterior lighting of towers and buildings, spectacular lighting in expositions, amusement parks, municipal festivals and similar occasions. When high-intensity beams of colored or clear light are played upon them the glitter of the light from their polished faces and the prismatic color effects produced by their cutting gives a pleasing spectacular effect.

Manufacturers:

Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y. "Crescent," "Porter."
Wallace & Co., J. D., 1401-17 Jackson Blvd., Chicago, Ill.

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JIB CRANES, ELECTRIC.—See Cranes, electric, miscellaneous.

JIFFY.—Trade name for current tap and twin socket manufactured by the Esler Electric Mfg. Co., Delphi & Western Aves., Marion, Ind.

JIFFY.—Trade name for adjustable cutters, loom clamps and other labor-saving devices distributed by Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.

JIFFY.—Trade name for box and cabinet cutter manufactured by the Universal Tool & Appliance Co., 373 Broadway, Milwaukee, Wis. (Exclusive distributor, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.)

JIFFY.—Trade name for porcelain knobs manufactured by the Trenton Porcelain Co., 803 E. State St., Trenton, N. J.

JIFFY.—Trade name for bowl hangers manufactured by the J. H. White Mfg. Co., 111 N. 3rd St., Brooklyn, N. Y.

J-M.—Trade name for fire extinguishers, etc., manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

JOBBERS, ELECTRICAL.—See Jobbing and jobbers of electrical supplies.

JOBBING AND JOBBERS OF ELECTRICAL SUPPLIES.—The electrical supply jobber, like any other kind of jobber, is an outgrowth of an economic condition through which it has been proved that certain manufacturers desiring national distribution of their products cannot attain such at as low a sales cost as a selected group of wholesale distributors who intensively "cover" comparatively small areas; nor can they maintain a sales force large enough to cover a territory equivalent to that reached by their jobbers at as reasonable an expense, nor assume the multitude of credit risks, nor carry over to the retail dealer that intimate, personal touch possible to be obtained by the jobber.

These and other similar truths having been recognized, the electrical supply jobber came into existence soon after the inception of the industry, though it was not until some years later when electrical apparatus was more fully developed, current generated cheaply and the public became imbued with the advantages of the uses of electricity, that his business began to acquire its present rate of rapid growth.

Since, in most instances, the jobber can distribute electrical wares and supplies through the dealer to the public at a lower cost than the manufacturer direct, it naturally follows that the jobber is an economic necessity, for nearly every human being wants or needs to buy at as low a price as possible. Thus has wide, economical and satisfactory distribution of electrical supplies been attained and the justification of the jobbing business established.

Development and Status. Electrical supply jobbing (or wholesaler distribution) is a business a little over 40 years old, the inception of this branch of the industry dating back to the year 1880 when the L. G. Tillotson Co. started in business in New York City jobbing telegraph and telephone supplies and instruments; while the Electrical Supply Co. of Chicago, operated by F. S. Terry, marks the introduction of the electrical jobber in the west.

From 1880 to 1895 a number of electrical jobbing houses started and then failed, some of which though still survive. Statistics seem to indicate, however, that the progress of the electrical supply jobbing field gained greater momentum between 1895 and 1900, during which period a large share of the jobbing institutions, operating today, were started.

Since the inauguration of this branch of the industry, upwards of 500 electrical concerns performing one or more of the functions of a jobber or wholesaler have come into existence, while there are approximately 300 hardware jobbers operating electrical departments. Many drug, mill and mine supply jobbers also operate electrical departments.

It has been estimated that in the year 1920 the aggregate business of the electrical jobbers in the United States amounted to between $400,000,000 and $425,000,000, making the average business done by the jobber between $800,000 and $850,000, though some of the larger electrical jobbers (excluding the Western Electric Co.) do a business of between $10,000,000 and $15,000,000 a year. Hardware jobbers, too, have been coming to the fore of late, some having done an electrical supply business of from $1,000,000 to $2,000,000 per year.

Between 30 and 35 jobbers throughout the country operate branch houses. In most cases these branches function as separate organizations, but report to and handle the same lines as the parent house. The largest such jobber has 45 branch houses, at least one of which is in nearly every state in the union.

It has been estimated that the electrical jobber, figuring on normal years, doubles his business every five years, thus making the average yearly increase 20%, though during the two years of the World War some jobbers doubled their business.

There are no authentic figures, showing the capital investment in the electrical supply jobbing field, but a sane estimate would place it at $75,000,000 or a trifle less.

In 1897 the first electrical supply jobbers' association was formed and between that year and 1909 (when the present Electrical Supply Jobbers' Association was organized) several such associations were attempted without much success. Franklin Overbagh of Chicago, was secretary of the first and subsequent organizations and has remained secretary to the present. (See Electrical Supply Jobbers' Association.)

Electrical supply jobbers are also formed into various other manufacturers' and territorial organizations. For instance: distributors of the Westinghouse Electric & Mfg. Co. have formed an organization known as the Westinghouse Agent-Jobbers Association, and distributors of the General Electric Co. are banded together in the General Electric Distributors' Club. Typical territorial organizations are the Missouri River Club, the Lake Erie Jobbers' Club and the Dixie Jobbers' Club, which consist of jobbers in the geographical locations that the names imply. These latter organizations usually meet quarterly at the various large jobbing centers.

There are upwards of 5100 jobbers' salesmen engaged in the selling of electrical supplies, this including only the purely electrical houses.

In rural districts the electrical contractors and dealers are visited by the jobbers' salesmen on an average of once every four weeks. City salesmen get around to their trade about once every two weeks. Salesmen operating in the city make eight to ten calls daily, whereas those operating outside of the large cities make an average of from five to eight calls daily. The total average cost of making such calls fluctuates between $3.00 and $3.50 each.

The electrical jobber's line comprises about 5000 different items, ranging from a lamp socket to large motors, other similar power apparatus, heating and labor-saving devices, etc. During the last five years his line has broadened perceptibly until now almost any conceivable electrical device may be obtained through him.

During the past year an innovation in the distribution of electrical specialties has come into being by the inauguration of several "electrical specialty jobbers." There are now three on record, namely: Commercial Electrical Supply Co., Detroit, Mich., Milner-Flower Electric Co., Buffalo, N. Y., and the Kimball Electric Co., New York City. This is still considered somewhat of an experiment, but those engaged in this enterprise have reported satisfactory results.

Jobbers in the past year have been coming to the fore with much good-will and other forms of advertising. Amounts known to have been spent range between $25,000 and $75,000 per year. The amount of jobber advertising is rapidly increasing and its effects have already been materially noticed.

The field covered by the electrical supply jobber consists principally of electrical contractors and dealers, central stations, industrial plants and telephone companies. Hardware, drug and department stores, handling electrical supplies, public and governmental institutions, office buildings, etc., also form a part of the jobbers' outlet.

Many wholesalers still operate retail stores, though this practice is fast being discontinued. About 65% of the jobbers still maintain retail stores.

A stock turnover of four or five times per year is what the average jobber enjoys at the present time. One jobber in the first six months of 1920 reported a stock turnover at the rate of 14½ times a year, but this is exceptional and includes mainly specialties.

The official organ or publication catering to the electrical supply jobber is "The Jobber's Salesman," which, as its name implies, is directed principally toward the salesmen themselves.

JOHNS-MANVILLE, INC.—New York, N. Y. Manufacturer of electrical insulating materials, cutout bases, fuses, fiber conduit, meter protective devices, tapes, etc. President and treasurer, T. F. Manville; vice-president, W. R. Seigle; vice-president and secretary, H. E. Manville. Main office, Madison Ave. & 41st St., New York, N. Y. Branch offices, Akron, Ohio; Albany, N. Y.; Atlanta, Ga.; Baltimore, Md.; Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Canton, Ohio; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Dallas, Tex.; Dayton, Ohio; Denver, Colo.; Des Moines, Iowa; Detroit, Mich.; Duluth, Minn.; El Paso, Tex.; Grand Rapids, Mich.; Great Falls, Mont.; Houghton, Mich.; Houston, Tex.; Indianapolis, Ind.; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Memphis, Tenn.; Milwaukee, Wis.; Minneapolis, Minn.; Nashville, Tenn.; Newark, N. J.; New Orleans, La.; Omaha, Neb.; Pittsburgh, Pa.; Philadelphia, Pa.; Portland, Ore.; Rochester, N. Y.; Sacramento, Cal.; Saginaw, Mich.; St. Louis, Mo.; St. Paul, Minn.; Salt Lake City, Utah; San Diego, Cal.; San Francisco, Cal.; Seattle, Wash.; Stockton, Cal.; Syracuse, Cal.; Tacoma, Wash.; Toledo, Ohio; Tulsa, Okla.; Washington, D. C.; Wilkes-Barre, Pa.; Youngstown, Ohio. Factories, Lockport, Manville, Milwaukee, Nashua, New Rochelle, New York, N. Y.; Riverdale, West Milwaukee, San Francisco. Mines, Asbestos, Que.; Crystotile, Ariz.

JOHNS-PRATT.—Trade name for molded insulation manufactured by the Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

JOHNS-PRATT CO., THE.—555 Capitol Ave., Hartford, Conn. Manufacturer of meter protective equipment, fuses, molded insulation and other electrical specialties. Business established 1886. Secretary and treasurer, Robert C. Buell. Exclusive distributor, The H. W. Johns-Manville Co. of New York, Madison Ave. & 41st St., New York, N. Y.

JOHNSEN & CO., ARTHUR.—4802 Fullerton Ave., Chicago, Ill. Manufacturer of fixture fittings. Sole owner, Arthur Johnsen.

JOHNSON.—Trade name for valves for hydraulic work manufactured by the William Cramp & Sons Ship & Engine Building Co., I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa.

JOHNSON.—Trade name for air-break switches manufactured by the Electro Service Co., Marietta, Ga.

JOHNSON.—Trade name for friction clutches and gears manufactured by the Carlyle Johnson Machine Co., 52 Main St., Manchester, Conn.

JOHNSON.—Trade name for oil filters manufactured by the John Johnson Co., 37th St. & 2nd Ave., Brooklyn, N. Y.

JOHNSON.—Trade name for electric washing machines manufactured by the Johnson Electric Washer Co., Emeryville, Cal.

JOHNSON.—Trade name for motors manufactured by the Phonograph Motors Corp., 341 N. Crawford Ave., Chicago, Ill.

JOHNSON.—Trade name for electric buffers made by the U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.

JOHNSON AUTOMATIC SEALER CO., LTD.—Battle Creek, Mich. Manufacturer of motor-driven packaging and wax wrapping machines.

JOHNSON CO., JOHN.—37th St. & 2nd Ave., Brooklyn, N. Y. Manufacturer of oil filters. Business established 1878. President, treasurer and general manager, John Johnson; sales manager, J. Homer Stover.

JOHNSON ELECTRIC WASHER CO.—Emeryville, Cal. Manufacturer of electric washing machines. Business established 1911. President and general manager, C. P. Johnson; vice-president, D. E. Coakley; secretary, J. H. Kraus; treasurer, E. M. Johnson.

JOHNSON FAN & BLOWER CO.—115 S. Clinton St., Chicago, Ill. Manufacturer of ventilating fans and blowers. President and general manager, A. J. Johnson; secretary and treasurer, John C. Burg.

JOHNSON FARE BOX CO.—4619 Ravenswood Ave., Chicago, Ill. Manufacturer of street car fare boxes.

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JOHNSON, GEORGE F.—625 Black Ave., Springfield, Ill. Manufacturer of static radio condensers.

JOHNSON LUMBER CO., A. C.—Bemidji, Minn. Manufacturer and producer of insulating lumber and poles. Business established 1915. President, A. C. Johnson; vice-president, Thomas S. Ervin; secretary, H. L. Huffman.

JOHNSON MACHINE CO., THE CARLYLE.—52 Main St., Manchester, Conn. Manufacturer of gasoline engines, friction clutches, gears, etc. Business established 1902. President, John Stambaugh; vice-president, R. C. Steese; secretary, treasurer and general manager, S. H. Simon; sales manager, W. I. Keith.

JOHSON TIN FOIL & METAL CO.—6030 S. Broadway, St. Louis, Mo. Manufacturer of tinfoil for electrical purposes. John L. Boyle, sales manager.

JOHNSTONE.—Trade name for blow-off valves manufactured by the Crosby Steam Gage & Valve Co., Boston, Mass.

JOINT.—A junction by which any two parts are united or, specifically, the point at which the junction is made. Electrical joints should have mechanical strength and good conductivity. Joints in conductors are usually soldered to improve their conductivity, or they are provided with special connectors giving the equivalent of a soldered joint.

JOINT, INSULATING, UNDERGROUND TELEPHONE CABLE.—Underground cable often carries stray current from power circuits. Sometimes bonding can not remove all of it. Then an insulating joint is put in to break up the current or keep it where it will do the least harm. The lead sheath is broken, but the moisture prevented from entering the core by suitable nonmetallic substances.

JOINT RESISTANCE, RELUCTANCE, CONDUCTANCE, ETC.—The resulting resistance when several separate resistances are connected in parallel is called the joint resistance of the combination. The same term is applied to combinations of admittances, reluctances, conductances, capacitances, etc., giving joint admittance, joint reluctance, joint conductance, joint capacitance, respectively.

JOINTLESS FIRE BRICK CO.—1130 Clay St., Chicago, Ill. Manufacturer of fire brick.

JOINTS, CABLE, SPLICING.—There are several forms of cable-splicing joints for single and multiple-conductor and concentric cables. With one form the two stranded ends of the cables to be joined are meshed like the bristles of two brushes, and the connector in the form of a split ring is slipped over this junction. By hammering the joint in a splicing tool the strands are forced together and the connector is wrapped around the joint until it forms a tight-fitting sleeve which gives good contact. Other forms have a split compression sleeve which is driven together by clamping members forced on from both ends, or a sleeve in which the pressure is applied by wedges. There are also joints specially arranged to provide as high a degree of insulation at the splice as anywhere else along the cable; some of these include special barriers between, or insulating cells around, the conductors. The paper sleeves used for insulating the conductors of telephone and telegraph cables are listed under Sleeves, paper, for cable conductors. For the outer lead sleeves see Sleeves, cable splicing, lead. The general process of jointing is described under Cable jointing.

Manufacturers:

American Mine Door Co., The, Canton, Ohio.

Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."

Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Matthews."

METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.

Mica Insulator Co., 68 Church St., New York, N. Y. "Conducell."

Mica Insulator Co., Victoriaville, Que., Can.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

JOINTS, FIBER CONDUIT.—See Bends, elbows and other fittings, fiber conduit.

JOINTS, FIXTURE INSULATING.—All combination gas and electric fixtures, also straight electric fixtures attached to metal ceilings or walls containing metal lath, and ungrounded electric fixtures must be effectively insulated from the gas piping and metal ceilings, etc. This is done by inserting a small coupling, called an insulating joint, between the fixture and the piping or metal work to which it is attached. This joint may consist of a molded insulating part in which threaded metal coupling inserts are secured.

Manufacturers:

Best Electric Corp., 476 Broadway, New York, N. Y.

MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

JOINTS, MISCELLANEOUS, INSULATING.—Besides the insulating joints separately listed there are several types designed for special uses, such joints as insulated ball and socket fixture joints, and insulated couplings for small rods and pipe.

Manufacturers:

MACALLEN CO., THE, 16 Macallen St., Boston, Mass.

JOINTS, RAIL.—The name applied to the fastening used for holding in proper position the abutting ends of two adjoining rails. There are a great variety of such joints, but they usually fall under two general heads, welded joints and mechanical joints. Welded joints unite the two ends into one homogeneous piece by means of intense heat usually applied through molten metal or by means of the electric current. (See Welding, rail.) Mechanical joints usually hold the rail in place by means of plates at the sides or under the base of the rail, frequently both, such plates being fastened together or to the rail by means of some combination of bolts, rivets or wedges. There are a large number of patented joints on the market for each of which some particular advantage is claimed.

Manufacturers:

Atlas Railway Supply Co., 1526 Manhattan Bldg., Chicago, Ill. "Atlas."

Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.

Indianapolis Switch & Frog Co., Springfield, Ohio. "Apex," "Simplex."

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Q & C Co., The, 90 West St., New York, N. Y. "Q & C."

Rail Joint Co., The, 61 Broadway, New York, N. Y.

Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

JOINTS, RAIL, INSULATED.—It is frequently necessary to insulate adjoining sections of rail, especially in block signaling systems. For this purpose instead of using an ordinary rail joint, a special insulated joint is employed. Such joints are of several patented designs, in several cases making use of fiber sheets or plates between the fish plates and the rails. To keep the ends of the abutting rails from coming into electrical contact fiber plates approximately the same section as the rail are introduced. The bolts are also insulated by being surrounded by insulating bushings. In some cases specially treated wood has been used instead of fiber.

Manufacturers:

Rail Joint Co., The, 61 Broadway, New York, N. Y.

JOINTS, WIRE, SELF-WELDING.—These are sleeves into which the wires are inserted and twisted. After twisting the sleeve fits very tightly on the wires and forms a joint very similar to a soldered joint. The sleeve is made up of two parallel tubes joined together so as to make a cross-section of figure 8 shape, the wall joining the tubes being only partially closed. Twisting closes this joint and holds the sleeve very snugly over the wires. They are sometimes called self-soldering wire joints.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.

Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."

JOIST BORING MACHINES.—See Boring machines or devices, ceiling, joist and wall.

JOKERS, FIRE-ALARM SYSTEM.—Combination relays used in conjunction with large fire-alarm systems to operate both registers and sounders in the transmission of fire-alarm signals. The instrument operates in connection with a time and station-recording device and a gong sounder so that not only is the alarm signal given but a record taken giving the exact time of the call and the station or box from which the call came.

Manufacturers:

Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.

JONES.—Trade name for gear speed reducers manufactured by the W. A. Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.

JONES.—Trade name for oil engines manufactured by the Jones Oil Engine Corp., 805-17 Free St., Syracuse, N. Y.

JONES.—Trade name for wood vehicle wheels manufactured by Phineas Jones & Co., Inc., Newark, N. J.

JONES & CO., INC., PHINEAS.—Newark, N. J. Manufacturer of wood wheels for vehicles. Business established 1855.

JONES & MOORE ELECTRIC CO., LTD.—296 Adelaide St., West, Toronto, Ont., Can. Manufacturer of motors, generators, etc. President, J. W. Jones; vice-president and general manager, F. B. Moore.

JONES CO., A. E.—819 W. Diamond St., N. S., Pittsburgh, Pa. Manufacturer of electric signs.

JONES FOUNDRY & MACHINE CO.—4401 W. Roosevelt Rd., Chicago, Ill. Manufacturer of friction clutches, gears, and other power transmission appliances. President, W. A. Jones; vice-president, W. G. Jones; secretary and treasurer, T. A. Jones.

JONES-MOTROLA, INC.—New York, N. Y. Manufacturer of electric phonograph motors, tachometers, odometers, etc. Business established 1915. President, J. W. Jones; secretary and general manager, C. E. Rees; treasurer, Robert Graves. Main office and factory, 29 W. 35th St., New York, N. Y. Branch offices, 57 E. Jackson Blvd., Chicago, Ill.; 315 S. Broadway, Los Angeles, Cal.

JONES OIL ENGINE CORP.—805-17 Free St., Syracuse, N. Y. Manufacturer of oil engines. President, N. Howard Woof; vice-president, W. R. Swartz; secretary, H. H. Farmer; treasurer, Arthur A. White.

JONES TOOL CO.—1912 Van Buren Rd., Cleveland, Ohio. Manufacturer of conduit and pipe bending machines and boring machines. Secretary, C. F. Jones; general manager, L. W. Jones.

JORDAN BROS., INC.—74 Beekman St., New York, N. Y. Manufacturer of commutator truing devices.

JOSLYN MFG. & SUPPLY CO.—Chicago, Ill. Manufacturer of pole-line construction material. Business established 1902. President, M. L. Joslyn; vice-president, B. S. Handwork; secretary and treasurer, A. G. Jarmin; sales manager, R. C. Boozer. Main office, 133 W. Washington St., Chicago, Ill. Factories, Chicago, Ill.; Macomb, Ill.; Centralia, Wash.; McCormick, Wash.; Hattiesburg, Miss. Branch offices and warehouses, Kansas City, Mo.; St. Paul, Minn.; New York, N. Y.; New Orleans, La.; Los Angeles, Cal.; San Francisco, Cal.; Seattle, Wash.

JOST.—Trade name for horn switch manufactured by Frank W. Morse, 291 Congress St., Boston, Mass.

JOULE.—If the dyne-seven, which is 10^7 dynes, is taken as the unit of force, then the joule may be defined as the work done by a dyne-seven moving or acting through a distance of one centimeter. A more common definition is that a joule equals 10^7 ergs. In an electric circuit a joule is the work done by a coulomb (or unit quantity) of electricity acting against a volt (or unit potential); the joule is sometimes called the volt-coulomb and equals one watt-second.

JOULE, JAMES PRESCOTT.—An English physicist, born in 1818, died 1889. He was the first to ascertain the mechanical equivalent of heat, devoting nearly 40 years of his life to its determination. He made many important researches in the fields of electricity and thermodynamics, and stated a law, which has been named after him, for determining the relation between heat and the current producing it. In 1847 he also stated the law of con-

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servation of energy. The practical unit of electrical energy has been named after him.

JOULE'S LAW.—A law stated by Joule relating to the power loss in conductors containing ohmic resistance only and no counter electromotive forces. This is stated symbolically as follows: $P=I^2R$ or $P=E^2g$, where P=power loss in watts; I=current in amperes; R=resistance in ohms; E=voltage drop=IR; g=conductance in mhos=1/R. Also see Power loss in conductors.

JOURNAL.—The part of a rotating shaft that rests in a bearing is called the journal.

JOURNAL BOX.—The journal box, also called bearing sleeve, is the bushing, sleeve, box or shell within which the shaft rotates. The term journal box is more particularly applied to the box in which the journal of a car-truck axle is housed. See Boxes, journal.

JOURNALS, ELECTRICAL.—There are quite a number of technical and trade journals covering various branches of the electrical industry. A complete list of American and Canadian electrical journals having a national or international circulation is given under Periodicals, electrical.

JOVE.—Trade name for dry batteries, radio detectors, telegraph keys and fire alarm boxes manufactured by J. H. Bunnell & Co., 32 Park Place, New York, N. Y.

JOVE.—Trade name for show window reflectors manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

JOVIAN ORDER.—A fraternal organization of men connected with the electrical industry. The original name was Sons of Jove. The order has recently been reorganized. Its presiding officer is called Jupiter and the secretary is called Mercury. The officers for 1921 are: Arthur J. Binz, Houston, Tex., Jupiter; Ell C. Bennett, Syndicate Trust Bldg., St. Louis, Mo., Mercury.

JOYCE.—Trade name for all kinds of jacks made by the Joyce-Cridland Co., Linden Ave., Dayton, Ohio.

JOYCE-CRIDLAND CO., THE.—Dayton, Ohio. Manufacturer of all kinds of jacks. Business established 1873. President and treasurer, W. F. Bippus; vice-president, J. M. Sweitzer; secretary, H. W. Pearce; sales manager, Harry Brock. Main office, Linden Ave., Dayton, Ohio. Branch office, Grand Central Palace, New York, N. Y. Sales representatives, Crerar-Adams & Co., 259 E. Erie St., Chicago, Ill.; F. E. Palmer Supply Co., St. Louis, Mo.; Lippincott-Beall & Co., Los Angeles, Cal., San Francisco, Cal.

J-P BAKELITE.—Trade name for molded insulation manufactured by the Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

J-P CONDENSITE.—Trade name for molded insulation manufactured by the Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

JUDD CO., H. L.—87 Chambers St., New York, N. Y. Manufacturer of bridle rings.

JUDD LAUNDRY MACHINE CO.—122 S. Michigan Ave., Chicago, Ill. Manufacturer of electric washing machines. Business established 1910. President, treasurer and general manager, Alfred L. Lindsey; vice-president, Clarence Bridge; secretary, James B. Gascoigne.

JUDSON GOVERNOR CO., THE.—Rochester, N. Y. Manufacturer of engine governors. President, Junius R. Judson; vice-president and general manager, Frank X. Cullinan; secretary and treasurer, John D. Hall.

JUICE EXTRACTORS.—See Extractors, motor-driven.

JUMBO.—Trade name for hydrometer syringes manufactured by E. Edelmann & Co., 2638-56 N. Crawford Ave., Chicago, Ill.

JUMBO.—Trade name for lamp lowering pulleys manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

JUMP SPARK.—A spark resulting from a sudden discharge between two bodies. This principle is employed largely in ignition systems. See Igniters, electric, internal-combustion engine.

JUMPER.—A jumper is a short length of wire or cable used to make a connection between terminals or around a break in a circuit, or around an instrument. It is usually a temporary connection.

JUMPER, TELEPHONE.—A jumper is a cross-connecting wire on a distributing frame, provided to give flexibility in the connections. The term jumper is also sometimes applied to a more or less temporary connecting wire in other parts of the circuit.

JUMPERS FOR ELECTRIC TRAINS AND TRAILERS.—Multiple-conductor flexible cables used for carrying electrical connections, such as for heat, light and control circuit wires between cars of a train. They are heavily insulated and provided with terminal plugs that fit into receptacles on the ends of the cars. The plugs have metal protecting casings. Also see Receptacles for trailer or train jumpers.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display advertisement on pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Consolidated Car Heating Co., Albany, N. Y.
CROUSE-HINDS CO., Wolf & 7th Sts., North Syracuse, N. Y. "Condulet."
DELTA-STAR ELECTRIC CO., 2463-53 Fulton St., Chicago, Ill.
Dossert & Co., 242 W. 41st St., New York, N. Y.
Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa. "Keystone."
Loeffelholz & Co., 170-182 Clinton St., Milwaukee, Wis. "Gibbs."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

JUNCTION BOXES, CABLE.—See Boxes, cable junction.

JUNCTION BOXES, CONDUIT.—See Boxes, conduit, junction and pull; Boxes, marine, outlet and junction.

JUNCTION BOXES, METAL RACEWAY OR MOLDING.—See Boxes, metal molding or raceway, outlet and junction.

JUNGNER CELL.—A gas cell in which the e.m.f. was obtained from the combination of oxygen and sulphur dioxide.

JUNIOR.—Trade name for wiring devices manufactured by the Bryant Electric Co., Bridgeport, Conn.

JUNIOR.—Trade name for bell-ringing transformers manufactured by the Jefferson Electric Mfg. Co., 426-430 S. Green St., Chicago, Ill.

JUNIOR.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

JUNIORPHONE.—Trade name for toy telephone set manufactured by the American Thermophone Co., 114-116 Bedford St., Boston, Mass.

JUPITER.—Trade name for show window lighting reflector manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

JUPITER.—Trade name for belted farm lighting and power plants and generators manufactured by the Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill.

JUST RIGHT.—Trade name for incandescent lamp guard manufactured by the Standard Wire Co., New Castle, Pa.

JUTE ROPE, TWINE AND YARN.—Jute is a coarse fiber of an East Indian plant. It is used for making twine, yarn and rope. In electrical work it is used as an insulating material, especially in the construction of cables; where several large conductors are used in a cable it is employed as a filler to build up the cable so that a circular covering may be used. It is usually saturated with some insulating material before being used.

Manufacturers:

Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Fulton Bag & Cotton Mills, Atlanta, Ga.

K

K.—The small letter k or the Greek letter K (kappa) is used as the symbol for magnetic susceptibility. The form K is widely used to designate a constant in general formulas.

KABLAK.—Trade name for varnished cloth and paper manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

KAESTNER & HECHT CO.—Chicago, Ill. Manufacturer of electric passenger and freight elevators and elevator safety devices. Business established 1863. President, Frank A. Hecht, Jr.; vice-president and secretary, R. Brenne; treasurer, J. L. Kind; sales manager, H. W. Balfanz. Main office and factory, 500 S. Throop St., Chicago, Ill. Branch offices, Detroit, Mich.; Milwaukee, Wis.; Birmingham, Ala.

KAETKER SAW MACHINE CO.—Cincinnati, Ohio. Manufacturer of motor-driven saws.

KAISER KLOCK KOMPANY, L. E.—134 W. Fayette St., Baltimore, Md. Manufacturer of electric clocks. Business established 1908. L. E. Kaiser, sole owner.

KALAMAZOO RAILWAY SUPPLY CO.—Kalamazoo, Mich. Manufacturer of track gages, drills, levels and other track equipment. President, J. McKinnon; vice-president, C. A. Peck; vice-president and general sales manager, F. E. McAllister; secretary, W. N. Sidnam.

KALBFLEISCH CORP., THE.—New York, N. Y. Manufacturer of sulphuric acid for battery purposes. President, H. L. Derby; vice-president and treasurer, A. B. Savage; secretary, A. C. Kalbfleisch. Main office, 31 Union Sq., West, New York, N. Y. Branch offices, Brooklyn, N. Y.; Waterbury, Conn.; Providence, R. I.; Danbury, Conn.; Erie, Pa.; Elizabeth, N. J.; Paterson, N. J.; Newark, N. J.; Chattanooga, Tenn.

KALES STAMPING CO.—Detroit, Mich. Manufacturer of metal stampings for electrical manufacturers. President, William R. Kales; vice-president, James T. Whitehead; secretary and treasurer, J. Frazer Whitehead. Main office, 1657-87 W. Lafayette Blvd., Detroit, Mich. Branch office, Walkerville, Ont., Can.

KALLAJIAN MFG., L. S.—1930 Washington St., Boston, Mass. Manufacturer of desk telephone brackets.

KALORIC.—Trade name for piston packing manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

KAM-LOK SWITCH BOX CO.—417 W. 35th St., New York, N. Y. Manufacturer of switch boxes.

KANAWHA MFG. CO.—Charleston, W. Va. Manufacturer of electric coil mining equipment. President, M. T. Davis, Jr.; secretary, E. H. Jones; treasurer, C. E. Parks.

K & B CO.—495-497 N. 3rd St., Philadelphia, Pa. Manufacturer of portable elevators, magnets and magnetic ore separators. Business established 1888. President, Richard L. Bender; general manager, Joseph C. Merkel.

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K & C.—Trade name for radio apparatus manufactured by the Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash.

K. & D.—Trade name for electric fans, motors, generators and medical coils manufactured by the Kendrick & Davis Co., Lebanon, N. H.

K. & G. WIRELESS SUPPLY CO.—152 Chambers St., New York, N. Y. Manufacturer of radio equipment. Business established 1919. President, E. J. Kilduff; general manager, O. S. Garry.

K. & W.—Trade name for carbon brushes manufactured by the John F. Walsh Co., 170 North St., Pittsfield, Mass.

KANSAS CITY BOLT & NUT CO., THE.—Kansas City, Mo. Manufacturer of pole-line hardware. Business established 1888. President, George T. Cook; vice-president and general manager, Solomon Stoddard; secretary, Lewis L. Middleton; treasurer, Howard R. Warren; sales manager, Ernest Baxter.

KANSAS CITY SCENIC CO.—1002 E. 24th St., Kansas City, Mo. Manufacturer of border lights, spotlights and other electrical stage equipment. President, B. F. Dunn; treasurer and manager, J. C. Bronaugh; G. L. Bronaugh.

KANSAS INDEPENDENT TELEPHONE ASSOCIATION.—President, T. L. Youmans, Osawatomis, Kans.; secretary, L. M. Kraege, Topeka, Kans.

KANSAS PUBLIC SERVICE ASSOCIATION.—Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kans.

KANSAS STATE ELECTRICAL CONTRACTORS' AND DEALERS' ASSOCIATION.—Secretary, H. S. Lee, 816 Kansas Ave., Topeka, Kans.

KANT-LEAK.—Trade name for grease cups manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

KANTSHOK.—Trade name for safety switches manufactured by the Lewis Electric Co., 753 Patterson Ave., S. W., Canton, Ohio.

KAOLIN.—Kaolin is a white china clay composed principally of the mineral kaolinite, known as hydrous silicate of aluminum. Kaolin is one of the principal materials used in the manufacture of porcelain. It is highly refractory and is used largely for lining electric ovens and as a base for heating units in electric ranges. Although its principal use in the electrical industry is as a thermal insulator, it is also used as an electrical insulator in places of high temperature, such as the inner linings of electric furnaces, etc.

KAPLAN, INC.—1243 S. Wabash Ave., Chicago, Ill. Manufacturer of floor lamps and lamp shades. President, A. Jacobs; vice-president and general manager, M. Kaplan; secretary and treasurer, N. Spiro.

KAPOTA ELECTRIC MACHINES SALES CO., HYMAN.—25 W. 42nd St., New York, N. Y. Manufacturer of violet-ray high-frequency apparatus. Business established 1910. Sole owner, Hyman Kapota.

KAPSA, RUDOLPH.—2320 S. Kedzie Ave., Chicago, Ill. Manufacturer of electric lighting fixtures. President and treasurer, James Polka; secretary, Otto Prusa.

KARBOLITH.—Trade name for composition car flooring made by the American Mason Safety Tread Co., 125 Perry St., Lowell, Mass.

KARMA.—Trade name for resistance material manufactured by the Electrical Alloy Co., Morristown, N. J.

KARRY-LODE INDUSTRIAL CO., INC.—Long Island City, N. Y. Manufacturer of industrial trucks. Main office, 100 National Ave., Long Island City, N. Y. Branch office, 140 S. Dearborn St., Chicago, Ill.

KARGE-BAKER CORP.—Phoenix, N. Y. Manufacturer of flexible shaft couplings. Business established 1918. President, E. H. Baker; vice-president, Maxwell R. Karge; secretary, Oliver D. Burden; treasurer, Charles F. Loomis.

KATIE FOUNDRY, THE.—Galt, Ont., Can. Manufacturer of fixture crowfeet. J. R. Fergusson, manager.

KAYESS.—Trade name for electro-therapeutic and X-ray apparatus manufactured by the Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.

KAY-KAY KONTROLLER.—Trade name for switch for oven lights manufactured by the Koening-Keller Co., Lancaster, Pa.

KAYLINE CO., THE.—600 Huron Rd., Cleveland, Ohio. Manufacturer of lighting fixtures. B. F. Klein, owner.

KAZOO.—Trade name for motors manufactured by the Warner Electric Co., Kalamazoo, Mich.

K.B.—Trade name for loom clamps manufactured by J. H. Parker & Son, Parkersburg, W. Va.

K-B PULVERIZER CO., INC.—92 Lafayette St., New York, N. Y. Manufacturer of electric coal pulverizers.

K-C.—Trade name for entrance switches and plug and panel cutouts manufactured by the King-Craymer Electric Mfg. Co., 32 Haviland St., South Norwalk, Conn.

K-D.—Trade name for automobile lamps manufactured by the K-D Lamp Co., 108-12 W. 3rd St., Cincinnati, Ohio.

K-D LAMP CO., THE.—108-12 W. 3rd St., Cincinnati, Ohio. Manufacturer of automobile lamps. President, E. W. Driemeyer; vice-president, C. C. Clark; secretary and treasurer, H. R. Kerans.

K-E.—Trade name for fuses, cutouts, cleat receptacles and ground clamps made by the Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y.

KEARSARGE.—Trade name for gasket packings manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

KEASBEY & MATTISON CO.—Ambler, Pa. Manufacturer of asbestos yarn, cloth, tape, etc. President, Dr. R. V. Mattison; vice-president and general manager, R. V. Mattison, Jr.; treasurer, U. G. Funk; secretary, M. J. Hoover. Main office and factory, Ambler, Pa. Branch offices, Atlanta, Ga.; Baltimore, Md.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Minneapolis, Minn.; New York, N. Y.; Pittsburgh, Pa.; Philadelphia, Pa.; Washington, D. C.; Wilmington, Del.; Detroit, Mich.; Wilkes-Barre, Pa.

KEELER CO., E.—Williamsport, Pa. Manufacturer of water-tube and fire-tube boilers and accessories. Business established 1864. President, C. La Rue Munson; vice-president, Isaac Barton; secretary, S. A. Comson; treasurer, F. T. Moore; sales manager, E. G. Wein. Main office and factory, Williamsport, Pa. Branch offices, Boston, Mass.; Philadelphia, Pa.; Pittsburgh, Pa.; Buffalo, N. Y.; 111 W. Monroe St., Chicago, Ill.

KEEN.—Trade name for electric hair wavers made by the Permanent Wave Machine & Supply Co., 465 Greenwich St., New York, N. Y.

KEENAN STRUCTURAL SLATE CO.—Bangor, Pa. Manufacturer of slate for electrical purposes.

KEENE MICA PRODUCTS CO.—Keene, N. H. Manufacturer of mica and mica products. President, L. L. Howard; treasurer, D. Waling.

KEEPER.—The armature of an electromagnet is sometimes called its keeper. The term is also applied to a short bar of iron placed across the poles of a horseshoe magnet to prevent loss of magnetism.

KEITH MFG. CO., INC.—Clinton, N. Y. Manufacturer of adjustable lighting fixtures and reading lamps. Business established 1916. President, W. V. Keith; secretary and treasurer, H. M. Keith. Sales representative, International Mercantile Sales Co., 110 W. 40th St., New York, N. Y.; John Peterson, 567 36th St., Milwaukee, Wis.

KEITH PROCESS.—One of the early attempts in the leaching and electrodeposition of copper. The name is also applied to an early unsuccessful attempt in the electrolytic refining of lead.

KELDON.—Trade name for commercial lighting reflector manufactured by the Ivanhoe Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

KELEKET QUALITY.—Trade name for X-ray apparatus manufactured by the Kelley-Koett Mfg. Co., Inc., Covington, Ky.

KELLER FURNACE.—An electric furnace of the open-shaft type, designed for the production of ferro-alloys.

KELLER MECHANICAL ENGRAVING CO.—70 Washington St., Brooklyn, N. Y. Manufacturer of automatic die and mold cutting machines. Business established 1896. President, Sidney A. Keller; vice-president and sales manager, Jules Dierckx; secretary, treasurer and general manager, Joseph F. Keller. Sales representatives, Motch & Merryweather Machinery Co., Cleveland, Ohio; Cincinnati, Ohio; Detroit, Mich.; Pittsburgh, Pa.; Robert W. Hoffman Co., 15 S. Clinton St., Chicago, Ill.; Henry Prentiss & Co., 149 Broadway, New York, N. Y.

KELLEY.—Trade name for electrometric titration apparatus manufactured by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Exclusive distributor, Arthur H. Thomas Co., W. Washington Sq., Philadelphia, Pa.

KELLEY ELECTRIC MACHINE CO.—111-119 Dearborn St., Buffalo, N. Y. Manufacturer of floor surfacing, finishing and cleaning machines and routers. President, C. Townsend Wilson; vice-president, secretary and treasurer, Theodore C. Knight; sales manager, L. R. DeCoux.

KELLEY-KOETT MFG. CO., INC., THE.—Covington, Ky. Manufacturer of X-ray apparatus.

KELLNER CELL.—A cell for the manufacture of hypochlorite by electrolysis of alkali-chloride solution. There are two types, the vertical and the horizontal cells. The former is a tall earthenware trough divided into vertical compartments by glass plates, which are wound with platinum-iridium wire and constitute bipolar electrodes. The brine is pumped in at the bottom from a supply tank containing cooling coils, and after flowing through the electrolyzing compartments falls back into the tank, circulation continuing until the desired strength is reached. The horizontal type is similarly constructed with terraced horizontal compartments and with the anodic half of the bipolar electrodes near the bottom of the cell and the cathodic half above the anode.

KELLOGG MFG. CO.—3 Circle St., Rochester, N. Y. Manufacturer of motor-driven air compressors and electric air pumps. Business established 1909. President and general manager, Joseph F. Weller; secretary and treasurer, Mortimer R. Anstice; sales manager, John Conolly. Sales representatives, Charles S. Monson, Detroit, Mich., and 1118 S. Michigan Ave., Chicago, Ill.; E. E. Kirk, Toledo, Ohio.

KELLOGG SWITCHBOARD & SUPPLY CO.—Chicago, Ill. Manufacturer of telephones, switchboards and other telephone equipment. President, J. B. Edwards; vice-president, J. G. Kellogg; secretary and treasurer, S. Guthrie; sales manager, G. D. Wolf. Main office and factory, Adams and Aberdeen Sts., Chicago, Ill. Branch offices, 86 3rd St., San Francisco, Cal.; 407 Broadway, Kansas City, Mo.; 111 N. Front St., Columbus, Ohio.

KELLY ELECTRIC WIRE CO.—Grand Haven, Mich. Manufacturer of weather-proof wire. Business established 1921. Partnership, Thomas F. Kelly and Paul J. Kelly.

KELLY MFG. CO., L. J.—307 N. Pearl St., Albany, N. Y. Manufacturer of cable reel and other jacks. Business established 1892.

KELMAN ELECTRIC & MFG. CO.—1650 Naud St., Los Angeles, Cal. Manufacturer of circuit breakers and high-tension switches. President, J. N. Kelman; vice-president, G. A. Miller; secretary, F. B. Drew; treasurer, G. H. Kelman; general manager, J. N. Kelman.

KELVIN BALANCE.—The Kelvin balance, devised by Lord Kelvin, is an electrodynamometer type of instrument for measuring current. In this instrument the forces of attraction and repulsion are actually weighed, as in an ordinary balance. A pair of coils are placed on the ends of a delicately supported beam. Two stationary coils are also placed at each end, one under and one above the movable coils. They are so connected that when current flows through the coils the beam is attracted in a downward direction at one end and upward at the other end. These forces are balanced or weighed by means of weights on the beam. The Kelvin balance may also be used to measure voltage; in this case it usually has a high resistance in series with the balance. It may be used for measuring power or wattage as well by making the stationary coils serve as the potential element and the movable ones the current element, or the reverse. Also see Electrodynamometers.

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KELVIN, LORD.—See Thomson, Sir William.

KELVINATOR.—Trade name for electric household refrigerators made by the Kelvinator Corp., 2051 Fort St., W., Detroit, Mich.

KELVINATOR CORP.—2051 Fort St., W., Detroit, Mich. Manufacturer of electric household refrigerators. Business established 1914. President and general manager, E. J. Copeland; vice-president, U. R. Loranger; secretary, H. W. Bailey; treasurer, A. H. Goss; sales manager, E. E. Longenecker.

KELVIN'S LAW.—A law relating to the economical selection of a conductor, deduced by Sir William Thomson (Lord Kelvin) in 1881. It has been slightly modified and is now stated as follows: "The most economical area of a conductor is that for which the annual cost of energy wasted is equal to the interest on that portion of the capital outlay which can be considered proportional to the weight of copper used." From this law it can be shofn that

$$\text{cir. mils} = 55{,}867 \times I \times \sqrt{C_e/(C_c \times A)}$$

in which cir. mills = the area in circular mils of the most economical conductor; I=the mean annual current; C_e=cost of energy per kw-hr. in dollars; C_c=cost of copper in dollars per pound installed; A= annual charge in per cent on the cost of the conductor.

KEMCO.—Trade name for automobile lighting and starting generators manufactured by the Kemco Electric Co., 1362 E. 3rd St., Cleveland, Ohio.

KEMCO ELECTRIC CO., THE.—1362 E. 3rd St., Cleveland, Ohio. Manufacturer of automobile lighting and starting generators. Partnership, George W. Hausheer, F. L. Mulhauser.

KENCO.—Trade name for toy transformers manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

KENDRICK & DAVIS CO.—Lebanon, N. H. Manufacturer of small motors and generators, electric fans and medical coils. Business established 1876. President, W. H. Crozier; secretary, K. H. Ferguson; treasurer, R. R. Wood.

KENNEDY CO., THE COLIN B.—140 Second St., San Francisco, Cal. Manufacturer of radio equipment. Business established 1919. President, Colin B. Kennedy; vice-president, Harry J. Rathbun; secretary, Nathan A. Bowers; treasurer, Emile A. Portal.

KENNEDY KITS.—Trade name for tool kits manufactured by the Kennedy Mfg. Co., Van Wert, Ohio.

KENNEDY MFG. CO.—Van Wert, Ohio. Manufacturer of tool kits. Main office and factory, Van Wert, Ohio. Branch office, 14 E. Jackson Blvd., Chicago, Ill.

KENNEDY VALVE MFG. CO., THE.—Water St., Elmira, N. Y. Manufacturer of valves. Business established 1878. President, Daniel Kennedy; secretary, treasurer and general manager, M. E. Kennedy; sales manager, C. H. Kennedy. Main office, Elmira, N. Y. Branch offices, 95 John St., New York, N. Y.; 47 India St., Boston, Mass.; 204-8 N. Jefferson St., Chicago, Ill.; 23-25 Minna St., San Francisco, Cal.; 208 Mutual Bldg., Kansas City, Mo. Sales representatives, S. A. Roberts & Co., 212 Dooly Bldg., Salt Lake City, Utah; Murry Jacobs, 1213 L. C. Smith Bldg., Seattle, Wash.; Baldwin-Kruse Manufacturers Sales Co., El Paso, Tex.

KENNEY.—Trade name for marine indicators and speedometers manufactured by the American Speed Indicator Co., New London, Conn.

KENOTRON.—Trade name for rectifiers manufactured by the General Electric Co., Schenectady, N. Y.

KENSINGTON HARDWARE & TOOL MFG. CO.—410-416 Mechanic St., Philadelphia, Pa. Manufacturer of metal and fiber stampings.

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KENT MFG. CO., ATWATER.—4937 Stenton Ave., Philadelphia, Pa. Manufacturer of automobile lighting and ignition equipment. Business established 1903. President and treasurer, A. Atwater Kent; vice-president, secretary and general manager, W. J. Little; sales manager, H. E. Rice.

KENT VACUUM CLEANER CO., INC., THE.—Rome, N. Y. Manufacturer of electric vacuum cleaners, floor polishing, scrubbing, surfacing machines, etc. Business established 1913. President and general manager, Gordon E. Kent; vice-president, George W. Turney; secretary, Frank J. De Bisschop; treasurer, James A. Spargo. Sales representatives, Pettingell-Andrews Co., Boston, Mass.; Erner Electric Co., Cleveland, Ohio; Frank Adam Electric Co., St. Louis, Mo.; Vacuna Sales Co., Washington, D. C.; Canadian General Electric Co., Toronto, Ont., Can.; Northern Electric Co., Montreal, Que., Can.; Alpha Electric Co., 151 W. 30th St., New York, N. Y.; Illinois Electric Co., 314 W. Madison St., Chicago, Ill.

KENTUCKY ASSOCIATION OF ELECTRICAL CONTRACTORS.—Secretary, F. F. Valinoti, Louisville, Ky.

KENTUCKY ELECTRICAL CO.—817 Lewis St., Owensboro, Ky. Manufacturer of projecting arc lamp compensators. President, E. T. Franks; vice-president, J. W. McCulloch; secretary, treasurer and manager, A. W. Stuntz.

KERCHER ELECTRIC COOKER CO.—2927 Newbury St., Berkeley, Cal. Manufacturer of electric fireless cookers. Business established 1920. President, H. S. Ridgely; vice-president, W. H. Humphry; secretary and general manager, A. L. Studebaker. Exclusive distributors, C. C. Payne Electric Co., Oakland, Cal.

KERITE INSULATED WIRE & CABLE CO.—50 Church St., New York, N. Y. Manufacturer of insulated wire and cable.

KER-O-EL.—Trade name for farm and marine electric light and power plants manufactured by the Matthews Co., Port Clinton, Ohio.

KEROSENE.—A mineral hydrocarbon oil, distilled from petroleum or coal oil. It is used somewhat as a fuel in internal-combustion engines, but not as extensively as gasoline.

KERR ENGINE CO., LTD., THE.—Walkerville, Ont., Can. Manufacturer of brass and iron valves.

KERR TURBINE CO.—Wellsville, N. Y. Manufacturer of steam turbines, turbo-generators, turbine-driven pumps, blowers, etc. President, F. P. Merrill; vice-president, F. C. Leonard; secretary, C. L. Shults; treasurer and general manager, Paul B. Hanks.

KESSELRING X-RAY TUBE CO.—652 W. Lake St., Chicago, Ill. Manufacturer of therapeutic electrodes and X-ray tubes. A. W. Gast, secretary.

KESTER.—Trade name for wire solder manufactured by the Chicago Solder Co., 4201 Wrightwood Ave., Chicago, Ill.

KETTLES, FRYING.—See Frying kettles and pans, electric.

KETTLES, MISCELLANEOUS, ELECTRICALLY HEATED.—Electrically heated kettles are used to some extent and for quite a number of purposes. There are quite a few designs but they generally have a heating element placed in the bottom of the kettle with a heat-insulating plate arranged to send the heat up into the kettle. One of the small forms in which the kettle is made is a hot-water kettle with a handle and spout, generally made of heavy spun copper and nickel or silver-plated; also see Tea kettles, electric. Kettles are also made in larger sizes, such as for hotel, hospital, restaurant and other larger kitchens where they are used in making soups, broths, etc. Some kettles are also used as water sterilizers having capacities as high as 1000 gals. per hour. In certain industrial processes where materials have to be molten or cooked at a uniformly maintained temperature electric kettles find useful application because of the ease with which the temperature can be maintained constant. The absence of fire or gases, such as accompanies use of oil, gas or other fuel direct, is another advantage that often leads to use of electric kettles.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Edison and Hughes electric appliances. The kettle for heating water has self contained heating element of same type as used in all Hotpoint electric percolators. It is located in center of bottom of kettle; when in use it is entirely surrounded by water, thus none of the heat generated is wasted. Made of drawn copper spun into shape; spout, white metal. Has handle of ebonized wood with steel sides. Finished outside in polished nickel; inside in blocked tin. Lid has no hinge; locks on securely. See display adv. pages 1292-3.—Adv.



"Hotpoint" Electric Kettle

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. Can furnish heating equipment for kettles and tanks for heating oil, paraffin, solutions, compounds, etc., where purchaser provides tanks with foundation and installs heating equipment. See adv. pages 1203-1223.—Adv.

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

KETTLES, PITCH.—These are large sheet-metal tanks built in a cabinet form often with a fire box beneath the tank for heating the pitch or other compound. They are used in keeping pitch or other insulating compounds in molten state for application to the parts to be coated or sealed with the compound. Electrically heated pitch kettles are also used to some extent where the installation is a permanent one served with electric power. They have the advantage of eliminating the fire hazard always attending a fire method of heating an inflammable compound, and also give a much more constant temperature.

Manufacturers:

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display advertisement on pages 1292-1293.)

Evans, F. H., 31 Hewes St., Brooklyn, N. Y.

Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.

Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal. "Presto."

KEWANEE PRIVATE UTILITIES CO.—Kewanee, Ill. Manufacturer of private water supply, electric light and sewage disposal systems. Vice-president and general manager, A. W. Errett, Jr.; secretary and treasurer, E. L. Kellogg. Main office, South Franklin St., Kewanee, Ill. Factories, Kewanee, Ill., and Lancaster, Pa. Branch offices, 1213 Marquette Bldg., Chicago, Ill.; 2080 Hudson Terminal Bldg., 50 Church St., New York, N. Y.

KEY ARM SWITCHES.—See Switches, fixture.

KEY CORP., THE ANDREW.—210 Olive St., St. Louis, Mo. Manufacturer of electric clocks. President, W. C. Hadley; vice-president, G. S. Suppiger; secretary, Arno W. Fowler; treasurer, W. E. Eichman; general manager, Andrew Key.

KEY MODEL.—Trade name for wrench manufactured by the Coes Wrench Co., 1 Coes Sq., Worcester, Mass.

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knife sharpener and polisher, and similar appliances and perform all the heavier hand operations necessary in the preparation of food. It serves as an economical power unit since only one motor is needed for interchangeably operating a number of appliances instead of having each separate appliance provided with its individual motor.

Manufacturers:

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."

KITS, AUTOMOBILE LAMP.—These are compact boxes or cartons containing a spare set of automobile incandescent lamps intended to be carried under the seat, in the side pockets, or in some other convenient place on the automobile. They generally contain two headlamps, two side lamps, a tail lamp and an instrument or dashboard lamp.

KITS, TOOL ELECTRICIANS' AND TROUBLEMEN'S.—Electricians' kits are made of leather or canvas in a number of sizes and types. The kits are made to hold the tools in a convenient case for carrying, each type of kit having compartments or straps suitable for the particular tools required for the various classes of work done by electricians. Such kits vary in size from the almost pocket-size kits used by electricians and troublemen doing telegraph, telephone or meter work to the large kits carried by means of a shoulder strap and containing the ordinary tools used by a troubleman in maintenance work on the heavier equipment, such as motors, generators, etc.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

HERBST, PAUL W., Chicago, Ill. We specialize in electricians' pocket tool kits as illustrated herewith. This kit consists of a genuine leather case, durable and compact. It is 8 ins. long, 3½ ins. wide and 2 ins. high when closed. Furnished in russet or black leather. The kit contains seven tools, all of superior quality, namely, special side cutting pliers, hand forged with knives of guaranteed quality, 5-inch nickel-plated scissors; double bladed knife, screw driver and wire scraper combined; 3-in. half round mill file and handle; 2½-in. screw driver; 3½-in. nickel-plated tweezer and 2-foot boxwood rule. We also make a kit 4x9 ins., particularly useful to electricians and wire men for switchboard and telephone work. It contains knife, side cutting pliers, oblique diagonal pliers, long nose pliers, screw driver, scissors, file and handle and tweezer. See display adv. page 1258.—Adv.



Pocket Tool Kit

Kennedy Mfg. Co., Van Wert, Ohio. "Kennedy Kits," "All Steel."

KITTINGER CO.—1893 Elmwood Ave., Buffalo, N. Y. Manufacturer of portable electric lamps. Business established 1866. President and treasurer, I. J. Kittinger; vice-president, secretary and general manager, R. G. Kittinger; sales manager, E. F. Colie.

KITTS MFG. CO.—Oswego, N. Y. Manufacturer of steam specialties. Business established 1887. President, James Parker; secretary and treasurer, A. D. Millar.

KJELLIN FURNACE.—One of the early types of electric induction furnace.

KK.—Trade name for weatherproof wire manufactured by the American Brass Co., 414 Meadow St., Waterbury, Conn.

K K K.—Trade name for electrical porcelain manufactured by the David Killoch Co., 57 Murray St., New York, N. Y.

K-L.—Trade name for ignition timer and other automobile accessories made by the M-R Co., 122 N. 14th St., Lincoln, Neb.

KLAUS RADIO CO.—Eureka, Ill. Manufacturer of radio apparatus and electric refrigerators. Business established 1918. Main office and factory, Eureka, Ill. Branch office, Peoria, Ill.

KLAXOCATOR.—Trade name for code signalling systems manufactured by the Klaxon Co., Newark, N. J.

KLAXON CO.—Newark, N. J. Manufacturer of telephones, signaling systems and accessories. Business established 1908. President and general manager, D. A. McConnell; vice-president, W. M. Sweet; sales manager, R. L. Wilkinson. Main office, Newark, N. J. Factories, Newark, N. J., Bloomfield, N. J. Branch offices, Detroit, Mich.; 47 Broadway, New York, N. Y., Mertopolitan Tower, New York, N. Y., 2715 S. Michigan Ave., Chicago, Ill.

KLAXOPHONE.—Trade name for loud speaking telephones manufactured by the Klaxon Co., Newark, N. J.

KLEIN & SONS, MATHIAS.—3200 Belmont Ave., Chicago, Ill. Manufacturers of tools for electricians, linemen and mechanics. Business established 1857. President John M. Klein; vice-presidents, Joseph A. Klein, Sr., and John M. Klein, Jr.; secretary and treasurer, Alex J. Klein; general manager, H. B. Wilson.

KLEINSCHMIDT ELECTRC CO., INC.—36 Flatbush Ave. Ext., Brooklyn, N. Y. Manufacturer of telegraph apparatus. Business established 1898. President, Edward Kleinschmidt; vice-president, Edward S. Moore; secretary and treasurer, H. A. Breen; sales manager, A. H. Relber.

KLEMM & CO.—132 N. 5th St., Philadelphia, Pa. Manufacturers of lighting reflectors. Business established 1855.

KLENCK CO., F. J.—55 New Montgomery St., San Francisco, Cal. Manufacturer of fiber sheets, rods, tubes, washers and insulating papers. Business established 1912.

KLIEGL.—Trade name for connectors, spotlights, stage pockets and plugs, theatrical electrical effects, receptacles, and sketch lamps manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

KLIEGLIGHT.—Trade name for studio arc lamps and carbons manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

KLINGTITE.—Trade name for transmission belting manufactured by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

KLITZEN RADIO MFG. CO., INC.—Flett Ave., Racine, Wis. Manufacturer of radio and X-ray apparatus. Secretary treasurer and general manager, M. F. Klicpera, Sales representative, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.

KLIX MFG. CO.—12 N. Market St., Chicago, Ill. Manufacturer of magic lanterns.

KLONDIKE.—Trade name for wet batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

KLYMAX.—Trade name for electric washing machines manufactured by the Home Utilities Co., 320-326 N. May St., Chicago, Ill.

KNAPP ELECTRIC & NOVELTY CO.—511 W. 51st St., New York, N. Y. Manufacturer of battery motors, electrical toys and specialties. Business established 1890. President, treasurer and general manager, David W. Knapp.

KNAUBER'S.—Trade name for box hanger manufactured by the Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.

KNEELAND MFG. CO., INC., THE.—216 N. Main St., Wethersfield, Conn. Manufacturer of portable electric lamps and hot plates. Business established 1920. President, Edward R. Woodhouse; vice-president and general manager, Elwood V. M. Kneeland; secretary, J. Henry Carey.

KNICKERBOCKER.—Trade name for electric vibrator manufactured by the Shelton Electric Co., 16 E. 42nd St., New York, N. Y.

KNICKERBOCKER ANNUNCIATOR CO.—116 West St., New York, N. Y. Manufacturer of annunciators and elevator signals. Business established 1913. Copartnership. W. A. Brohmer and Andrew Jochum.

KNIFE HANDLE.—Trade name for wrench manufactured by the Coes Wrench Co., 1 Coes Sq., Worcester, Mass.

KNIFE SHARPENERS AND BUFFERS, MOTOR-DRIVEN.—These are motor-driven sharpening and buffing wheels used mainly in hotels, restaurants, clubs and large residences. The motor-driven stones are also much used in the meat-packing industry where the knives used by the butchers must be kept sharp constantly so as not to slow down the continuous conveyor system of butchering generally used in these plants.

Manufacturers:

Blakeslee & Co., G. S., Cicero, Ill. "Blakeslee."

Hamilton-Low Co., Jersey City, N. J. "P. D."

KNIFE SWITCHES.—See Switches, knife (three types).

KNIGHT ENGINEERING & SALES CO.—Los Angeles, Cal. Manufacturer of electric drills and grinders. President and General Manager, George L. Knight; vice-president, K. E. Van Kuran; secretary, R. A. Hopkins; treasurer, George O. Noble. Main office, 447 E. 3rd St., Los Angeles, Cal. Branch office, 30 W. Walton Pl., Chicago, Ill. Sales representative, Sanford Bros., 30 W. Walton Pl., Chicago, Ill.

KNIVES, CABLE STRIPPING AND SPLITTING.—The cable-stripping knife is a flat-bladed knife with a curved blade coming to a sharp hooked point. The splitting knife is similar except that the knife blade is straight-edged. As their name implies, these knives are used on lead-covered cables for stripping and splitting the cable sheath.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

Coes Wrench Co., 1 Coes Sq., Worcester, Mass.

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. See page 1259 for illustrations of Klein products, and write for our catalog of construction tools.—Adv.

Village Blacksmith Folks, The, Watertown, Wis.

KNIVES, DRAW OR POLE-DRESSING.—Wood poles to be set in city streets are shaved and knots are trimmed off for appearance's sake. This is most readily accomplished by a suitable draw knife. Only as much of the surface need be taken off as is necessary to remove the knots and straggling ends of the inner bark of the tree, if the pole is to be painted. Otherwise the entire pole surface is shaved. The draw knife is slightly curved and has a handle at each end. It is operated by holding it with both hands and drawing it toward the operator on the cutting stroke.

Manufacturers:

Buck Bros., Millbury, Mass.

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."

Village Blacksmith Folks, The, Watertown, Wis.

White Co., The L. & I. J., 143 Perry St., Buffalo, N. Y.

Winsted Edge Tool Works, The, Winsted, Conn.

KNIVES, ELECTRICIANS' AND LINEMEN'S.—These are heavy pocket knives used chiefly in skinning the insulation on wires when a special wire skinner is not at hand. One blade is often ground to a screw-driver point for small screws, or there may be an auxiliary screw-driver blade.

Manufacturers:

Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)

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BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

Coes Wrench Co., 1 Coes Sq., Worcester, Mass.

HERBST, PAUL W., Chicago, Ill. We carry a complete stock of electricians' knives of all kinds. See display advertisement on page 1258.—Adv.

Old File Cutlery Co., Havana, Ill. "Old File."

KNOBS, CLAMP, LAMP-SUPPORTING.—A form of clamp used to fasten a supporting hook to the rope used for raising and lowering arc lamps or other large street lamps. They are sometimes provided with insulators or insulation arms. The knob is often designed to catch in a specially designed recess in the lamp hanger so as to carry the weight of the lamp when pulled up and thus remove the tension on the rope or chain.

Manufacturers:

Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St. New York, N. Y.

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

KNOBS, GLASS.—These are small glass insulators used to insulate wires from a supporting surface. They have a hole through the center for the bolt or screw used to fasten the knob to the support and are grooved to hold the line direct or the wire used to tie the line to the insulator.

Manufacturers:

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

Metallic Mfg. Co., 544 W. 35th St., Chicago, Ill. (Brass.)

KNOBS, PORCELAIN, SOLID.—Cylindrical insulators of glazed or unglazed porcelain, provided with a central hole for a fastening nail or screw and a circumferential groove about which the wire to be held in place is given a tight turn. Knobs vary somewhat in shape and size, depending on the size of the wire with which they are to be used. They are extensively used for concealed knob-and-tube wiring and for open wiring. If nails are used to fasten knobs there is generally used a leather washer or "leatherhead" under the nail head to prevent splitting the knob by the last tightening blow on the nail.

Manufacturers:

Adamant Porcelain Co., East Liverpool, Ohio. "Hold Fast."

American Porcelain Co., The, East Liverpool, Ohio.

Brunt Porcelain., The, P. O. Box 493, Columbus, Ohio. "Brunt."

Canadian General Electric Co., Ltd., 212 King St., W.. Toronto, Ont., Can.

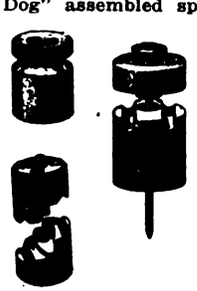
DAVIDSON PORCELAIN CO., East Liverpool, Ohio. Also manufacturers of "Eveready" wing assembled porcelain split knobs and cleats.—Adv.

Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."

Federal Porcelain Co., The, Carey, Ohio. "Fedco."

Findlay Electric Porcelain Co., The, Findlay, Ohio.

ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. We manufacture all styles and sizes of solid and split porcelain knobs. We specialize on the "Bull Dog" assembled split knob made and sold under license U. S. Patent No. 1,329,656 of Feb. 3, 1920. We also manufacture a well known line of cleats, sub-switch bases, ceiling buttons, etc.; also strain insulators and pole line insulators for telephone and power service up to 25,000 volts. Special designs in porcelain made in accordance with specifications. For further information see page 1301.—Adv.



Joslyn Mfg. & Supply Co., 133 W. Washington. St., Chicago, Ill.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Mogadore Insulator Co., The, Mogadore, Ohio.

PARKER & SON, INC., J. H., Parkersburg, W. Va. Solid knobs of every variety and shape, and grooves. They are constructed from high-grade porcelain and accurately designed.—Adv.

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Southern Electrical Porcelain Co., Inc., Erwin, Tenn.

Star Porcelain Co., The, Trenton, N. J. "Ideal."

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

Trenle Porcelain Co., P. O. Box 493, East Liverpool, Ohio.

Trenton Porcelain Co., 803 E. State St., Trenton, N. J. "Jiffy."

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

Wheeling Tile Co., Wheeling, W. Va.

KNOBS, PORCELAIN, SPLIT.—Split knobs are made so as to combine the advantages of a porcelain knob and a porcelain cleat. They are made in either two mating parts, of which the lower or base is a little higher than the top or cap, or in reversible half parts, either of which can be used as base or cap since they are exactly alike. The latter type eliminates need for keeping complete sets of mating parts, either of which are likely to be broken and spoil the set until duplicates are obtained. The nonreversible knobs are sometimes furnished assembled with screw or nail and leatherhead. All split knobs have two (or in a few cases four) grooves in one or both of the mating parts symmetrically arranged on each side of the center. The wire is readily clamped in this groove and securely held when the top or cap is fastened in place. In this respect they correspond to the cleat, but they have only one fastening screw or nail like a knob. Split knobs are usually round, but occasionally square.

Manufacturers:

Boch-Metsch Porcelain Co., The, East Liverpool, Ohio.

Brunt Porcelain Co., The, P. O. Box 493, Columbus, Ohio. "Brunt."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.

DAVIDSON PORCELAIN CO., East Liverpool, Ohio. Manufacturers of the "Eveready" wing assembled porcelain split knob. (See illustration). Made of imported clay, selected for its exceptionally high insulating properties. Unusually durable. Practically unbreakable. The "Eveready" wing makes it impossible for the two parts of knob to become separated in shipping or handling. Reaches the job assembled, ready for use. Exclusive licensees of Eveready Porcelain Co., East Liverpool, Ohio. Also manufacturers of porcelain solid knobs and cleats.—Adv.



Federal Porcelain Co., The, Carey, Ohio. "Fedco."

Findlay Electric Porcelain Co., The, Findlay, Ohio.

Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.

ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display advertisement on page 1301.)

Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Mogadore Insulator Co., The, Mogadore, Ohio.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

PARAGON ELECTRIC CO., Old Colony Bldg., Chicago, Ill. Paragon self-tying



Paragon Split Porcelain Knob

knobs, porcelain, for attaching and insulating telephone wires.—Adv.

PARKER & SON, INC., J. H., Parkersburg, W. Va. Split knobs, all types, for all sizes of wire up to No. O. The



"Nail-it" Knob (Patented)

"Nail-it," and "Screw-it" knobs are furnished with 10 penny nail and leather nail head and No. 10 screw 3 in. long.—Adv.

Southern Electrical Porcelain Co., Inc., Erwin, Tenn.

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

Trenle Porcelain Co., The, P. O. Box 493, East Liverpool, Ohio.

Trenton Porcelain Co., 803 E. State St., Trenton, N. J. "Jiffy," "Buckeye," "Findlay."

Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

KNOCKOUT.—In metal conduit boxes, such as outlet and switch boxes, junction or pull boxes, cutout or fuse boxes, also in sheet-metal cabinets, it is customary to make provisions for having the conduit connected from various sides or the bottom, top or back of the box or cabinet. This is usually done by having a number of circular pieces in the metal wall arranged with a weakened circumference so that by giving the circle a tap with a hammer the metal is easily knocked out, leaving a fairly smooth circular opening through which the conduit can enter the box. These blanked openings are called knockouts. They save the time and trouble that would be required to drill holes for the conduits. Only those knockouts are opened that are needed for the conduits to be used, but if for any reason any have been knocked out that are no longer needed, the holes can be closed by a knockout seal.

KNOCKOUT SEALS.—These seals are used to close holes in outlet, switch, cutout and other boxes and cabinets where the blank has been knocked out but the hole is no longer needed. The seals are generally made slightly larger than the knocked out blank and are either held in place by metal flaps which bend over on the inside of the box or are made to be forced in to a tight fit.

Manufacturers:

Duck, J. J., 436 St. Clair St., Toledo, Ohio.

Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.

Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."

UNITED METAL BOX CO., 514-516 W. 46th St., New York, N. Y.

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KNO-GLAIR.—Trade name for lamp shade manufactured by J. A. Whaley & Co., 118 5th Ave., New York, N. Y.

KNOLL MFG. CO.—Reading, Pa. Manufacturer of electric washing machines.

KNOSTRAIN.—Trade name for split socket bushing manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

KNOWLSON & KELLEY CO., INC.—Troy, N. Y. Manufacturer of steam and internal combustion engines. Business established 1868. President, George B. Kelley; vice-president, Harry R. Kelley; secretary and treasurer, James R. Knowlson.

KNOX CO., GEORGE S.—513 Pennwood Ave., Pittsburgh, Pa. Manufacturer of stationary electric vacuum cleaners.

KNU-CANOPY.—Trade name for fiber insulators manufactured by the Wilmington Fibre Specialty Co., Wilmington, Del.

KNU-CANOPY.—Trade name for fiber insulators manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

KNUTSON.—Trade name for trolley retrievers manufactured by the Trolley Supply Co., Massillon, Ohio.

KNY-SCHEERER CORP. OF AMERICA.—56-58 W. 23rd St., New York, N. Y. Manufacturer of electrotherapeutic and X-ray apparatus. Business established 1889. President and treasurer, N. E. Franklin; vice-president, A. T. Brand; secretary, E. S. Beck; sales manager (Electromedical Dept.), William A. Winter.

KOBZY.—Trade name for automobile signals manufactured by the Chicago Die & Specialty Co., 551-557 W. Monroe St., Chicago, Ill.

KOCH & SONS, A. S.—Lancaster, Pa. Manufacturer of pivots for electrical instruments.

KOCHS CO., THEODORE A.—659 Wells St., Chicago, Ill. Manufacturer of illuminated barbers' poles, vibrators and other supplies. President, R. T. Kochs; vice-president, William Huesner; secretary, W. Tuehe; treasurer, C. W. Fischer; sales manager, W. D. Peck.

KOEHLER MFG. CO.—Marlboro, Mass. Manufacturer of electric mine lamps, electromagnets, etc. Main office, Marlboro, Mass. Branch offices, 530 Fernando St., Pittsburgh, Pa., 1643 Jefferson Ave., Scranton, Pa.

KOENIG-KELLER CO.—Lancaster, Pa. Manufacturer of oven light switches. Sales representative, Jaburg-Miller Co., 137 Hudson St., New York, N. Y.

KOHLER CO.—Kohler, Wis. Manufacturer of farm lighting plants. Business established 1873. President and treasurer, Walter J. Kohler; vice-president, J. B. Murphy; secretary, O. A. Kroos. Main office and factory, Kohler, Wis. Branch offices and warehouses, Boston, Mass.; New York, N. Y.; San Francisco, Cal. District offices, Philadelphia, Pa.; Pittsburgh, Pa.; Indianapolis, Ind.; St. Louis, Mo.; Detroit, Mich.; Houston, Tex.; Chicago, Ill.; Seattle, Wash.

KOKEN COMPANIES.—St. Louis, Mo. Manufacturers of adjustable lighting fixtures, curling irons and therapeutic lamps. Business established 1874. President, Walter F. Koken; vice-presidents, T. W. Van Schrick, G. W. Sutherland, G. B. Chisholm; secretary and treasurer, Edgar W. Meier; sales manager, William S. Jencks. Main office, 2528 Texas Ave., St. Louis, Mo. Factories, St. Louis, Mo.; Brooklyn, N. Y.. Branch offices, 86 34th St., Brooklyn, N. Y.; Atlanta, Ga.; Detroit, Mich.; 22 E. Monroe St., Chicago, Ill.

KOKOMO ELECTRIC CO.—Kokomo, Ind. Manufacturer of ignition specialties. Business established 1904. President, C. T. Byrne; vice-president, George Kingston; secretary, J. P. Grace; treasurer, J. W. Johnson; sales manager, M. L. Grace. Main office and factory, Kokomo, Ind. Branch offices, 245 W. 55th St., New York, N. Y.; 1430 Michigan Ave., Chicago, Ill.; 870 Woodward Ave.; Detroit, Mich.; 1235 Van Ness Ave., San Francisco, Cal.; 17 Jersey St., Boston, Mass.

KOKOMO OPALESCENT GLASS CO.—Kokomo, Ind. Manufacturer of illuminating glassware. Business established 1888. President, W. E. Blacklidge; vice-president and general manager, J. W. Learner; secretary and treasurer, L. C. Hoss. Factories, Kokomo, Ind., and Clarksburg, W. Va. Sales representative, The Morris Glass Co., 440 Canal St., New York, N. Y.

KOLITE.—Trade name for electric signs manufactured by Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y.

KOLLATH BROS.—424 Brandywine Ave., Schenectady, N. Y. Manufacturers of electric signs. Business established 1920. General manager, Joseph Kollath.

KOLLINS.—Trade name for electric cream whippers and egg beaters manufactured by the Kollins Kitchen Kraft, 501 Monadnock Block, Chicago, Ill.

KOLLINS KITCHEN KRAFT.—501 Monadnock Block, Chicago, Ill. Manufacturer of electric egg beaters and cream whippers.

KONTAK.—Trade name for leather belting manufactured by George Rahmann & Co., 31 Spruce St., New York, N. Y.

KOOKERETTE.—Trade name for electric ovens and radiators manufactured by the Faraday Co., 746 Chapel St., New Haven, Conn.

KOO-LEE.—Trade name for refillable fuses manufactured by the Cooley Mfg. Co., 98 Park Pl., New York, N. Y.

KOPPAT.—Trade name for resistors manufactured by the Railway & Industrial Engineering Co., Greensburg, Pa.

KOPPEL INDUSTRIAL CAR & EQUIPMENT CO.—Koppel, Pa. Manufacturer of storage battery trucks and tractors. Main office and factory, Koppel, Pa. Branch offices, Peoples Gas Bldg., Chicago, Ill.; Pittsburgh, Pa.; Cortland Bldg., New York, N. Y.; Koppel Sales Co., Inc., San Francisco, Cal. Sales representatives, Electromobile Co., Boatmen's Bank Bldg., St. Louis, Mo.

KOPPER KING.—Trade name for spark plugs manufactured by the Sharp Spark Plug Co., Wellington, Ohio.

KOPPER KING JUNIOR.—Trade name for spark plugs manufactured by the Sharp Spark Plug Co., Wellington, Ohio.

KOPPERS CO., THE.—Union Arcade, Pittsburgh, Pa. Manufacturer of motor-driven coke drawing coal and ash handling machinery and gas producers. President, H. B. Rust; vice-president, C. J. Ramsburg; vice-president and general manager, W. F. Rust; secretary and treasurer, S. T. Brown; contract manager, H. B. Kirkpatrick.

KORRECT-I-KUT.—Trade name for electric cloth cutting machines manufactured by the American Electric Cutting Machine Co., 149-151 Lafayette St., New York, N. Y.

KOSMO.—Trade name for adjustable portable lamp manufactured by the Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.

KOSMOLITE MFG. CORP.—5-7 E. 16th St., New York, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1918. President and sales manager, Max Kossman; secretary, Leon Kossman; treasurer, Moses Samuels.

KOSSUTH PROCESS.—A process for the electrolytic production of bromine from bromide solutions.

KOVEN & BRO., L. O.—Jersey City, N. J. Manufacturers of tanks, air washers, and floor boxes. Business established 1861. Partnership, L. Oscar Koven and Gustav H. Koven. Main office and factory, 154 Ogden Ave., Jersey City, N. J. Branch office, 50 Cliff St., New York, N. Y.

K. P.—Trade name for fuseless rosettes manufactured by the Bryant Electric Co., Bridgeport, Conn.

K-P-F ELECTRIC CO.—37 Stevenson St., San Francisco, Cal. Manufacturer of high-tension pole-tope switches.

KR LAW.—The KR law states that the transmission loss in a telephone line is proportional to the product of the capacitance and the resistance for the entire line. The assumption was that if the KR value exceeded 15,000 it was beyond the commercial limit. The law was stated by Sir William Henry Preece, of England.

KRAEUTER & CO., INC.—583 18th Ave., Newark, N. J. Manufacturer of pliers. Business established 1860. President, A. A. Kraeuter; secretary, treasurer and sales manager, Gairvard. Factory, Irvington, N. J.

KRAFTGUARD.—Trade name for goggles for industrial purposes manufactured by the Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.

KRAMER-BISSELL CO., INC.—6259 Duwamish Ave., Seattle Wash. Manufacturer of ladders. Business established 1901. President, I. D. Kramer; vice-president, Harry Williams; secretary, treasurer and general manager, M. L. Bissell.

KRAMERLITE CO., INC.—577 Broadway, New York, N. Y. Manufacturer of lighting fixtures, portable lamps and glass domes. Business established 1906. President, Samuel Kramer; secretary and treasurer, Abraham Kramer; sales manager, Samuel Rothfarb; general manager; Mortimer Elliott.

KRAMIG & CO., R. E.—8th St. & Eggleston Ave., Cincinnati, Ohio. Manufacturers of asbestos products. Business established 1900. Factory, Lockland, Ohio. Branch office, Indianapolis, Ind.

KRANTZ.—Trade name for safety switches manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

KRANTZ & SELL CO., THE.—Honesdale, Pa. Manufacturer of electroliers and portable lamps. President, G. William Sell; secretary and treasurer, Walter S. Fritz. Main office, Honesdale, Pa. Factories, Honesdale, Pa., and Barryville, N. Y. Branch offices, 7 W. 24th St., New York, N. Y.; 39 E. Madison St., Chicago, Ill.; 41 Pearl St., Boston, Mass.

KRAYBEN METAL PRODUCTS CO., INC.—138 Prince St., New York, N. Y. Manufacturer of conduit fittings. Business established 1919. President and general manager, Irwin I. Krainess; secretary and treasurer, Harry B. Schultz.

KREKOE.—Trade name for brackets manufactured by J. Marshal Frye & Co., Hattiesburg, Miss.

KRESS CO., GEORGE R.—1900-1902 Brighton Rd., Pittsburgh, Pa. Manufacturer of lightning rods. Business established 1889. President, Alf. S. Kress; vice-president George R. Kress, Jr.; secretary, treasurer and general manager, O. A. Steuernagel.

KRETZER BRAND.—Trade name for lightning rods and accessories manufactured by the St. Louis Lightning Rod Co., 2135 De Kalb St., St., Louis, Mo.

KRIBS CO., LTD., W. A.—Hespeler, Ont., Can. Manufacturer of electric washing machines. Sales representatives, Northern Electric Co., Ltd., Montreal, Que., Can.; Great West Electric Co., Ltd., Winnipeg, Man., Can.

KROESCHELL BROS. CO.—440 W. Erie St., Chicago, Ill. Manufacturer of motor-driven refrigerating machines and boilers. President, R. O. Butz; vice-president, A. H. Goelz; secretary, R. A. Kroeschell; treasurer, C. H. Kroeschell.

KROMORE.—Trade name for resistance wire manufactured by the Driver-Harris Co., Harrison, N. J.

KRUEGER LUMBER CO., A. L.—511 Lumber Exchange, Minneapolis, Minn. Producer of cedar poles.

KRUSE ELECTRIC CO.—Ft. Wayne, Ind. Manufacturer of box hangers. President and general manager, E. H. Kruse.

KUHLMAN ELECTRIC CO.—Bay City, Mich. Manufacturer of transformers. Business established 1893. President, J. C. Hewitt; vice-president, J. T. Kuhlman; secretary, treasurer and general manager, J. A. Johnson; sales manager, F. E. Johnson. Main office and factory, 26th & Jefferson Sts., Bay City, Mich. Branch offices, 280 Carolina St., Buffalo, N. Y.; 1500 W. Montgomery Ave., Philadelphia, Pa. Sales representatives, O. E. Thomas Co., Los Angeles, Cal.; W. J. Hugo, Madison, Wis.; Duquesne Electric & Mfg. Co., Pittsburgh, Pa.; Austin-Henderson Co., Spokane, Wash.; H. B. Harley Sales Co., Indianapolis, Ind.; C. F. Henderson, San Francisco, Cal.; Baltimore Electrical Supply Co., Baltimore, Md.

KUHLMAN ENGINEERING CO., THE.—840 Champlain St., Toledo, Ohio. Manufacturer of switchboards and special panels and cabinets. President, L. J. Harpst; vice-president, A. B. Kuhlman; secretary and treasurer, C. H. Kuhlman.

KUHN & JACOB MACHINE & TOOL CO.—Prospect & P. & R. R., Trenton, N. J. Manufacturer of dies and molds for electrical insulation. President, Eugene Jacob; vice-president, Walter Jacob; secretary and treasurer, George Kuhn.

KURTZMANN PHONOGRAPH CO., INC.—700 Main St., Buffalo, N. Y. Manufacturer of electric phonographs. President, Volney P. Kinne; vice-president, Christian Kurtzmann; secretary and treasurer, Frank J. Bushman.

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KURTZMANOLA.—Trade name for electric phonograph manufactured by the Kurtzman Phonograph Co., Inc., 700 Main St., Buffalo, N. Y.

KURZ & ROOT.—Appleton, Wis. Manufacturers of motors, generators, switchboards and armatures. Business established 1898. W. W. Root, general manager.

KV.—Abbreviation for kilovolt; 1 kv. = 1000 volts.

KV-A.—Abbreviation for kilovolt-ampere. The form K.V.A. is still used to some extent, but kv-a. is preferred because it better represents the compound character of the unit, which may be regarded as the product of the kilovolts by the amperes of a circuit.

KV-A.-RATING FOR ELECTRICAL MACHINERY.—The rating of alternating-current generators and of transformers is usually expressed in kilovolt-amperes (kv-a.) available at the output terminals, at a specified power-factor.

KW.—Abbreviation for kilowatt or kilowatts when used with numerical values. The abbreviation K.W. is still also much used, but kw, is the preferred form, since kilowatt is written as a single word.

K.W.—Trade name for rosettes manufactured by the Bryant Electric Co., Bridgeport, Conn.

K.W.—Trade name for storage batteries manufactured by the K. W. Battery Co., 1532-34 S. Michigan Ave., Chicago, Ill.

K-W.—Trade name for ignition equipment manufactured by the K-W Ignition Co., E. 30th St. & Chester Ave., Cleveland, Ohio.

K.W. BATTERY CO.—Chicago, Ill. Manufacturer of storage batteries. Business established 1913. President, Hermann Paepcke; secretary, P. E. Duzeski; treasurer, Charles Wiedemann; general manager, E. Leewenherz; sales manager, J. E. Ward. Main office, 1532 S. Michigan Ave., Chicago, Ill. Branch office, 514 W. 53rd St., New York, N. Y.

KW-HR.—Abbreviation for kilowatt-hour or kilowatt-hours. Formerly (and to some extent still) written K.W.H.; this form does not suggest the complete term as well as the preferred form, kw-hr.

K-W IGNITION CO.—E. 30th St. & Chester Ave., Cleveland, Ohio. Manufacturer of ignition equipment. President, J. A. Williams; vice-president, William Kaple; general manager, C. Albracht; secretary and treasurer, A. F. Williams.

KW. RATING FOR ELECTRICAL MACHINERY.—The rating of d-c. generators is expressed in kilowatts (kw.) available at the terminals. It is recommended by the Standardization Rules of the A. I. E. E. that motors shall also be rated according to the power in kw. available at the shaft. This has not as yet been widely adopted, most manufacturers and users of motors expressing the motor output in horsepower.

KWICK-LITE ELECTRIC CORP.—360 Kearney St., San Francisco, Cal. Manufacturer of electric lanterns.

KWIK-KUT.—Trade name for motor-driven hacksaws manufactured by E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind.

KWIK-LITE.—Trade name for flashlights and batteries made by the Usona Mfg. Co., Inc., 1 Hudson St., New York, N. Y.

KWIKON.—Trade name for conduit fittings and wiring devices manufactured by S. R. Fralick & Co., 15 S. Clinton St., Chicago, Ill.

KWIKON NOBOLT.—Trade name for fixture stud manufactured by S. R. Fralick & Co., 15 S. Clinton St., Chicago, Ill.

KYANIZING.—A method of preserving wood from decay. It is used somewhat on telegraph poles, crossarms, etc. It consists of an impregnating process, using a strong solution of corrosive sublimate of mercury chloride. The process requires about 24 hours to penetrate one inch.

KYLE.—Trade name for electricians' boring machine manufactured by the Hykon Mfg. Co., Alliance, Ohio.

L

L.—The symbol for inductance expressed in henrys, or for what used to be called the coefficient of self-induction. The form l is also used as a general symbol for length in electrical formulas, usually expressed in centimeters, unless specifically stated to be inches, feet or some other unit.

LA BELLE.—Trade name for electric iron manufactured by the W. T. Burt Co., New Cumberland, W. Va.

L. A. BRASS FOUNDRY.—1539 E. 16th St., Los Angeles, Cal. Manufacturer of brass castings. Business established 1916. Partnership, A. H. Freitag and Wm. Eichenhofer.

LABELS AND TRANSFERS, LAMP, APPLIANCE AND CARTON.—Printed labels bearing ratings, trademarks, manufacturers' names and similar information are used to the extent of many millions every year in the electrical industry. They are used on lamps, fuses, cutout boxes, cabinets, etc., and on paper boxes and cartons containing devices, appliances and supplies, being pasted on the box or article before leaving the factory. Decalcomania transfers are extensively used for ornamental designs, trade-marks, etc., on various household appliances, such as washing machines and vacuum cleaners. They are also used on telephones, coin boxes, etc., and many metal parts and machines. Such transfer designs adhere better than labels and are capable of being made quite elaborate.

Manufacturers:

Dennison Mfg. Co., Framingham, Mass.
Gair Co., Robert, Brooklyn, N. Y.
Meyercord Co., 133 W. Washington Blvd., Chicago, Ill.
Palm Bros. Co., The, Norwood, Cincinnati, Ohio.

LABORATORY APPARATUS, ELECTRICALLY HEATED OR MOTOR-DRIVEN, MISCELLANEOUS.—This classification includes all electrically operated laboratory apparatus which is not otherwise listed in the several classifications devoted to such equipment. Particularly such devices as inspirators and evaporators, special heaters and ovens, agitators and stirrers used in medical and other laboratories and other similar apparatus and electrical devices whose application is too special for separate listing are to be included under this heading.

Manufacturer:

Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md.

LACANITE.—Trade name for molded insulation manufactured by the Scranton Button Co., 409 Cherry St., Scranton, Pa.

LACHUTE SHUTTLE CO., LTD., THE.—Lachute Mills, Que., Can. Manufacturer of crossarms, brackets, insulator pins, etc. Business established 1870. President, J. T. Ayers; vice-president, W. H. Ayers; secretary, Clement Tremblay; general manager, E. F. Ayers.

LACLEDE-CHRISTY CLAY PRODUCTS CO.—St. Louis, Mo. Manufacturer of fire brick, fire clay and other refractories. President, John L. Green; vice-president and general manager, Richard D. Hatton; secretary and treasurer, W. J. Westphalen.

LACLEDE STEEL CO.—Arcade Bldg., St. Louis, Mo. Manufacturer of steel, axles and other steel products. President and treasurer, Thomas R. Akin; vice-president, W. L. Allen; secretary, Harry F. Kay; general sales agent, D. F. Eschenbrenner.

LACO.—Trade name for lighting fixtures manufactured by the Lighting Appliance Co., 4 White St., New York, N. Y.

LACO-DALITE.—Trade name for diffusers manufactured by the Laco-Philips Co., 131 Hudson St., New York, N. Y.

LACO-PHILIPS CO.—131 Hudson St., New York, N. Y. Manufacturer of illuminating glassware. President, J. C. Lowe; secretary, William Berry; treasurer, C. A. Votteler; sales manager, E. F. Oliver.

LACQUERS, ARMATURE.—Lacquers are often applied to the surface of armatures of electrical machines as a final protective coating to the completed armature. The lacquer used is waterproof and to some extent insulating, and should be capable of withstanding the temperatures developed in the armature when carrying a heavy load. It serves to reduce the liability for water, dust and dirt adhering to or penetrating the winding and damaging it.

Manufacturers:

Barrett & Co., M. L., 233 W. Lake St., Chicago, Ill.
Celluloid Zapon Co., 200 5th Ave., New York, N. Y. "Zapon."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv., page 1320.)
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Du Pont De Nemours & Co., E. I., Wilmington, Del. "Pyroxylin."
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Impervious Metal Corp., 421 Wood St., Pittsburgh, Pa.
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Products." (See display adv., page 1320.)
Standard Varnish Works, 90 West St., New York, N. Y.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.

LACQUERS, LAMP.—See Coloring and frosting compounds, incandescent lamp.

LACQUERS, METAL.—These lacquers are varnishes made up by dissolving shellac in alcohol. They may be clear or given various colors by the addition of pigments. They are commonly used to furnish a protective coating to polished metal surfaces. Brass fixture parts and other brass parts of instruments and machines are generally given this protective coating. Generally a clear lacquer which does not detract from the polished appearance of the metal is employed, although where protection is more important than appearance a slight yellowish or other tint is, of course, not objectionable.

Manufacturers:

Barrett & Co., M. L., 233 W. Lake St., Chicago, Ill.
Celluloid Zapon Co., 200 5th Ave., New York, N. Y. "Zapon."
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Du Pont de Nemours Co., E. I., Wilmington, Del. "Pyroxylin."
Egyptian Lacquer Mfg. Co., The, 5. E. 40th St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo." (See display adv., page 1318.)
Impervious Metal Corp., 421 Wood St., Pittsburgh, Pa.
Nikolas & Co., G. J., 1227-35 Van Buren St., Chicago, Ill.
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.
Waukegan Chemical Co., Waukegan, Ill.

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LADD CO., THE GEORGE T.—Pittsburgh, Pa. Manufacturer of water tube boilers. Business established 1910. President and treasurer, George T. Ladd; secretary, Robert E. Chew. Main office, First National Bank Bldg., Pittsburgh, Pa. Branch office, 528 McCormick Bldg., Chicago, Ill.

LADDER SHOES, SAFETY OR NON-SLIPPING.—The ladders used on tile and metal floors are usually equipped with special shoes to prevent the ladder from slipping over the smooth surface. This is of particular importance when working around electrical machinery, switchboards, etc., where the danger involved is greatly increased by the possibility of receiving serious shocks. The shoes are usually made of iron fitted with a tread of carborundum or other abrasive compound, cork or rubber.

Manufacturers:

American Mason Safety Tread Co., 125 Perry St., Lowell, Mass. "Non-Slip."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
Superior Ladder Co., The, Goshen, Ind.

LADDERS, ELECTRICIANS', LAMP TRIMMERS' AND MOTOR TENDERS'.—The ladders generally used by electricians are rugged step ladders. As they are commonly used for working on ceilings they are high and are sometimes provided with a folding shelf for tools, blow torch, fixture parts, etc. Trimmers' and motor tenders' ladders are usually of the straight ladder type. The trimmers' ladders sometimes are provided with a curved iron rest to provide greater stability when placed against a round pole. Both types may be equipped with a safety tread to provide more secure footing when standing on smooth stone or metal floors.

Manufacturers:

Bent Rung Ladder & Mfg. Co., 725 South St., Indiana, Pa.
Brown Safety Ladder Mfg. Co. "W-N-B." (Sales department, Swanstrom Sales Co., 825 Manhattan Bldg., Chicago, Ill.)
Kramer-Bissell Co., Inc., 6259 Duwamish Ave., Seattle, Wash. "Safety."
Superior Ladder Co., The, Goshen, Ind. (Also extension, sectional and special.)

LADDERS, MANHOLE.—Operating and maintenance work in manholes requires that ladders be provided as a ready means of entrance. When manholes are entered frequently it is desirable to leave a ladder in each manhole. A very satisfactory type of ladder is one of galvanized iron which is light enough to be handled by one man. Where the floor gives 6 ft. of headroom the ladder must be about 8 ft. long to reach the manhole cover. Wood ladders may be used where they are carried on a wagon, but ladders left in the manhole continuously should be of galvanized iron.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Brown Safety Ladder Mfg. Co. "W-N-B." (Sales department, Swanstrom Sales Co., 825 Manhattan Bldg., Chicago, Ill.)
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Flour City Ornamental Iron Co., 27th St. & 28th Ave., S., Minneapolis, Minn.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv., page 1254.)
Kramer-Bissell Co., Inc., 6259 Duwamish Ave., Seattle, Wash. "Safety."
Lanz & Sons, Mathew, Pittsburgh, Pa.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

LADDERS, TRAVELING, FOR ELECTRICAL USES.—The traveling ladder is built to run over a trolley supported by brackets from the front of wall cases. It is usually equipped with steps instead of rungs and rolls along the floor on two small wheels fastened at the bottom of the ladder. They are used in electrical dealers' stores, jobbing houses, warehouses, stockrooms, etc., where it is necessary to store electrical supplies, lamps, etc., in cases, drawers, etc., on shelves high up on the walls where they would otherwise not be readily accessible. Numerous superposed shelves are required especially where a high rental is paid for an electric shop centrally located and where waste of floor or wall space is consequently inadvisable.

Manufacturer:

Calander Mfg. Co., John, 629-33 Jackson St., St. Paul, Minn. "Millbrad."

LADLES, POURING, SOLDER AND LEAD.—These ladles are simply metal cups provided with long metal handles. They are used chiefly to pour lead or solder in making wiped or soldered joints in lead-covered cables, large stranded cables and other electrical construction.

Manufacturers:

Ashton Mfg. Co., 184 Emmet St., Newark, N. J. "Red-Hot:"
Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.
HERBST, PAUL W., Chicago, Ill. We specialize in standard types of pouring ladles used in general construction work where soldering is required. (See display adv., page 1258.)—Adv.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."

LA FRANCE.—Trade name for safety devices for linemen, welders, etc., manufactured by the American LaFrance Fire Engine Co., Elmira, N. Y.

LAFFITTE.—Trade name for welding flux, brazing compounds, etc., manufactured by the Phillips-Laffitte Co., Pennsylvania Bldg., Philadelphia, Pa.

LAG.—When two sinusoidal vector quantities of the same frequency reach their maximum values at different times, the one which occurs last in time is said to lag behind the other. In clock diagrams the lagging vector is drawn clockwise with respect to the leading vector. A lagging current, as in an inductive circuit, is drawn clockwise with respect to the vector of the voltage that causes it to flow. Also see Lead and lag.

LAG SCREWS.—The lag screw is a heavy screw with a square or hexagonal head. It is made in several sizes and pointed so that it may be driven into wood and tightened by giving it a few turns with a wrench. Pole-line hardware is commonly fastened to the pole and crossarms by means of these screws, which are heavily galvanized for this purpose. Lag screws are also used extensively for general construction work.

Manufacturers:

Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
Clark Bros. Bolt Co., Milldale, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Galvanized Products Co., First St., Phillipsburg, N. J.
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Kansas City Bolt & Nut Co., The, Kansas City, Mo.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio.. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Marine Lamp Co., The, Forestville, Conn.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Olney & Warrin, Inc., 297-301 Lafayette St., New York, N. Y.
Paine Co., The, 1742 W. Van Buren St., Chicago, Ill. "Never-Give-Up."
Pawtucket Mfg. Co., 327 Pine St., Pawtucket, R. I.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.

LAGANKE ELECTRICAL CO.—6969 Aetna Rd., Cleveland, Ohio. Manufacturer of switchboards, switches, etc. Business established 1920. W. E. Laganke, owner.

LAGONDA MFG. CO., THE.—Springfield, Ohio. Manufacturer of boiler tube cleaners. Business established 1890. President, H. S. Bradley; secretary and treasurer, C. J. Carle; sales manager, M. M. Sellers. Main office and factory, Sheridan Ave., Springfield, Ohio. Branch offices, Philadelphia, Pa.; Pittsburgh, Pa.; St. Louis, Mo.; Syracuse, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Kansas City, Mo.; Detroit, Mich.; Boston, Mass.; 90 West St., New York, N. Y.; 332 S. Michigan Ave., Chicago, Ill. Sales representatives, Charles C. Moore & Co., Engineers, San Francisco, Cal.; Babcock & Wilcox Co., Denver, Colo.; L. A. Rodgers Machinery Co., Dallas, Tex.; L. E. Pollard, Minneapolis, Minn.; Frank R. Small, Baltimore, Ohio.

LAGONDA PIANO CO.—New Castle, Ind. Manufacturer of electrically operated pianos.

LAKESIDE.—Trade name for pliers and wrenches manufactured by the Lakeside Forge Co., East Lake Rd., Erie, Pa.

LAKESIDE BRIDGE & STEEL CO.—N. Milwaukee, Wis. Manufacturer of electric hoists and coal and ash handling machinery. Business established 1913. President, V. W. Coddington; vice-president and sales manager, R. W. Reed; secretary, H. M. Risseeuw; treasurer and general manager, S. C. Coddington.

LAKESIDE FORGE CO.—East Lake Rd., Erie, Pa. Manufacturer of pliers, wrenches and drop forgings. President, F. B. McBrier; vice-president, Alex. Jarecki; secretary, F. A. Brevillier; treasurer and general manager, C. L. McCloskey.

LAKESIDE SUPPLY CO.—Chicago, Ill. Manufacturer of electrically operated phonographs, phonograph motors, lights and automatic stops. Business established 1913. President and treasurer, Gustav C. Fricke; secretary, William A. Fricke; sales manager, Stanly Fritz. Main office and factory, 416 S. Dearborn St., Chicago, Ill. Branch office, 693 Mission St., San Francisco, Cal. Sales representative, Arnold Electric Co., 140 S. Dearborn St., Chicago, Ill.

LAKEWOOD ENGINEERING CO.—Cleveland, Ohio. Manufacturer of storage battery trucks, tractors, loaders and industrial haulage equipment. President, Charles F. Lang; vice-presidents, Roy G. Qwens, Henry Pleines, Lion Gardiner, L. Brown; treasurer, Mr. Stone; sales manager, Roy G. Owens. Main office, Cleveland, Ohio. Branch offices, Atlanta, Ga.; Boston, Mass.; Buffalo, N. Y.; 11 S. LaSalle St., Chicago, Ill.; Dallas, Tex.; Detroit, Mich.; Des Moines, Iowa; Indianapolis, Ind.; Kansas City, Mo.; Memphis, Tenn.; Milwaukee, Wis.; Minneapolis, Minn.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Richmond, Va.; St. Louis, Mo.; San Francisco, Cal.

LAKIN.—Trade name for conduit bender manufactured by the Thomas & Betts Co., 63 Vesey St., New York, N. Y.

LALANDE CELL.—A type of primary cell using the combination copper-sodium hydroxide-zinc, with copper oxide as a depolarizer. The commercial form most in use is known as the Edison-Lalande cell.

LALLEY LIGHT CORP.—Detroit, Mich. Manufacturer of farm and portable lighting plants. Business established 1916. President, treasurer and general manager, William H. Lalley; vice-presidents, George E. Willis and Henry Kennady; secretary, Henry Kennady; sales manager, George E. Willis.

LALOR CO., W. M.—208 S. La Salle St., Chicago, Ill. Manufacturer of electrically heated stills. Business established 1914. President, treasurer and general manager, W. M. Lalor; vice-president and secretary, Racine Thompson.

LAMB BROS. & GREENE.—Nappanee, Ind. Manufacturer of portable electric lamps and lamp shades. President and general manager, George L. Lamb; secretary and treasurer, Harry B. Greene.

LAMBERT.—The C. G. S. unit of brightness. It is the brightness of a perfectly diffusing surface radiating one lumen per sq. cm. This is equivalent to the brightness of a perfectly diffusing surface having a coefficient of reflection equal to unity and an illumination of one phot, because the brightness of an object depends both upon the intensity of illumination on it and the percentage of light that it reflects. Brightness expressed in candles per square centimeter may be reduced to lamberts by multiplying by π, or if expressed in candles per square inch may be reduced to lamberts by multiplying by $\pi/6.45 = 0.4868$. The millilambert (= 0.001 lambert) is a more convenient unit, since most brightness values in interior illumination are but small fractions of a lambert.

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LAMBERT MACHINE CO.—311 S. Jefferson St., Marshall, Mich. Manufacturer of electric coffee, cereal and peanut machinery. Business established 1898. President and general manager, A. P. Grohens; secretary, C. H. Billings; treasurer, I. W. Houston. Sales representatives, M. S. Kenny, 401 Board of Trade, New Orleans, La.; A. H. Kellogg, 101 Varick St., New York, N. Y.

LAMBETH ROPE CORP.—New Bedford, Mass. Manufacturer of cotton tape. President, H. W. O'Leary; treasurer, A. L. O'Leary.

LAMGRE.—Trade name for portable electric lamps manufactured by Lamb Bros. & Greene, Nappanee, Ind.

LAMINATED BRUSH.—A commutator brush made up of thin leaves or layers of copper. See Brushes, Copper, leaf and gauze.

LAMINATED CORE.—A core or part of a magnetic circuit which is constructed of thin layers of iron or steel, or laminations. Also see Laminations.

LAMINATIONS.—The pieces of thin sheet iron or steel of special quality, which are piled up and pressed together to form the cores of transformers, armatures and other electrical equipment where an alternating or pulsating magnetic flux is present. It is necessary to laminate the iron in order to reduce eddy currents. See Eddy currents; Armature punchings; Cores, electromagnetic; Cores, field coil; Cores, transformer; Iron, sheet, for electrical purposes; Steel, sheet, for electrical purposes.

LAMME, BENJAMIN G.—An American electrical engineer, born near Springfield, Ohio, and educated in the schools of that vicinity. He graduated from Ohio State University as mechanical engineer in 1888. The next year he entered the testing department of the Westinghouse Electric & Mfg. Co., but was soon transferred to the work of designing of which he was later made director. In 1900 he was appointed assistant chief engineer, and in 1903, chief engineer of this company, which duties he still actively fulfills. Mr. Lamme is known for his important part in the development of much alternating-current apparatus, including the induction motor, polyphase generators, synchronous converters and single-phase railway apparatus. He was also a pioneer in the development of much direct-current apparatus for railway, lighting and power work, and has to his credit a large number of important patents covering electrical apparatus. Among his many noteworthy achievements in electrical design was that of the 5000-hp. generators used in the first large hydroelectric plant at Niagara Falls, which embodied many new features, including the revolving field and vertical shaft construction. In the design of many other machines he was also a pioneer. On recommendation of the American Institute of Electrical Engineers, the Secretary of the Navy appointed Mr. Lamme a member of the Naval Consulting Board in 1915 and he gave valuable aid to this body during the prosecution of the late war. He was awarded the Edison medal by the A. I. E. E. in 1919.

LAMP.—In general the word lamp is a term applied to any artificial source of light. In electrical engineering it is called an electric lamp and refers to a source of light in which electrical energy is utilized. The term lamp is used in two senses. In one sense it refers only to that complete unit in which the light is produced, as an incandescent lamp. In this case it refers to the base, bulb and filament assembled as a complete unit and ready for use in a socket.

In the other ordinary usage of the word lamp it refers to this complete unit together with the accessories, the socket in which it is connected, the supporting stand, the electric controlling mechanism and light-modifying auxiliaries, such as shades, reflectors, globes, refractors, etc., in fact everything that goes to make up a complete portable or semiportable unit.

Both meanings of the word are commonly used and the lamps described below are classified to include both the complete units with accessories and the light source itself as a unit.

LAMP ACCESSORIES.—Lamp accessories are appliances associated with light sources to confine and direct the luminous flux where it is desired. In many lamps, taken in the sense of a complete unit, they form an integral and very important part of the unit. The most important of such accessories are reflectors, refractors, shades, and globes. See these items for further details and listings of producers.

LAMP ADAPTERS.—See Adapters, lamp, miscellaneous.

LAMP ADJUSTERS.—See Adjusters, lamp.

LAMP ANNUNCIATORS.—See Annunciators, lamp type.

LAMP BASES.—See Bases, incandescent lamp.

LAMP CAPS.—See Caps, lamp, color, diffusing and reflecting.

LAMP CHANGERS.—See Changers, lamp.

LAMP CHARACTERISTIC CURVE.—The characteristic curve of a lamp is a curve expressing a relation between two variable properties of the lamp, as candlepower and volts.

LAMP CLAMPS.—See Clamps, lamp.

LAMP COLORING.—See Coloring and frosting compounds, incandescent lamp.

LAMP CORD.—See Cord, flexible, lamp.

LAMP DISTRIBUTION CURVE.—A polar curve representing the luminous intensity of a lamp, or lighting unit, in a plane passing through the axis of the unit, and with the unit at the origin. Unless otherwise specified, a vertical distribution curve is assumed to be an average vertical distribution curve, such as may in many cases be obtained by rotating the unit about its axis and measuring the average intensities at the different elevations. It is recommended that in vertical distribution curves, angles of elevation shall be counted positively from the nadir (lowest point) as zero, to the zenith as 180°. In the case of incandescent lamps, it is assumed that the vertical distribution curve is taken with the tip downward.

LAMP EFFICIENCY.—What is commonly but wrongly called the "efficiency" of a lamp is the ratio between the watts input and the luminous intensity. This gives a value called "watts per candle," which for carbon incandescent lamps is about 3.5 and for tungsten gas-filled lamps about 1.1 to 0.5. To call this the efficiency results is an awkward expression because the higher the actual lamp efficiency is, the lower is the numerical value that denotes it. Moreover, efficiency usually means the ratio of useful output to total input, both being measured in the same units. Light output and the energy producing it cannot be expressed in the same or readily comparable units. The use of the term efficiency is therefore discouraged as applying to lamps. It is better instead to give the specific output in lumens per watt or the specific consumption of the lamp in watts per lumen. Instead of the latter, the term "watts per candle" is, however, extensively used commercially and denotes the watts per mean horizontal candlepower.

LAMP EYE SHIELDS.—See Eye shields, lamp; also Caps, lamp, color, diffusing and reflecting.

LAMP GLOBES.—See Globes, arc lamp and street lamp; Globes, miscellaneous lighting; Globes, vaporproof.

LAMP GRIPS.—See Grips, lamp.

LAMP GUARDS.—See Guards, arc lamp and street lamp; Guards, lamp, locking; Guards, lamp, nonlocking, portable and miscellaneous.

LAMP HANGERS.—See Hangers, arc lamp; Hangers, incandescent lamp.

LAMP, INCANDESCENT, DEVELOPMENT OF.—No one man should be given credit for the complete development of the electric incandescent lamp. Throughout the 19th century many efforts were made by many workers on both sides of the Atlantic to make a serviceable incandescent lamp, for it was known that a wire could be heated to incandescence by passing sufficient current through it. But the early lamps were impractical and used only in the laboratory in the absence of an inexpensive method of generating electricity.

Another difficulty lay in producing a vacuum and finding some method to prevent the rapid vaporization of the filament. Among those looking for such a method was Edison. He searched the world for some filament material that would resist this vaporization. In 1878 he produced a lamp using a platinum spiral filament which he improved and made more practical about a year later by substitution of a filament of carbonized bamboo fiber which was quite successful. During the next few years the lamps were further improved and in 1882 they were used in the first multiple central-station systems. But filament vaporization was not entirely eliminated and the interior of the bulb blackened early and this shortened the useful life of the lamp. However, these lamps with occasional minor improvements were used for some ten years.

In 1891 a carbonized cellulose filament (made by steeping cotton in zinc chloride) was introduced, and it quickly replaced the bamboo filament. Because it could be made uniform in diameter, its life was prolonged, for there were no smaller parts of the filament to heat more quickly than the rest. In the bamboo filament the portion of smallest diameter often burned out very quickly. Gradually other improvements in method and manufacture were introduced, among them the "chemical exhaust" devised by an Italian experimenter in 1895 to better the quality of the lamps and reduce the cost of manufacture. Molded bulbs, similar in many ways to those used today, had been used earlier. In fact things generally were shaping themselves for an incandescent lamp epoch.

One forerunner of this epoch of much better lamps was the attempt by Welsbach in 1898 to replace the carbon filament with a metal filament of osmium. Tungsten filaments had been used unsuccessfully nine years earlier because the experimenters did not realise the necessity of extreme purity in the metal. Experiments with tantalum had also been conducted after von Bolton produced ductile tantalum.

The metallized or graphitized filament lamp, very similar to the carbon creation, was perfected in 1905, on the discovery that a filament similar to the cellulose carbon filament would assume the electrical properties of a metal when highly heated in an electric furnace. These lamps, called Gem lamps, resembled somewhat the later metal-filament lamps and were more efficient than the carbon lamps. About this time also the tantalum-filament lamp was announced. This lamp could be burned at temperatures high enough to produce a still more efficient light. The filament required the metal in a pure state and the purification process was tedious and expensive. In addition the lamp was often short-lived, for alternating current had a destructive effect on the filament. Efforts to eliminate the shortcomings of these lamps were curtailed by the advent of the tungsten incandescent lamp.

In 1907 the first commercial tungsten-filament lamp, the result of several years of experimentation, was brought out. These first tungsten filaments were very brittle, but lamp development engineers in 1911 had found a way to make tungsten ductile, and the lamps became quite rugged and long-lived. Tungsten ore, which is found in many parts of the world, is converted into the pure metal and made ductile and then drawn into fine wire in which form it is used for lamp filaments. Because practically all the air was removed from the bulb, the radiation of heat was slight. But at high temperatures the filament evaporated rather rapidly and deposited as a film of metallic tungsten on the bulb, decreasing the candlepower of the lamp. To make a lamp in which the filament would not vaporize unduly became the problem of research workers.

After thousands of experiments, a lamp employing a ductile tungsten filament, but filled with an inert gas, was produced about 1913. Under pressure of the gas the filament resists vaporization more strongly and chemicals added cause the deposit that does form to be practically transparent so that it decreases the candlepower of the lamp only slightly. But a new problem presented itself to the makers of lamps. Practically all of the electrical energy supplied to the filament of an incandescent lamp is transformed into heat energy. The gas used in the first of these gas-filled lamps, although it would not combine chemically with the tungsten filament and thus bring about its deterioration, did radiate and conduct heat away from the glowing filament and thus lowered the lamp's efficiency, either by reducing the brilliancy of the filament or by requiring more current to maintain the required brilliancy of incandescence.

It was known that this conduction and radiation of heat is practically constant in all lamps, irrespective of the size of the filament. So the smaller lamps, with a few exceptions, are now made in the vacuum type, and the high-wattage lamps are gas-filled. The filament loses heat more slowly if the filament construction is compact, and all gas-filled lamps are therefore made with

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the filament coiled and concentrated in a small space, so that the surface is in contact with very little of the heat-radiating and conducting gas. The inert gas used in these lamps is derived from the air and is a mixture of argon and nitrogen.

In 1920 about 180,000,000 incandescent lamps, representing a total wattage of over nine billion watts, were sold in the United States. About half of this wattage was in gas-filled tungsten lamps. The number of lamps sold has doubled every five years from natural growth. Industry consumes a large portion of the lamps made, but new uses are found for them constantly. Tungsten lamps are now manufactured in many sizes from the tiny wheat-grain lamp used in surgery to the high-wattage moguls used for motion-picture projection and for large interiors, such as in armories, exhibition halls and gymnasiums.

Years ago it was difficult for the users of lamps to purchase the proper type of lamps for a particular use. But in recent years lamps have been standardized to a remarkable degree. In place of several hundred bases, four sizes of base now fit every socket in America, aside from those on automobiles. All incandescent lamps are made in four shapes, the straight-side, pear-shaped, round and tubular, excepting, of course, decorative lamps and those for special uses.

As the manufacturers have been ever alert to perfect the quality of the lamps in use today, so they are now working on the lamps of the future. Patient scientists are working years ahead of their time searching for the perfect lamp. Perhaps these workers will some day discover the secret of the cold light of the firefly; such a dream is not impossible, for lamps how operate at efficiencies undreamed of even a quarter of a century ago.

LAMP LIFE TESTS.—See Life tests.

LAMP-MAKING MACHINERY, INCANDESCENT.—To produce lamps at a reasonable cost it is essential that the processes be largely automatic and that the operators need not be technically skilled. As a consequence, incandescent lamps are made to a large extent by machinery which is more or less automatic, the machines being for the most part operated by girls. Many of the operations involve the heating and shaping of the glass parts. This is usually done by gas jets, which are arranged to strike the glass tubular stem, rod or bulb at the proper point. Other machines form the filament supports and base, draw the filament material, coil it (for gas-filled tungsten lamps), pump the air from the bulb, seal it, etc. There are about forty materials that are used to make up the average incandescent lamp. Their manufacture into the various lamp parts requires a large number of separate processes and many more operations, followed by the assembling of the parts into the completed lamp. Many machines are used for these various operations, aside from those mentioned. Practically all the machines are motor-driven.

Manufacturers:

Arrow Machine Co., 4334 Hudson Blvd., West Hoboken, N. J.
Eisler Engineering Co., Charles, 15 Kirk Pl., Newark, N. J.
Hofmann, Alfred, 150-152 Hudson Ave., Union Hill, N. J.
Newark Engineering & Tool Co., 476-82 18th Ave., Newark, N. J.
Save Electric Corp., 220-254 36th St., Brooklyn, N. Y.
York Electric & Machine Co., 30 N. Penn St., York, Pa.

LAMP PERFORMANCE CURVE.—The performance curve of a lamp is a curve representing the behavior of a lamp in any particular, such as candlepower or consumption, etc., at different periods during its life. It is plotted between this quantity and the life in hours.

LAMP POSTS.—See Posts, ornamental and plain street lamp (two types).

LAMP PULLEYS.—See Pulleys, lamp lowering.

LAMP ROPE.—See Rope, lamp lowering and lamp trimmers'.

LAMP TESTERS.—See Testers, lamp.

LAMP WINDLASSES.—See Windlasses, lamp lowering.

LAMPAGRAPH CO.—320 Republic Bldg., Chicago, Ill. Manufacturer of combination electric lamps and phonographs. President, George N. Dobson; vice-president, E. C. Linn; secretary and treasurer, A. J. Burns.

LAMPS, ARC, CARBON, ENCLOSED AND OPEN.—Lamps in which the light is produced by an electric arc between two electrodes or pencils of pure carbon, these electrodes being fed together by the arc lamp mechanism as fast as the carbons burn away. In the open carbon arc, the arc is formed in the open air with a large globe loosely surrounding it for the purpose of keeping strong wind or other air currents from the arc, or providing diffusion if the globe is of opal glass. Such arc lamps require trimming or renewal of electrodes about every 12 or 14 hours. It was the earliest type of arc lamp to come into commercial use and was at one time used for nearly all the electric street lighting in the United States. This open arc lamp was later superseded by the enclosed carbon arc lamp, in which a small practically vapor-proof globe surrounded the arc and prevented the rapid burning away of the electrodes. The efficiency of this lamp was lower than that of the open carbon arc, but the decreased cost of trimming made it popular for street lighting for many years previous to the past decade. The enclosed arc lamp requires trimming only about one-tenth as frequently as the open arc lamp. The use of both of these arc lamps is very limited in the United States at the present time. The open arc lamp, on account of its very concentrated light source (most of the light coming from the hot crater of the positive carbon) has been the source of light most commonly employed for searchlights and projection purposes, such as stereopticons and moving pictures. Concentrated-filament incandescent lamps are replacing the arc lamp in the latter field very successfully, as there are many places where they are more economical and less troublesome in operation.

Manufacturers:

BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Gelb Co., Joseph, 517 W. 36th St., New York, N. Y. "Spectro."
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y. "Universal," "Violet Ray."
Sun-Light Arc Co., Inc., 218 W. 48th St., New York, N. Y.
Wagenhorst & Co., J. H., 704 Dollar Bank Bldg., Youngstown, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

LAMPS, ARC, CARBON FLAME.—A type of electric lamp in which the light is produced by an arc between the ends of two pencils or electrodes of carbon, the carbon being impregnated with certain salts which produce a flame in connection with the arc. Such lamps have a much higher efficiency than arc lamps employing pure carbon, the flame of the arc being very luminous. However, they give off fumes which condense into a form of ash which soon clouds up globes and reflectors and calls for frequent cleaning. Even if the cleaning is very thorough, the glass tends to become etched, thus absorbing a large percentage of the light produced. Since the advent of large size gas-filled tungsten lamps, flame arc lamps have been but little used in this country.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Gelb Co., Joseph, 517 W. 36th St., New York, N. Y. "Spectro."
Toering Co., Inc., C. J., 1215 Bristol St., Philadelphia, Pa.
Wagenhorst & Co., J. H., 704 Dollar Bank Bldg., Youngstown, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

LAMPS, ARC, METALLIC FLAME, MAGNETITE OR LUMINOUS.—An electric lamp in which the light is produced by an arc between two electrodes, one of which is a heavy piece of metal, such as copper, capable of conducting away and radiating considerable heat to prevent its own destruction, the other electrode being a steel tube filled with metallic oxides in which the metallic oxide of iron, called magnetite, is usually the principal ingredient. The principal light comes from the luminous flame of the arc rather than from the hot electrodes, as in the case of the carbon arc lamp. On account of its high efficiency and excellent illuminating and operating qualities, this is the type of arc lamp most commonly in use for street lighting in the United States at present, all other types of street arcs having been very largely displaced by tungsten incandescent lamps. Magnetite arcs operate only on d-c. constant-current series circuits and are usually designed for 4 or 6.6 amperes. The light is nearly white and quite steady. A clear or opal enclosing globe is provided for the lamp.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Series luminous arc lamps, pendent type, which give quality, quantity, and steadiness of illumination, and are very reliable and easy to maintain. They are very efficient and give a soft, white light having spectrum similar to daylight. The maximum volume occurs at about 10 degrees below the horizontal, which is the ideal distribution for street illumination. There is an entire absence of shadows, the arc is in a fixed position, burns without flickering, and its length remains constant throughout the trim. Made in four different forms, the principles of operation of each being essentially the same and the mechanisms are similar in general details. (Bulletins 43253 and 43320.) See adv. pages 1203-1223.—Adv.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Sun-Light Arc Corp., 1600 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

LAMPS, ARC, PROJECTING, STAGE AND STEREOPTICON.—Arc lamps enclosed in a sheet metal housing upon a metal frame or stand and usually provided with hand feed mechanism for the carbons. They are used for projecting motion pictures or motionless slide pictures upon a screen in a theater, lecture hall or other large room, or to project an intense beam of light on some performer on the stage. They are also used on the stage to produce various color and other scenic effects.

The arc lamps used are always of the high-current carbon type. They are operated on direct current whenever possible and if it is not available a motor-generator, rectifier or synchronous converter is used to convert it and to reduce it to the proper voltage.

Manufacturers:

Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y.
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.
Sun-Light Arc Corp., 1600 Broadway, New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Universal."
Williams, Brown & Earle, Inc., 917 Chestnut St., Philadelphia, Pa.

LAMPS, AUTOMOBILE.—The lamps commonly used on an automobile consist of two headlights, usually mounted 3 to 3.5 ft. high and 2.5 to 3.5 ft. apart at the front of the machine, and a tail light showing red to the rear, with provisions for lighting

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a license plate, to one side of, below, or above the tail lamp. Two headlamps and a tail lamp constitute the minimum requirement of most states and cities in the United States. In addition, the car may have any or all of the following:

Two side lights, one on each side of the wind shield, are often provided; these are generally for use when the car is standing or "parked" along the curb and the headlights are not lighted; they are usually not powerful enough to be of any value in revealing the road ahead. A lamp, sometimes called a "speedometer lamp," placed on the instrument board in front of the driver serves to light the instruments and switches on the instrument board. On closed cars a deck light under the roof and a step light are frequently provided for lighting the interior and step or running board of the car while loading or unloading.

The standard electric lamp sizes now manufactured in America for automobiles are 21-cp. gas-filled lamps for use in headlamps, 15-cp. vacuum lamps for headlamps, and lamps of 2 and 4 cp. for other locations; all these are tungsten incandescent lamps. The most common gasoline automobile electric equipment voltage is 6 volts, supplied from three cells of lead storage battery. A number of equipments are 12 volts, having 6 cells. A large number of Ford type cars not having electric starters have the headlights supplied from a magneto, giving a variable voltage according to the speed of the engine, the maximum voltage being about 18, so that two 9-volt lamps are run in series. Headlights are separately listed under Headlights, electric, automobile.

Manufacturers:

Accessories Mfg. Co., 2311-29 N. Crawford Ave., Chicago, Ill.
Adams & Westlake Co., 319 W. Ontario St., Chicago, Ill. "Adlake."
Advance Lamp Works, 316 W. Superior St., Chicago, Ill.
American Auto Lamp Co., 415-417 Union St., Union Hill, N. J.
American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind.
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Blue Bird Lamp Co., 45 E. 17th St., New York, N. Y. "Blue Bird."
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Lamp & Stamping Co., Ltd., Ford, Ont., Can. "Clasco."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Continental Electric Lamp Co., 1438 Bryan Pl., Chicago, Ill.
Cowles & Co., C., Water & Chestnut Sts., New Haven, Conn.
Desmond Incandescent Lamp Co., 719-21 Bergen Ave., Jersey City, N. J. "Dilco."
Domestic Tungsten Lamp Co., Inc., 418-20 Tenth St., West, New York, N. Y.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv. pages 1272-1273.)
Electric Glass Co., 505 N. St. Clair St., Toledo, Ohio.
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
Gray & Davis, Inc., Boston, Mass.
Guide Motor Lamp Mfg. Co., The, Cleveland, Ohio. "Guide."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "Simplex."
Jaeger Co., H. J., 280 Park Ave., Weehawken, N. J.
Jefferson Glass Co., The, Follansbee, W. Va. "Ruby-Jefferson."
Kilborn-Sauer Co., Fairfield, Conn.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
Metal Specialties Mfg. Co., 3200-3208 Carroll Ave., Chicago, Ill. "Presto."
Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J. "Tung-Sol."
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv. pages 1270-1271.)
Banner Electric Division, Youngstown, Ohio. "Banner."
Bryan-Marsh Division, Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y. "Bryan-Marsh."
Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
Colonial Electric Division, Warren, Ohio. "Colonial."
Columbia Lamp Division, St. Louis, Mo. "Columbia."
Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
Packard Lamp Division, Warren, Ohio. "Packard."
Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
Shelby Lamp Division, Shelby, Ohio. "Shelby."
Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."
National Specialties Co., Inc., 54 W. La Fayette Blvd., Detroit, Mich.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Sharpe Electric Appliance Co., 502-8 Murphy Bldg., Detroit, Mich.
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Standard Metal Mfg. Co., Chestnut, Jefferson & Malvern Sts., Newark, N. J. "Standard."
Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y. "Star."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. (See display adv. page 1274.)

LAMPS, BICYCLE.—See Lamps, vehicle and bicycle.

LAMPS, BLUEPRINTING, PHOTOENGRAVING AND PHOTOGRAPHIC.—Lamps used for photographic work, or reproduction work of any kind where the light and chemical action combine to give the desired result, should have a high intensity of actinic light, which consists chiefly of rays at the blue end of the spectrum. Ordinary incandescent lamps are stronger in the red and yellow rays than sunlight or than is desired for actinic work. Special tungsten lamps are now made and used widely for this service; they have a blue bulb which screens out most of the nonactinic light and transmits those rays which are chemically active. This light appears much like daylight and permits very short exposures. Formerly arc lamps were used for general photographic work. They are still largely used for photoengraving and blueprinting. Direct-current arcs of high current rating are employed for this purpose. Mercury-vapor lamps have also been widely used with success for general studio and motion-picture photography, blueprinting and similar service. They are very rich in green, blue and violet rays and are especially adapted for actinic work. For motion-picture photography they are made in banks of five to ten or more parallel tubes, giving a large-area source; such banks may be mounted close to the floor, on stands of medium height, or suspended from the ceiling or from a special traveling crane.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Burke & James, 240 E. Ontario St., Chicago, Ill. ("Rexo" photographic)
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
COOPER HEWITT ELECTRIC CO., 95 River St., Hoboken, N. J. Mercury-vapor lamps for all classes of photographic work, including portraiture, copying, printing, motion-picture photography, enlarging and blueprinting. See descriptive advertisement under Lamps, vapor, mercury.—Adv.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. on pages 1272-1273.)
Gelb Co., Joseph, 512 W. 36th St., New York, N. Y. "Spectro."
GENERAL ELECTRIC CO., Schenectady, N. Y. A special enclosed-carbon arc lamp which gives an intense light containing an excess of violet, ultra-violet or actinic rays for blue printing and photographic work. Adjusted for 20 amps. at 110 volts a-c., 15 amps. at 220 volts a-c. and 10 amps. at 220 volts d-c. Equipped with heat-resisting globes. See adv. pages 1203-1223.—Adv.
Hadaway, Tom, 235 5th Ave., New York, N. Y.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Macbeth Arc Lamp Co., Philadelphia, Pa.
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Nela Specialties Division, Cleveland, Ohio. "Tru-tint."
New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y. "Panchro," "H. D. F. Photo Arc," "White Hope," "Sun," "Violet Ray," "Universal."
Ostrander-Seymour Co., 7 S. Dearborn St., Chicago, Ill.
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.
Simplex Photo Products Co., Richmond Hill, N. Y. "Multiflex," "Portraitlite," "Northern Light."
Toering Co., Inc., C. J., 1215 Bristol St., Philadelphia, Pa.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Klieglight."
Wagenhorst & Co., J. H., 704 Dollar Bank Bldg., Youngstown, Ohio. "Hi-Power."
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. (See display adv. page 1274.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Wohl & Co., Inc., M. J., Payntar Ave. & Hancock St., Long Island City, N. Y. "Duplex," "Broadside," "Wohlite."

LAMPS, BOUDOIR.—Boudoir lamps are small portable lamps, generally single socket, used as dresser or dressing-table lamps and largely for decorative purposes. These lamps commonly have a silk or parchment shade, the stand or base being made of highly polished woods or of metal, generally with an attractive enamel finish. For the most effective use there should be one on each side of the dressing table, as then neither side of the face will be in shadow.

Manufacturers:

Aladdin Mfg. Co., Muncie, Ind. "Dresalamp."
Art Metal Works, Aronson Sq., Newark, N. J. "Ronson."
Burt Co., W. T., New Cumberland, W. Va. "Allendale."
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
COLONIAL ART GLASS CO., Meriden, Conn. "Colonial Lamp."
Decker Art Studios, M. R., 4026 N. Keeler Ave., Chicago, Ill.
Fulper Pottery, Flemington, N. J.
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y. "Harrison."
Highlands Mfg. Co., Muncie, Ind. "Etrurian," "Nippon."
Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y. "Princess."
Keystone Art Glass Co., 333 N. 5th St., Philadelphia, Pa.
McDowell, Inc., J. M., 222 E. 42nd St., New York, N. Y. "Colonia."
Novelty Statuary Co., 1363 W. Lake St., Chicago, Ill.
OVALITE CO., THE, 313 E. 22nd St., New York, N. Y. "Ovalite."
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Polychrome Art Works, 2700 Diversey Ave., Chicago, Ill.
Rose Bros. Co., 221 E. Chestnut St., Lancaster, Pa.
Royal Art Glass Co., 243 Canal St., New York, N. Y.
Siegel Light Supply Co., The, 231 Market St., Philadelphia, Pa. "Waldorf."
Standard Wood Turning Co., 1756 W. Austin Ave., Chicago, Ill.
Starbuck & Son, R. M., 63 Asylum St., Hartford, Conn.
Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."

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Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Wrought Iron & Art Glass Fixture Co., 195 Canal St., New York, N. Y.

LAMPS, CANDLEPOWER OF.—The candlepower of a lamp may be measured in several directions. The one ordinarily referred to in speaking of a lamp is the mean horizontal candlepower, which is the average candlepower in the horizontal plane passing through the luminous center of the lamp. It is always assumed that the lamp is mounted in a vertical position.

The mean spherical candlepower of a lamp is a value sometimes used. It is the average candlepower of the lamp in all directions in space. It is equal to the total luminous flux of the lamp in lumens, divided by 4π. The mean hemispherical candlepower is also used sometimes, considering merely the upper or lower hemisphere. This value is obtained by dividing the total luminous flux emitted by 2π. The mean zonal candlepower of a lamp is the average value of candlepower over a given zone usually confined within certain specified angles.

LAMPS, CAP.—See Lamps, miners' and miners' safety.

LAMPS, CLAMP, BED OR DRESSER.—Lamps of a portable or semiportable type which are provided with flexible cords to plug into a convenient wall receptacle or fixture socket and are arranged to clamp onto the back of a bed or chair or onto the side or face of a dresser mirror. The spring or suction clamp is usually padded with felt or rubber to prevent marring polished surfaces. An adjustable reflector is provided to throw the light on the book being read or on the face or hair in case of dresser or dressing-table use; the reflector should be turned to shade the light from the eyes, if possible. Some of these lamps are equipped with a compact reel that fits in the base of the outfit and winds up the slack in the connecting cord or the full length of the cord when not in use, thus making a compact outfit for traveler's use. Clamp type lamps are of convenience not only for the uses referred to, but also when lighting up any temporary close visual work, such as hand sewing, shaving, etc., where insufficient light is provided by the permanent fixtures and means for attaching a clamp lamp are available but other portable boudoir or reading lamps are not at hand.

Manufacturers:

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. "Adapt-a-Lite." See display adv. page 1294.
Berendsen, Inc., Sophus, 365 1st Ave., New York, N. Y. "Dixie."
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Bridgeton Chandelier Co., Belmont & Oxford Sts., Bridgeton, N. J.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill. "Amronlite."
Greist Mfg. Co., New Haven, Conn. "Wallace."
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y. "Harrison."
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y. "Kosmo."
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv., page 1275.)
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Dresalite," "Emeralite."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mautner Lamp Mfg. Co., 55 Mercer St., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Lite-Arm."
Rose Bros. Co., 221 E. Chestnut St., Lancaster, Pa.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
White Co., The O. C., 17 Hermon St., Worcester, Mass.
Wirt Co., 5221 Greene St., Philadelphia, Pa. "Dim-A-Lite."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

LAMPS, COLOR MATCHING AND DAYLIGHT.—These lamps are designed to give a light of nearly the same color character as daylight. The Moore tubes, described under Lamps, vapor, Moore tube, neon, etc., when filled with carbon dioxide give a light very similar in color value to daylight. Incandescent lamps with the bulbs made of a special bluish colored glass are also used for this purpose. They are generally tungsten-filament gas-filled lamps.

Where colors are to be matched at any time without waiting for bright daylight or where daylight is not readily available or if colored goods are to be shown at night or on dark days in their true daylight colors these lamps are very useful. Also see Color matching lamps and outfits for equipment used with these lamps or special screen, reflector or other color-modifying equipment to be used with ordinary tungsten lamps.

Manufacturers:

Acme Lamp Works, 55 Cambridge Ave., Jersey City, N. J. "Alwo."
ARTIFICIAL DAYLIGHTING CO., INC., 227 W. 17th St., New York, N. Y. "Macbeth." See descriptive advertisement under "Color-matching lamps and outfits."
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Aladolamp."
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
McFaddin & Co., H. G., 38 Warren St., New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "Truda," "Trudalight." (See display adv., page 1405.)
New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y. "White Hope." "White Light."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Aladolamp."
Save Electric Corp., 220-254 36th St., Brooklyn, N. Y. "Save."
Solex Co., Ltd., The, 1202 St. Lawrence Blvd., Montreal, Que., Can.
Sun-Light Arc Corp., 1600 Broadway, New York, N. Y.
Wagenhorst & Co., J. H., 704 Dollar Bank Bldg., Youngstown, Ohio.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. (See display adv., page 1274.)
Whitelite Electric Co., 368-70 Broome St., New York, N. Y.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y.

LAMPS, DENTAL AND DIAGNOSTIC.—Dental lamps are miniature incandescent lamps equipped with small reflectors and suitable handles, for use by dentists in inspecting teeth cavities; they are usually low-voltage lamps supplied from a battery, d-c. potential reducer or bell-ringing transformer. Diagnostic lamps are also low-voltage miniature lamps similarly supplied; they are of various types depending on the part of the body to be examined. For throat inspections the lamp may be combined with a compact sight tube or low-power microscope that is placed within the patient's mouth and his lips closed over it, leaving the eyepiece outside. For nasal work a parabolic mirror reflector with a miniature lamp at its focus is sometimes worn on the physician's forehead.

Manufacturers:

American Surgical Specialty Co 6 E. Lake St., Chicago, Ill. "Cameron."
ANDERSON ELECTRIC & EQUIPMENT CO., Chicago, Ill. The Anderson Dentalite provides an instrument, essential for every dentist, which permits the same thorough examination heretofore only possible with expensive electrical outfits. The two principal features of the Dentalite are, its simplicity, and its ease of sterilizing. The transparent shield can be thoroughly sterilized, and all parts are quickly detachable, eliminating possibility of infection. Dentalite outfits are packed in neat leatherette cases, and include two tungsten lamps, two mirrors, eight feet of conductor cord, and a resistance unit for attaching to electric light socket, or a 4-volt dry cell battery. See display advertisement on page 1294.—Adv.

BURDICK CABINET CO., Milton, Wis. The Burdick deep therapy lamp contains special gas-filled globe, equipped with color screen which produces a balanced white light, closely related to sunlight. Reflector of highest known reflecting efficiency provides an even distribution of light rays. As a result, treatment can be given with the lamp at close range for long intervals of time with absolute comfort to the patient. Adjusted without locknuts or thumbscrews. Finished in old ivory enamel, with nickel trimmings.—Adv.



Burdick Deep Therapy Lamp

Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y. "Dentalyte."
DeZeng Standard Co., Camden, N. J. (Diagnostic.)
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. pages 1272-1273.)
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Morse, Frank W., 289 Congress St., Boston, Mass. (Mouth lamp.) "Fenner."
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."

LAMPS, DESK.—Lamps for localized lighting on desks. Desk lamps are of many designs too numerous to be described here, but usually comprising a shaded lamp, a supporting standard, often adjustable, and a base. As it is now generally recognized that for office work general illumination of sufficient quantity is better than that supplied by individual desk lamps, the use of desk lamps in the best practice is now confined to locations where the general lighting is not sufficient or satisfactory. This is true of drafting tables as well as ordinary office desks.

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y.
Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Aladdin Mfg. Co., Muncie, Ind. "Desk-Flex."
Arnessen Electric Co., 109 Broad St., New York, N. Y.
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.
Art Metal Works, The, Aronson Sq., Newark, N. J. "Ronson."
ARTIFICIAL DAYLIGHTING CO., INC., 227 W. 17th St., New York, N. Y. "Macbeth."
Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Beers Sales Co., 1 Hudson St., New York, N. Y. "Lyhne."
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y. "Cas-O-Lux."
Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. (Reed.) "Chicago."
Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio. "Ray."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
COLONIAL ART GLASS CO., Springdale Ave., Meriden, Conn. (See Lamps, table and reading.)—Adv.
Eclipse Electric Mfg. Co., Northwestern Furniture Exposition Bldg., St. Paul, Minn.

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Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill. "Verdelite."
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Fine Arts Product Co., 4311 Grand Blvd., Chicago, Ill. "Voylroid."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Franks Mfg. Co., Rock Island, Ill. "Adjustalite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Linolite."
HANDEL CO., THE, 381 E. Main St., Meriden, Conn.
Highlands Mfg. Co., Muncie, Ind. "Reth-Flex" desk.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv., pages 1266-1269.)
KING MFG. CO., THE, St. Joseph, Mo. (See display adv. page 1257.)
Kneeland Mfg. Co., Inc., The, 216 N. Main St., Wethersfield, Conn.
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
Lindcraft Studios, Jamaica Ave. & 125th St., Richmond Hill, N. Y.
Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. (See display adv., page 1275.)
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Manufactures the Liberty Light, a desk lamp of vitreous china reflector with either pompeian bronze finished base for general use, or glazed white finish

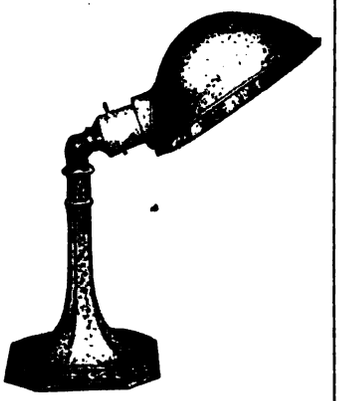


The Liberty Light

for physicians, hospitals, etc. Height, 16 ins. over all. Furnished with silk cord and plug, toggle switch in base. For other Luminous Unit products see display adv. pages 1276-7.—Adv.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mautner Lamp Mfg. Co., 55 Mercer St., New York, N. Y.
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Emeralite."
Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.
Miller & Co., Edward, 99 Center St., Meriden, Conn. "Miller."
Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv., page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio. "Bluebird."
OVALITE CO., THE, 313 E. 22nd St., New York, N. Y. This company manufactures the "Deskolite," an adjustable,



"Deskolite"

portable lamp designed for the home or office. In three finishes, Ivory, Gold and Verde. Adjustable swivel permits perfect flexibility in directing the light rays. The reflecting surface of the hood is white enamel, distributing maximum illumination. This lamp is sold only through distributors and for list of these see under "Ovalite Company."—Adv.
Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Rex-O-Lux."
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn. "Plumwood."
Rainaud Co., The H. E., Meriden, Conn.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. See display adv. page 1308.
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
Rose Bros. Co., 221 E. Chestnut St., Lancaster, Pa.
Royal Art Glass Co., 243 Canal St., New York, N. Y.
Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
Starbuck & Sons, R. M., 63 Asylum St., Hartford, Conn.
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
White Co., The O. C., 17 Hermon St., Worcester, Mass.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.
Ypsilanti Reed Furniture Co., Ionia, Mich.

LAMPS, FLOOD.—See Projectors, floodlight.

LAMPS, FLOOR.—A complete lighting unit adapted to stand on the floor. It is usually portable or semiportable and consists of a base or pedestal, an upright shaft or standard, the lamp or cluster of 2 to 4 lamps, and usually a shade over the lamps; a connecting cord with attachment plug at the free end enters the base and passes up through the standard. Wood, turned or carved, is the most common material for the standard or shaft and base, though metal and reedware are used to some extent; when wood or reedware is used the base is usually weighted with metal to keep the outfit from overturning in case it is bumped into. For shades silk fabric is now most common. Parchment and reedware are also used. The heights of floor lamps range from 4 to 6 ft. An upturned reflector for indirect or semidirect lighting is sometimes used in place of the shade or concealed by the shade; a cluster of lamps may be placed below the indirect lighting reflector and separately controlled so that direct or indirect lighting or both may be obtained. In floor lamps of this type the shade is open at the top to let light go to the ceiling. Some types of floor lamps, usually made of tubular metal, are made telescopic for vertical adjustment and have the lamp socket adjustable in angular position; a pear-shaped half shade is often used over the lamp proper. Such floor lamps are much used in dens and may have a smoker's tray arranged on the stem. Most floor lamps are used in living rooms, libraries, music rooms, etc., where their utility and artistic value accounts for their great popularity. For separate listing of bases for these lamps, see Bases and pedestals, floor lamp. Also see Shades, silk, cretonne, etc.

Manufacturers:

Adjustable Fixture Co., The 62 Mason St., Milwaukee, Wis.
AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.
Baetz Bros. Specialty Co., Ltd., Kitchener, Ont., Can.
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.
BEARDSLEE CHANDELIER MFG. CO., 218 S. Jefferson St., Chicago, Ill.
Beers Sales Co., 1 Hudson St., New York, N. Y. "Lyhne."
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.
Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Burt Co., W. T., New Cumberland, W. Va. "Allendale."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Compolux."
Caswell-Runyan Co., Huntington, Ind.
Chicago Lamp & Fixture Co., 517 W. Jackson Blvd., Chicago, Ill.
Cincinnati Artistic Wrought Iron Works, 2941-43 Eastern Ave., Cincinnati, Ohio.
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Crucet Mfg. Co., 292 5th Ave., New York, N. Y.
Dale Lighting Fixture Co., Inc., 107-9 W 13th St., New York, N. Y.
Day Co., Thomas, 725 Mission St., San Francisco, Cal.
Decker Art Studios, M. R., 4026 N. Keeler Ave., Chicago, Ill.
Eclipse Electric Mfg. Co., Northwestern Furniture Exposition Bldg., St. Paul, Minn.
Empire Lamp & Brass Mfg. Co., 663 W. Washington St., Chicago, Ill. "Empire."
Falkenbach Mfg. Co., Inc., 159 E. 54th St., New York, N. Y. "Woodfibre."
Faries Mfg. Co., Decatur, Ill. "Amronlite."
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Fine Arts Lamp & Shade Co., 2301 Wabansie Ave., Chicago, Ill.
Fine Arts Product Co., 4311 Grand Blvd., Chicago, Ill. "Voylroid."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Aladolamp."
Granden Electric Co., 1511 Howard St., Omaha, Neb.
Gudeman & Co., 30 Irving Pl., New York, N. Y.
HANDEL CO., THE, 381 E. Main St., Meriden, Conn. An excellent assortment of artistically designed hand-decorated silk and cast overlay floor lamps.—Adv.
Hartman-Malcom Co., 847 N. Troy St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind. "Reth-Flex."
Home Light Co. of America, 2120 Harrison Ave., New York, N. Y. (Wood.)
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
International Lamp Mfg. Co., 533 S. Wabash Ave., Chicago, Ill.
Kaplan, Inc., 1243 S. Wabash Ave., Chicago, Ill. "Quality."
KING MFG. CO., THE, St. Joseph, Mo. (See display adv., page 1257.)
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
Lamb Bros. & Greene, Nappanee, Ind.

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LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."
Lindcraft Studios, Jamaica Ave., & 125th St., Richmond Hill, N. Y.
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. "Brascolite." (See display adv., pages 1276,1277.)
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Emeralite."
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.
Midland Wood Turning Co., 2035 W. Harrison St., Chicago, Ill.
Miller & Co., Edward, 99 Center St., Meriden, Conn. "Miller."
Modern Lamp & Shade Co., 1104 S. Wabash Ave., Chicago, Ill.
Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Designs to harmonize with any setting. See adv. page 1405.—Adv.
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio.
Ornamental Wood Turning Co., 3217 W. Harrison St., Chicago, Ill.
Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Aladolamp."
Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Rex-O-Lux."
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn. "Plumwood."
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven Conn. (See display adv., page 1308.)
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Spiro Mfg. Co., The C., 68 E. 131st St., New York, N. Y. "Uniq."
Standard Lamp Mfg. Co., 1323 S. Michigan Ave., Chicago, Ill.
Standard Wood Turning Co., 1756 W. Austin Ave., Chicago, Ill.
Sterling Bronze Co., 201 E. 12th St., New York, N. Y.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. (Wood.)
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.
Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.
Villmont & Co., Peter S., 20 22nd St., New York, N. Y.
Walsh Mfg. Co., Owen, 525-531 W. 26th St., New York, N. Y.
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
White Co., The O. C., 17 Hermon St., Worcester, Mass.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."
Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.
Ypsilanti Reed Furniture Co., Ionia, Mich.

LAMPS, HAND, INSPECTION, EXTENSION AND TROUBLE.—These are compact portable lamps, consisting of an incandescent lamp, a socket set into or secured to a handle and a wire or other metallic guard to fit over the lamp. The guard or handle is often provided with a hook so that the lamp may be hung from any convenient place where it is not desired to hold it in the hand. The handle is drilled for an extension cord. Weatherproof sockets are often provided and in some cases an enclosing glass globe is used to make a vaporproof lamp. The ordinary open guards are sometimes provided with a half reflector to direct the light where it is wanted and to keep it from the user's eyes.

These lamps are very useful for inspectors in examining machinery or apparatus of various kinds, also for automobilists, mechanics, electricians, trouble and repairmen, as they provide a convenient and reliable source of light wherever it is needed around an automobile or other machine in a garage, shop, locomotive round house, in a boiler or engine room, on shipboard, etc. As extension lamps they are especially useful in that they provide ample protection to the lamps which are so easily broken in this service unless guarded.

Manufacturers:

ANDERSON ELECTRIC & EQUIPMENT CO., Chicago, Ill. Manufacturers of electric, automotive, and surgical lighting specialties. The "Reelite" is a flexible electric lighting device with automatic spring cord reel. It is furnished in three types, drop cord, portable, and machine tool, for use in industrial and commercial lighting installations. For local lighting, or supplementary to general lighting. Specially adapted for use in machine shops, foundries, garages warehouses, libraries, etc The Anderson "Reelite" permits instant adjustment of the light to its proper distance from the area of work, providing a more effective and concentrated illumination. Standard metal reflectors are recommended for use with the Drop cord type "Reelite," to meet the requirements of the service for which they are intended. The black enameled reel case has a base for attaching to any 3 in. (or 4 in. if specified) outlet box, or direct to the ceiling, and contains 12 feet of approved portable cord with socket attached The cord winder is of the plural-spring type insuring long life under most severe usage. Position of lamp is adjusted by raising or lowering operation, similar to the performance of an ordinary window curtain. "Reelite" portable type is for use around machinery, where proper illumination is difficult to obtain through ordinary fixed lighting units; for lighting during the construction and erection of such machinery; and for automotive repair work in garages. With the portable "Reelite," only the length of cord actually required for the work in hand is unreeled, the remainder being left wound on the drum in the reel case, free from the possibility of deterioration or damage. The "Reelite" machine tool type, is for connecting portable tools used over a considerable radius from the circuit outlet. In place of the hand lamp, is a two-pin plug connector, which can be attached to any portable electric tool, such as a soldering iron, grinders, drills, hammers, fans, laundry irons, etc. As the reel is attached to the ceiling, the cord is always clear of the floor and out of the way. See display advertisement on page 1294.—Adv.



Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Fibre handle portable 160P has removable lamp guard of hard fibre, and fibre half shade. Guard parts are formed edgewise, radially with the lamp. The distribution of light is therefore as free as with any metallic guard. Porcelain lamp grip socket is deeply imbedded in body of the wooden handle. There are no exposed metal parts to cause short circuits or grounds. It thus offers protection alike to workmen and electrical apparatus. Takes 50-watt lamp. Portable lamps with vapor proof globes, for use around inflammables, are also made by this company.—Adv.



Benjamin Hand Lamp

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago. Ill. "Handy."
CINCINNATI SPECIALTY MFG. CO., INC., 1907-21 Powers St., Cincinnati, Ohio.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Crescent Mfg. Co., The, 129 Reade St., New York, N. Y. "Crescent."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Cuno Engineering Corp., The, Meriden, Conn. (For automobiles.)
Faries Mfg. Co., Decatur, Ill. "Amronlite."
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
McGill Mfg. Co., Valparaiso, Ind.
Manhattan Brass Co., 332 E. 28th St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mescolite."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass. "Harwood," "Fenner."
Motor Specialties Co., Waltham, Mass.
North American Electric Lamp Co., 930 N. 22nd St., St. Louis, Mo.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Stickalite."
Rowe Mfg. Co., Henry, Newaygo, Mich.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Sharpe Electric Appliance Co., 502-8 Murphy Bldg., Detroit, Mich.
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I. "Duracord."

LAMPS, INCANDESCENT, CANDELABRA AND MINIATURE.—These terms are applied to small incandescent lamps mounted on bases smaller than the medium screw, which is the most common. The candelabra lamps are used to imitate candles and in some cases the bulbs are blown to a shape similar to a candle flame. A still smaller type of lamp than the candelabra is the miniature, the principal use of which is for flashlights operated from batteries for special decorative lamps, and for special lamps used by surgeons and dentists. They are made both with carbon and tungsten filaments and in sizes down to about ¼ watt. The tendency is to use tungsten-filament lamps for as many of the miniature-lamp uses as possible because of their much higher efficiency and whiter light, especially for flashlights, whose batteries last longer than when the low-efficiency carbon lamps are used. In candelabra lamps where it is desired to simulate a candle effect the carbon lamp does so better than the tungsten, the latter's light being too white compared to that of an actual candle.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Desmond Incandescent Lamp Co., 719-21 Bergen Ave., Jersey City, N. J. "Dilco."
Diamond Electric Specialties Corp., 101 S. Orange Ave., Newark, N. J.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv. pages 1272-1273.)
Electric Glass Co., 505 N. St. Clair St., Toledo, Ohio.

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Faries Mfg. Co., Decatur, Ill. "Amronlite."
French Battery & Carbon Co., Madison, Wis.
Herzog Miniature Lamp Co., W. F., 51 Jackson Ave., Long Island City, N. Y.
Howard Miniature Lamp Co., East Orange, N. J.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J. "Tung-Sol."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv. pages 1270-1271.)
Banner Electric Division, Youngstown, Ohio. "Banner."
Bryan-Marsh Division, Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y. "Bryan-Marsh."
Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
Colonial Electric Division, Warren, Ohio. "Colonial."
Columbia Lamp Division, St. Louis, Mo. "Columbia."
Federal Miniature Lamp Division, 920 S. Michigan Ave., Chicago, Ill.; 6 E. 39th St., New York, N. Y. "Federal."
Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
Packard Lamp Division, Warren, Ohio. "Packard."
Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
Shelby Lamp Division, Shelby, Ohio. "Shelby."
Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."
Propp Co., M., 108 Bowery, New York, N. Y.
Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv. page 1274.)
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

LAMPS, INCANDESCENT, CARBON.—Incandescent lamps having filaments of carbon. Previous to 1905 all commercial incandescent lamp filaments were of carbon, but this has been very largely supplanted by metal filaments of tungsten. The first successful carbon filament was produced by Edison from strips of bamboo in 1879. Edison and Swan were both very active in this line. The manufacture of carbon lamps increased very rapidly from that time on and as different methods of producing the filaments became known, the lamps became more uniform and reliable.

The method used in preparing the filament is to prepare cellulose, a compound rich in carbon, by treating absorbent cotton with zinc chloride to form a gelatine-like mass. This material is then "squirted" or forced through steel dies into alcohol, where it hardens. The filament is then dried, cut to the desired lengths and wound on forms to be carbonized by heating to a high temperature away from air. Various methods of subsequently treating the carbon filament have been devised, the so-called metallized-filament or Gem lamps being the best known, although no longer made on a commercial scale.

Carbon-filament lamps have very largely been replaced by the tungsten-filament lamps as their efficiency is poor in comparison. Their commercially rated efficiency is usually 3.5 watts per candlepower. Carbon lamps are made mostly for 110 to 125 volts in sizes from 8 to 50 cp.; for 220 to 250 volts they range from 16 to about 50 cp. They are also made for use on battery circuits of 1 to 24 volts ranging in size from the miniature lamps for pocket flashlights to various larger lamps for special purposes. For almost every purpose it is now possible to make tungsten lamps of an efficiency of 3 to 7 times as high, consequently the use of carbon lamps is decreasing in importance in relation to the total number of incandescent lamps now produced and used.

One of the principal uses for which carbon lamps are still employed is in places where there is very violent vibration, also where lamps are subject to very rough usage.

Manufacturers:

Ablett Co., Charles R., 199 Fulton St., New York, N. Y.
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Consolidated Electric Lamp Co., Danvers, Mass. "Champion."
Danvers Lamp Co., Danvers, Mass.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. pages 1272-1273.)
General Illuminating Co., 5317-5321 21st Ave., Brooklyn, N. Y. "Gico."
Howland Mfg. Co., The, 60 Franklin St., Malden, Mass. 'Mor-Lite," "How-Co."
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Zokul Electric Lamp Division, Cleveland, Ohio.
National Specialties Co., Inc., 54 W. LaFayette Blvd., Detroit, Mich.
North American Electric Lamp Co., 930 N. 22nd St., St. Louis, Mo. "Naico."
Novelty Incandescent Lamp Co., Emporium, Pa. "Nilco."
Rooney Lamp Co., F. J., Hoboken, N. J.
Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
Security Electric Lamp Co., 134 S. Clinton St., Chicago, Ill.
SUNLIGHT ELECTRICAL MFG. CO., THE, 523 Dana Ave., Warren, Ohio. "Sunlight."

LAMPS, INCANDESCENT, DECORATIVE AND TREE.—Miniature incandescent lamps used for Christmas tree decoration in place of candles or for other decorative purposes. They are generally fitted with miniature screw bases or in some cases candelabra bases. They are made for use on 110-volt circuits or for lower voltages to be connected in series, as for Christmas tree decoration, in which case eight lamps in series constitute a standard set. A great many forms of bulbs and colors are used. The simplest are merely pear-shaped lamps of different colors, but others are made to resemble various fruits, nuts, flowers, birds, animals, fish, Santa Claus and other figures popular with children. Electric tree lamps give not only a greater variety and more pleasing effect to the Christmas tree illumination, but eliminate the serious fire hazard of open candles that has given a tragic end to many holiday celebrations. Other decorative lamps are used for giving a pleasing effect to statuettes, floral sets, miniature fountains, and other decorative specialties.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Diamond Electric Specialties Corp., 101 S. Orange Ave., Newark, N. J.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv. pages 1272-1273.)
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
Herzog Miniature Lamp Co., W. F., 51 Jackson Ave., Long Island City, N. Y.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv. pages 1270-1271.)
Banner Electric Division, Youngstown, Ohio. "Banner."
Bryan-Marsh Division, Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y. "Bryan-Marsh."
Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
Colonial Electric Division, Warren, Ohio. "Colonial."
Columbia Lamp Division, St. Louis, Mo. "Columbia."
Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
Packard Lamp Division, Warren, Ohio. "Packard."
Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
Shelby Lamp Division, Shelby, Ohio. "Shelby."
Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."
Owl Flashlight Co., Inc., The, 102 Franklin St., New York, N. Y. "Owl."
Propp Co., M., 108 Bowery, New York, N. Y.
Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv. page 1274.)

LAMPS, INCANDESCENT, DOUBLE-FILAMENT OR REGULATING.—Lamps from which two or more different intensities of light may be obtained by switching on different filaments contained in the same bulb. A common form is to have one filament of very low candlepower and another of the candlepower corresponding to that kind of lamp as ordinarily used. They are not made in large sizes, not over 40 watts as a rule, and the low-intensity filament may be anywhere from ½ to 5 watts. Two cords hang from the lamp base to permit sliding a contact from one filament terminal to the other. These lamps are of special value as all-night lamps in hallways, bathrooms, bedrooms, etc., where it is desired to have a small light to find one's way about without bumping into chairs or other obstructions.

Manufacturers:

Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J. (Miniature.) "Tulite."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Economical Electric Lamp Division, 25 W. Broadway, New York, N. Y. "Hylo."
Propp Co., M., 108 Bowery, New York, N. Y.
Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
Whitelite Electric Co., 368-70 Broome St., New York, N. Y. "Dualite."

LAMPS, INCANDESCENT, MAZDA.—This is an extensive line of metal-filament lamps made by a group of manufacturers licensed under the basic patents covering these lamps and co-operating in the research that has led to their development and that is being continued for their further improvement. These lamps are produced and sold under the trade-mark "Mazda."

Manufacturers:

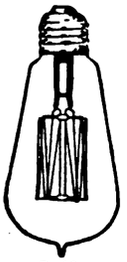
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J.
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Nela Park, Cleveland, Ohio.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y.

District offices and warehouses of all these manufacturers in principal cities through the country.

Research for the Benefit of Man.—The trade-mark Mazda is the mark of a Research Service—a service dedicated to the perfection of incandescent electric lamps that man may be happier in his work, his play, his rest. Mazda

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Service, although centered in the Mazda Research Laboratories, is really world-wide. Practical scientists and investigators throughout the world communicate with the Research Laboratories constantly. When a new discovery is made that improves the quality of Mazda lamps—and makes them more economical for the users of artificial light—that information is furnished through these Research Laboratories to all manufacturers of Mazda lamps. Likewise, the findings of any Mazda lamp factory are sent to the Research Laboratories where this new information is made commercially practical and sent on to all Mazda lamp factories. This world-wide research service benefits all Mazda lamp manufacturers and, in turn, all users of Mazda incandescent lamps. The highly efficient incandescent lamps in use today are products of Mazda Research.



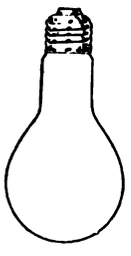
S-19



G-18½

This Service perfected the vacuum tungsten lamp, three times as efficient as the carbon lamp. Later the improved and more efficient gas-filled lamp came from Mazda Research. Other improvements in incandescent lamps may be expected year after year, for this world-wide research service works constantly in search of methods to make better incandescent lamps. Even until the perfect lamp is invented, Mazda Research will continue to serve and to furnish its new-found knowledge to all the manufacturers of Mazda lamps. Tomorrow as well as today, the name Mazda etched on an incandescent lamp will mean that that lamp is the most efficient that science and industry, working hand in hand, has yet produced. For that is the big purpose of Mazda Research—to connect the manufacturers of Mazda lamps with the research workers in light, that the one may employ the findings of the other to make better and better lamps to light the ways of men.

Shapes, Sizes and Types of Mazda Lamps.—The principal shapes and sizes of Mazda lamps are designated by letters and numbers. The letter S indicates a lamp whose sides are straight.



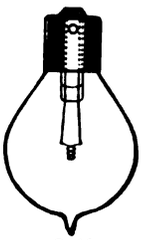
PS-20



T-10

The letter G when applied to a Mazda lamp means that the lamp is round or globular in shape. Pear-shaped lamps are abbreviated by the letters PS. And the letter T when used to designate a Mazda lamp stands for tubular. These four shapes comprise the principal makes of large lamps. The S-11 lamp is an automobile lamp and the FE-3¾ is a flashlight lamp, FE indicating flat-end. The numerals that go with these shape initials indicate the greatest diameter of the lamp in eights of an inch. For example, S-19 refers to a lamp whose side is straight and whose greatest diameter is 19 eights of an inch, or 2⅜ inches. Miniature Mazda lamps are regularly identified by "Mazda Numbers," each lamp of particular size and rating having its own distinctive "Mazda Number." This system of identification makes for greater ease in merchandising between manufacturer, distributor and retailer.

Then Mazda lamps are made in many different wattages, the watt being the "rate of working." It requires 746 watts to equal one horsepower. A 750-watt Mazda lamp therefore consumes practically one horsepower. Mazda lamps are made in many different wattage sizes from the 10-watt to the 1000-watt lamp, a range of 100 to 1. The tiny miniature lamps further increase this range to 2000 to 1. This range in Mazda lamp wattages enables the user of lamps to secure the most economical lamp for every lighting use. Mazda lamps are made in two general types. The Mazda B lamp is a vacuum lamp, the Mazda C lamp is filled with an inert gas. In the vacuum types the heat radiation is slight, but the incandescent filament in the larger sizes, when heated to extreme incandescence, evaporates comparatively rapidly and deposits on the side of the globe. To overcome this, the larger lamps (Mazda C lamps) are now made in the gas-filled type and the filament is coiled to cut down the surface exposed to the gas. The smaller sizes (Mazda B lamps) are vacuum type and burn at lower temperatures where the heat of incandescence does not deteriorate the filament too rapidly.



S-11



FE-3¾

Mazda Lamps for Every Use.—In industry Mazda lamps increase production and decrease the unit cost, prevent accidents, improve sanitary conditions and better the morale of the workers. Experience and observation have shown that good lighting is the factory manager's best investment. Sturdy mill-type Mazda lamps in industry will stand the severest jars and vibrations and give three times as much light for the same current cost as do the old carbon lamps. Merchants know that people like to trade in a well-lighted store. That's why so many thousands of Mazda lamps are used for store lighting. Customers are able to recognize the quality in goods when Mazda lamps illuminate the counters and shelves. And Daylight Mazda lamps give goods their natural colors even after darkness falls. And in the home Mazda lamps give cheerful light to make the home what it should be—a place of laughter, happiness and cheer. The glareless White Mazda lamp (PS-20, illustrated at left) is ideal for home lighting. And plenty of home light from Mazda lamps conserves human eyesight. On the farm—the greatest of all the industries—Mazda lamps light the kitchen and the parlor where the farmer and his family work, play and relax at night. In the barn and out-buildings, Mazda lamps increase the hours of work. The day of drudgery on the farm passed with the invention of farm lighting plants and the perfection of Mazda lamps. Motor cars glide down silent roads behind the piercing gleam of Mazda automobile lamps. Millions of flashlights cast the rays from a Mazda flashlight lamp into dark crooks and corners nightly. In fact there is a Mazda lamp for every lighting need, from the lamp, as tiny as a grain of wheat, used in surgery, to the 1,000-watt mogul for motion-picture projection or the special photographic lamp which makes the photographer independent of skylights and uncertain weather conditions.

Service to Users of Lamps.—The manufacturers of Mazda lamps are not content merely to sell lamps or even light—but they are making every effort to sell illumination, which is good lighting properly directed. To that end each Mazda lamp manufacturer maintains a competent and complete engineering department with illuminating engineers whose advice and service are available to all who sell, purchase or use their Mazda lamps. These specialists are not desk theorists, but practical lighting experts with field experience on thousands of actual installations covering every phase and field of illumination. They are prepared to furnish, from their practical experience, recommendations, layouts and other advice on the proper lamps, the most modern and efficient lighting systems, and the best methods of installation and maintenance for factories, stores, homes and, in short, wherever artificial light is needed or used. Also see display advertising pages 1270 to 1274.—Adv.

LAMPS, INCANDESCENT, PROJECTING.—Lamps of a type used in stereopticons and motion-picture machines, having the filaments concentrated into a very small space to suit them for use in the optical system of the projecting apparatus. Concentrated-filament lamps used in flood-light projectors with parabolic or approximately parabolic reflectors are also sometimes called projecting lamps. These lamps are nearly always of the gas-filled type. For motion-picture projection and stereopticon machines they are made to operate at a very high temperature, the life of the lamp being sacrificed purposely to obtain a whiter light. They are made to operate at standard voltages in small sizes but for the large size machines, a lamp operating on a high current and low voltage similar to a series street lamp is used.

Manufacturers:

Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv., pages 1272-1273.)

Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."

International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."

Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."

NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv., pages 1270-1271.)

- Banner Electric Division, Youngstown, Ohio. "Banner."
- Bryan-Marsh Division, Central Falls, R. I.; 623 Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y.; "Bryan-Marsh."
- Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
- Colonial Electric Division, Warren, Ohio. "Colonial."
- Columbia Lamp Division, St. Louis, Mo. "Columbia."
- Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
- General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
- Packard Lamp Division, Warren, Ohio. "Packard."
- Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
- Shelby Lamp Division, Shelby, Ohio. "Shelby."
- Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
- Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."

WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv., page 1274.)

LAMPS, INCANDESCENT, RENEWED.—Incandescent lamps in which new filaments have been placed in old bulbs. This practice has developed into a special branch of the lamp industry and affords a considerable saving to large users of

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lamps or to central stations providing a lamp-renewal service for their customers. The old bases, filament supports and in most cases bulbs of the lamps are used over again, a new filament being inserted in place of the one burned out or broken.

Manufacturers:

Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
French Battery & Carbon Co., Madison, Wis.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Boston—Economy Lamp Division, Providence, R. I.
North American Electric Lamp Co., 930 N. 22nd St., St. Louis, Mo.
Re-New Lamp Co., Malden, Mass. "Malden."
Turnbull Electric Mfg. Co., Inc., 1237 Atlantic Ave., Brooklyn, N. Y.
V. & D. Electric Co., The, 335 S. Center St., Franklin, Ohio. "Ring-O-Lite."

LAMPS, INCANDESCENT, SIGN.—For the majority of electric signs no special type of incandescent lamp is now required, standard medium-based lamps being the most generally used. At the present time the 15-watt tungsten lamp is the most popular for sign use. Before the drawn-wire tungsten lamps were developed it was impossible to make small tungsten lamps of standard voltage. Therefore it was quite common to use special low-voltage sign lamps with a special sign lighting transformer; these are now seldom required, although still used to a limited extent. Special sign lamps are used in miniature letter signs in which they are shaped to the form of the various letters.

Manufacturers:

Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Canadian General Electric Co., Ltd., 212 King St., W., Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv., pages 1272-1273.)
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Hygrade Lamp Co., 60 Boston St., Salem, Mass. "Hygrade."
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv., page 1251.)
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv., pages 1270-1271.)
- Banner Electric Division, Youngstown, Ohio. "Banner."
- Bryan-Marsh Division, Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, City. "Bryan-Marsh."
- Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
- Colonial Electric Division," Warren, Ohio. "Colonial."
- Columbia Lamp Division, St. Louis, Mo. "Columbia."
- Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
- General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
- Packard Lamp Division, Warren, Ohio. "Packard."
- Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
- Shelby Lamp Division, Shelby, Ohio. "Shelby."
- Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
- Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."

National Specialties Co., Inc., 54 W. La Fayette Blvd., Detroit, Mich.
North American Electric Lamp Co., 930 N. 22nd St., St. Louis, Mo.
Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
SMITH-HECHT CO., Century Bldg., Indianapolis, Ind.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv., page 1274.)

LAMPS, INCANDESCENT, STREET SERIES.—Lamps made to burn on a constant current in a street-lighting circuit in which the lamps are all placed in a series circuit, one after the other. The common standard current values for such circuits are 4 and 6.6 amperes, with a considerable number of 5.5 and 7.5 amperes, and a smaller number of 10, 15 and 20 amperes on transformers or compensators. Such series lamps have short heavy filaments and are rugged, long-lived lamps. They are almost always of the gas-filled tungsten type and operate at high efficiencies, about 1.1 to 0.65 watt per candlepower, the largest lamps having the best efficiencies. They are usually made in standard ratings from 650 watts (1000 cp.) to about 35 watts (32 cp.), but larger lamps to 1500 watts (20 amp., 2500 cp.) and smaller ones to 25 cp. are made special. The high-current lamps nearly always have the compensator or series transformer on or near the lamp post or pole and only the low-voltage circuit is connected to the lamp.

Series incandescent lamps were used first in small towns and in residence districts of some cities for which arc lamps proved to be too large on account of numerous trees. Since tungsten lamps have been perfected in so many sizes, they have replaced most arc lamps for street lighting in both large cities and small towns and on all kinds of streets.

Manufacturers:

Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King Street, W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Continental Lamp Works., Inc., 532-46 W. 22nd St., New York, N. Y. "Continental."
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv., pages 1272-1273.)
Hygrade Lamp Co., 60 Boston St., Salem, Mass. "Hygrade."
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv., page 1251.)
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
National Specialties Co., Inc., 54 W. La Fayette Blvd., Detroit, Mich.
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv., pages 1270-1271.)
- Banner Electric Division, Youngstown, Ohio. "Banner."
- Bryan-Marsh Division, Central Falls, R. I.; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y.. "Bryan-Marsh."
- Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
- Colonial Electric Division, Warren, Ohio. "Colonial."
- Columbia Lamp Division, St. Louis, Mo. "Columbia."
- Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
- General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
- Packard Lamp Division, Warren, Ohio. "Packard."
- Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
- Shelby Lamp Division, Shelby, Ohio. "Shelby."
- Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
- Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."

Safety Electric Co., 431 S. Dearborn St., Chicago, Ill.
Save Electric Corp., 220-254 36th St., Brooklyn, N. Y. "Save."
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv., page 1274.)

LAMPS, INCANDESCENT, TANTALUM.—Lamps having filaments of the metal tantalum. These lamps were the first metallic-filament lamps made and were developed and used to a limited extent between the years 1905 and 1908. The superior efficiency of the tungsten lamp prevented further use. On account of the low specific resistance of tantalum it was necessary to use a long slender filament, which was arranged in a series of loops and necessitated special means of support. Its life was rather uncertain when used on a-c. circuits, but more satisfactory for d-c. service. Tantalum lamps are no longer manufactured for commercial use in this country, although they are still used somewhat abroad.

LAMPS, INCANDESCENT, TUNGSTEN, GAS FILLED.—Incandescent lamps having filaments of the metal tungsten and having the bulbs filled with an inert gas, such as nitrogen or argon. As the gas contains no oxygen, the filament cannot burn. Owing to the pressure of the gas the filament does not disintegrate as rapidly as in a vacuum. Partly offsetting this is the fact that the gas conducts away considerable heat from the filament. To reduce this effect, the filaments of gas-filled lamps are wound in compact spirals so that the cooling effect of the gas is at a minimum. In small sizes of lamps, below 50 watts, the cooling effect of the gas more than offsets the other advantages. Between 50 and 100 watts both gas-filled and vacuum bulbs are used. For 100 watts and over the tungsten gas-filled lamps are the most economical.

Gas-filled tungsten lamps were developed in 1913. Under many conditions they show an efficiency much higher than that of their vacuum predecessors. This is due to the fact that it is possible to operate the filament at a temperature much nearer its melting point than was possible before. The efficiency obtained in lamps of this type in the larger sizes is 0.7 to 0.6 watt per candlepower, more than five times as efficient as the ordinary carbon lamp. Gas-filled lamps are made in various types for different purposes, such as office and industrial lighting, street lighting, flood lighting, motion-picture projection, photography and other classes of service. They range in wattages from 50 to 1000 for multiple circuits and from about 35 to 1500 for series circuits. Their light is much whiter than that from other incandescent lamps, excepting those with special blue glass bulbs.

Manufacturers:

Ablett Co., Charles R., 199 Fulton St., New York, N. Y.
Acme Lamp Works, 55 Cambridge Ave., Jersey City, N. J. "Alwo."
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Apex Electrical Specialty Co., 79 Orange St., Newark, N. J.
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y. "Factory Special," "Bettalyte," "G. M."
Blue Bird Lamp Co., 45 E. 17th St., New York, N. Y. "Blue Bird."
Brite Lite Lamp Mfg. Co., Inc., 214 Oxford St., Providence, R. I. "Marvel."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Consolidated Electric Lamp Co., Danvers, Mass. "Champion."
Continental Lamp Works, Inc., 532-40 W. 22nd St., New York, N. Y. "Continental."
Danvers Lamp Co., Danvers, Mass.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison Mazda." (See display adv. pages 1272-1273.)
Electric Lamp & Products Co., 512-514 Paterson Plankroad, Jersey City, N. J. "Lyhtan."
First Co., B., 170-172 W. Broadway, New York, N. Y. "First."
Friedlander, Inc., Oscar O., 40 Murray St., New York, N. Y. "Fredro."
General Illuminating Co., 5317-5321 21st Ave., Brooklyn, N. Y. "Gico."
Howland Mfg. Co., 60 Franklin St., Malden, Mass. "Mor-Lite," "How-Co."
Hygrade Lamp Co., 60 Boston St., Salem, Mass. "Hygrade."
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. "Argolite." (See display adv., page 1251.)
International Electric Lamp Co., 125-27 W. Lake St., Chicago, Ill.

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International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J., "Liberty Ora."
Jaeger Co., H. J., 280 Park Ave., Weehawken, N. J.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty Nitrogen Opalite."
Lux Mfg. Co., 123 E. Kinney St., Newark, N. J.
Lyhtan Electric Lamp Co., 591 Central Ave., Jersey City, N. J.
M. & W. Co., Springfield, Mass. "M. & W."
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv., pages 1270-1271.)
- Banner Electric Division, Youngstown, Ohio. "Banner."
- Bryan-Marsh Division, Central Falls, R. I. ; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y.. "Bryan-Marsh."
- Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
- Colonial Electric Division, Warren, Ohio. "Colonial."
- Columbia Lamp Division, St. Louis, Mo. "Columbia."
- Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
- General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
- Packard Lamp Division, Warren, Ohio. "Packard."
- Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
- Shelby Lamp Division, Shelby, Ohio. "Shelby."
- Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
- Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."

National Specialties Co., Inc., 54 W. La Fayette Blvd., Detroit, Mich.
New Jersey Tungsten Lamp Co., Hoboken, N. J.
Nitrogon Electric Co., Inc., 48 Spring St., Newark, N. J. "Nitrogon Service."
Novelty Incandescent Lamp Co., Emporium, Pa. "Nilco."
Save Electric Corp., 220-254 36th St., Brooklyn, N. Y. "Save."
Security Electric Lamp Co., 134 S. Clinton St., Chicago, Ill.
Solex Co., Ltd., The, 1202 St. Lawrence Blvd., Montreal, Que., Can. "Solex."
Triumph Lamp Works, Union Hill, N. J.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.
Union Lamp Co., Union Hill, N. J. "Daylight," "White Opal."
Universal Electric Lamp Co., Newark, N. J. "Universal."
Weehawken Tungsten Lamp Co., Weehawken, N. J.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse." (See display adv. page 1274.)
Whitelite Electric Co., 368-70 Broome St., New York, N. Y. "Whitelite."

LAMPS, INCANDESCENT, TUNGSTEN, VACUUM.—Lamps with filaments of the metal tungsten, having the bulb exhausted of air so as to produce as perfect a vacuum as possible. The object of this vacuum is to prevent burning or oxidation of the filament by oxygen. Vacuum tungsten lamps are now used chiefly in sizes of 50 watts and below, for 50 watts and above the lamps are usually gas-filled. In the case of low-voltage miniature lamps, the gas-filled lamp is used extensively where the current is over 1.5 amperes.

Tungsten possesses a very high melting point. Its use in incandescent lamps followed closely upon the development of the tantalum lamp. The difficulty encountered in using tungsten was that no method had been devised for drawing it into a wire and it was necessary to produce the filament in some other way. One of these methods was to use it in powdered form, held together with some binding material. This gave a paste, which was squirted through the dies into a filament form, and the binding material was then expelled, usually by heating. Tungsten lamps were first produced commercially in 1907 using a method somewhat similar to the above. All lamps produced at that time, however, had a very fragile filament and were easily broken.

Tungsten wire has since 1911 been produced in any desired length and of very uniform cross-section. This permits a much more rugged filament to be produced, and it may be drawn into very fine wire, the filament for a 10-watt, 110-volt lamp being about 0.00075 inch in diameter. The efficiency of these lamps is much higher (2.5 to 3 times) than that of the carbon lamps. They are made in a number of sizes and shapes from 10 to 100 watts for 110-125 volts, from 25 to 250 watts for 220 to 250 volts and also in miniature and candelabra lamps for lower voltages.

Manufacturers:

Ablett Co., Charles R., 199 Fulton St., New York, N. Y.
ACTON ELECTRIC CO., INC., 119 Sussex Ave., Newark, N. J. Manufacture the "Acton" special—the lamp with unbreakable filament, stronger than the carbon lamp. Especially designed to meet the need for a lamp to withstand shocks, jars and vibrations such as occur in mills, factories, garages, etc.—Adv.
Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y. "Factory Special," "Bettalyte," "W. G. M."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont. Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Consolidated Electric Lamp Co., Danvers, Mass. "Champion."
Danvers Lamp Co., Danvers, Mass.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. "Edison." (See display adv. pages 1272-1273.)
General Illuminating Co., 5317-5321 21st Ave., Brooklyn, N. Y. "Gico."
Howland Mfg. Co., The, 60 Franklin St., Malden, Mass. "Mor-Lite," "How-Co."
Hygrade Lamp Co., 60 Boston St., Salem, Mass. "Hygrade."
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. "Tungsol." (See display adv. page 1251.)
International Electric Lamp Co., 125-127 W. Lake St., Chicago, Ill.
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International Ora," "Century Special."
Jaeger Co., H. J., 280 Park Ave., Weehawken, N. J.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty."
Lux Mfg. Co., 123 E. Kinney St., Newark, N. J.
M & W Co., 30 Taylor St., Springfield, Mass.
NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Cleveland, Ohio. (See display adv., pages 1270-1271.)
- Banner Electric Division, Youngstown, Ohio. "Banner."
- Bryan-Marsh Division, Central Falls, R. I. ; 623 S. Wabash Ave., Chicago, Ill.; Detroit, Mich.; 33 Union Sq., W., New York, N. Y.. "Bryan-Marsh."
- Buckeye Electric Division, Cleveland, Ohio. "Buckeye."
- Colonial Electric Division, Warren, Ohio. "Colonial."
- Columbia Lamp Division, St. Louis, Mo. "Columbia."
- Fostoria Incandescent Lamp Division, Fostoria, Ohio. "Fostoria."
- General Incandescent Lamp Division, Cleveland, Ohio. "G. I."
- Packard Lamp Division, Warren, Ohio. "Packard."
- Peerless Brilliant Lamp Division, Warren, Ohio. "Peerless."
- Shelby Lamp Division, Shelby, Ohio. "Shelby."
- Sterling Electric Lamp Division, Warren, Ohio. "Sterling."
- Sunbeam Incandescent Lamp Division, 500 S. Clinton St., Chicago, Ill. "Sunbeam."

National Specialties Co., Inc., 54 W. La Fayette Blvd., Detroit, Mich.
Nitrogon Electric Co., Inc., 48 Spring St., Newark, N. J. "Nitrogon Service."
Novelty Incandescent Lamp Co., Emporium, Pa. "Nilco."
Rooney Lamp Co., F. J., Hoboken, N. J.
Save Electric Corp., 220-254 36th St., Brooklyn, N. Y. "Save."
Security Electric Lamp Co., 134 S. Clinton St., Chicago, Ill.
Solex Co., Ltd., The, 1202 St. Lawrence Blvd., Montreal, Que., Can. "Solex."
Turnbull Electric Mfg. Co., Inc., 1237 Atlantic Ave., Brooklyn, N. Y. "Fire Fly."
V. & D. Electric Co., The, 335 S. Center St., Franklin, Ohio. "Ring-O-Lite."
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. "Westinghouse Mazda." (See display adv. page 1274.)

LAMPS, MERCURY-VAPOR.—Lamps in which the source of light is mercury vapor, formed by an arc between two electrodes in a confined tube. The mercury-vapor lamp consists principally of a vacuum tube containing some metallic mercury and an electrode at each end of the tube, through which the current is conducted to and from the lamp. The mercury vapor is formed from the metallic mercury which covers one electrode and which gives off mercury vapor from its surface when the current is passing. This mercury vapor fills the tube so that the whole tube glows with a yellowish green light. The arc is started either by momentarily tipping the lamp so as to cause the mercury to flow between the electrodes and then break to form an arc, or by passing the spark from an induction coil between the electrodes to vaporize enough mercury to form an arc. A resistance is used in such lamps for the arc. The ordinary mercury-vapor lamps are made with long glass tubes. The tube must be long as the voltage per unit length of tube is determined by the temperature the glass tube is capable of withstanding.

An improvement over this type was made in the quartz lamp. The tubes in this are made of quartz and as they will withstand a much higher temperature than glass, the drop in potential per inch of length can be raised to about 30 times that permissible with glass tubes. This causes the mercury vapor to become incandescent and the character of the light given off is changed, some red and orange rays being added to give a more nearly white light. The commercial form of this lamp uses a short quartz tube containing mercury. The mechanism needed for starting and controlling the lamp is placed in a cylindrical case above the tube. The tube is enclosed in a large glass globe to exclude the ultraviolet rays which are not screened by the quartz glass. This type is available for direct current only. Its efficiency is very high.

The ordinary glass tube lamps are not used in homes or stores where natural colors are desired, but are used for various industrial purposes where acuity of vision is needed; they are rich in actinic rays, making them suitable for photographic work.

Manufacturers:

Baetz Bros. Specialty Co., Ltd., Kitchener, Ont., Can.
BURDICK CABINET CO., Milton, Wis.
COOPER HEWITT ELECTRIC CO., Hoboken, N. J. The Cooper-Hewitt lamp is the coming lamp for all industrial lighting. Its peculiar method of producing light has many important advantages both in quality of illumination and efficiency. Its light is bluish-green, a color which possesses extraordinary properties, enabling the eye to see small objects and fine details more distinctly than any other light, not excepting daylight itself. The large extent of luminous surface gives perfect diffusion, practically eliminating shadows. The glowing vapor being entirely free from glare, the Cooper-Hewitt lamp is the only commercial light-unit that can be safely used without diffusing globes or shades. Consumption of .65 watts and below per hemisphered candle makes the Cooper-Hewitt lamp the most efficient of any lamp suitable for industrial lighting. The only attention it requires is an occasional cleaning of the tube and reflector, the tube having a life of several thousand hours before replacement is necessary. Chief of the recent improvements is the standardization of a unit, having 85% power factor. The Cooper-Hewitt lamp is applicable for lighting almost any industrial establishment. Used in textile mills, it permits twenty-four hour operation. It is possible to match col-

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ors accurately under this light. Its characteristics make it especially valuable for all classes of photographic work, including portraiture, copying, printing, motion picture photography, enlarging and blue printing.—Adv.

Hanovia Chemical & Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.

R. U. V. Co., Inc., The, 165 Broadway, New York, N. Y.

LAMPS, MINERS' AND MINERS' SAFETY.—An electric incandescent lamp and storage battery, forming a complete unit to be carried by miners. The lamp is usually carried on the cap and the battery on the back, the two being connected by a flexible cord. These sets are often made with the lamp in a special socket and reflector that is connected to the battery by a reinforced cord, so that the lamp may be placed on the cap or in other positions that the self-contained unit type cannot be used for. In the unit type the lamp is usually mounted directly above the storage battery or fastened to the enclosing case in some manner so as to make a portable lantern with bail or other handle. The storage batteries used are developed especially for this service and are light, but rugged and arranged so they will not spill; they are usually enclosed in a hinged aluminum case. They operate for 8 or 12 hours and the batteries are recharged when the miner is off duty.

Safety devices are attached to some lamps for use in explosively dusty or gaseous atmospheres. These generally provide for turning off the current instantly if the enclosed reflector or shell should be broken or crushed, and before the lamp itself breaks, thus eliminating the possibility of a spark and explosion.

Manufacturers:

Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind. "Anthony Wayne."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Concordia Electric Co., 389 Union Arcade Bldg., Pittsburgh, Pa. "Ceag."

EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. pages 1273-1274.)

EDISON STORAGE BATTERY CO., Orange, N. J. (See display adv. page 1313.)

International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."

Koehler Mfg. Co., Marlboro, Mass. "Wheat," "Koehler."

Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J. "Tung-Sol."

Pioneer Storage Battery Co., 1415 Race St., Philadelphia, Pa. "Pioneer."

Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.

LAMPS, MOORE TUBE, NEON AND OTHER GASEOUS TYPES.—A number of forms of lamps have been developed in an experimental way in which light is given from gases confined in long tubes, through which charges of electricity are passing. One of the best known of these is the Moore tube, which has been used to a limited extent for color matching, where daylight effects were desired. These make use of the Geissler-tube discharge through an evacuated tube in which some gas has been placed. The lamps are rather difficult to operate and require a considerable length of tube, usually from 40 to 200 ft. The tube may be placed around the walls of a room or window. The ends of the tube have electrodes that are connected to the high-tension side of a transformer. The color of the light depends upon the gas used, nitrogen giving a yellowish color, air a pink tint and carbon dioxide a white light which approaches daylight very closely.

Neon tubes are very similar to the Moore tubes in principle, but employ neon gas, which may be obtained as a by-product of the manufacture of oxygen from the air. They have a life comparable to that of an incandescent lamp, require a potential of about 800 volts for a tube 6 meters long and give about 200 cp. per meter of length. Their efficiency is high about 0.5 watt per candlepower. The color of the light is red, unless modified by substance. This type of lamp has been developed in France, but is not produced on a commercial scale.

LAMPS, NERNST.—A type of electric lamp invented by Nernst in which the light is produced by the passage of the electric current through a glower made of certain rare oxides which are heated to incandescence. These oxides are not conductors of electricity when cold, so they are heated by electric heating coils mounted on the lamp, these coils being disconnected when the lamp reaches incandescence and the current flows through the glower. Nernst lamps were in considerable use prior to the advent of the tungsten lamp in 1908, but went out of use after that time because of the better efficiency and cheapness of the tungsten lamp.

Manufacturer:

Stupakoff Laboratories, The, 6617-6627 Hamilton Ave., Pittsburgh, Pa.

LAMPS, PIANO.—This is a term used generally to designate lamps with a heavy base and horizontal arm (often adjustable) carrying a lamp and reflector to throw light down on the sheet of music when the lamp is standing on an upright piano. The simpler of these lamps resemble desk lamps designed for roll-top desks. The term piano lamp is sometimes, but less correctly, applied to floor lamps standing beside a piano, or to table lamps sometimes used on grand pianos.

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y.

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."

Arnessen Electric Co., 109 Broad St., New York, N. Y.

Art Craft Fixture Co., 85 Academy St., Newark, N. J.

Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.

Art Metal Works, The, Aronson Sq., Newark, N. J. "Ronson."

ARTIFICIAL DAYLIGHTING CO., INC., 227 W. 17th St., New York, N. Y. "Macbeth."

BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.

Beers Sales Co., 1 Hudson St., New York, N. Y. "Lyhne."

Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. (Reed.) "Chicago."

Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio. "Ray."

Cole Mfg. Co., Kent St., Lindsay, Ont., Can.

Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.

Eclipse Electric Mfg. Co., Northwestern Furniture Exposition Bldg., St. Paul, Minn.

Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.

Faries Mfg. Co., Decatur, Ill. "Verdelite."

Fibreduro, Inc., 396 Broadway, New York, N. Y.

Fine Arts Product Co., 4311 Grand Blvd., Chicago, Ill. "Voyiroid."

First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.

Franks Mfg. Co., Rock Island, Ill. "Pianolite."

Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Linolite."

HANDEL CO., THE, 381 E. Main St., Meriden, Conn.

Highlands Mfg. Co., Muncie, Ind. "Reth-Flex" desk.

INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)

KING MFG. CO., THE, St. Joseph, Mo. (See display adv. page 1257.)

Kneeland Mfg. Co., Inc., The, 216 N. Main St., Wethersfield, Conn.

Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.

Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."

LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Lightolier."

Lindcraft Studios, Jamaica Ave. & 125th St., Richmond Hill, N. Y.

Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.

LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. (See display adv. page 1275.)

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)

Manhattan Brass Co., 332 E. 28th St., New York, N. Y.

Mautner Lamp Mfg. Co., 55 Mercer St., New York, N. Y.

Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.

McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Emeralite."

Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.

Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.

Miller & Co., Edward, 99 Center St., Meriden, Conn. "Miller."

Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.

Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio. "Bluebird."

OVALITE CO., THE, 313 E. 22nd St., New York, N. Y. "Deskolite."

Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.

Parker Co., The Charles, 48 Elm St., Meriden, Conn.

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Rex-O-Lux."

Play-O-Lite Co., Inc., 1760 Main St., Buffalo, N. Y. "Play-O-Lite."

Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn. "Plumwood."

Rainaud Co., The H. E., Meriden, Conn.

Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.

Rose Bros. Co., 221 E. Chestnut St., Lancaster, Pa.

Royal Art Glass Co., 243 Canal St., New York, N. Y.

Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.

Starbuck & Sons, R. M., 63 Asylum St., Hartford, Conn.

Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.

Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.

White Co., The O. C., 17 Hermon St., Worcester, Mass.

Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."

Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

Ypsilanti Reed Furniture Co., Ionia, Mich.

LAMPS, PORTABLE, SPECIAL AND MISCELLANEOUS.—Portable lamps of several types are listed separately but those of very special character or use are included under this classification. Among such lamps is a small, low-voltage portable night lamp operated from a transformer in the base; also several types of portable extension lamps with self-contained reel for the cord that are especially suitable for travelers; combination automobile cowl and trouble lamps, etc. The various types of what are frequently called portable lamps listed elsewhere include the following types of lamps: Boudoir; clamp, bed or dresser; desk; floor; hand, inspection, etc.; piano; table or reading. Also see Flashlights; Lanterns.

Manufacturers:

Acme Lighting Fixture Co., 132 W. 14th St., New York, N. Y.

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.

AJAX ELECTRIC SPECIALTY CO., St. Louis, Mo. A complete line of standard portable lamps, with flexible and jointed arm, for all commercial purposes.—Adv.

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill. "Adapt-a-Lite."

Art Specialty Co., 805 S. 11th St., Philadelphia, Pa.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin hand portables, with watertight, vaporproof globe reflector, and metal guard with removable cast hook. Especially designed for marine service. Takes up to 75 watt lamp.—Adv.



Benjamin Hand Lamp

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Berendsen, Inc., Sophus, 365 1st Ave., New York, N. Y. "Dixie."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cincinnati Artistic Wrought Iron Works, 2941-43 Eastern Ave., Cincinnati, Ohio.
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.
Electric Novelty Mfg. Co., 152 Chambers St., New York, N. Y. (Statue of Liberty.)
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Faries Mfg. Co., Decatur, Ill. "Amronlite."
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Aladolamp."
Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y. "Harrison."
Jefferson Glass Co., The, Follansbee, W. Va.
Kneeland Mfg. Co., Inc., The, 216 N. Main St., Wethersfield, Conn.
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Lindcraft Studios, Jamaica Ave. & 125th St., Richmond Hill, N. Y.
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. (See display adv., page 1275.)
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.
Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
Metal Specialties Mfg. Co., 3200-3208 Carroll Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass. "Grether" portable searchlight.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv., page 1405.)
New England Brass & Fixture Co., 77 Summer St., Boston, Mass.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio. "Bluebird."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Aladolamp."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Porter Co., The, 241 Water St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.
Van Briggle Tile & Pottery Co., The, Colorado Springs, Colo. (Ornamental hand lamp.)
White Co., The O. C., 17-21 Hermon St., Worcester, Mass.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

LAMPS, PROJECTING AND STEREOPTICON.—Lamps of the incandescent or arc type enclosed in a sheet-metal housing upon a metal stand or frame and provided with lenses and (for stereopticons) slide carrying equipment for projecting pictures upon a screen. When using incandescent lamps, they often are made of such design that they can be used in a motion-picture or stereopticon machine that was previously operated with an arc lamp. A rheostat to regulate the voltage at the lamp is generally provided as part of the outfit, often being mounted on the same stand. The incandescent lamps used are those described under Lamps, incandescent, projecting; the arcs are described under Lamps, arc, projecting, stage and stereopticon. Also see Motion-picture machines; Stereopticons.

Manufacturers:

Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind.
Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y.
Bettalyte Incandescent Lamp Co., Inc., 366 W. 15th St., New York, N. Y.
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Burke & James, 240 E. Ontario St., Chicago, Ill. ("Rexo" projecting.)
Continental Lamp Works, Inc., 532-40 W. 22nd St., New York, N. Y. "Continental."
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Graphoscope Mfg. Co., 49 Mechanic St., Newark, N. J. "Graphoscope."
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill. "McIntosh-Nernst."
Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J. "Tung-Sol."
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv., page 1405.)
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegel." "Lilliput."
Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. (See display adv., page 1274.)
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

LAMPS, RAILWAY SIGNAL AND SWITCH.—Electric signal lamps were at first used at electrified terminals and their use has been somewhat confined to these terminals, though more recently they have been employed in connection with electrified sections of trunk and interurban lines. Their chief advantage is their very low maintenance cost. The electric signal lamps of the semaphore type are made similar in external dimensions to the oil types; in fact, many of the oil-lamp signals have been remodeled by using an adapter to permit replacing the oil lamp by an incandescent lamp. Only one lamp is used, the three colors commonly employed in signaling being obtained by the ordinary means, that is, moving colored glass roundels attached to the other end of the semaphore arm into position in front of the lamp.

For some purposes the signals are used both day and night. Such semaphores use lamps equipped with reflectors; this arrangement gives a light signal that can be seen from a greater distance than can the semaphore arm itself. The position-light system utilizing the electric lamps has also been employed. For several years it has been used with considerable success on one of the largest railroads in the country. One of the difficulties encountered in the use of incandescent lamps has been to set the light source in the focus of the lens or reflector. Various mechanical devices have been tried which make the lamp adjustable by rotation of the socket; another such device consists of an adapter which allows the lamp to be moved with respect to the lens by a collapsible tube framework connecting the lamp and lens, further adjustment being obtained by a ball-and-socket fitting in the lamp socket. Another expedient has been to rebase the lamps.

The incandescent lamps used are commonly of low voltage and to give greater life are usually burned at less than the rated voltage. Their useful life may vary from five months to over a year, depending on the number of hours of normal burning per day. Also see Lanterns, railway signals.

Manufacturers:

Adams & Westlake Co., 319 W. Ontario St., Chicago, Ill. "Adlake."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE LAMP CO., 165 Broadway, New York, N. Y. (See display adv., page 1274.)

LAMPS, SPECIAL AND MISCELLANEOUS.—The term lamp is applied to both the source of light and to many types of complete self-contained lighting devices. This classification includes lamps which come under either meaning of the term and which are not listed under any other class of lamps entered above or below. Such special and miscellaneous lamps include lecturer's reading lamps, double-base tubular incandescent lamps, white enameled tungsten lamps, also other lamps of very special sizes, ratings or shapes to suit unusual requirements.

Manufacturers:

Anthony Wayne Lamp Co., 1016 Savilla Ave., Ft. Wayne, Ind.
Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill. ("Donahoe" switchboard pilot.)
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (Watertight marine portable.) (See display adv., pages 1231-1234.)
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill. (Demonstration arc lamp.)
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Cole Mfg. Co., Kent St., Lindsay, Ont., Can.
Continental Lamp Works, Inc., 532-40 W. 22nd St., New York, N. Y. "Continental."
Eastman Kodak Co., Rochester, N. Y. ("Safe-Light" photograph developing, "Brownie Safelight" photograph enlarging.)
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
Fowler Lamp & Mfg. Co., 61 E. 24th St., Chicago, Ill. (Made to blueprint designs.)
International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J. "International."
Kramerlite Co., Inc., 577 Broadway, New York, N. Y. "Kramerlite."
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y. "Liberty Spotlite."
McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill. (Lecturer's.)
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Schweitzer & Herz, 231 N. Wells St., Chicago, Ill. (Double base.)
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.
Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.
Union Electric Corp., 103 Mott St., New York, N. Y. "Nitelite."
Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md. (For microscopes.)
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
White Co., The O. C., 17-21 Hermon St., Worcester, Mass.

LAMPS, TABLE OR READING.—A complete portable lighting unit for use on a table. It consists of a support or base, resting on the table, an upright standard or shaft often integral with the base, the incandescent lamp or cluster of lamps and a lamp shade supported by the standard. Metal, wood, reedware, special composition and pottery are commonly used for the bases and standards. Glass, metal, silk, parchment, paper and pottery are in common use for the shades of table lamps. Clusters of from two to four sockets are generally found in this class of lamps. A very great number of these lamps have been produced in a great variety of designs. While most are designed for direct lighting, some indirect and also combined direct and indirect lighting designs have been produced. The decorative value of table lamps has given them wide popularity. They serve the purpose of illuminating the table and at the same time are an attractive addition to the

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furnishings of the room. To a considerable extent these lamps have come to displace the ceiling fixture for lighting of living rooms. They are also widely used in libraries and dens; in club and hotel writing and reading rooms, etc.

Manufacturers:

Acme Gas & Electric Fixture Co., 132 W. 14th St., New York, N. Y. "Acmetal."

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.

Aladdin Mfg. Co., Muncie, Ind.

A. & R. Lamp Co., The, 121-123 Lafayette St., Newark, N. J.

ANDERSON ELECTRIC & EQUIPMENT CO., Chicago, Ill. The Adapt-a-lite extension unit is a complete device ready for use, with plug to attach to any existing socket or receptacle. For installing, take out a lamp, screw in the Adapt-a-lite, insert the lamp in the socket, and reel out the extension as far as required up to 10 feet. It has a brushed brass finish, and silk covered conductor cord. The Adapt-a-lite portable is of similar construction, having a patent adjustable shade and a bracket base of unique design which combines a base for use as a table lamp, for hanging on a wall, a clamp for attaching to the frame of a bed, or the edge of a table or desk. Shade can be adjusted to direct the light rays in any direction. It has brush brass finish. See display advertisement on page 1294.—Adv.



Adapt-a-lite Extension Unit

Anodion Metal Co., The, 124 South St., Baltimore, Md.

ARTIFICIAL DAYLIGHTING CO., INC., 227 W. 17th St., New York, N. Y. "Macbeth."

Art Metal Works, The, Aronson Sq., Newark, N. J. "Ronson"

Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.

Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."

BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.

Bergen Co., The J. D., Meriden, Conn.

Biddle-Gaumer Co., 3846-56 Lancaster Ave., Philadelphia, Pa.

Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.

Cassidy Co., Inc., 15-21 Wilbur Ave., Long Island City, N. Y. "Cas-O-Lux."

Caswell-Runyan Co., Huntington, Ind.

Central Cut Glass Co., 1114 E. 63rd St., Chicago, Ill. (Cut glass.)

Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."

Cincinnati Artistic Wrought Iron Works, 2941-43 Eastern Ave., Cincinnati, Ohio.

Cole Mfg. Co., Kent St., Lindsay, Ont., Can.

When writing to manufacturers please mention the

E M F ELECTRICAL YEAR BOOK

COLONIAL ART GLASS CO., Springdale Ave., Meriden, Conn. Colonial lamps, made with all metal base, overlaid metal on opalescent glass shades, wired complete (less bulbs) with chain pull sockets, six feet of silk cord and attachment plug. Made in a variety of styles and shapes.—Adv.



"Colonial" Table Lamp

Crown Chandelier Co., Inc., 610-614 Broadway, New York, N. Y.

Crucet Mfg. Co., 292 5th Ave., New York, N. Y.

Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y.

Day Co., Thomas, 725 Mission St., San Francisco, Cal.

Decker Art Studios, M. R., 4026 N. Keeler Ave., Chicago, Ill.

Empire Lamp & Brass Mfg. Co., 663 W. Washington St., Chicago, Ill. "Empire."

Empire Lighting Fixture Co., 224 Centre St., New York, N. Y.

Falkenbach Mfg. Co., Inc., 159 E. 54th St., New York, N. Y. "Woodfibre."

Faries Mfg. Co., Decatur, Ill. "Amronlite."

Fibreduro, Inc., 396 Broadway, New York, N. Y.

Fine Arts Lamp & Shade Co., 2301 Wabansia Ave., Chicago, Ill.

Fine Arts Product Co., 4311 Grand Blvd., Chicago, Ill. "Voyiroid."

First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.

Goshen Novelty & Lamp Co., Goshen, Ind.

Granden Electric Co., 1511 Howard St., Omaha, Neb.

Greist Mfg. Co., New Haven, Conn. "Wallace."

Gudeman & Co., 30 Irving Pl., New York, N. Y.

HANDEL CO., THE, 381 E. Main St., Meriden, Conn. A wide selection of artistically designed hand-decorated table and reading lamps; also a complete line of hand-decorated glassware. —Adv.

Harrison Fixture Works, 59 Harrison St., Brooklyn, N. Y. "Harrison."

Hartman-Malcom Co., 847 N. Troy St., Chicago, Ill.

Home Light Co. of America, 2120 Harrison Ave., New York, N. Y. (Wood.)

International Lamp Mfg. Co., 533 S. Wabash Ave., Chicago, Ill.

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv., pages 1266-1269.)

Jefferson Glass Co., The, Follansbee, W. Va.

Keith Mfg. Co., Inc., Clinton, N. Y. "Keith."

Keystone Art Glass Co., 333 N. 5th St., Philadelphia, Pa.

Kittinger Co., 1893 Elmwood Ave., Buffalo, N. Y.

Kneeland Mfg. Co., Inc., The, 216 N. Main St., Wethersfield, Conn.

Krantz & Sell Co., The, Honesdale, Pa.

Lamb Bros. & Greene, Nappanee, Ind.

Lindcraft Studios, Jamaica Ave., & 125th St., Richmond Hill, N. Y.

Lion Electrical Appliance Co., Inc., 360 Morgan Ave., Brooklyn, N. Y.

LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv., page 1275.)

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. "Brascolite." (See display adv., pages 1276, 1277.)

Mautner Lamp Mfg. Co., 55 Mercer St., New York, N. Y.

Mazzolini Artcraft Co., 4424 Payne Ave., Cleveland, Ohio.

McDowell, Inc., J. M., 222 E. 42nd St., New York, N. Y.

McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Emeralite."

Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.

Miller & Co., Edward, 99 Center St., Meriden, Conn. "Miller."

Moran & MacNair, Inc., 72 W. Lake St., Chicago, Ill.

Morreau Co., 1303-1307 Oregon Ave., N. E., Cleveland, Ohio. "Qualiti-Lite."

Mosaic Shade Co., 589 E. Illinois St., Chicago, Ill.

Mugnai Statuary Co., 1337 W. Grand Ave., Chicago, Ill.

National Plastic Relief Co., 330 Main St., Cincinnati, Ohio.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv., page 1405.)

New England Brass & Fixture Co., 77 Summer St., Boston, Mass.

Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.

Northwestern Art Shade Co., 184 W. Lake St., Chicago, Ill.

Novelty Lamp Shade Co., 2480 E. 22nd St., Cleveland, Ohio. "Bluebird."

Ornamental Wood Turning Co., 3217 W. Harrison St., Chicago, Ill.

OVALITE CO., THE, 313 E. 22nd St., New York, N. Y. "Deskolite."

Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill.

Parisienne Lamp & Shade Co., 1220 W. 6th St., Cleveland, Ohio. "Parisienne."

Parker Co., The Charles, 48 Elm St., Meriden, Conn.

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.

Peters Co., H. J., 227-229 W. Huron St., Chicago, Ill.

Phoenix Glass Co., Federal Reserve Bank Bldg., Pittsburgh, Pa. "Phoenix."

Phoenix Light Co., 525 Market St., Milwaukee, Wis.

Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.

Polychrome Art Works, 2700 Diversey Ave., Chicago, Ill.

Rainaud Co., The H. E., Meriden, Conn.

Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.

RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv., page 1308.)

Renner & Maras, Inc., 289 4th Ave., Long Island City, N. Y. ("Renmar" adjustable.)

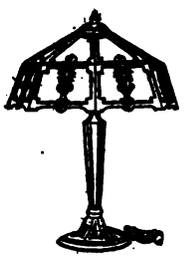
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.

Rose Bros. Co., 221 E. Chestnut St., Lancaster, Pa.

Royal Art Glass Co., 243 Canal St., New York, N. Y.

Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."

SHAPIRO & ARONSON, INC., 20 Warren St., New York, N. Y. The lamp shown herewith is one of the eight standardized portable lamps manufactured by this company. Other designs in various finishes. All lamps are shipped wired complete. These are described in Catalog No. 22. Sent to interested parties on request.—Adv.



No. 3308

SIGNAL ELECTRIC MFG. CO., Memominee, Mich. "Signal."

Standard Wood Turning Co., 1756 W. Austin Ave., Chicago, Ill.

Starbuck & Sons, R. M., 63 Asylum St., Hartford, Conn.

Sterling Bronze Co., 201 E. 12th St., New York, N. Y.

Stiles & Co., H. A., 97 Oliver St., Boston, Mass. (Wood.)

Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.

Triangle Wood Specialty Co., Inc., 3347 W. Madison St., Chicago, Ill.

Van Briggle Tile & Pottery Co., The, Colorado Springs, Colo. (Pottery.)

Villmont & Co., Peter S., 20 W. 22nd St., New York, N. Y.

VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.

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Warner, Inc., C. B. & J., 138 W. 14th St., New York, N. Y.
Warren & Co., Walter G., 1401 W. Jackson Blvd., Chicago, Ill.
White Co., The O. C., 17 Hermon St., Worcester, Mass.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."
Williamson & Co., R., Washington & Jefferson Sts., Chicago, Ill.
Wrought Iron & Art Glass Fixture Co., 195 Canal St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.
Young Co., William B., 1733 N. 6th St., Philadelphia, Pa.
Ypsilanti Reed Furniture Co., Ionia, Mich.

LAMPS, TELEPHONE SWITCHBOARD.—Small incandescent lamps developed for use on manual switchboards. They are tubular in shape, of small diameter, about 5/16 in., and about 1 in. long. They have flat metal terminals at the rear. Lamps are given several names depending upon the apparatus they are associated with and their function, as follows:

Busy Lamp. A lamp associated with a trunk jack and which is lighted as long as the trunk is busy.

Line Lamp. A switchboard lamp associated with a subscriber line on a common-battery manual switchboard. It lights when a subscriber takes the receiver from the hook. It is usually operated by a line relay. A few magneto boards have been made with line relays and lamp signals. The larger toll boards have lamp signals.

Pilot Lamp. A lamp common to a group of lamps and arranged to light when any one of them lights. The line pilot lamp lights when any line lamp lights. The supervisory pilot lamp lights when any answering supervisory lamp lights. A pilot lamp assists the operator and the supervisor in seeing what is wanted.

Resistance Lamp. A lamp used as a resistance only, not for its light. For instance, most ringing generators deliver their current to the switchboard through a resistance lamp so that if the line being rung is dead short-circuited it will not dead short-circuit the generator.

Supervisory Lamp. A lamp associated with a switchboard cord by means of which the subscriber can attract the attention of the operator, and by which the operator can supervise the connection. When the subscriber hangs up his receiver, the supervisory lamp lights. By working the hook slowly down and up the lamp will "flash." Rapid working of the hook will not give the lamp filament time to become incandescent. Also see Supervision, manual telephone switchboard.

Ringing Lamp. A lamp associated with a trunk at the B board which remains lighted until the called subscriber has answered. By this the B operator knows when to stop ringing.

Test Lamp. A lamp used by switchmen to test circuits on a working switchboard. It has one or more flexible cords and operates on the normal battery voltage of the board.

Manufacturers:

Bettalyte Incandescent Lamp Co., Inc., 366-372 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Novelty Incandescent Lamp Co., Emporium, Pa. "Nilco."
Stanley & Patterson, 34 Hulbert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

LAMPS, THERAPEUTIC.—Lamps used by the medical profession for healing purposes may be classed under three heads: (a) Lamps which act largely by heat radiation. In these an incandescent lamp of low efficiency and high wattage is used, the heat and light rays being directed by a concentrating reflector so as to converge at a point a short distance from the lamp, so that considerable radiant heat can be applied to the part of the body to be treated. (b) Lamps giving light radiation of a certain color. Blue lamps, in which the red rays and heat rays have been largely filtered out by the blue glass, have been used in the treatment of certain skin diseases. (c) Lamps giving ultra-violet light. The quartz-tube mercury-vapor lamp is used for this. The ultra-violet rays have a pronounced germicidal effect, but must be used with great care.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind. "Giant." "Murphy's."
Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Brooklyn Medical Battery & Instrument Co., Inc., 991 Madison St., Brooklyn, N. Y.
BURDICK CABINET CO., Milton, Wis.
COOPER HEWITT ELECTRIC CO., 95 River St., Hoboken, N. J. "Cooper Hewitt."
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv. pages 1272-1273.)
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Cosmo."
Koken Companies, 2528 Texas Ave., St. Louis, Mo. "Koken."
Magic Pain Relieving Lamp Co., 544 Garfield Ave., Chicago, Ill. "Sterling."
McFaddin & Co., H. G., 38 Warren St., New York, N. Y. "Thermolite."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill. "Solaray."
Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y. "Pittsburgh."
Sanitarium Equipment Co., Battle Creek, Mich. "Solar."
Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y. "Sanitax."
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Heatolite."
Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.
Sharp & Smith, 65 E. Lake St., Chicago, Ill. "Sands."
Sterling Pain Relieving Lamp Co., 546 Garfield Ave., Chicago, Ill. "Sterling."
Taylor, Dr. W. D., Mechanic Falls, Me.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.

LAMPS, VEHICLE AND BICYCLE.—These outfits usually consist of a battery of one or two dry cells and one or a group of lamps needed on the particular vehicle for which they are designed, generally one headlight and a small tail lamp. They are equipped with fittings for conveniently fastening the battery and lamps to the vehicle dashboard or frame. Their freedom from the troubles common with gas and oil lamps has made them quite popular.

Manufacturers:

American Every Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Anthony Wayne Lamp Co., 1016 Savilla St., Ft. Wayne, Ind.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Delta Electric Co., Marion, Ind. "Delta."
EDISON LAMP WORKS OF GENERAL ELECTRIC CO., Harrison, N. J. (See display adv., pages 1272-1273.)
Howe Lamp & Mfg. Co., 115-123 E. Ontario St., Chicago, Ill.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass.
Rose Mfg. Co., 910 Arch St., Philadelphia, Pa. "Neverout."
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."

LAMSON.—Trade name for bolts and wrenches manufactured by the Lamson & Sessions Co., 2188 Scranton Rd., Cleveland, Ohio.

LAMSON & SESSIONS CO., THE.—2188 Scranton Rd., Cleveland, Ohio. Manufacturer of pole-line hardware. Business established 1866. President, F. C. Case; vice-president and treasurer, J. G. Jennings; secretary, H. C. Holt.

LAMSON CO., THE.—Boston, Mass. Manufacturer of conveyors and carrier systems. Business established 1888. President, W. F. Merrill; vice-president, H. C. Turner. Main office, 100 Boylston St., Boston, Mass. Factory, Lowell, Mass. Branch offices, 9-11 E. 37th St., New York, N. Y.; 210 N. Broad St., Philadelphia, Pa.; 319 3rd St., Pittsburgh, Pa.; Equitable Bldg., Baltimore, Md.; 194 E. Main St., Rochester, N. Y.; 525 Woodward Ave., Detroit, Mich.; 2063 E. 4th St., Cleveland, Ohio; 119 E. 5th St., Cincinnati, Ohio; Washington & Illinois Sts., Indianapolis, Ind.; 6 N. Michigan Ave., Chicago, Ill.; 320 Tribune Annex, Minneapolis, Minn.; McCague Bldg., Omaha, Neb.; 1622 Arapahoe St., Denver, Colo.; 617 Mission St., San Francisco, Cal.; 221 San Fernando Bldg., Los Angeles, Cal.; 709 Pine St., St. Louis, Mo.; 227 Bourbon St., New Orleans, La.; 210 New Ridge Bldg., Kansas City, Mo.; 905½ Elm St., Dallas, Tex.; 215 Stewart St., Seattle, Wash.; Moore Bldg., Atlanta, Ga.; 426 Colorado Bldg., Washington, D. C.; 136 Simcoe St., Toronto, Ont.; 104 Empire Bldg., Vancouver, B. C.

LAMSON ELECTRICAL & MFG. CO.—625 W. Jackson Blvd., Chicago, Ill. Manufacturers of telegraph recording systems, screws, etc. Business established 1915.

LANCASHIRE DYNAMO & MOTOR CO. OF CANADA, LTD.—Toronto, Ont., Can. Manufacturer of motors, generators, motor-generators, electric trucks, etc. Business established 1911. President and general manager, S. A. Gaskell; vice-president, W. Kilvert; secretary and treasurer, B. Brady. Main office and factory, Toronto, Ont., Can. Branch office, 602 New Birks Bldg., Montreal, Que., Can.

LANCASTER.—Trade name for electric forge blowers manufactured by the Champion Blower & Forge Co., Lancaster, Pa.

LANCASTER IRON WORKS.—Lancaster, Pa. Manufacturers of storage tanks, smoke stacks, breechings, etc. Incorporated 1910. Main office and factory, Lancaster, Pa. Branch office, 501 5th Ave., New York, N. Y.

LANCASTER LENS CO., THE.—220 W. Main St., Lancaster, Ohio. Manufacturer of dry batteries and lenses. Business established 1910. President, Edmund Dickey; vice-president, Scott S. Wilson; secretary, Albert Steiner; treasurer, Walter E. Gunlon.

L & A.—Trade name for electric vibrators for foundry use manufactured by the Pressed Steel Co., 39 8th St., Muskegon, Mich.

LAND LINE TELEGRAPH.—A wire telegraph system or line that extends over the land, as distinguished from submarine cable telegraphy.

LANDERS, FRARY & CLARK.—New Britain, Conn. Manufacturer of electric household and industrial electrical appliances. President, Arthur G. Kimball; vice-presidents, F. A. Searle, F. J. Wachter, J. F. Lamb, H. A. Johnson; secretary, Edward F. Hall; treasurer, Pardon C. Rickey. Main office and factory, New Britain, Conn. Branch offices, 180 N. Wabash Ave., Chicago, Ill.; 200 5th Ave., New York, N. Y.

LANDERS, FRARY & CLARK, UNITED VACUUM APPLIANCE DIVISION.—Connersville, Ind. Manufacturer of electric scrubbing machines and vacuum cleaners. Sales manager, E. H. Glass.

LANDIS ENGINEERING & MFG. CO.—Waynesboro, Pa. Manufacturer of electric clocks. M. H. Landis, secretary.

LANDIS MACHINE CO.—St. Louis, Mo. Manufacturer of motor-driven shoe repairing machines. President, J. C. Moon; vice-president, C. R. Crawford; secretary, E. M. Primeau; treasurer, B. W. Sharp.

LANDIS MACHINE CO.—Waynesboro, Pa. Manufacturer of pipe and bolt threading machines. Business established 1903. President, J. J. Oller; vice-president, J. F. Shank; secretary, J. G. Mumma; treasurer and general manager, J. G. Benedict; sales manager, C. N. Kirkpatrick.

L. & L.—Trade name for showcase lighting fixture manufactured by Charles W. Leveridge, Inc., 133 Liberty St., New York, N. Y.

L. & N.—Trade name for potentiometers and other electrical measuring instruments manufactured by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

L. & N. CO., LTD., THE.—St. Johns, Que., Can. Manufacturer of flexible non-metallic conduit. Business established 1908. President, W. Northey; vice-president and general manager, E. Longfin; secretary and treasurer, V. N. Longfin.

LANGE, HENRY G.—162 N. May St., Chicago, Ill. Manufacturer of motor-driven glass beveling machines, ice cream freezers, etc.

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LANGELIER MFG. CO.—Arlington, Cranston, R. I. Manufacturer of motor-driven sensitive drills, tapping and wire drawing machines. President and treasurer, A. J. Langelier; secretary, C. L. Leclerc.

LANGHAAR BALL BEARING CO., THE.—Aurora, Ind. Manufacturer of ball and thrust bearings. Business established 1919. President, A. M. Diehl; vice-president and general manager, L. Langhaar; secretary, Joseph F. Pflum; treasurer, George C. Kimmel.

LANGLEBEN.—Trade name for carbon brushes manufactured by Hart & Co., 124 N. Main St., Fostoria, Ohio.

LANGMUIR, IRVING.—An American chemist and physicist, born in Brooklyn, N. Y., 1881. He graduated as Metallurgical Engineer from Columbia University in 1903, and in 1906 received the degree of Ph. D., from the University of Gottingen. From 1906 to 1909 he was an instructor in chemistry at Stevens Institute of Technology. Since then he has been assistant to Dr. W. R. Whitney in the Research Laboratory of the General Electric Co. He is known for his investigations of the principles of thermionic emission in high vacua, heat conduction in gases, chemical reactions at low pressures, absorption and surface tension phenomena, structure of liquid films, and other molecular and atomic properties, which have found application in the Coolidge X-ray tube, the Pilotron and Kenotron electron tubes, the gas-filled incandescent lamp, and the high-vacuum mercury-vapor pump. In 1917 and 1918 he was engaged on devices for submarine detection. He was awarded the Nichols medal by the American Chemical Society in 1915 and the Hughes medal from the Royal Society of London in 1918.

LANGSTADT-MEYER CO.—Appleton, Wis. Manufacturer of portable and farm lighting and power plants. Business established 1890. President, A. C. Langstadt; vice-president, H. H. Cole; secretary, treasurer and general manager, August H. Meyer; sales manager, B. G. Bilter. Branch offices, Green Bay, Wis., Oshkosh, Wis.

LANSDEN CO., INC., THE.—Danbury, Conn. Manufacturer of electric trucks and tractors. Business established 1913. President, Harry McLaghlan; vice-president, Arnold Turner; secretary, James Doran; treasurer, Frank H. Lee; general manager, Frank E. Queeney; sales manager, R. D. Dumont. Main office and factory, Danbury, Conn. Branch office, 229 W. 42nd St., New York, N. Y. Sales representatives, R. D. Dumont, 229 W. 42nd St., New York, N. Y.; Day Baker Co., 110 Arlington St., Boston, Mass.

LANTERNS, ELECTRIC, RAILWAY SWITCHMEN'S.—These lanterns, quite similar to the oil lanterns commonly used, have a battery of dry cells mounted in the base or directly below the handle. The type with the battery above the lantern is equipped with a wire frame base so that the light of the lantern shining through the base illuminates the ground about the lantern. They have the marked advantage over oil lamps of being free from the liability of being blown out by the wind. They are also safer than any oil lamp.

LANTERNS, EYE TESTING.—See Ophthalmometers; also Optical test charts, electrically illuminated.

LANTERNS, FOR DECORATIVE LIGHTING FIXTURES.—There are two distinct types of lantern shades of this class, those having glass panel sides in a bell shaped metal frame and those types very similar to railway or marine lanterns. The former are commonly made of brass, copper or iron with art glass plates. They are generally used for entrance, hall and porch fixtures, also for grill rooms, etc. The latter type are used in rooms built in imitation of ships' salons, staterooms, deck, etc. They are more commonly used in such rooms in yacht or boat clubs and to some extent in seaside restaurants and hotels.

Manufacturers:

Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Day Co., Thomas, 725 Mission St., San Francisco, Cal.
Herwig Art Shade & Lamp Co., 2140 N. Halsted St., Chicago, Ill.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio.
Star Chandelier Co., Inc., 33 Bleecker St., New York, N. Y. "Star."

LANTERNS, MAGIC.—The magic lantern is a small projection lantern especially adapted to use with small slides and postcards. The lantern is essentially a box containing one or two electric lamps, a slide holder and lenses for projecting the image upon the screen. It is usually simple, particularly adapted for operation by children in giving parlor entertainments.

Manufacturers:

Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y.
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Brenopticon."
Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa. "Victor."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa. "Franklin."

LANTERNS, PORTABLE, DRY BATTERY.—These lanterns contain one or two dry cells mounted in a metal box. The cells are commonly of standard No. 6 size. The small tungsten lamp is usually mounted on the front of the box and equipped with a parabolic reflector and lens. The metal box has a handle or bail for carrying or a hook for fastening the lamp to the clothing when it is desired that both hands remain free while the lantern is in use. These lanterns are used on farms, by watchmen, by railway switchmen, in private garages unprovided with other light and to some extent about the home. These outfits were first called lantern-type flashlights. Having large cells, however, they do not need to be flashed on and off at short intervals and may be kept burning for an hour or more steadily.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
American-LaFrance Fire Engine Co., Elmira, N. Y. "LaFrance."
Beacon Electric Works of National Carbon Co., Inc., Long Island City, N. Y. "Beacon."
Burgess Battery Co., Madison, Wis.
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Dad's Factories, 238 S. Meridian St., Indianapolis, Ind. "Dad's."
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. Federal electric lantern casts no downward shadows.



Federal Lantern

Cannot go out suddenly. Strong and sturdy. Nickel plated. See display adv. on page 1291.—Adv.

Franco Electric Corp., Franco Bldg., Brooklyn, N. Y. "Franco."
French Battery & Carbon Co., Madison, Wis. "Ray-O-Lite."
Grether Fire Equipment Co., Dayton, Ohio. "Grether."
Hipwell Mfg. Co., Pittsburgh, Pa. "Hipcoscope."
Kwick-Lite Electric Corp., 360 Kearney St., San Francisco, Cal. "Quick-Lite."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y. "Niagara."
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill. "Universal."
Usona Mfg. Co., Inc., The, 1 Hudson St., New York, N. Y. "Kwik-Lite."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

LANTERNS, PORTABLE, STORAGE-BATTERY TYPE.—Lanterns of this type have a battery of one or two cells mounted in a rugged metal case on which is mounted a small tungsten lamp with a parabolic reflector. They are used in mines, powder works, oil refineries, grain elevators, flour mills and similar places where an explosive atmosphere makes it hazardous to use illuminants having a flame as the light source. They are also used by watchmen in industrial plants and factories and on ships, and by firemen in entering a smoke-filled building. These lanterns are quite compact and give a steady, penetrating light.

Manufacturers:

FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. (See display adv. page 1291.)
Grether Fire Equipment Co., Dayton, Ohio. "Grether."
Pioneer Storage Battery Co., 1415 Race St., Philadelphia, Pa. "Pioneer."

LANTERNS, RAILWAY SIGNAL.—The lanterns used in connection with electric lamps for railway signal service are in some types similar in external design to the older oil-lamp types. The lamp and reflector or lens is housed in a sheet metal casing. The lanterns use either a Fresnel lens or reflector, the two not being commonly combined. Some types include an adapter or similar device for focusing the lamp. To obtain economy in distribution of energy a few systems transmit the current at a relatively high voltage and transform down at the lamp. In such cases an autotransformer is usually employed to reduce the voltage and this device may also be included within the lantern case. Many of these lanterns have been of special design to suit a particular installation. One of the earliest types of lanterns was made up for use in the Boston subway system. This lantern used two lamps per lens, the lamps being connected in multiple and set adjacent to each other, the focus point being midway between the two filaments. The lamps were rated at 50 volts, 4 cp. Present day practice is to use low-voltage lamps of special design, having a short coil filament; only one lamp is used per lantern, as experience has shown that a single lamp is entirely reliable and that use of two lamps causes needless complication. Also see Lamps, railway signal and switch.

Manufacturers:

FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Piper Co., Ltd., The Hiram L., 73 St. Remi St., Montreal, Que., Can.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

LANZ & SONS, MATHEW.—Pittsburgh, Pa. Manufacturers of pole-line hardware, washers, etc.

LAP WINDING.—A type of armature winding in which a circuit through its conductors goes forward and then laps back alternately. Lap windings are also called multiple, or parallel, windings in contradistinction to series, or wave, windings. Lap windings for d-c. machines have as many circuits in parallel as there are poles or a multiple thereof.

LARCO WRENCH & MFG. CORP.—7800 Woodlawn Ave., Chicago, Ill. Manufacturer of pipe and monkey wrenches. John V. Larson, president.

LARGE-DAIL MFG. CO., INC.—606 Cherry St., Philadelphia, Pa. Manufacturer of switchboards, switches, panelboards, steel cabinets and boxes. Business established 1909. President and general manager, Edward A. Dail; secretary, James P. Blore; treasurer, Edna P. Dail.

LATCHES, ELECTRIC DOOR OPENER.—A form of latch used in connection with solenoid or magnetically operated door openers used on sliding doors.

Manufacturer:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

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LATERAL.—In electrical circuits the term lateral is used to designate any branch circuit or conduit line that proceeds out from a main circuit or line, such as a service connection to a main, etc. Also see Laterals, underground conduit.

LATERALS, UNDERGROUND CONDUIT.—The connections from an underground conduit line to buildings are termed laterals or subsidiaries. They are of iron pipe or fiber where bends are included, but may be of the same material as the conduit line, if run approximately straight. The duct material with its concrete jacket is usually less expensive than iron pipe, if there are two ducts in the lateral.

LATHES, JEWELERS' MOTOR-DRIVEN.—This type of lathe, a small bench lathe often belt-driven from a fractional-horsepower motor, is designed for work which must be done to a high degree of accuracy on small parts. They are used by jewelers, watchmakers and in the electrical field by instrument and meter builders in the manufacture and repair of these instruments.

Manufacturer:

General Platers' Supply Co., Inc., 480-493 Broome St., New York, N. Y.

LAUNCHES, ELECTRIC.—The storage-battery launch is used to some extent in the ponds of amusement parks, public parks, summer-resort lakes and similar places. Its simplicity of control makes it of particular value in such places, as it can be operated by relatively inexperienced persons. It may be used for short hauls where the heat, odor, noise and smoke of the engine-driven motorboat is objectionable.

LAUNDRY DRIERS,—See Driers, clothes, electric.

LAUNDRY IRONING MACHINES.—See Ironing machines, electric, laundry.

LAUNDRY IRONS.—See Irons, electric, pressing, laundry.

LAUNDRY MAID.—Trade name for electric washing machine manufactured by the One Minute Mfg. Co., Newton, Iowa.

LAUNDRY MACHINERY, MOTOR-DRIVEN.—Motor drive, due in part to its freedom from dirt and dripping oil, is particularly adapted to use on large laundry machines, such as are used in commercial, hotel, institutional and other large laundries. The machines themselves are of several kinds and include washing machines, extractors, ironing machines, and exhaust fans. Individual motor drive is occasionally used, especially for fans and ironing machines, but group drive is quite common. Electric heat is seldom used for these machines, the heat generally being supplied by steam or gas flame. Also see Washing machines, clothes, laundry, and Ironing machines, electric, laundry.

Manufacturers:

Keystone Ironing Machine Co., Knickerbocker Bldg., New York, N. Y. "Keystone."

Mateer & Co., F. W., 226-232 W. Ontario St., Chicago, Ill.

LAUNDRY QUEEN.—Trade name for electric washing machines manufactured by the Grinnell Washing Machine Co., Grinnell, Iowa.

LAUN-DRY-ETTE.—Trade name for electric washing machines made by the Laundryette Mfg. Co., 1190 E. 152nd St., Cleveland, Ohio.

LAUNDRYETTE MFG. CO—1190 E. 152nd St., Cleveland, Ohio. Manufacturer of electric washing machines. Business established 1915. Secretary, A. G. Cook; treasurer and general manager, F. C. Maxhimer; director of sales, F. C. Foster.

LAURAINE.—Trade name for magnetos and magneto parts manufactured by the Lauraine Magneto Co., Inc., Long Island City, N. Y.

LAURAINE MAGNETO CO., INC.—Long Island City, N. Y. Manufacturer of magnetos and magneto parts.

LAUSON-LAWTON CO., THE. — De Pere, Wis. Manufacturer of gas and gasoline engines and farm lighting plants. Business established 1908. President, E. W. Lawton; vice-president and general manager, E. O. Gutknecht; secretary and treasurer, E. L. Wilson.

LAVA TUBES, ETC.—Lava is the mineral steatite, sometimes called hydrated magnesium silicate. It is slightly soluble in hydrochloric acid, but is not affected by other acids or alkalis. In its natural state it can be machined into almost any form with the same freedom as brass. After machining, it is baked at about 1100° C. to a condition of extreme hardness. It neither shrinks nor expands with changes in moisture and has a very small temperature coefficient of expansion. Its dielectric strength varies from 3000 to 10,000 volts per mm., depending upon its thickness. One of its principal uses is in making small insulators of various shapes. The insulation resistance is high and the ability to machine it accurately, together with its hardness and mechanical strength make it a very useful material. Lava composition, made of crushed mineral with a suitable binder, may be made in many forms, such as rods, tubes, slabs, etc., and has practically the same characteristics but is cheaper than solid lava.

Manufacturers:

American Lava Corp., 1429 Williams St., Chattanooga, Tenn.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn, N. Y. "Lavarock."

Steward Mfg. Co., D. M., Chattanooga, Tenn. "Lavite."

Tennessee Burner Mfg. Co., Chattanooga, Tenn.

LAVAROCK.—Trade name for lava insulators and bushings manufactured by M. Kirchberger & Co., Inc., 1425 37th St., Brooklyn, N. Y.

LA VIDA.—Trade name for vibrators manufactured by the Adbro Mfg. Co., Pittsburgh, Pa.

LAVITE.—Trade name for lava products manufactured by the D. M. Steward Mfg. Co., Chattanooga, Tenn.

LAWRENCE—Trade name for shaft couplings manufactured by the Kentucky Electrical Co., 817 Lewis St., Owensboro, Ky.

LAWRENCE.—Trade name for feed water regulators, steam pressure governors, valves and boiler furnace draft regulators manufactured by the Watts Regulator Co., 252 Lowell St., Lawrence, Mass.

LAWRENCE PUMP & ENGINE CO.—Lawrence, Mass. Manufacturer of electric pumps. President and manager, H. L. Mellor; treasurer, F. A. Hall. Main office and factory, Lawrence, Mass. Branch office, 90 West St., New York, N. Y.

LAWRENCE SHOT & LEAD CO.—1104 Woodmen Bldg., Omaha, Neb. Manufacturer of lead sheets, bars, etc. President, J. R. Wettstein; vice-president, E. J. Cornish; secretary and treasurer, E. E. Brando.

LAWS OF MAGNETIC FORCE.—Corresponding to the laws of electric attraction, there are certain laws of magnetic force. These have been determined experimentally and are: (1) Like poles repel and unlike poles attract. (2) The force of attraction or repulsion varies with the pole strength and also depends upon the medium in which the poles are immersed. (3) The force varies inversely as the square of the distance between point poles. (4) These three laws can all be expressed algebraically thus: $F=m_1 m_2/(\mu d^2)$ where μ is the permeability of the medium, m_1 and m_2 represent the pole strengths in terms of unit poles, and d is the distance between them. When d is in centimeters, the force (F) is in dynes.

LAY.—The lay of a stranded conductor or cable refers to the helical disposition of the strands in which each strand makes a complete revolution about the axis of the cable or conductor. The direction of lay is the lateral direction in which the strands of a cable run over the top of a cable as they recede from an observer looking along the axis of the cable. The lay is usually expressed as the pitch of the twist of the strands, or the distance measured along the cable from the point at which one strand is on top to the next point at which the same strand or wire is again on top.

LEACOCK CO., A. M.—291-5 Cortlandt St., Belleville, N. J. Manufacturer of armatures, armature coils and impregnating compounds. Business established 1916. A. M. Leacock, proprietor.

LEAD.—A heavy blue-gray metal, malleable and ductile, but of little mechanical strength. Its symbol is Pb; at. wt. 206.9; sp. gr. 11.35; m.p. 326° C.; b. p. 1580° C. The principal ore is the sulphide, galena (Pb S). It is obtained from the ore by smelting in blast furnaces, which yield impure lead containing usually antimony, bismuth, copper, gold, silver and other metals. This product is refined by liquation and oxidization of the impurities and is desilverized either by the Pattinson process of fractional crystallization or by the Parkes process, in which a small amount of zinc is added to the molten lead, the silver alloying with the zinc in preference to the lead and rising to the top in a scum. The scum is heated in a retort, distilling off the zinc, and the silver (and gold) is recovered from the resulting lead bullion by cupellation and subsequent parting. Impure lead containing much bismuth is better refined by the Betts electrolytic process (which see), which recovers the bismuth as well as the precious metals. The principal lead-producing countries are (in order) the United States, Spain, Germany, Australia and Mexico. The United States production in 1919 amounted to 412,000 metric tons, the world's production to about 1,000,000 tons.

LEAD AND LAG.—Of two sinusoidal vector quantities of the same frequency that quantity whose maximum value occurs first in time is said to lead the other. In the clock diagram the leading vector is drawn counter-clockwise with respect to the lagging vector. A leading alternating current is represented by a vector drawn counter-clockwise and a lagging current is represented by a vector drawn clockwise with reference to the vector representing the voltage to which the current is due. The angles between the current and voltage vectors are correspondingly angles of lead and lag.

LEAD-BURNING OUTFITS AND TOOLS.—Lead-burning outfits are used very extensively in the assembling of lead storage batteries to burn the plates to the plate-connecting straps (or busbars in large cells) and to burn on the terminal posts and cell-to-cell connectors; the sheet lining of lead-lined tanks for large cells also has its joints lead-burned together. Solder cannot be used because the acid would disintegrate it, so pure lead connections are needed. Very often oxy-hydrogen sets are used, the oxygen and hydrogen being drawn from different storage tanks or gas generators and united at the burner or torch, thus giving a very hot flame which causes the two lead surfaces that are to be joined to fuse together. The hydrogen is often generated from zinc and old sulphuric acid, an automatic generator being used; compressed oxygen or compressed air is used with it. Sometimes illuminating gas is used in place of hydrogen. Occasionally both hydrogen and oxygen are produced electrolytically. Oxy-acetylene sets are also used in some cases of heavy work. Electric "torches" which operate from an a-c. source have been used in removing or burning on cell connectors or terminal posts. Lead-burning sets usually contain all the necessary tools, such as different sizes of burner tips, gages, scrapers, etc. Burning racks which hold the plates in position while the straps are being attached and lead molds which make it possible to recast small pieces of scrap lead into burning sticks are also made by the same firms; these burning sticks are used to build up depressions and crevices around the joints.

Manufacturers:

Admiral Welding Machine Co., The, 413-415 E. 15th St., Kansas City, Mo. "Admiral."

Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.

GENERAL ELECTRIC CO., Schenectady, N. Y. "Pyrotip" Electric Lead a set with Burner, a transformer designed to be connected to the ordinary 110-volt lamp socket. For almost any form of soldering work. Some of its



"Pyrotip" Outfit

advantages are repair work; in remote corners easily done; joints need not be cleaned; when properly used, there is no glare to injure operator's eyes. Current required is about the same as that drawn by a flat iron. (Booklet B3586.) See adv. pages 1203-1223.—Adv.

General Welding Co., 355-57 14th St., Hoboken, N. J. "Ideal."

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

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Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Liquid Carbonic Co., 31st St. & Kedzie Ave., Chicago, Ill.
Modern Engineering Co., 23rd & Walnut Sts., St. Louis, Mo. "Meco."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
TURNER BRASS WORKS, THE, Sycamore, Ill. (See display adv., page 1326.)

LEAD BUSHINGS.—A lead bushing is a short tube or bushing made of lead. One of the uses for it is to fit into the end of a conduit, where it is used to protect wires leading out of the conduit from abrasion by the sharp conduit edges. Such bushings are often used in the holes into which expansion or anchor bolts are to be fastened.

Manufacturer:

Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."

LEAD CHROMATE.—Cee Chrome yellow.

LEAD-COVERED CABLE.—See Cable, lead-covered, miscellaneous.

LEAD GASKETS.—Due to its softness, lead is sometimes used for gaskets. The gaskets are cut from sheet lead in the size and shape desired for the particular fitting in which they are used. Piping systems with flanged pipe are sometimes made tight by means of such gaskets

Manufacturers:

Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J. "Devo," "Goetzerit," "Triumph."
National Lead Co., 111 Broadway, New York, N. Y.
U. S. Indestructible Gasket Co., Fulton & Church Sts., New York, N. Y.

LEAD-LINED TANKS.—See Tanks, lead-lined.

LEAD OXIDES FOR STORAGE-BATTERY PASTE, PAINTS, ETC.—These oxides are used in the preparation of the paste for lead storage-battery plates of the Faure or pasted type. The two oxides in common use are litharge (PbO and red lead (Pb_3O_4). For use in battery paste the oxides should be quite pure. The paste is made with dilute sulphuric acid and one or a mixture of both the oxides, to which in some cases other ingredients are added in small amounts to increase the porosity of the finished plate. These oxides are also much used in making certain paints, especially red lead which gives a reddish paint particularly suited for high-temperature piping, also for tightening joints and threaded connections in piping.

Manufacturers:

Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.

LEAD PEROXIDE.—PbO_2; of interest electrochemically chiefly as the active material of the positive plates of the lead storage battery.

LEAD. PIG, REFINED.—Pig lead of the refined grade is used to a large extent in the storage-battery and lead-covered cable branches of the electrical industry. Batteries of the pasted plate type use molded grids cast from pig lead. The lead used is what is called hard lead or antimonious lead, which contains a certain percentage of antimony, but is quite free from other impurities. Pig lead is also used for casting battery connecting straps, busbars, terminal posts, etc. Large quantities are used for making the sheaths for lead cable, the lead being molten and squeezed out of a die surrounding the completed cable core so that it hardens just as it touches the cable and thus forms a continuous protection for it. Pig lead is used in making many brass compositions; it is molten with the zinc and copper, the percentage of lead in the resulting brass seldom exceeding 10%.

Manufacturers:

American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal.
Anaconda Copper Mining Co., 42 Broadway, New York, N. Y. "I. L. R."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill.
Lawrence Shot & Lead Co., 1104 Woodmen Bldg., Omaha, Neb.
Merchant & Evans Co., 2035 Washington Ave., Philadelphia, Pa.
United Lead Co., 111 Broadway, New York, N. Y.
U. S. Indestructible Gasket Co., Fulton & Church Sts., New York, N. Y.

LEAD, SHEET.—Storage-battery tanks and boxes of the larger sizes are lined with sheet lead. Lead sheet is used here and for several other similar purposes due to its power of resisting corrosion from sulphuric acid and many other powerful chemicals. It is also used for lining some plating tanks, electrochemical cells and vats, chemical laboratory tables, etc. The lead sheets are cut to the proper size and the seams are lead-burned or welded instead of being soldered, since solder does not resist the action of acids.

Manufacturers:

American Smelters Securities Co., 201 1st St., San Francisco, Cal.
Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Lawrence Shot & Lead Co., 27th & A Sts., Omaha, Neb.
National Lead Co., 111 Broadway, New York, N. Y.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
U. S. Indestructible Gasket Co., Fulton & Church Sts., New York, N. Y.

LEAD SLEEVES.—See Sleeves, cable splicing, lead.

LEAD SPONGE.—The condition of the lead plates of a storage battery connected to the negative pole after being first formed by electrolytic action and after each complete recharge. In the Plante type plates the spongy lead forms by the outside of the plates becoming spongy or porous while being charged. In pasted plates nearly the entire pasted material is converted to spongy lead, starting at the outer surface.

LEAD TREE.—A deposit of lead, produced by the electrolysis of a lead salt in solution, which is very irregular and resembles the branches of a tree.

LEAD TUBING.—This tubing is generally used for conducting acids, corrosive gases or solutions. Its resistance to sulphuric acid makes it especially useful where this acid is handled.

Manufacturers:

American Smelters Securities Co., 201 1st St., San Francisco, Cal.
Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
National Lead Co., 111 Broadway, New York, N. Y.
United Lead Co., 111 Broadway, New York, N. Y.

LEADER.—Trade name for binding posts manufactured by the H. H. Ebv Mfg. Co., 13th & Wallace Sts., Philadelphia, Pa.

LEADER.—Trade name for electric pumping units, water systems, controllers and storage tanks, manufactured by the Leader Iron Works, Decatur, Ill.

LEADER.—Trade name for electric peanut butter mill manufactured by the Lembert Machine Co., 311 S. Jefferson St., Marshall, Mich.

LEADER.—Trade name for power plant injectors and ejectors manufactured by the Randle Machinery Co., Powers St. & C. H. & D. R. R., Cincinnati, Ohio.

LEADER IRON WORKS.—Decatur, Ill. Manufacturer of electric controllers, pumping units, water systems and storage tanks. Branch offices, 21 E. 40th St., New York, N. Y.; 327 S. LaSalle St., Chicago, Ill.

LEADS.—A term used generally to refer to a set of conductors or wires forming part of a circuit, or making a connection by which the current is led to and from a device. In parallel distribution systems conductors connected to the positive and negative terminals of a source are spoken of as positive or negative leads. With testing and measuring instruments the conductors by which the instrument is connected in the circuit are called "leads."

LEADS, FLEXIBLE.—See Pigtails and flexible leads.

LEAK-CURE.—Trade name for metal mending cement made by the Leak-Cure Metal Cement Co., 110 Fulton St., New York, N. Y.

LEAK-CURE METAL CEMENT CO.—110 Fulton St., New York, N. Y. Manufacturer of metal mending cement. Business established 1916.

LEAKAGE.—A name sometimes given to insulation resistance. It varies inversely as the leakage current.

LEAKAGE COEFFICIENT.—See Dispersion, coefficient of.

LEAKAGE CURRENT.—When a condenser is charged all of the electricity does not accumulate on the positive plate, but some of it flows away from the plate through the dielectric. The rate at which the electricity flows through the dielectric is called the leakage current. The current in the wire connecting the source of e.m.f. to the positive plate of the condenser consists of two parts: of the leakage current and the charging current; also see Charging current. Similarly electricity leaks over the insulators and through the dielectric surrounding the wires of a transmission line. This is also known as leakage current. See Corona. The term "leakage current" is also sometimes inaccurately applied to the exciting current of a transformer

LEAKAGE, MAGNETIC.—A part of a magnetic field which does not perform the same function as the main field. In d-c. and a-c. machines, magnetic leakage often refers to the line of force set up by the d-c. excitations which are not cut by the armature conductors. In a-c. transformers, induction motors and generators, leakage refers to the lines of force set up by the currents in either the primary or the secondary which link with that winding only. Such leakage causes a drop in voltage under load, but may serve as a protection in limiting the current in case of a short-circuit.

LEARNELECTRICO.—Trade name for electric novelties manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

LEATHER BELTING.—See Belting for motors and generators.

LEATHER BELTS.—See Belts, linemen's tool.

LEATHER POUCHES.—See Pouches, leather, tool.

LEATHER STRAPS.—See Straps, climber; Straps, linemen's safety.

LEATHER WASHERS.—See Washers, leather.

LEATHERHEADS FOR NAILS.—Where nails are used for fastening porcelain knobs or cleats, the porcelain must be provided with some protection to prevent chipping or cracking the porcelain when the nail is driven in. This protection is provided by placing a leather washer or "leatherhead" between the nail and knob or cleat. These leatherheads are usually made from leather trimmings and are quite inexpensive.

Manufacturers:

American Leather Products Co., The, Indianapolis, Ind.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Chicago Leather & Mercantile Co., 1848-50 W. 14th St., Chicago, Ill.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Field & Co., R. B., 10 Clarence St., Worcester, Mass. "Fieldco."
Indiana Leather Stamping Co., Williamsport, Pa.
Lynn Leather Washer & Mat Co., East Lynn, Mass.
Simplex Mfg. Co., Auburn, N. Y. "Simco."

LEATHEROID.—Trade name for insulation fiber manufactured by the Rogers Fibre Co., 121 Beach St., Boston, Mass.

LEAVITT & CO., C. W.—30 Church St., New York, N. Y. Importers of electric steel furnaces.

LEBANON GEAR & MACHINE WORKS.—15th & Forge Sts., Lebanon, Pa. Manufacturer of metal castings, gears and pinions. Business established 1916. President and general manager, W. S. Giel.

LE BIJOU SPECIALTIES.—186 N. LaSalle St., Chicago, Ill. Manufacturer of electric hair wavers.

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LEBRON ELECTRICAL WORKS.—318-320 S. 12th St., Omaha, Neb. Manufacturer of motor-driven buffing and grinding machines. President and treasurer, Bert LeBron; vice-president, L. LeBron; secretary, H. LeBron.

LECARBONE.—Trade name for carbon brushes manufactured by W. J. Jeandron, 229 Fulton St., New York, N. Y.

LE CHATELIER.—Trade name for pyrometers manufactured by the Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

LE CLANCHE.—Trade name for wet batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

LECLANCHE' CELL.—A type of primary cell using the combination zinc-ammonium chloride-carbon, with manganese dioxide as a depolarizer. It is used as a wet cell and also as the basis for practically all so-called dry cells.

LECTRIC-LUSTRE.—Trade name for motor-driven nail buffers manufactured by the Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill.

LECTRO-HATCH.—Trade name for electric incubators, hovers and brooders made by the Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind.

LECTRO-WARM.—Trade name for electric heating pad and blanket made by the Electric Controller Co., Central Ave. & 10th St., Indianapolis, Ind.

LECTROFLATER.—Trade name for motor-driven air compressor manufactured by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md.

LECTROSEAL.—Trade name for transformer oil manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LEE.—Trade name for insulator pins manufactured by the R. Thomas & Sons Co., East Liverpool, Ohio.

LEE-BUILT.—Trade name for springs manufactured by the Lee Spring Co., 347-51 Classon Ave., Brooklyn, N. Y.

LEE RUBBER & TIRE CORP.—61 Broadway, New York, N. Y. Manufacturer of rubber tires for electric vehicles and trucks.

LEE SPRING CO., THE.—347-51 Classon Ave., Brooklyn, N. Y. Manufacturer of springs. Business established 1916. President and general manager, R. L. Johannsen; vice-president, R. H. Stoughton; secretary and treasurer, R. G. Johannsen; sales manager, J. I. Wineke.

LEEDS & NORTHRUP CO.—Philadelphia, Pa. Manufacturer of electrical measuring instruments for students, commercial and precision testing. Business established 1898. President, M. E. Leeds; 1st vice-president, W. M. C. Kimber; 2nd vice-president, C. S. Redding; secretary and sales manager, C. R. Cary; treasurer, M. E. Leeds. Main office and factory, 4901 Stenton Ave., Philadelphia, Pa. Branch office, 1304 Monadnock Block, Chicago, Ill. Exclusive distributor of "Kelly" electrometric titration apparatus, Arthur H. Thomas Co., W. Washington Sq., Philadelphia, Pa.

LEESONA.—Trade name for coil winding machines manufactured by the Universal Winding Co., 95 South St., Boston, Mass.

LEFFEL & CO., THE JAMES.—Springfield, Ohio. Manufacturer of waterwheel and turbogenerators. Business established 1862. President, George R. Prout; vice-president and general manager, A. F. Sparks; secretary, A. L. Baylor; treasurer, B. K. Kauffman; sales manager, E. J. Sanderson. Main office, 426 East St., Springfield, Ohio. Branch office, 161 Devonshire St., Boston, Mass. Sales representatives, Rowland & Burns, 31 Cortlandt St., New York, N. Y.; H. H. White, Atlanta, Ga.

LEGAL OHM.—A name given to the value of the ohm as defined by the Paris Congress in 1894. It is the resistance of a column of pure mercury one sq. mm. in cross section and 106 cm. long at a temperature of 0° C. It is equal to 0.9972 of the international ohm. Although called the legal ohm it has never been legalized in America or Great Britain. Also see Units, systems of.

LEGLER-EILERMAN CO., THE.—Dayton, Ohio. Manufacturer of die castings, bushings and bearings.

LEHIGH.—Trade name for electric ventilating fans, air washers, etc., manufactured by Hersh Bros. Co., Allentown, Pa.

LEHMAN.—Trade name for counter-current condensers manufactured by the Petroleum Iron Works Co., Drawer 539, Sharon, Pa.

LEHON CO., THE.—W. 44th St., & Oakley Ave., Chicago, Ill. Manufacturer of waterproofing materials, insulating papers, etc.

LEICH ELECTRIC CO.—Genoa, Ill. Manufacturer of telephones, switchboards, rectifiers and other telephone equipment and spark plugs. Business established 1907. President, Elias Mayer; secretary and general manager, O. M. Leich; sales manager, A. J. Kohn.

LEITELT IRON WORKS.—Grand Rapids, Mich. Manufacturer of electric elevators and steam reciprocating pumps. Business established 1862. President, David C. McKay; vice-president and sales manager, Fred J. Zylman; secretary and general manager, Fred H. Meyer; treasurer, Glen W. Sackett. Main office, 315 Mill Ave., Grand Rapids, Mich. Branch office, 1900 N. Michigan Ave., Saginaw, W. S., Mich.

LEKTROX SWEDOX.—Trade name for welding wire manufactured by the Central Steel & Wire Co., 119-127 N. Peoria St., Chicago, Ill.

LEMKE ELECTRIC CO.—509-513 Cedar St., Milwaukee, Wis. Manufacturer of ignition equipment. Business established 1902. President and general manager, O. H. Lemke; vice-president and sales manager, A. G. Mueller; secretary, Paul Hempel.

LEMLEY.—Trade name for friction clutches and pulleys manufactured by the W. A. Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.

LENOX.—Trade name for hacksaws manufactured by the American Saw & Mfg. Co., Springfield, Mass.

LENOX.—Trade name for telephones and telephone switchboards manufactured by the Samson Electric Co., Canton, Mass.

LENOX.—Trade name for illuminating glassware manufactured by the U. S. Glass Co., Pittsburgh, Pa.

LENSES, AUTOMOBILE LAMP.—Lenses or glass fronts for automobile headlights made with prisms or other refracting devices so as to modify the beam of light from the parabolic reflector. Many different designs have been placed on the market, the designers of several of which have misunderstood the illuminating problem involved. With a number of headlamp lenses, however, the approved principle of slightly deflecting the beam and spreading it horizontally, so as to cover a greater width of road than the plain round beam from the reflector, has been adopted. Also see Headlights, electric, automobile.

Manufacturers:

Bausch & Lomb Optical Co., Rochester, N. Y.
Clamert Mfg. Co., Pittsburgh, Pa. "Tirrill."
HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y.
Jefferson Glass Co., The, Follansbee, W. Va.
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa. "Liberty," "Macbeth."
Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.
Safetee Glass Co., 326 N. Broad St., Philadelphia, Pa. "Safetee Glass."
Shaler Co., C. A., 22 Jefferson St., Waupun, Wis. "Roadlighter."
Suess Glass Co., 8th & Virginia Sts., Seattle, Wash.

LENSES, FLASHLIGHT.—The pocket flashlights are commonly used to provide general illumination over a small area. The reflector being parabolic in shape, throws parallel rays, which must be redirected to give the spread of light desired. This is done by using a small plano-convex lens in the flashlight; the convex side of the lens is turned outward. These lenses are not required to be accurately ground optical lenses, since they are used for distributing and not focusing the light. Consequently they are usually mold-cast to approximate shape and thereby produced in an inexpensive manner.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y.
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
Jefferson Glass Co., The, Follansbee, W. Va.
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo".
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.

LENSES, MISCELLANEOUS.—This classification is intended to include only such types of lenses as are not separately listed elsewhere in this book. Such lenses include those used in microscopes, reflecting galvanometer telescopes, and other highly sensitive laboratory instruments, all of which require accurately ground lenses. Searchlights of the enclosed type also use accurate lenses, usually of the Fresnel type.

Manufacturers:

Culver Superior Glass Co., 72-74 N. State St., Westerville, Ohio.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill., "X-Ray". (See display adv., page 1405.)
Ostrander-Seymour Co., 7 S. Dearborn St., Chicago, Ill.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Spencer Lens Co., 442 Niagara St., Buffalo, N. Y.
Voightlander & Son, 240 E. Ontario St., Chicago, Ill. (Photographic lenses.)

LENSES, RAILROAD SIGNAL.—These lenses consist usually of a compound lens built up of a succession of concentric annular lenses, the complete lens being called an echelon or Fresnel lens. They concentrate the light so that an oil or electric lamp will throw out nearly parallel rays. They are made in the several colors required for railroad signal work, chiefly clear, red and green.

Manufacturers:

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Jefferson Glass Co., The, Follansbee, W. Va.
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.

LENSES, SIGN LETTER.—Instead of the usual exposed lamp sign, electric signs are sometimes made luminous by housing the lamps within the sign, the legend being punched out of the sign by a series of holes in the form of the letters. The holes are sometimes filled with small glass sign lenses. These lenses may be clear or colored or clear and lacquered on the interior face with lacquer of whatever color may be desired.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Clinton Sign Lens Co., Clinton, Iowa.
Lancaster Lens Co., The, 220 W. Main St., Lancaster, Ohio.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Popper & Sons, Leo, 143 Franklin St., New York, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

LENZ'S LAW.—A law relating to the direction of an induced e.m.f. in a circuit. This is ordinarily stated that when a circuit is closed, the induced e.m.f. tends to produce a current in the direction such as to oppose the change in flux. An amplification of this has been stated as follows: If a constant current flows in the primary circuit A, and if, by the motion of A, or of the secondary circuit B, a current is induced in B, the direction of the induced current will be such that, by its electromagnetic action on A, it tends to oppose the relative motion of the circuits.

LEONARD.—Trade name for switches manufactured by the Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.

LEONARD ELECTRIC CO., WARD.—See Ward Leonard Electric Co.

LEONARD ELECTRIC MFG. CO., THE.—3907 Perkins Ave., Cleveland, Ohio. Manufacturer of switches, switchboards, panelboards, etc. Business established 1903.

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President, treasurer and general manager, S. A. Leonard; vice-president, R. N. McCurdy; secretary, C. M. White. Sales representative, Williams-Beasley Co., 1626 Chemical Bldg., St. Louis, Mo.; 53 W. Jackson Blvd., Chicago, Ill.

LEONARD WATCH CO.—Chicago, Ill. Manufacturer of luminous attachments for switch buttons, etc. President, C. Hayden Whitney; treasurer, Willard C. Leonard. Main office, 10 S. Wabash Ave., Chicago, Ill. Branch office, 1 Washington St., Boston, Mass.

LEONHARDT WAGON MFG. CO.—412 E. Saratoga St., Baltimore, Md. Manufacturer of tower wagons, etc.

LE ROI CO.—Mitchell St. & 60th Ave., Milwaukee, Wis. Manufacturer of gasoline engines. President and general manager, C. W. Pendock; vice-president, J. R. Frantz; secretary and treasurer, G. H. Cheyne.

LESCHEN & SONS ROPE CO., A.—St. Louis, Mo. Manufacturer of galvanized wire strand and wire rope for all purposes. Business established 1867. Main office, 5909 Kennerly Ave., St. Louis, Mo. Branch offices, Denver, Colo.; San Francisco, Cal.; 173 W. Lake St., Chicago, Ill.; 90 West St., New York, N. Y.

LESSER BROS. & KURZ, INC.—58 Spring St., New York, N. Y. Manufacturer of pearl disks for push buttons.

LESTER ELECTRIC CO., LTD., THE.—St. Thomas, Ont., Can. Manufacturer of switch blocks.

LETTENEY.—Trade name for wood preservatives manufactured by the Northeastern Co., 80 Beverly St., Boston, Mass.

LETTER BOXES.—See Boxes, letter and bell or signal.

LETTER FOLDING MACHINES, MOTOR-DRIVEN.—In these devices the motor drives the mechanism which receives the flat letter or sheet, which as it passes through the machine is folded one step at a time until it emerges completely folded for insertion in an envelope. They are sometimes combined with mechanism for inserting the mailing matter in the envelop. These machines are used chiefly by large business houses, particularly for mailing form letters, circulars, and other advertising matter.

Manufacturers:

American Multigraph Sales Co., The, E. 40th St. & Kelly Ave., Cleveland, Ohio.
Dick Co., A. B., 736 W. Jackson Blvd., Chicago, Ill. "Edison-Dick."
Mailometer Sales Co., 3469 E. Jefferson Ave., Detroit, Mich. (Sealing, stamping and counting) "Mail-O-Meter".

LETTER OPENING MACHINES, MOTOR-DRIVEN.—Small machines carrying a circular knife or cutting edge which trims the edge or edges of envelopes as they are moved past the knife by rubber-clad rollers. They are extensively used in mail-order houses and other large business offices receiving large quantities of mail. They not only reduce the cost of opening the mail but also greatly facilitate sorting and handling the letters because all envelopes are uniformly slit without damage to the contents.

LETTERS, SIGN, GLASS.—Some types of electric enclosed or box signs use glass letters. Double-faced signs can thereby be made to use a relatively small number of lamps. To avoid bright spots on these letters they are sometimes made of prismatic or of opal glass, which diffuse the light and break up any such spots. The glass may be colored to produce special effects. Certain miniature signs also use special glass letters that are really self-contained lamps shaped in the letter form.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Greenwood Advertising Co., Knoxville, Tenn.
Lousiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill.
Opalite Sign Co., 407 N. Wells St., Chicago, Ill. "Opalite."
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill. "Eradium Luminous."
Pressed Prism Plate Glass Co., 25 N. Dearborn St., Chicago, Ill. "Heralite."

LETTERS, SIGN, METAL.—Metal letters either blocked out and mounted on frames or mounted on box signs are generally used on the large electric signs used on roofs. The metal letters have the sockets mounted in the letters, so as to outline the skeleton letter, being mounted flush with the surface or recessed in a trough. The letters are commonly painted with a light-colored reflecting paint to render the sign more easily readable. They serve as non-electric signs by day and electric signs by night.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Clinton Sign Co., 134 5th Ave., Clinton, Iowa.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Enameled Steel Sign Co., 190 N. State St., Chicago, Ill.
Flour City Ornamental Iron Co., 27th St. and 28th Ave., S., Minneapolis, Minn.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Metallic Sign Letter Co., 433 N. Clark St., Chicago, Ill.
Moise-Klinker Co., 369 Market St., San Francisco, Cal.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Strachan, Inc., R. & H., 395 Fulton St., Brooklyn, N. Y.

LEUPOLD, VOELPEL & CO.—107 E. 70th St., N., Portland, Ore. Manufacturers of mechanical and electrical water stage recorders. F. Leupold, manager.

LE VALLEY-VITAE CARBON BRUSH CO.—521 W. 23rd St., New York, N. Y. Manufacturer of commutator brushes.

LEVELS, INSTRUMENT.—The commonest use for these levels is on surveying instruments. They are, however, also used in electrical laboratories on such instruments as galvanometers, electrodynamometers, electrometers, balances, etc., particularly instruments of the suspension type. The levels are usually of the glass tube air bubble type.

Manufacturers:

Starrett Co., The L. S., Athol, Mass.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

LEVELS, MECHANICS' AND ELECTRICIANS'.—These levels usually have air-bubble level glasses mounted in wood or metal pieces of varying lengths. The level tube is protected by a metal plate so that the instrument is more rugged and suited to construction work. Electricians find them necessary to produce a workmanlike job of cabinet setting or fixture hanging. In setting motors or generators levels are necessary to insure level operation and proper alinement of shafting.

Manufacturers:

Acme Level & Mfg. Co., Toledo, Ohio. "Acme."
Athol Machine Co., Athol, Mass. "Athol."
Berger & Sons, C. L., Boston, Mass. "Monitor."
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Goodell-Pratt Co., Greenfield, Mass. "Stratton."
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Sand & Sons, J., 4841-53 Rivard St., Detroit, Mich. "Sand's."
Starrett Co., The L. S., Athol, Mass.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

LEVELS, TRACK.—An instrument for ascertaining whether or not track rails are placed at the proper elevation with respect to each other or with respect to an established grade. The kinds in most general use are some form of the "level board" and consist of a beam with a spirit level attachment to show when the beam is in a horizontal position. The beam may be of such shape and have such attachments in addition to the level as the shape of the rail or the type of track construction may require.

Manufacturers:

Aldon Co., 3338 W. Ravenswood Ave., Chicago, Ill.
Buda Co., The, Harvey, Ill.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

LEYDEN JARS.—These jars derived their names from the city of Leyden in Holland, in which they were supposed to have been invented. This type of jar was the earliest kind of static condenser and was employed in connection with electrostatic machines. A glass jar is coated with tinfoil both on the inside and outside extending out to nearly its full height. By means of a metal chain or other similar device the inner coating is connected to a brass rod which passes through a wooden stopper in the top of the jar; a brass ball terminal is fixed on this rod. The jar may be charged in several ways, as by connecting its two coatings to the terminals of an electric machine, or by connecting the inner coating to one terminal and the outer coating to ground. If made of large size, such a jar has considerable capacitance.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Standard Scientific Co., 9 Barrow St., New York, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Wireless Specialty Apparatus Co., C and Fargo Sts., Boston, Mass.

LEVERIDGE, INC., CHARLES W.—133 Liberty St., New York, N. Y. Manufacturer of fire alarm systems, showcase lighting fixtures, switches, lamp guards and other electrical specialties. Business established 1900. President, Charles W. Leveridge; secretary and treasurer, W. J. Leveridge.

LEVI, BENJAMIN.—355 W. Broadway, New York, N. Y. Manufacturer of blue printing machinery, screw machine products and special machines.

LEVITON.—Trade name for pull-chain sockets manufactured by the American Brass & Copper Co., 138 Lafayette St., New York, N. Y.

LEVOLIER.—Trade name for pull chain sockets manufactured by the McGill Mfg. Co., Valparaiso, Ind.

LEWIS ELECTRIC CO., THE.—753 Patterson Ave., S. W., Canton, Ohio. Manufacturers of safety switches. President J. C. Lewis; vice-president, Charles W. Creger; secretary, W. H. Gardner; treasurer, T. J. Edwards.

LEWIS SAFETY ENTRANCE.—Trade name for service entrance switches manufactured by the Lewis Electric Co., Inc., 12 W. Main St., Massillon, Ohio.

L. F.—Trade name for arc lamp brackets manufactured by the L. F. Mfg. Co., 426-428 Hoboken Ave., Jersey City, N. J.

L. F. MFG. CO.—426-428 Hoboken Ave., Jersey City, N. J. Manufacturer of arc lamp brackets. Louis Fort, sole owner.

L'HOMMEDIEU & SONS CO., CHARLES F.—4521 Ogden Ave., Chicago, Ill. Manufacturer of electric buffers, generators and rheostats. President, Charles F. L'Hommedieu; secretary, Arthur W. L'Hommedieu; treasurer, Charles E. L'Hommedieu. Sales representative, Mefford Chemical Co., Los Angeles, Cal.

LIBBEY GLASS MFG. CO., THE.—Toledo, Ohio. Manufacturer of illuminating glassware. President, J. D. Robinson; vice-president and treasurer, W. F. Donovan; vice-president and general sales manager, J. W. Robinson; vice-president and assistant general manager, S. O. Richardson III; secretary and assistant treasurer, J. H. Wright; general manager, George Dougherty.

LIBERTY.—Trade name for fire extinguishers manufactured by James M. Castle, Inc., 1210-12 Arch St., Philadelphia, Pa.

LIBERTY.—Trade name for complete line of incandescent lamps manufactured by the Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.

LIBERTY.—Trade name for electric bread slicers and other labor-saving devices manufactured by the Liberty Bread Slicer, Inc., 108 Platt St., Rochester, N. Y.

LIBERTY.—Trade name for boiler-tube cleaners manufactured by the Liberty Mfg. Co., Frick Bldg., Pittsburgh, Pa.

LIBERTY.—Trade name for electric starters, manufactured by the Liberty

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Starter Co., 2281 W. Fort St., Detroit, Mich.

LIBERTY.—Trade name for automobile lenses manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

LIBERTY.—Trade name for socket-type transformers manufactured by the Bertrand F. Miller Co., High & Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

LIBERTY.—Trade name for rubber-covered wires and cables manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

LIBERTY.—Trade name for automobile testing bench manufactured by Paul G. Niehoff & Co., Inc., 232-242 E. Ohio St., Chicago, Ill.

LIBERTY APPLIANCE CORP.—249 E. 43rd St., New York, N. Y. Manufacturer of incandescent lamps and lamp frosting compound. Business established 1918. President, J. Hohenstein; secretary and treasurer, Louis M. Rosenthal.

LIBERTY BREAD SLICER, INC.—Rochester, N. Y. Manufacturer of electric bread slicers and other labor-saving devices. President, W. C. Knapp; vice-president, H. T. Lockman; secretary and treasurer, T. C. Parsons. Main office, 108 Platt St., Rochester, N. Y. Branch office, 1400 Broadway, New York, N. Y.

LIBERTY ELECTRIC CORP.—Port Chester, N. Y. Manufacturer of radio equipment, motors, panelboards, switchboards, switches, transformers, water pumping systems, marine signaling systems and sheet metal stampings. President, P. R. Mallory; vice-president, F. K. Leatherbee; vice-president and treasurer, F. E. Seeley; secretary, Richard Hunt; general manager and sales manager, W. H. Knowles. Main office and factory, Port Chester, N. Y. Branch office and warehouse, Independent Wireless Telegraph Co., 18 Murray St., New York, N. Y. District office, 42 Broadway, New York, N. Y.

LIBERTY LAMP & SHADE CO.—103 Court St., Brooklyn, N. Y. Manufacturer of lighting fixtures and shades.

LIBERTY MACHINE CO.—Wauwatosa, Wis. Manufacturer of fixture fittings and parts.

LIBERTY MFG. CO.—Pittsburgh, Pa. Manufacturer of boiler tube cleaners. Business established 1897. President, W. S. Elliott; vice-president and treasurer, F. A. Rohrmann, Jr.; secretary, J. P. Rogers. Main office, Frick Bldg., Pittsburgh, Pa. Factory, Jeannette, Pa. Branch offices, New York, N. Y.; Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; St. Louis, Mo.; Kansas City, Mo.; Detroit, Mich.; Cleveland, Ohio; Cincinnati, Ohio; Syracuse, N. Y.; Pittsburgh, Pa.

LIBERTY MFG. CO., INC.—3201-41 Carrollton Ave., New Orleans, La. Manufacturer of switchboards, panelboards, cabinets, electric incubators and signs. W. P. Conery, general manager.

LIBERTY MICA CO.—79 Sudbury St., Boston, Mass. Manufacturer of mica and mica products. President and secretary, B. C. Hamm; treasurer, W. E. Macurda.

LIBERTY NITROGEN OPALITE.—Trade name for nitrogen filled tungsten lamp with opal bulb. Manufactured by the Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.

LIBERTY ORA.—Trade name for gas-filled tungsten lamps manufactured by the International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J.

LIBERTY SPOTLITE.—Trade name for vacuum lamp containing concentrated filament manufactured by the Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.

LIBERTY STARTER CO.—2281 W. Fort St., Detroit, Mich. Manufacturer of electric automobile starters. Business established 1918. President, W. J. Hartwig; vice-president, F. F. Hartwig; secretary, C. W. Hartwig.

LIBRARIES, ELECTRICAL. — Libraries are the storehouses of recorded knowledge. They place at the disposal of all who consult them a far greater mass of information than can be gathered in the average private collection of books, few persons having the funds and space available for accumulating any extensive general or special library. When studying or investigating any subject extensively, it is therefore necessary in nearly all cases to visit a public or semipublic library that covers the subject adequately.

Fortunately for electrical men there are scattered throughout the United States many libraries that contain excellent collections of electrical books, including text books that have become classics, standard electrical reference books, bound volumes of the leading electrical periodicals, the bound transactions of the principal national electrical societies, technical and statistical reports issued by government bureaus and boards, etc. A considerable percentage of these libraries can be visited by anyone; many others may be consulted for reference purposes by permission of the librarian; in a few cases of libraries maintained by educational institutions or societies a person seeking use of the library is required to be introduced by someone connected with the institution or a member of the society.

In the belief that a list of libraries rich in electrical books would prove of value to students and others interested in the electrical sciences and arts, the following list has been prepared. It was compiled from direct correspondence with the librarian in the case of public and semipublic libraries, and with the dean or director in the case of educational institutions. Only those libraries are included that have over 150 volumes on electrical subjects and which are open to the public either without restrictions or with those referred to above. The number of volumes given is that of distinctively electrical books. Some libraries report the number of titles on electrical subjects, in which case the actual number of volumes is usually somewhat greater. The number of periodicals given is that of electrical periodicals kept on file, usually in bound volumes except the current volume. In several cases it was found impossible to hazard an estimate of the number of electrical books on hand, but this was known to exceed the minimum stated above.

The list may not be complete, although effort was made to make it so. The editors will appreciate aid in adding to the list and correcting possible errors in it. No effort was made to include corporation libraries of electrical utility or manufacturing companies or of other organizations maintaining fairly complete libraries for their own purposes exclusively. For convenience in locating a library nearby, the list is arranged geographically by states.

Alabama:

Alabama Polytechnic Institute, Auburn, Ala. 300 volumes.

University of Alabama, University, Ala. 600 volumes; 6 periodicals.

Arizona:

University of Arizona, Tucson, Ariz. 200 volumes; 4 periodicals.

Arkansas:

University of Arkansas, Fayetteville, Ark. 239 volumes; 8 periodicals.

California:

California State Library, Sacramento, Cal. 425 volumes.

Los Angeles Public Library, Science and Industry Department, Los Angeles, Cal. 1,100 volumes.

Colorado:

Public Library, Denver, Colo. 334 volumes.

University of Colorado, College of Engineering, Department of Electrical Engineering, Boulder, Colo. 425 volumes; 26 periodicals.

Connecticut:

Sheffield Scientific School Library, Yale University, New Haven, Conn. 200 volumes.

District of Columbia:

Engineer School Library, War Department, Washington Barracks, D. C. 3,000 to 4,000 volumes.

Library of Congress, Washington, D. C. 8,000 volumes.

Public Library, Industrial Division, Washington, D. C. 1,300 volumes.

Florida:

University of Florida, Gainesville, Fla. 200 volumes; 7 periodicals.

Georgia:

Georgia School of Technology, Atlanta, Ga. 400 volumes; 12 periodicals.

Idaho:

University of Idaho, Engineering College, Moscow, Idaho. 520 volumes; 13 periodicals.

Illinois:

Armour Institute of Technology, Chicago, Ill. 1,750 volumes, 14 periodicals.

Chicago Public Library, Chicago, Ill. 700 to 800 volumes.

Engineering Library, University of Illinois, Urbana, Ill.

John Crerar Library, Michigan Ave. and Randolph St., Chicago, Ill. A scientific and technical reference library open to the public. 10,000 volumes; 4,000 pamphlets; 50 periodicals.

Lewis Institute, 1949 W. Madison St., Chicago, Ill. 350 volumes; 5 periodicals.

Indiana:

Indianapolis Public Library, Indianapolis, Ind. 300 titles.

Purdue University, West Lafayette, Ind. 725 volumes; 30 periodicals.

Rose Polytechnic Institute, Terre Haute, Ind. 600 volumes; 15 periodicals.

Iowa:

Iowa State College, Ames, Iowa. 300 volumes; 12 periodicals.

State University of Iowa, Iowa City, Iowa. 263 volumes; 14 periodicals.

Kansas:

Kansas State Agricultural College, Manhattan, Kans. 300 volumes; 12 periodicals.

University of Kansas, Lawrence, Kans. 1,000 volumes, 16 periodicals.

Louisiana:

Tulane University of Louisiana, New Orleans, La. 500 volumes; 4 periodicals.

Maine:

University of Maine, Orono, Me. 1,200 volumes; 9 periodicals.

Maryland:

Enoch Pratt Free Library of Baltimore City, 106 W. Mulberry St., Baltimore, Md. 625 volumes.

The Johns Hopkins University, Baltimore, Md.

Massachusetts:

City Library Association, Springfield, Mass. 850 volumes.

Free Public Library, New Bedford, Mass. 417 volumes.

Free Public Library, Worcester, Mass. 800 volumes, including bound volumes of periodicals.

Harvard University, Cambridge 38, Mass. 1,500 volumes; 30 periodicals.

Massachusetts Institute of Technology, Cambridge, Mass. 20,000 titles; practically all periodicals.

Public Library of the City of Boston, Boston, Mass.

Worcester Polytechnic Institute, Worcester, Mass. 6,000 volumes, 40 periodicals.

Michigan:

Grand Rapids Public Library, Grand Rapids, Mich. 489 titles.

Michigan Agricultural College, East Lansing, Mich. 1,000 volumes; 10 periodicals.

Michigan College of Mines Library, Houghton, Mich. 350 volumes.

Public Library, Detroit, Mich. 1,000 volumes.

University of Michigan, Ann Arbor, Mich. 500 volumes; 5 periodicals.

Minnesota:

City of St. Paul Public Library, St. Paul, Minn. 418 volumes.

Public Library, Minneapolis, Minn. 950 volumes.

University of Minnesota, College of Engineering and Architecture, Minneapolis, Minn. 1,000 volumes; 30 periodicals.

Missouri:

Kansas City Public Library, Kansas City, Mo. 1,800 to 2,000 volumes.

St. Louis Public Library, Olive, 13th and 14th Sts., St. Louis, Mo. 2,764 volumes.

University of Missouri, Columbia, Mo. 400 volumes; 12 periodicals.

Montana:

Billings Polytechnic Institute, Polytechnic P. O., Mont. 150 volumes; 5 periodicals.

Montana State College, Bozeman, Mont. 400 volumes; 8 periodicals.

Nebraska:

University of Nebraska, Station A, Lincoln, Nebr. 500 volumes; 16 periodicals.

New Hampshire:

New Hampshire College, Durham, N. H. 185 volumes; 8 periodicals.

New Jersey:

Free Public Library, Jersey City, N. J. 800 volumes.

Free Public Library of Newark, N. J. 1,200 to 1,500 volumes.

Princeton University, School of Electrical Engineering, Princeton, N. J. 5,000 volumes; 15 periodicals.

Rutgers College, New Brunswick, N. J. 1,000 volumes; 10 periodicals.

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New York:

Brooklyn Public Library, 26 Brevoort Place, Brooklyn, N. Y. 1,255 titles.

Buffalo Public Library, Buffalo, N. Y. 2,500 titles.

Columbia University, New York, N. Y. 1,400 volumes; all periodicals.

Cooper Union for the Advancement of Science and Art. 8th St. and 4th Ave., New York, N. Y. 590 volumes, 5 periodicals.

Cornell University, Ithaca, N. Y. 5,000 volumes; 7 periodicals.

Engineering Societies Library, 29 W. 39th St., New York, N. Y. 150,000 volumes on all branches of engineering.

New York Public Library, Technology Division, 476 Fifth Ave., New York, N. Y. 2,500 titles.

New York State Library, Albany, N. Y. 4,000 volumes.

Pratt Institute, Brooklyn, N. Y. 808 volumes; 13 periodicals.

Queens Borough Public Library, Jamaica, N. Y. 1,300 volumes.

Rensselaer Polytechnic Institute, Department of Electrical Engineering, Troy, N. Y. About 700 volumes, 14 periodicals.

Syracuse University, L. C. Smith College of Applied Science, Syracuse, N. Y. 2,000 volumes; 10 periodicals. Open to public by special permission.

North Carolina:

University of North Carolina, Chapel Hill, N. C. 300 volumes; 15 periodicals.

Ohio:

Cleveland Public Library, Cleveland, Ohio, 21,000 volumes. (Includes files of important magazines and proceedings.)

Municipal University of Akron, Akron, Ohio.

Ohio Mechanics Institute, Cincinnati, Ohio.

Ohio State University, Columbus, Ohio. 500 volumes; 30 periodicals.

Public Library of Cincinnati, Ohio. 700 volumes.

University of Cincinnati, Cincinnati, Ohio. 600 volumes; 14 periodicals.

Oregon:

State Library, Salem, Ore. 200 volumes.

Oklahoma:

University of Oklahoma, Norman, Okla. 450 volumes; 17 periodicals.

Pennsylvania:

Bucknell University, Lewisburg, Pa. 1,200 volumes; 4 periodicals.

Drexel Institute, Philadelphia, Pa. 450 volumes; 3 periodicals.

Franklin Institute, Philadelphia, Pa. 2,000 volumes; 1,500 bound periodicals. Open for reference to those who are introduced by members of the Institute.

Lafayette College, Department of Electrical Engineering, Easton, Pa. 1,500 volumes; 12 periodicals.

Lehigh University, Bethlehem, Pa. 1,200 volumes; 20 periodicals.

Pennsylvania State College, State College, Pa.

William B. Stephens Memorial Library, Krams Ave., Manayunk, Philadelphia, Pa. 589 volumes.

Texas:

Agricultural and Mechanical College of Texas, College Station, Texas. 400 volumes; 10 periodicals. Open to public under certain restrictions.

Virginia:

University of Virginia, University, Va. 1,000 volumes; 10 periodicals.

Virginia Polytechnic Institute, Blacksburg, Va. 250 volumes; 6 periodicals.

Vermont:

University of Vermont, Burlington, Vt. 500 volumes.

Washington:

Seattle Public Library, Seattle, Wash 600 titles.

University of Washington, Seattle, Wash. 350 volumes; 23 periodicals.

West Virginia:

West Virginia University, Morgantown, W. Va. 1,000 volumes; 8 periodicals.

Wisconsin:

School of Engineering of Milwaukee, 373 Broadway, Milwaukee, Wis. 1,000 volumes; 23 periodicals.

University of Wisconsin, Madison, Wis. 4,000 volumes; 25 periodicals.

Wyoming:

University of Wyoming, Laramie, Wyo. 250 volumes; 4 periodicals.

Canada:

McGill University, Montreal, Quebec. 1,000 volumes; 18 periodicals.

Queen's University, Kingston, Ontario. 500 volumes; 18 periodicals.

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

LIDDELL ELECTRIC MFG. CO., THE.—481 N. Washington Ave., Bridgeport, Conn. Manufacturer of telephone equipment, push buttons and other electrical specialties. Business established 1919. President and general manager, Robert Liddell; vice-presidents, Vaughn Wheeler, Michael Gombar; secretary, C. Edgar Bilton; treasurer, William Ruddiman; sales manager, R. R. Adams. Sales representatives, R. J. Smyth Corp., 229 W. 42nd St., New York, N. Y.; Eugene Rosenblatt, 51 Hopkins Pl., Baltimore, Md.

LIDGERWOOD MFG. CO.—New York, N. Y. Manufacturer of electric contractors and mine hoists. President, John H. Lidgerwood; vice-president, James G. Lidgerwood; secretary, Charles D. Butler. Main office, 96 Liberty St., New York, N. Y. Factories, Brooklyn, N. Y., and Newark, N. J. Branch offices, 1917 Fisher Bldg., Chicago, Ill.; Union Bank Bldg., Pittsburgh, Pa.; Widener Bldg., Philadelphia, Pa.; Hammond Bldg., Detroit, Mich.; Union National Bank Bldg., Cleveland, Ohio; 63-65 Columbia St., Seattle, Wash.; Central Bldg., Los Angeles, Cal.

LIEBEL-FLARSHEIM CO., THE.—410-418 Home St., Cincinnati, Ohio. Manufacturer of electrotherapeutic and X-ray apparatus. Business established 1914. President and general manager, G. H. Liebel; vice-president, E. M. Flarsheim; secretary and treasurer, E. S. Flarsheim.

LIFE MOTOR.—Trade name for resuscitating device manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

LIFE OF INSULATION, EFFECT OF HEAT ON.—See Insulation, effect of heat on.

LIFE SAVING DEVICES CO.—109 N. Dearborn St., Chicago, Ill. Manufacturer of resuscitation apparatus. Business established 1913. President and treasurer, Frank T. Fowler; vice-president, D. E. Clarke; secretary, M. F. Augustin. Exclusive distributor, Lungmotor Co., 711 Boylston St., Boston, Mass.

LIFE TESTS.—A life test as applied to electrical apparatus is a test made under ordinary operating conditions to determine the number of operations or number of hours of operation of the apparatus before failure occurs or before the efficiency has decreased to the point where it is practically worthless or no longer economical to operate. Life tests are made on many appliances.

One of the most important of these is on incandescent lamps. Tests are made to determine the number of hours the lamp will operate at its rated voltage, usually until its candlepower has fallen to 80% of its initial value. A large number of lamps are generally tested simultaneously, as out of a lot of 100 lamps some will fail before 500 hours of burning while others will burn considerably over the rated life of 1,000 hours. Lamp lives are comparable only when the lamps are operated at the same lumens per watt.

Life tests are also made on storage batteries to determine the number of charges and discharges under ordinary conditions before the capacity has decreased excessively. Switches of various kinds, key and pull-chain sockets and other similar mechanisms are tested to determine the number of operations that may be expected before they will fail. Life tests of such devices often result in improvement of general design or of construction details by using more sturdy parts for those found to be weak.

LIFETIME.—Trade name for cedar posts manufactured by the Western Lumber & Pole Co., Peyton Bldg., Spokane, Wash.

LIFTING MAGNETS.—See Magnets, lifting, hand and portable; Magnets, lifting, crane or hoist type.

LIFTS, CAR-PIT, ARMATURE AND MOTOR.—A special type of car-pit jacks, consisting of a simple portable machine utilizing the principle of the screw or the hydraulic press, and designed to lift motors or armatures to or from car trucks. It is usually operated by man power.

Manufacturers:

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Columbia Machine Works & Malleable Iron Co., Brooklyn, N. Y. "Columbia."

Duff Mfg. Co., Preble Ave. (North Side Station), Pittsburgh, Pa.

LIFTS, PAPER, MOTOR-OPERATED.—The large presses used in printing newspapers, large catalogs, etc., use rolls of paper much too heavy to handle except with special machinery. They are usually lifted and put in place with the aid of a motor-driven lift especially designed for handling this material in connection with large continuous web printing presses. By means of the lift new rolls of paper are quickly raised to the feeding end of the press as one after another is used up.

Manufacturer:

Rouse & Co., H. B., 2214 Ward St., Chicago, Ill.

LIGHT.—Light is a wave phenomenon capable of producing the sensations of sight and color. This definition is usually extended to include waves in the infrared and ultra-violet parts of the spectrum which are too long or too short to affect the eye.

Since light passes through a vacuum, a medium called ether is assumed to exist in space and to pervade all matter. Light waves are believed to be electromagnetic disturbances propagated in the ether, differing from electric and heat waves only in wave length. On passing through a prism, the different wave lengths of light are separated, producing the colors of the spectrum. This separation is caused by the difference in the velocity of the various wave lengths in the medium of the prism. In free space all colors of light travel with the same velocity, 186,000 miles, or 300,000 kilometers, per second.

The spectrum of a substance in the gaseous state consists of a series of bright lines with dark spaces between them, thus indicating that only certain wave lengths are present. Each element produces characteristic spectrum lines and may be identified by its spectrum. A number of elements have been discovered by observing lines previously unknown in the spectrum.

Light waves are believed to be produced by the vibratory, or the rotational, motion of the electrons within the atom when a body is heated to incandescence, or in the case of gaseous substances by the action of the electric arc, or spark, or by electric discharge through the gas at low pressure in a closed tube.

LIGHT BATH, ELECTRIC.—In electrotherapeutics, electric light baths are sometimes given to patients, whereby the body or parts of it are exposed to the rays from numerous incandescent lamps. For a description of this apparatus and list of manufacturers see Baths, electric light.

LIGHT HOUSE.—Trade name for lighting fixtures manufactured by Charles Polacheck & Bro. Co., 217 3rd St., Milwaukee, Wis.

LIGHT LIGHT.—Trade name for street lighting fixtures manufactured by the Line Material Co., South Milwaukee, Wis.

LIGHTERS, CIGAR, ELECTRIC.—These are small devices consisting essentially of a short coil electrically heated to a glowing temperature and mounted against a non-inflammable surface, such as asbestos. They have come into general use on cigar and tobacco counters in stores, hotels, clubs and other rooms where smokers congregate.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric automobile cigar and pipe lighters, made only for 6-volt storage battery service, spiral wire element is used. Outside finished in polished nickel, handle is of wood, ebony finish. Complete with protector sleeve and 5-ft. cord directly connected to lighter and either one or two point Ediswan standard automobile attachment plug. —Adv.

Cowles & Co., C., Water and Chestnut Sts., New Haven, Conn.

Cuno Engineering Corp., The, Meriden, Conn. (For automobiles.)

Davenport Mfg. Co., Davenport, Iowa. "Midland."

Drake Mfg. Co., Milwaukee, Wis. "Drake."

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DURALECTRIC CORP., THE., Mt. Tabor Bldg., Jamestown, N. Y. (Formerly Clark, Osgood & Allison, Bemus Point, N. Y.) The "Duralectric" cigar lighter is made in three types for counter use. Type AC, for a-c. circuits, 110 volts, 60 cycles, continuous duty; Type AI, same voltage and cycles, for intermittent duty; Type D-C, for 110 volts, d-c. circuit, intermittent duty. The igniting element is made of genuine nickel-chromium alloys; insulation of



"Duralectric" Cigar Lighter

mica and special asbestos; body of sheet steel. Standard finish is grained mahogany, nickel trimmed; other finishes and designs are furnished as ordered. Each lighter is supplied with cord and plug. The Duralectric consumes very little current and is durable and attractive. The Duralectric "Midget" is a small lighter of the same appearance for use on the mantle, library table, in the smoking room, or for use on 60-cycle lighting circuits anywhere. It consumes but 20 watts, half the amount required by an ordinary lamp. (Illustration above shows a Type A-C, 110-volt 40-watt Duralectric lighter.)—Adv.

Electric Automatic Cigar Lighter Co., 556 W. 27th St., New York, N. Y. "Cig-R-Lite." (For automobiles.)

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

General Scientific Equipment Co., North Philadelphia, Pa. "Genco."

Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."

Morse, Frank W., 289 Congress St., Boston, Mass.

Polacheck & Bro., Co., Charles, 217 3rd St., Milwaukee, Wis.

Spielman Electric Co., 1931 Broadway, New York, N. Y. "Handy," "Seco."

Taylor Co., H. D., 101 Oak St., Buffalo, N. Y. "Gehring."

LIGHTERS, GAS, ELECTRIC.—A system in which each gas burner in a chandelier or other lighting fixture or gas stove is equipped with a small series spark gap connected to a source of relatively high-tension electricity which when energized ignites the gas previously turned on. Another form, for individual gas jets, consists of a "make-and-break" spark gap interconnected with the gas valve and energized by the inductive spark obtained from a small spark coil. For gas stoves the metal frame of the stove is sometimes connected to a spark-coil circuit and a lighter rod (a metal rod with insulated handle), is connected to the other side of the circuit, by touching the rod to the burner an igniting spark is formed.

Manufacturers:

American Lava Corp., 1429 William St., Chattanooga, Tenn.

Art Craft Fixture Co., 85 Academy St., Newark, N. J.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

Everson & Co., C. G., 70 W. Lake St., Chicago, Ill.

Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.

Safety Gas Lighter Corp., Roanoke, Va. "Matchless," "Electric Match."

Wiese Electrical Appliance Co., Milwaukee, Wis.

LIGHTFINDER SALES CORP., INC.—14 W. 17th St., New York, N. Y. Manufacturer of radium beads, tacks and buttons for switches. Business established 1916. President, S. E. Kellar; general manager, R. A. Norton.

LIGHTHOUSE CORP.—98-100 Bleecker St., New York, N. Y. Manufacturer of lighting fixtures. President, I. Newland; vice-president, Charles Lewis.

LIGHTING APPLIANCE CO.—4 White St., New York, N. Y. Manufacturer of lighting fixtures.

LIGHTING DISTRIBUTION LINES.—See Distribution lines for power and lighting.

LIGHTING, ELECTRIC, DEVELOPMENT OF.—The history of electric illuminants began with the experiments upon the electric arc made by Sir Humphrey Davy in England. In 1809 he produced an arc of considerable magnitude between pencils of charcoal using as the source of current a battery of 2,000 zinc-copper cells. Further improvements in cells and carbon pencils made possible very bright arcs which led inventors to see the possibilities of the electric arc as a lamp. While these studies were being made on the arc, other investigators had found that sending a heavy current through a wire would make it incandescent. In 1845 a crude incandescent lamp burning in a vacuum was brought out by J. W. Starr, of Cincinnati. A year later Staite produced a fairly satisfactory arc lamp which lacked only a cheap and reliable source of current to make it practicable.

These inventions turned the attention of experimenters to the study of a means of producing power by means other than primary cells. Since Faraday's discovery of the generator principle a number of inventors had gradually developed the dynamoelectric machine and had succeeded in producing some fair machines. About 1849 one of the first of these generators or dynamos, the Alliance machine invented by Nollet, was tried out for arc lighting. Several years later the self-feeding arc was invented. In 1863 the arc light was used for the first time for actual service lighting, this being in lighthouses off the coast of France.

Some seven years later Gramme introduced his ring-armature dynamo, which permitted generating higher voltages and resulted in a revolution in arc lighting since it could then be served from a practical source of energy. This gave electric lighting its start as an industry.

Within the ten years following the introduction of this invention arc lighting, theretofore experimental, became an established business. Up to this period it had been thought necessary to operate each lamp from an individual dynamo. As this was quite expensive, attempts were made to develop a series system of lighting. In 1876 Jablochkoff invented his "candle"—an arc lamp that could be operated in series. However, the short life of the candle, about two hours, made this system inconvenient and expensive. In 1878 a marked improvement was made by the employment of the Brush system. This was quite complete; it included the dynamo, current regulator, differential coil regulators, and a simple ring clutch mechanism. Brush also invented the use of double sets of carbons for all-night burning of street lamps. The first arc lighting system was installed in Cleveland in 1879. Other installations followed immediately afterward, both in this country and abroad.

It was soon discovered that arc lighting was only suitable for outdoor lighting and special lighting of large areas and for projectors. Previous to this time a number of experimentors, chief among them Edison and Swan, had been working on incandescent lamps. These lamps, with their lower candlepower and low brightness, would be suitable for indoor lighting. Edison, who saw the possibilities of these lamps, had been experimenting in his laboratories at Menlo Park, N. J., with various filament materials and finally in 1879 made a bamboo-filament lamp with a reasonable life. To use this lamp required a generator of moderate voltage and a suitable power distribution system. Further experiments led to his development of the constant-potential dynamo, the multiple two-wire and later the three-wire systems of distribution. These systems were particularly adapted to the generation of power in some central point to be distributed to the various consumers. A private system was first installed in Menlo Park and this led to the building of the first commercial central station in New York City in September, 1882. This was followed by installation of another station at Appleton, Wis., one month later. These stations, built to serve localities of rather limited area, employed direct-current systems.

About the time they were being built experimenters were at work on the development of alternating-current, high-voltage systems and equipment. In 1885 the first alternating-current lighting system was installed at Buffalo, N. Y. The current was generated at 500 volts, stepped up to 3,000 volts, distributed at that voltage, and stepped down to 100 volts for the consumer. With the many improvements in equipment this system at first gradually and later rapidly superseded the direct-current systems except in limited congested areas in large cities and in isolated plants. The alternating-current system made distribution over a fairly large area economical. Central stations, which had been forced to limit their customers to those in the central business districts, were now able to spread out to the residence districts and sell at a fair rate to residence customers. The numerous improvements in central-station plant and line equipment did much to develop the residence lighting field, but one of the chief factors in the rapid developments in that and other lighting fields was the rapid improvement in incandescent lamps.

The original commercial incandescent lamps were carbonized bamboo-filament lamps. These lamps, though they were improved until they had a filament life of some 3,000 hours, vaporized rapidly which reduced their efficiency considerably, due to blackening of the inside of the bulb. About 1891 a lamp using a carbonized cellulose filament was introduced. This lamp had a higher efficiency, due to decreased vaporization and was much used until the advent (about 1905), of the metalized-filament lamp with a carbon filament specially treated in an electric furnace to permit operating at higher temperature and efficiency. About this time the first of the metal-filament lamps was introduced. This was the tantalum lamp, which was used for a few years, being superseded about 1908 by the tungsten-filament lamp, which had a still higher efficiency. The first tungsten lamps were very fragile, but this fault was remedied in 1911 by development of wire-drawn filaments and this lamp with its high efficiency and more desirable color quality gave electric lighting a great impetus in every field of lighting, particularly residence lighting.

The tungsten lamp has a considerably higher brightness than the old carbon-filament lamps and fixture and lamp-accessory manufacturers set to work to develop fixtures, reflecting and diffusing equipment which would fulfill the usual lighting requirements and at the same time overcome the excessive and glaring brightness of the lamps. The result was the development of the new lighting methods using indirect and semi-indirect fixtures. These new lighting systems, though they to some extent found their way into the home, were largely employed at first in offices, stores and public buildings.

Lamp manufacturers continued in their efforts to produce a more efficient lamp. One of the chief difficulties in increasing the efficiency of the vacuum tungsten lamps was that at the higher temperatures necessary to increase the efficiency, the filament vaporized too rapidly. About 1913 it was found that this could be overcome by introduction of an inert gas in the bulb. This was done and the filament concentrated into a small space and the result was the present gas-filled tungsten lamp. These tungsten lamps are today the most efficient incandescent lamps ever produced and the most prevalent type of electric illuminants, but other lamps developed along with or before them are also of interest.

About 1906 the Nernst lamp, a special form of incandescent lamp using a rare-earth glower, was introduced. Its use spread rapidly for a few years, but by 1911 it fell into disuse to the greater advantages of the wire-drawn tungsten lamps. Among the very earliest experimental electric lamps were the gas or vapor types. These lamps really originated with the invention of the Geissler tube in 1854 and were the subject of considerable experimentation. It is of interest to know that, though these tubular lamps of the strictly gas type were never used to any great extent for general lighting, they have been the means of producing the nearest approach to natural daylight color value that any electric illuminant has attained, this being in the Moore tube filled with carbon dioxide gas.

The somewhat similar mercury-vapor or mercury-arc lamps have been developed to commercially practical lamps, known in America as the Cooper Hewitt lamps. Due to the greenish color of their light, when of the long tube type, which is the most used, they have been used chiefly for industrial purposes and for photographic or blueprinting service where the high actinic properties of their light makes them desirable. These lamps are also made with short tubes of quartz, operating at a higher vapor pressure and temperature and giving a whiter light than the long-tube lamps.

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Arc lighting had a very interesting development through numerous stages, since the first d-c. open carbon arc lamps were used for street lighting. The first big improvement in the lamps was the use of an inner globe surrounding the arc and reducing the amount of air available for combustion of the electrodes; this lengthened their life about ten times and greatly cut down the trimming expense. Such lamps were also made for use on alternating current. These so-called "enclosed" arc lamps came into use to a considerable extent in large interiors, such as factories and stores, as well as for street and other outdoor lighting, but their efficiency was not as high (especially of the a-c. lamps) as that of the old open arcs. The use of cored carbons was introduced to steady the arc somewhat. This led to the use of special chemicals in the core or to the impregnation of the entire carbon with the salts of calcium or magnesium and other chemicals that gave high and distinctive luminosity to the arc stream. These lamps therefore came to be called flaming arcs and soon after their introduction about 1902 were put into extensive use for street and other outdoor lighting where a more powerful source than the open or enclosed carbon arcs was desired. They were developed for a-c. service also and had quite a high initial efficiency. They require more maintenance, however, and even under the most favorable conditions a considerable amount of ash or deposit from the salts used was formed on the inside of the globe. This greatly cut down the actual light output and reduced the efficiency materially. Even when very carefully cleaned, it was found that the globes became etched which further prevented approach to the initial high candlepower and efficiency. When the magnetite arc came into use and later as tungsten lamps were developed in large sizes and of very efficient types, both these two illuminants replaced the carbon flame arcs so that these are used to only a very limited extent at the present time.

Soon after the carbon flaming arcs were developed, a modification of them, variously called the magnetite, metallic-flame or luminous arc were introduced about 1903. In this the carbon electrodes used in the older lamps are replaced by one copper and one composite electrode containing chiefly the iron oxide magnetite and salts of titanium and other compounds. This lamp has a considerably higher efficiency than the old carbon electrode arcs, but must be operated on direct current. It is still widely used for street lighting and is the only arc lamp now in use for this service.

For large searchlights, motion-picture projection in large theaters, stage spotlights, and for photoengraving, blueprinting and certain other photographic work, carbon arc lamps are still used.

The high efficiency of the vacuum tungsten lamp led to the rapid spread of residence lighting and in the same manner the introduction of the more efficient gas-filled tungsten lamp had its effect upon the industrial and other lighting fields. Previous to the advent of these lamps lighting in shops and factories had been largely confined to low-intensity lighting of stairways and aisles and some drop-cord lighting over machines in the darker shops. About 1914 central-station men began to realize the possibilities of a day lighting load in industrial plants and factories in general. As a consequence some experimentation was done and numerous tests were made utilizing these lamps for such a purpose. These tests demonstrated a fact of much importance both to the central stations and their industrial customers. The efficiency of a shop could be so much increased by what was then considered a very high intensity of illumination that the money saved in reduced cost of shop production much more than paid for the increased cost of energy.

The new industrial lighting is a marked departure from the old methods. The fundamental principle is to provide general high-intensity lighting over the entire working area by employing high-powered lamps placed at regular intervals over the shop, instead of the scattered drop cords placed at whatever point was thought to be convenient. To this method of illumination the gas-filled lamp with its high candlepower and high efficiency was peculiarly adapted. However, due to its concentrated filament its glare was injurious to the eye. This difficulty was overcome by utilizing reflecting equipment (and in some cases also diffusers), which effectually cut off direct view of the filament from all ordinary angles.

Along with the introduction of the gas-filled lamp in the industrial field came some modifications in commercial indirect and semi-indirect lighting. Theretofore this type of equipment had utilized several vacuum lamps in each unit. It was readily seen that it would be more economical to employ one larger gas-filled lamp to replace the several smaller vacuum lamps. The gas-filled lamp here again presented the difficulty of high brightness, this time easily overcome by employing dense glassware or the indirect system. This repeated problem of glare with the gas-filled lamps for direct lighting brought the attention of lighting men to the subject of excessive brightness and its injurious effect upon the eyes. As a result many developments in all fields of electric lighting have been in accessories designed with a view to reducing direct and reflected glare. This subject also had its influence upon electric lighting in residences. Much of the recent development in this field has had to do with the reduction in glare in lighting fixtures and in the design of the newer fixtures, particularly the semi-indirect and indirect fixtures, this influence can plainly be seen.

The growth of electric lighting since its inception a little over 40 years ago has been phenomenal. At the present time some 33,000,000 people are living in electrically lighted homes in the United States alone. Figures on the number of lighting customers previous to 1915 are unfortunately not available. In 1915 there were 3,435,000 residence customers. In 1920 their number had almost doubled, being 6,517,600. The growth in commercial lighting has been marked, though not so striking as that of the residence customers in the same period. In 1915 there were 1,085,900 commercial lighting customers and in 1920 about 1,675,900, an increase of 54% in five years.

The Bureau of the Census report published during the past year showed that for 1917 there were consumed for light 5,112,412,249 kilowatt-hours of energy, or 29% of the total output of electrical energy in the United States. It is estimated that in 1920 there were consumed about 9,000,000,000 kilowatt-hours for lighting alone. Some idea of the extent of electric lighting may also be gained from the figures on the lamps sold in the United States during 1920. Careful estimates place this figure at 230,000,000 (excluding miniature lamps), and of this number 210,000,000 were tungsten lamps.

For further treatment of electric lighting see Lamps, incandescent, development of; Lighting, industrial, survey of; Lighting, residence, survey of; Lighting, store, survey of; Street lighting, development and status of.

LIGHTING, ELECTRIC, METHODS OF. Lighting is the distribution of light, interior or exterior, for purposes of seeing. Lighting and illumination are terms which are now used to apply to the utilization of light after it is produced, rather than to the production of the electrical energy which is converted into light, a former use of the term. Electric lighting is usually divided into the two great subdivisions, interior and exterior lighting.

Interior Lighting. Interior lighting is commonly divided into two general classes, direct and indirect. Indirect is also sometimes called diffused lighting. The term direct lighting is usually applied to all kinds of lighting where a considerable part of the light is received on a working plane, direct from the light source, or from its enclosing globe, even though a part of the light may be received indirectly by reflection from the ceiling, walls and floor of the room. Indirect lighting is lighting in which none of the light on the working plane is received directly from the source of light or its surrounding globe, but all is received by reflection. Since the ceiling, which is usually the indirect source of light with indirect lighting, is a diffuse reflector, indirect lighting is also diffuse lighting. Daylight obtained through a window from the sky, in which there is no sun visible from the window, is also diffuse.

Another classification of lighting of interiors is that of local and general. General lighting applies to the lighting of the whole room. Local or localized lighting is with a shaded lamp, such as a table or desk lamp, in which the light source is close to the work. The general tendency of lighting practice, with improved lamps and methods, has been toward general lighting for offices, factories and places of business. This is because localized lighting is no longer as necessary as formerly for reasons of economy, and furthermore it has been found that localized lighting, except for certain specific operations, does not permit as rapid work and is less cheerful and not as stimulating to the best and most rapid work as general lighting.

Semi-indirect lighting is a term applied to lighting in which the source of light has a bowl or reflector of translucent glass hung underneath so as to throw a considerable portion of the light to the ceiling. The bowl, which is usually of some kind of opal, allows some light to pass directly through (however, with considerable diffusion), so that the effect from the bowl is like that of direct lighting. Semi-indirect lighting is applied to a great variety of effects, but illuminating experts (knowing the bad effects upon the eyes of allowing too much light to come directly through the bowl so as to produce a great brightness of bowl), look with most favor upon semi-indirect bowls of considerable density, which cause a minimum of glare and reflect most of the light to the ceiling for use by the indirect method. At the same time, bowls of thinner material are cheaper and more easily sold to certain purchasers, who like the brightness of the bowl and do not realize the bad effect on the eyes.

The best illuminating practice now calls for concealing the light sources altogether, as in indirect lighting, or cutting down the brightness of the visible sources to a low point wherever possible in the lighting of rooms where the lamps are within the field of vision. This applies especially to large offices and auditoriums, where persons are obliged to sit for long periods in the same position. Bright light sources constantly within the field of view have been found to cause a marked eye fatigue during periods of work, as compared to diffused lighting in which the light sources were not visible, such as indirect lighting and day lighting.

It is still considered good practice to use localized lighting at points where especially strong illumination is needed, but the lamp in such cases should be thoroughly shaded and the position of the lamp with reference to glossy paper or polished metal, upon which work is being done, should be such as to avoid the glare from these surfaces as much as possible.

Exterior Lighting. Exterior lighting is limited very largely to street lighting at present. In the early days of electric arc lighting, attempts were made to light large areas by means of arc lamps on high towers. This was not practicable because of the distance of the lamps from streets and because of the shadows caused by buildings and trees. Practice therefore went back to former gas-lighting practice of scattering units along the streets. However, as the electric arc lamps available for street lighting in the early days were large units, it was customary to use them at rather infrequent intervals, with very poorly lighted spaces between. Later the reduction in cost of electrical energy made it possible to put lamps at more frequent intervals, and also the perfection of the tungsten lamp for street lighting made it possible to produce light economically from a smaller candlepower of lamp than formerly. For the lighting of residence districts, which constitute the largest part of the area of most of our cities, the practice of placing one lamp at each street intersection is the most common. For long blocks, however, this leaves much to be desired, even if the lamps are large. For special lighting of business streets, frequently called "white way" lighting, lamps at frequent intervals, one for each 50 to 100 lineal feet, on ornamental posts are commonly used.

The lighting of shop, factory and railroad yards is carried out in general much like street lighting, except that which is done by flood lighting. Flood lighting is a form of exterior lighting in which the aim is to light fairly large areas from central points by means of projecting lamps, with parabolic or nearly parabolic reflectors. Flood lighting is also used for making monuments, buildings or advertising signs visible by night as well as by day.

Exterior lighting of expositions and other buildings by outlining the architectural features with small lamps has been practiced extensively in the past with some beautiful results. Recently, however, flood lighting has been more popular for such purposes. The Panama-Pacific Exposition at San Francisco in 1915 was the most notable example of exposition lighting yet achieved. It was lighted almost exclusively with flood lighting of various types, the light sources being entirely concealed.

LIGHTING FIXTURES.—See Fixtures, lighting (thirteen types).

LIGHTING, INDUSTRIAL, SURVEY OF EXISTING CONDITIONS AND TENDENCIES IN.—There are, in the United States, about 140,000 mills and factories, employing at least 12,500,000 workers. This is the greatest of all lighting fields, representing 43% of the total demand for all lighting equipment, yet only one factory in every four is reasonably well lighted.

A recently conducted extended survey of industrial lighting in nearly 500 plants showed that 78% of all lighting equipment

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used in industrial plants is purchased from the electrical contractor, retailer or jobber, and manufacturers regularly consult these sources for advice on lighting matters or when any lighting changes are contemplated. Incandescent lamps are in use in 88% of all plants, mercury-vapor lamps in 4.3%, and arc lamps in 3.4% of plants. Of the factories employing incandescent lamps, vacuum lamps are in use in 93% of the plants, gas-filled lamps in 71% and daylight lamps in but 9%. Sizes of lamps in most common use are 40, 60 and 100-watt lamps, while the average number of lighting units per plant is 1,270. About 69% of mills and factories purchase lighting energy from central stations, at an average cost during summer months of $213 per month, and during winter months nearly triple this figure.

Approximately one-fourth of all factory production is accomplished under artificial illumination, which, together with the fact that improved illumination has been found, on the average, to increase factory production by 15%, serves to indicate the importance to the manufacturing industry of good artificial lighting. Adequate illumination further tends to reduce the average industrial accident hazard about 20%.

The fundamental requirements of a good installation are: (1) Sufficient light on all working areas; (2) moderate light on adjacent areas and walls; (3) freedom from glare, glaring reflections and objectionable shadows; (4) a system which is simple, reliable, easy to maintain and reasonable in operating cost.

Adequate lighting equipment may be installed, operated and maintained at a cost of from 0.75% to 5% of the pay roll, the exact figure depending upon the nature of the industry. These figures include a depreciation allowance which charges off the cost of equipment and installation within five years, as past experience has shown that the majority of industrial lighting equipment becomes obsolete over a five-year period.

In using incandescent lamps it is the present practice to plan wherever possible for general overhead illumination of sufficient intensity for every operation within a room or factory bay. Dome type metal reflectors or semi-enclosing glassware, together with gas-filled lamps are regularly used and the lighting units are mounted as high as practicable and spaced to provide even illumination over the floor area or working plane. Usually not more than four units are placed on one circuit. Localized lighting or drop cords are provided only where it is not possible to meet all lighting requirements with the general overhead system.

The proper intensity of illumination to provide is dependent chiefly upon the nature of the industry and may be found from standard lighting codes, which see. Present standards are from 3 to 12 foot-candles for interior working areas.

For the illumination of outdoor storage spaces or for protective illumination, weatherproof metal dome or angle units on high mountings, or floodlight projector units, are now commonly used.

The tendency in factory lighting is towards considerably higher illumination intensities than are at present in general use. A number of practical installations of overhead lighting have been made with resulting average intensities as high as 20 foot-candles and it has been demonstrated that present lighting equipment permits of intensities as high as 60 foot-candles without unpleasant glare. There is a growing tendency towards standardization both of industrial lighting equipment and in methods of installation.

No doubt it will eventually become the custom to measure periodically the illumination intensities obtained from factory lighting installatoins so that defects may be detected and remedied. With this custom will come systematical and periodical cleaning of lighting units and replacement of burned-out lamps or damaged equipment.

As industrial executives become more familiar with the importance of good illumination as a means of increasing production, decreasing spoilage and preventing accidents, it is found that they become more willing to make the increased investment in lighting equipment and installation required for high illumination intensities.

LIGHTING OUTFITS, AUTOMOBILE AND MOTORBOAT.—These outfits include a battery, usually of three storage cells, and a set of lamps suitable for the headlights, side and tail lights and dash instrument lights used on automobiles. They also include the various switches, dimmers or other control mechanisms sometimes used in these lighting sets. For motorboats they may include some cabin lights, a spotlight or searchlight and other lamps depending on the size of the boat. These lighting outfits do not include such types as combine lighting and starting equipment. Such systems are listed separately under Starting and lighting outfits, automobile and motorboat.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St. U. B. Bldg., Dayton, Ohio. "Dayton."
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Duplex Storage Battery Co., Beaver Dam, Wis.
Fisher Electrical Works, 1014 Lynn St., Detroit, Mich.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."
K-W Ignition Co., The, E. 30th St. and Chester Ave., Cleveland, Ohio. "K-W."
Liberty Electric Corp., Port Chester, N. Y.
MacRae, Hector C., 314 St. Paul St., Baltimore, Md. "Champion."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Matthews Co., The, Port Clinton, Ohio. "Ker-O-El."
Matthews Engineering Co., Sandusky, Ohio.
Morse, Frank W., 289 Congress St., Boston, Mass.
National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C. "Newbold."
North East Electric Co., Rochester, N. Y. "North East."
Porter Co., The, 241 Water St., New York, N. Y.
RADIANT MFG. CO., Water and Perry Sts., Sandusky, Ohio. "Radiant."
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display pages 1395-1402.)

LIGHTING OUTFITS, PORTABLE, CONSTRUCTION AND EMERGENCY.—Portable lighting outfits generally consist of a small battery of storage cells capable of supplying power to a few lamps, or a small motor. They are mounted on a truck or skids or, when small enough, in a carrying case with handles. Some of their uses are: Lighting for underground construction or other night work, and emergency lighting of exits in theaters or similar buildings. For emergency work in factories, theaters, etc., small portable light and power plants are sometimes installed; (see Plants, portable, lighting and power).

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio. "All Purpose."
Buda Co., The, Harvey, Ill. "Buda-Ross."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian Westinghouse Co., Ltd., Sanford and Meyler Sts., Hamilton, Ont., Can. "Westinghouse."
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Cushman Motor Works, 932 N. 21st St., Lincoln, Neb.
Duplex Storage Battery Co., Beaver Dam, Wis.
EDISON STORAGE BATTERY CO., Orange, N. J. "Edison." (See display adv., page 1272-1273.)
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Lalley Light Corp., Detroit, Mich.
Matthews Engineering Co., Sandusky, Ohio.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
RADIANT MFG. CO., Water and Perry Sts., Sandusky, Ohio. "Radiant."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
UNIVERSAL MOTOR CO., 39 Ceape St., Oshkosh, Wis. "Universal." (See display adv., page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LIGHTING PLANTS, FARM.—See Farm lighting and power plants.

LIGHTING PLANTS, PORTABLE.—See Plants, portable, lighting and power.

LIGHTING REFLECTORS.—See Reflectors (eighteen types).

LIGHTING, RESIDENCE, SURVEY OF EXISTING CONDITIONS AND TENDENCIES IN.—Approximately 9,000,000 of the 24,000,000 homes in the United States are electrically lighted, representing a total power consumption of about 2,500,000,000 kw-hrs. While 15,000,000 homes are still unwired, a third of this number is within territory served by central stations and these homes, therefore, may be classed as prospective users of electric service. In this territory 98% of newly built houses are electrically equipped. Of the 6,000,000 farm residences, more than 200,000 are now provided with country home lighting plants and fully one-half of the remainder are prospective users.

In 1905 electricity had quite extensively replaced gas for illumination purposes and the average city family then paid $20 a year for light. Today the corresponding lighting cost is $14 a year, yet the amount of illumination used by the average family has been more than doubled. The reduction in cost is due both to the lowered expense of producing electrical energy, and to the greatly increased efficiency of modern incandescent lamps.

A recent survey of lighting conditions in 1,500 Chicago homes is indicative of the general conditions in the large cities throughout the country. The outstanding results of the investigation as summarized are: 80% of homes in large cities are apartments; 97% of fixtures are of the direct type; 2.8% of fixtures are semi-indirect; 56% of fixtures are equipped with glassware, most of which is clear glass; 31% of fixtures have no shades; 80% of homes are of middle class, in which homes there is but one baseboard outlet to every 17 rooms; convenient control, utilization of color, supplementary use of pleasing transparencies on such units as electric candles, night lamps, bedside lamps, etc., are all rare; lack of portable lighting equipment, other than floor and table lamps, makes it difficult for people of the renting class to provide for pleasing and adequate illumination where such provision has not been made by the landlord.

A survey in Cleveland indicated an average of 20 lighting sockets per home, of which less than one socket per home was without a lamp. There were no empty sockets in 72% of homes, while 42% of homes kept extra lamps on hand.

For the lighting of living rooms, table lamps, floor lamps and other portable lamps are popular. Their use does much to better the standard of home illumination and is the foremost step in adding the element of pleasing decorative and color quality to home lighting. At present the central fixture is used almost universally in living rooms and will doubtless continue in favor.

The essential lighting need for the dining room is strong illumination on the table. For this reason it is probable that some modification of the once popular dining-room dome will again find favor. At present shower and candelabra fixtures are very largely used.

Kitchen lighting is commonly accomplished by a single lamp with or without a reflector. If but one outlet is provided, the lamp should be mounted as high as possible and provided with a good reflector.

Bedrooms are usually lighted from a single central outlet, but the use of auxiliary lighting equipment, such as wall brackets, dresser or stand lamps, is advisable as this equipment adds greatly to the decorative effect and permits of convenient variety in the amount of illumination.

The primary considerations in properly lighting a home may be summarized in Table I.

TABLE I.

Utilitarian	Decorative
Ample light	Pleasing and tasteful appearance of lighting units, either lighted or unlighted.
Absence of glare	
Proper distribution	
Convenience of control	
Reasonable cost	Appropriate color effects
	Variety

The proper amount of light for each room in the home may not be rigidly applied from any table of figures, as intensity of illumination for the home is largely a matter of individual preference.

Table II is, therefore, merely indicative of the approximate total wattage of tungsten lamp capacity which may be normally employed to good advantage in each room in the home. The total wattage for any

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room may be divided between central fixture, portable lamps, or in other ways. If ceilings, walls or decorations are dark-colored, more lamp capacity is advisable than is here indicated.

TABLE II.

	Small Room	Average Room	Large Room
Living room	100	150	250
Dining room	75	100	150
Kitchen	50	75	125
Pantry	25	25	50
Reception hall	10	25	50
Bathroom	25	50	75
Bedroom	50	75	100
Attic or basement	25	50	75
Porches	10	25	50
Music room	100	125	175
Nursery	50	75	100
Sewing room	50	75	100
Library	75	125	200

Daylight tungsten lamps and white bulb tungsten (White Mazda) lamps are suited to many home uses. Lighting fixtures also are now on the market which permit the satisfactory use of gas-filled tungsten lamps in the home.

For the principal rooms of the home the decorative element in lighting is no less important than the purely utilitarian element. Lighting equipment which is beautiful, efficient and easily removable from one residence to another is bound to be the outcome of the popular need among tenants. Commercial progress is already being made in these directions through the marketing of removable shades, adapters, converters and fixtures that may be easily connected or disconnected.

LIGHTING SCHEDULES.—See Schedules for street lighting.

LIGHTING SPECIALTIES, DECORATIVE AND MISCELLANEOUS.—Special lighting effects are often produced for decorative purposes, such as small statues having candelabra or miniature lamps mounted thereon. There are a large number of these special and miscellaneous devices, the latter type generally consisting of some common article with a special lamp attached to it in such manner as to give effective illumination on it. Examples of this are illuminated copy holders and illuminated pencils, the latter including a small flashlight battery and incandescent lamp. Many other specialties are also manufactured to give similar effects on other articles.

Manufacturers:

Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin engineers are foremost in the production of special units to meet unusual conditions and in planning illumination systems for industries, large commercial establishments, etc. Write for details.—Adv.
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Champion Brass Works, Coldwater, Mich.
Chemelectric Co., The, 4327 Kenmore Ave., Chicago, Ill. (Exclusive distributor, G. & W. Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.)
Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Duplexalite."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Arbolux," a set with miniature lamps wired in multiple, which makes each lamp independent of every other, designed primarily for Christmas tree lighting. Its other uses are to decorate and give soft illumination in pergolas, to take the place of Japanese lanterns among trees and shrubberies at lawn fetes, or in summer house, pavilion, pagoda, band stand, ball room or club room. The proper degree of softness for such purposes can readily be attained by covering the bulbs with tissue or foliage. See adv. pages 1203-1223.—Adv.
Herwig Art Shade & Lamp Co., 2140 N. Halsted St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Line-A-Time Mfg. Co., Inc., Rochester, N. Y. (Illuminated copy holder.)
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. (See display adv., page 1275.)
Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind.
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Brascolites with special bowls containing emblematic insignia, or trade marks are furnished by this company. National trade marks or emblems can be furnished from stock but others can be supplied if desired. (Emblems are



The Brascolite, Type SF

reproduced in full colors.) Brascolite unit type SF is illustrated. It can be furnished in three sizes, for 200-watt medium socket and 300-watt mogul socket with 19-in. reflectors and 11½-in. bowls, and for 400—500-watt mogul socket with 23-in. reflectors and 16-in. bowls. For other Luminous Unit products see display adv. pages 1276-7. —Adv.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv., page 1405.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Parker, C. W., Leavenworth, Kans.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Polly Mfg. Co., Milwaukee, Wis.
REFLECTOLYTE CO., 914 Pine St., St. Louis, Mo.
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill.
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio.
SAMPSON AXCESS SYSTEM, INC., 434 Union St., Lynn, Mass. "Axcess."
Schweitzer & Herz., 231 N. Wells St., Chicago, Ill.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
WHEELER REFLECTOR CO., 156 Pearl St., Boston, Mass.
Wolf & Davis, 71-73 Spring St., New York, N. Y.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

LIGHTING, STORE, SURVEY OF EXISTING CONDITIONS AND TENDENCIES IN.—There are upward of 1,500,000 stores in the United States. In these the incandescent electric lamp predominates as a source of artificial illumination. It is estimated that of the total domestic production of these lamps, outside of miniature types, 20% go into commercial service as compared with 43% into industrial and 25% into residential service. Illumination, in general, is better and of higher intensity in stores than in industrial plants, but it is satisfactory only in a comparative sense. There is room for material improvement.

Table I gives the present standards for store illumination in foot candles:

TABLE I.

Kind of Store and Part	Recommended Intensities	Under Some Conditions
Show window	10 to 70	
First floor, department store on bright street corner	10	6 to 12
Other clothing, dry goods, haberdashery, millinery, jewelry, etc.	8	5 to 10
Other drug, grocery, meat, bakery, book, florist, furniture, lunchroom, confectionery, etc.	6	4 to 8

A survey of the lighting in 27 prominent department stores in New York, Boston, Philadelphia and Newark discloses the fact that present lighting intensities are considerably below those recommended by the Illuminating Engineering Society.

A survey of the lighting in six department stores in Cleveland, in which foot-candle readings were taken in different sections throughout the stores, shows somewhat higher intensities than were found in the foregoing eastern stores. See Table II.

TABLE II.

Section of Store	Average Foot-Candles
Tailor shop	7½
Hosiery, petticoats	6
Art needle work, furniture	5½
Apparel, bedding, candy, dresses, dress goods, infants' wear, millinery, neckwear, silks, stationery, suits, umbrellas, underwear	5
Costumes, men's furnishings, handkerchiefs, men's hats, laces, leather goods, notions, pictures, shoes, toys, trunks, waists	4½
Carpets, rugs, men's and boys' clothing, ladies' and children's coats, corsets, embroideries, furs, glassware, gloves, jewelry, linens, patterns, ribbons, shirts, silverware, sporting goods, toilet goods	4
Curtains, draperies, sweaters	3½
Electric fixtures, rugs, wall paper	3

The past decade has seen marked developments in the incandescent lamp; larger sizes have become available which have largely replaced lower wattage lamps in stores. This has necessitated the use of those types of fixture units that insure the required diffusion and a minimum of glare. Hence the tendency is away from open reflectors with clear lamps and toward totally enclosing, semi-enclosing, indirect and semi-indirect units.

Special Tungsten filament lamps producing a light of afternoon sunlight quality are finding considerable application in stores. These so-called daylight lamps are not designed for color-matching purposes. Though frequently employed for general illumination, they will never supplant the regular clear bulb lamp with its warmer color quality. Color matching is not required in over 90% of sales, yet a nearer approach to daylight than is possible with clear bulb lamps is desirable in showing certain classes of goods, such as men's clothing, linens, furs, jewelry, silks and shoes.

The most accurate color-matching light is obtained through the use of clear lamps with especially colored glass screens. Many of the more progressive stores are supplementing their general illumination by installing portable units involving this principle on counters and in other parts of the store where more exacting color discrimination is required.

The amount of light used in show windows has been increasing very rapidly. It is not uncommon in the larger cities to find intensities ranging from 75 to 100 foot-candles. From a study of window installations in 125 high-class dry goods and department stores in 40 cities, it was found that 53 were using one-piece mirrored-glass reflectors; 43, mirrored troughs; 16, prismatic-glass angle reflectors; and 5, dense opal-glass reflectors. The average power consumption was 53 watts per running foot of window front.

Daylight lamps have become a valuable medium in the hands of the display manager. They add a distinction to his windows, causing them to stand out prominently. Greater attention is being given to securing color effects in window lighting. A mechanical means recently introduced for the purpose consists essentially of a metal frame that fits over the reflector opening and holds a slide containing a colored gelatine. Other methods of getting individuality into window lighting involves the use of spotlights and portable lamps for individual settings.

Showcase lighting has scarcely kept pace with window lighting. But since the tendency is toward a greater use of showcases, undoubtedly more thought will be given to this lighting field. Possibly the best solution today is the small mirrored-glass reflector for use with low-wattage lamps.

LIGHTING, STREET.—See Street lighting, development and status of.

LIGHTING STUDIOS CO.—220 W. 42nd St., New York, N. Y. Manufacturer of commercial lighting units. President and treasurer, James T. Robb; secretary, W. E. Jerome.

LIGHTING SYSTEMS, CAR.—See Car lighting equipment, railways, complete.

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LIGHTING UNIT.—A combination of lamp, socket and reflector with the necessary diffuser or globe and means for holding the parts together as a unit. Such a combination, when manufactured and sold as a complete assembled combination, is usually referred to commercially as a lighting unit. If the lamp is of the incandescent type, it is often not sold with the unit. The common distinction between lighting unit and lighting fixture is that the former usually does not include the stem, chain or other supporting means, but does include the glassware; a fixture invariably includes the supporting means, but may or may not include the illuminating glassware.

LIGHTING UNITS, OFFICE, STORE AND SIMILAR COMMERCIAL TYPES.—These units generally include the lamp and reflecting equipment of the fixture only. They are usually made of opal or other heavy diffusing and reflecting glassware. One type is made up in two pieces; the upper piece is a pan-shaped piece of glassware placed above the lamp and from the upper piece is suspended a bowl of smaller diameter than the upper piece. The bowl protects the eye from a view of the lamp and reflects a large part of the light upward to the upper plate which in turn reflects a large part of the light downward and in effect produces a semi-indirect lighting unit. Another type is very similar in principle but instead of suspending the bowl it is connected by clear glass to the top piece so as to form a one-piece unit. There are numerous other types. In many cases these units are designed to facilitate cleaning of the glassware and in some designs the interior of the unit is practically sealed so as to exclude dust, thus requiring wiping of the exterior only.

Manufacturers:

Ainsworth, George, New Liggett Bldg., New York, N. Y. "Archer."

Art Metal Mfg. Co., The, Cleveland, Ohio. "Illuminent," "Snapon," "Amco."

Bauman & Loeb, Inc., 138 Bowery, New York, N. Y. "B. & L."

BEARDSLEE CHANDELIER MFG. CO., 216-220 So. Jefferson St., Chicago. Manufacturers of the "Denzar" lighting unit, scientifically designed for use with the powerful Mazda "C" lamp. Carries reflector shaped to give the proper distribution of light and allows sufficient light to filter through to the



"Denzar" Lighting Unit

ceiling so as to avoid shadows or streaks. The upper portion of the bowl is clear glass, permitting the greater portion of the light to be thrown upward to the reflector and be redirected from there to the working plane where it is needed. This portion of clear glass also prevents the accumulation of dust and dirt in the bowl and makes the "Denzar" practically a dust-, dirt- and bugproof unit. The lower part of the bowl is finished with a hard smooth white translucent enamel of good diffusing quality, completely concealing the filament and eliminating all glare. We also manufacture a complete line of direct, indirect and semi-direct lighting units; also a complete line of lighting fixtures, brackets, etc., to meet all conditions.—Adv.

Commercial Excelite Co., Inc., 312 N. Eutaw St., Baltimore, Md. "Excelite."

Consolidated Lamp & Glass Co., Coraopolis, Pa. "Amelite," "Cora."

Crescent Brass Products Co., The, 8410 Lake Ave., Cleveland, Ohio. "New Era."

Egan & Egan, 21 E. 40th St., New York, N. Y. "Ray-O-Day."

Empire Lighting Fixture Co., 224 Centre St., New York, N. Y. "Hexalite, Jr."

First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio. "Perfeclite."

Frankel Light Co., 5016 Woodlawn Ave., Cleveland, Ohio. "Frankelite," "Simplex."

General Gas Light Co., Kalamazoo, Mich. "Radio 30."

Giese Art Metal Work, 4414 Germantown Ave., Philadelphia, Pa. "Bryterlyte."

Gillinder Bros., Port Jervis, N. Y.

HOLOPHANE GLASS CO., INC., 340 Madison Ave., New York, N. Y. "Apollo."

KING MFG. CO., THE, St. Joseph, Mo. "Ve-Lu-So," "Rite-Lite." (See display adv. page 1257.)

Lighting Studios Co., 220 W. 42nd St., New York, N. Y. "Lsco," "Studio Lite." "Doric Lite."

LIGHTOLIER CO., 569-71 Broadway, New York, N. Y. "Excelite." "16-21."

Luminous Specialty Co., 236-238 S. Meridian St., Indianapolis, Ind. "Eye Shield Diffuser." "Day-Glow."

Manhattan Distributing Co., Transportation Bldg., Chicago, Ill. "Broadway Radiant."

Mitchell Vance Co. 507 W. 24th St., New York, N. Y. "T. R. B."

MORAN & HASTINGS MFG. CO., 16-18 W. Washington St., Chicago, Ill. "Raymo."

National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill. "National A," "Nefcolite."

Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa. "Magian." "Daylight Competitor."

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash. "Perfeclite."

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Pittsburgh Lamp, Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Four-In-One."

Standard Light Co., 448 E. Water St., Milwaukee, Wis. "Everlast Stanlico."

Wagner-Woodruff Co., 830 S. Olive St., Los Angeles, Cal. "Briterlite," "Miralux," "Argolux."

Wardell Lighting Co., Detroit, Mich. "EnameLight."

LIGHTING SETS, CHRISTMAS TREE.—See Christmas tree lighting outfits, complete; also see Lamps, incandescent, decorative and tree.

LIGHTING UNITS, ORNAMENTAL STREET.—These are units generally designed to be used on top of ornamental posts for street lighting, but in some types may also be used for suspension or bracket mounting. They consist essentially of a casing which fits the top of the column in the post type, forming both the capital and the globe holder; a socket which is also supported by this casing, and the globe or lantern. In some cases for series street lighting a compensator or reactance coil is also included in the casing. The globes are used chiefly to diffuse the light and often also to redirect the light to useful planes so that it will illuminate the sidewalks and roadway more uniformly. Globes with metal trimmings and cappings or ventilators are often used and some of these may be designed to give a lantern effect. When a metal capping is used a metal reflector is generally employed with it and this effectively redirects the light passing above the horizontal to useful planes.

There are several types of ornamental lighting units made. They differ chiefly in the globe or lantern shape and size and in the trimming. The simplest form of globe is a spherical one with no ventilation. This is widely used but permits much of the light to be wasted above the horizontal plane. The lantern type is used quite extensively and is made in a number of styles with either flat or curved panels. There are other types of units which are interchangeable for post and suspension mounting, the unit being supported by two ornamental arms for post mounting. Many units include special refractors and diffusing globes.

The single-lamp units have superseded practically all of the cluster types in new installations both because of the higher efficiency of the larger lamp used and the lower first cost obtained by dispensing with several bracket arms, globes, sockets and lamps. Where the initial investment must be kept low, standard designs of single-lamp units should be used. If the initial cost is not so limited or if unusual or distinctive effects are desired, special designs can be developed to advantage and these may provide exceptionally pleasing illumination as well as attractive general appearance.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv., pages 1231-1234.)

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Chicago Concrete Post Co., 608 S. Dearborn St., Chicago, Ill.

Duplex Storage Battery Co., Beaver Dam, Wis.

Flour City Ornamental Iron Co., 27th St. and 28th Ave., S., Minneapolis, Minn.

GENERAL ELECTRIC CO., Schenectady, N. Y. "Novalux" Ornamental Units are highly ornate and built to accommodate the Mazda lamp. With these lamps available in high candle powers, the single-light units have replaced clusters, giving the following advantages: More graceful and permit more artistic treatment; save 10% in power cost; light building fronts to a 50% higher intensity; initial cost lower; saving in maintenance for lamp renewals and labor; adaptable to all conditions of light distribution. (Bulletin 43503-B.) For general information on G-E service in exterior lighting see page 1209.—Adv.



Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv., page 1278.)

Massey Concrete Products Corp., 122 S. Michigan Ave., Chicago, Ill.

McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity."

Northwood Co., H., 36th & Wetzel Sts., Wheeling, W. Va. (Glass.) "Luna."

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y. "D-Light", "Illuminator."

LIGHTING UNITS, YARD, DOCK, ETC.—The effective lighting of railroad, industrial, power plant and similar yards is necessary for safety and protection as well as to permit economical night work. Flood lighting is now much used for this purpose, projector units being used; for these see Projectors, floodlight. In many cases such projectors are not so suitable and other units are used in their stead. Among these are dome type, radially fluted or wave type, and angle type reflector units, the reflectors being preferably of porcelain-enameled steel; units using prismatic glass refractors to give wide lateral distribution are also used. In all cases the units are mounted quite high, either on poles with crooks or brackets attached to buildings, the latter being especially true of angle reflectors.

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In some cases streethood units are placed on pole brackets or suspended by span wires over areas to be lighted if poles can not be set close by. Units of the dome reflector or prismatic refractor types have the advantage of giving relatively little glare compared with flood lights, angle reflectors or the other types mentioned.

On docks, piers and wharves similar lighting units may be used but they are better protected because of excessive moisture present. Along bodies of salt water special water-tight enclosures are usually employed and all metal parts exposed are either porcelain-enameled or protected with special paint. Cluster units have been used somewhat but are being superseded by single-lamp units because of their lower first cost and higher efficiency.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Lighting Units include many types of weatherproof reflector fixtures with and without weatherproof supporting fittings designed to meet all conditions of outdoor lighting. Among them is the Benjamin elliptical angle reflector socket, which because of its special shape is specifically adapted to the lighting of both large and small areas from the side where conditions do not permit hanging fixtures overhead. The reflector is seamless porcelain enameled steel, black outside, white inside, and includes a porcelain two-piece easy-to-wire receptacle with lamp grip and a heavy suspension fitting which makes rigid support possible. The elliptical angle reflector is particularly useful in lighting yards, docks, playgrounds, tennis courts, driveways and other areas where light must come from the side.—Adv.



Elliptical Angle Reflector

Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."

GENERAL ELECTRIC CO., Schenectady, N. Y. Flood lighting projectors extensively used for these and many other similar purposes. For general description see "Projectors, Flood Lighting," or send for Bulletin 43850-B for detailed information. See adv. pages 1203-1223.—Adv.

Gillinder & Sons., Inc., Tacony St., Philadelphia, Pa.

Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."

Hickey & Schneider, Inc., 434-43 S. Jersey St., Elizabeth, N. J. "H & S".

Hommel & Co., Ludwig, 530-534 Fernando St., Pittsburgh, Pa. "Hommel-Lite."

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv., pages 1266-1269.)

McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity."

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Projectors, floodlight. Also adv. page 1405.

Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Rex-Lite."

Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.

REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill. "Flood-O-Lite."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LIGHTNING.—The flash produced by the discharge of atmospheric electricity is commonly known as lightning. About the middle of the 18th century, Benjamin Franklin and others demonstrated that the lightning of a thunderstorm and the discharge of an ordinary electric machine were identical in nature. There is a difference, however, in that the charge on a cloud is irregularly distributed while that on laboratory instruments is generally uniform. Franklin's historic experiment, performed in June, 1752, was the first definite proof of this relationship. During a thunderstorm he flew a kite, which was made of a silk handkerchief with an iron wire extension to the frame, and he succeeded in conducting sufficient electricity down the hemp string to charge a Leyden jar.

The theory of lightning advanced as a result of this and other experiments was that it was a spark discharge from cloud to cloud or from cloud to ground, just as an electrically charged condenser discharging to ground. Recent calculations of the energy that would be required for such a discharge and that actually occurring, estimated from the effects produced, do not indicate that this condition is true.

A recent theory holds that lightning is an internal readjustment of the electrica stresses within a cloud or an equalization of potential differences. The moisture particles in the clouds are given their charges by moving in an electrostatic field, probably produced by the negative electrons which are constantly given off by the sun. In this manner each particle is given a charge corresponding to its position in the field. The value of this charge increases as the distance from the earth increases at the rate of about 100 volts per yard.

The potential of rain drops will be greater than that of the individual particles and may be increased in either of two ways—by the union of similarly charged drops into larger ones, or by evaporation of drops. The first method is probably more common as the particles formed are too small to fall as raindrops until they gradually conglomerate into a large drop. The capacitance of a drop is directly proportional to the surface, and therefore to the radius, and the charge is proportional to the volume, hence to the radius cubed. The potential of the drops is the charge divided by the capacitance and is therefore proportional to the radius squared, and as the size of the drop increases the potential increases very rapidly. In the second method, after the drops have formed in this manner they start to fall toward the earth and meet the heated air ascending. This causes partial evaporation to take place but the charge on the drop remains the same. This reduces the capacitance of the drop and for the charge to remain constant the potential must increase.

The older theory of a discharge holds that a cloud consists of a lower portion that is a heavily charged positive layer, and the upper portion a highly charged negative layer. When the potential difference is great enough a discharge will occur either from the lower layer to the upper from the lower layer to the upper layer of an adjacent cloud, or from the lower layer to ground. Laboratory apparatus shows that before a discharge can take place freely the atmosphere must be ionized, and this is accomplished by a small initial discharge losing itself in a brush discharge rapidly followed by another, etc., until the air is sufficiently ionized to permit a free flow.

According to the more recent theory, that of the equalization of potential differences within the cloud, it is held that the cloud, not being uniform in cross-section, will have large potential differences between points in the cloud fairly close together. When this potential gradient becomes too steep a small local discharge occurs between the points and equalizes their potentials. This produces a new potential difference between the equalizing-arc voltage and the points immediately adjacent to the arc extremities and, since the air is ionized and an arc is flowing, only small voltage is required to maintain the flow. The arc therefore continues to spread, overcoming the potential differences at its extremities until the potential of a large portion or perhaps the entire cloud is equalized. In this manner a potential of 30 million volts will maintain an arc two miles long. The duration of a discharge is estimated at from 0.0002 second for a single flash to one second for a multiple flash consisting of a series of sequent discharges.

Several forms of lightning are seen in electrical storms and the principal forms are commonly called streak, rocket, ball, sheet and beaded lightning. Streak lightning is by far the most common. This is probably due to the fact that atmospheric conditions at times form practically continuous sheets and streams of water at high potential and also streaks and layers of highly ionized air, both of which are conductors, therefore the lightning discharge appears as a long streak. Rocket lightning is a progressive growth in the length of a streak appearing so slow as to suggest the flight of a rocket. Ball lightning is very often merely an optical illusion as it consists of a brush discharge which may be fixed or roving. Sheet lightning is usually only the reflection from the body of the cloud of streak lightning in invisible portions. Beaded lightning, or streaks broken up into more or less evenly spaced dashes, is an end-on view of the irregular portions of the path, i. e., its branches.

Heat lightning differs from ordinary lightning in that it occurs when there is no storm or shower, that is, when no rain falls. The moisture particles are charged in a simialr manner to those causing ordinary lightning and as they increase in size they come closer to the earth. The heated air from the earth, which during the day has been warmed greatly, is traveling upwards, and, coming into contact with the drops, causes partial evaporation. This process continues until the voltage built up is sufficient to start a discharge.

It is an interesting fact to note that lightning troubles on transmission lines seem to increase with the voltage of the line up to certain limits. This is probably related to the line voltage only in that the higher-voltage circuits extend farther and into more open country than low-voltage circuits and for this reason are more likely to pick up induced lightning voltages. Lines from 30,000 to 50,000 volts seem to have the maximum amount of lightning trouble. Circuits of 100,000 volts and over are practically immune from trouble. This is probably due to the degree of insulation used for these lines. The insulators used will have a flash-over voltage of from one-half million to one million volts, indicating that the lightning voltages induced on the lines are less than this value.

It is very rarely that a direct stroke of lightning hits a line, the voltage surge produced being merely induced by a discharge somewhere near the line. The discharge voltage may be 100 times as large as the induced voltage or from 50 to 100 million volts. This value would cause a spark to jump only 50 to 100 yards, and as discharges are frequently several miles long, the voltage would have to be so enormously high as to eliminate the possibility of it ever being a mere spark discharge as originally believed.

Figures obtained by assuming the discharge to be from a cloud to ground, determined from the capacitance of a cloud one-half square mile in area and one-half mile high, show that it would require a voltage of one billion volts and the current would be 5,000,000 amperes. This would be 7 billion foot-pounds of energy or equivalent to dropping 1000 tons from the cloud one-half mile high. The effects of direct strokes of lightning do not indicate these values of energy. The energy actually dissipated in a discharge may be computed from a comparison of the damage done by lightning and that on transmission lines during short-circuits where the values are known, also by the illumination produced, and by the volume of the cloud and the diameter of the resulting flash; all these calculations seem to indicate about 20 million foot-pounds of energy. This is equivalent to dropping one ton from a height of one-half a mile.

LIGHTNING.—Trade name for motor-driven routing and sanding machines manufactured by the J. A. Fay & Egan Co., 705-755 W. Front St., Cincinnati, Ohio.

LIGHTNING.—Trade name for die stocks, threading dies and screw plates manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

LIGHTNING.—Trade name for speed indicators manufactured by the McDonnell Odometer Co., 3501-03 S. Kedzie Ave., Chicago, Ill.

LIGHTNING ARRESTER.—A device to protect electric circuits and equipment from destruction or damage by lightning. It "arrests" the progress of the lightning discharge along the circuit by diverting it to the ground. For application and types see Arresters, lightning.

LIGHTNING PROTECTION.—This subject naturally falls into two main divisions: protection of buildings, especially those outside the cities, and protection of exposed electrical circuits and equipment. Farm houses and barns, especially if standing on an elevation of ground, and buildings like churches, having tall steeples or towers, are particularly apt to be struck by lightning and should be protected by properly designed and carefully installed lightning rods. (See Rods, lightning.) Tall brick or concrete chimneys also need protection, but for the most part city buildings, including those like central stations, used for housing electrical equipment, are very rarely struck. This is perhaps due to the large number of points extending into the air in the city, these permitting a more general and rapid dissipation of the charges due to low passing clouds than is possible with scattered or isolated buildings as in the country.

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The extent to which modern distribution systems have been spread over wide and varied territories renders them particularly subject to atmospheric electrical disturbances. If suitable protection were not provided, lightning discharges striking the wires would follow them into buildings, causing damage to transformers, generators and motors by puncturing insulation and burning them out, also possibly causing injury to persons or setting fire to the building.

For signal circuits, such as telegraph and telephone lines, the lightning protector or arrester usually consists of blocks of carbon, one connected to the line, the other to the ground, the two being spaced apart by a thin sheet of mica, which sometimes has a hole punched in it. The excessive rise in potential caused by the lightning striking the line causes a flash over to ground at this point, usually clearing the line without damage to the equipment.

Power and lighting systems require something more elaborate and are usually protected by a combination of choke coil and lightning arrester, the latter offering a path to ground. A lightning discharge is of very high frequency and consequently produces a powerful inductive effect. The choke coil, consisting of a limited number of turns of heavy wire, will offer very little impedance to the normal current but will form a practically impassable barrier to the high-frequency lightning discharge, which is deflected to the earth through the arrester, thus protecting the apparatus beyond the choke coil. On low-voltage lines and equipment the arrester is of fairly simple construction, as is true on street cars, to prevent the motors or other car equipment from being injured should lightning, as sometimes happens, strike the trolley wire. For the high-voltage transmission lines, however, and for the protection of substations much more elaborate equipment, is required. It is usual to mount this apparatus, together with the disconnecting switches, at a high point outdoors or at a location in the station well protected from accidental contact. For the classified types and manufacturers of arresters see Arresters, lightning.

LIGHTNING RODS.—See Rods, lightning.

LIGHTOLIER.—Trade name for lighting fixtures and portable lamps manufactured by the Lightolier Co., 569-71 Broadway, New York, N. Y.

LIGHTOLIER CO.—569-71 Broadway, New York, N. Y. Manufacturer of lighting fixtures, fixture fittings and parts and portable lamps. President, B. Blitzer; vice-president and general manager, M. D. Blitzer; secretary and treasurer, Charles A. Gottesman; sales manager, Max Blitzer.

LIGHTS.—A term used loosely to refer to any lamps or light sources, as in "turn on the lights." Also used to refer to certain particular lamps or units, as cargo lights, porch lights; in many cases used in compound or composite names of lighting units, as headlights, searchlights, floodlights. In technical lighting practice the word lights is seldom used because it is not sufficiently specific; but in the trade it is still widely used.

LIGHTS, AISLE AND STEP.—Motion-picture, continuous vaudeville and other theaters find a need for illuminating the aisles so that their patrons may find their way to seats safely and readily when the house is darkened. This is done by mounting small special fixtures along the aisles and beneath the seats. These fixtures are designed to confine the light to within a few feet of the floor, illuminating the floor without in any way detracting from the effect of the darkened house. Stair lights are similar, but slightly larger and are mounted or recessed at the sides of the stairway, usually at the top and bottom landings only. They are generally used in railway stations, theaters and other public buildings where the large number of people using the stairs would make accidents frequent if some such safety measure were not taken.

Manufacturers:

Argus Enterprises, Inc., The, 815-823 Prospect Ave., Cleveland, Ohio. "Argus Aisle-Lite."
Brookins Co., The, 1741 Euclid Ave., Cleveland, Ohio. "Aislelite."
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Cesco."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

LIGHTS, BOILER AND GAGE.—One type of gage light is intended for housing the lamps which illuminate the various gages, the water glass and lubricator installed in the cab of steam locomotives. These lights consist of a small cast iron housing, inclosing receptacle for the lamp, with openings for directing the light upon the glass or gage to be illuminated. They are also used to illuminate air gages and electrical instruments in electric locomotives, electric railway cars, etc. Other types used more commonly in central-station boiler and turbine rooms are box-like housings with an opal glass plate through which an evenly diffused light is cast upon the gage or glass, and more simple types using a lamp mounted on a bracket and equipped with a reflector.

Manufacturers:

CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."
National Co., Cambridge 39, Boston, Mass.

LIGHTS, BRIDGE SIGNAL.—These lights are used on draw or lift bridges; they usually are high-powered red lanterns or special illuminated signs bearing the words "stop", "danger" or similar legends on a plate of red glass set up conspicuously at the abutments. They are used as warnings to traffic when the bridge is open to prevent vehicles from plunging into the channel at the open bridge. In addition large lamps are placed at the top of draw bridges; these have red lenses showing at right angles to the bridge and green lenses in the direction of the bridge; turning with the bridge, they show the danger signal along the stream while the bridge is closed and along the street, highway or railroad when the bridge is open. For lift bridges these red lamps are placed at the end of the leaf or leaves that are swung upward.

Manufacturers:

Marin Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
National Marine Lamp Co., The, Forestville, Conn.
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

LIGHTS, CABIN.—See Fixtures, lighting, marine, water-tight and vaporproof.

LIGHTS, CARGO.—Lights mounted in cargo spaces are subjected to hard usage and exposure. They are therefore, usually steam-tight guarded fixtures of heavy metal that will withstand the effects of exposure to moist salty air and water. Where the lights are permanently installed they are usually of two sizes, one 50-watt or smaller and the other 100-watt or smaller, and they are placed close to the ceiling so as to be out of the way. In many cases lighting is required in the cargo spaces only at certain times, such as when loading and unloading, and under special conditions. Ocean-going vessels usually have outlets for large portable cargo lights located near the hatchways. These are removed when the ship is under way.

Manufacturers:

American-LaFrance Fire Engine Co., Elmira, N. Y. "LaFrance."
Arnessen Electric Co., 109 Broad St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. For work done in the dark cargo holds of ships or at night around piers and docks the Benjamin cargo light will furnish the right sort of illumination. It is a sturdy portable lighting fixture intended to be suspended in mid-air from which it is possible to easily direct the light upon any part or all of the work. A strong wire guard prevents damage to the lamps.—Adv.



Benjamin Cargo Light

Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Morse, Frank W., 289 Congress St., Boston, Mass.
National Marine Lamp Co., The, Forestville, Conn.
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Porter Co., The, 241 Water St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

LIGHTS, DRESSER.—See Lamps, clamp, bed or dresser; Lamps, boudoir.

LIGHTS, NAVIGATING AND OTHER MARINE, ELECTRIC OR COMBINATION.—All vessels are required by law to carry at night certain lights, the requirements depending on the size of the boat. Navigating lights, as these lights are called, are made up with Fresnel lenses of the various colors required. For the smaller boats these lights are sometimes combined so that one light may replace two or three lights by using different colored glass sections in the light, one color only being visible within the required angles. For reliability the lights may be made combination oil and electric. The larger vessels connect the lamps to a telltale indicator located in the pilot house. This indicator should give both an audible and visual signal when a running light has failed. The combination lights or straight electric lights should permit of rapidly transferring the spare lamp in case of the failure of the one normally used. The laws giving the requirements of running, anchor, and towing lights may be obtained from the Bureau of Navigation, Department of Commerce. Beside the regularly required lights, special electric lights, particularly for signaling, are often used on larger vessels.

Manufacturer:

National Marine Lamp Co., The, Forestville, Conn. ("Champion" side and bow lights, "Dainty" sailing lights.)

LIGHTS, PHONOGRAPH.—Many phonographs are located in the corner of a room where the light is poor and it is very difficult to see clearly enough to set the needle properly upon the record and to set the stop mechanism at the proper point. To provide proper illumination on the record face to overcome these difficulties a small lamp is sometimes mounted beside the revolving table. The lamp is usually controlled by an automatic switch so that lifting and closing the cabinet top turns the light on and off. The lamp may be a battery lamp operated from a small dry battery that may be concealed in the cabinet, or, if the phonograph is operated by an electric motor, the lamp may be a small 110-volt lamp connected to the standard lighting circuit.

Manufacturers:

Cleveland Phon-Arm Co., The, 1265 W. 2nd St., Cleveland, Ohio.
Electric Phonograph Corp., 4132 Park Ave., New York, N. Y. "Phonolamp."
Gelb Co., Joseph, 517 W. 36th St., New York, N. Y.
Interstate Music Corp., Milwaukee, Wis.
Lakeside Supply Co., 416 S. Dearborn St., Chicago, Ill.
Metropolitan Electric Mfg. Co., East Ave. and 14th St., Long Island City, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."
Standard Accessory Corp., 355-357 E. Water St., Milwaukee, Wis. "Record-Flasher."
Stuart Products Corp., 665 Washington Blvd., Chicago, Ill. "Fonolier."

LIGHTS, PORCH.—Porch lights are usually substantially built and equipped with enclosing glassware to make them to some extent weatherproof. The fixtures are made in various styles, the more common types being a simple band or ring with receptacle and shade or globe holder and enclosing glass ball or globe; an iron lantern type is also much used, this often being equipped with stippled or ribbed glassware.

Manufacturers:

Beacon Mfg. & Sales Co., Inc., Freeport, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."
Eastern Brass Works, 22-123 Thirteenth Ave., Newark, N. J.
Faries Mfg. Co., Decatur, Ill.
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Highlands Mfg. Co., Muncie, Ind.
Morse, Frank W., 289 Congress St., Boston, Mass.
Novelty Lamp & Shade Co., 2480 E. 22nd St., Cleveland, Ohio.
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.

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Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polly Mfg. Co., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."

LIGHTS, SEWING-MACHINE.—Sewing-machine lights are used to throw a circle of light directly on the work under the needle. In the larger shops the machines are often set in long tables, end to end, in double rows and the lights supported from arms fastened to a conduit over the middle of the double row and running the length of the table. The lights with the reflectors should be mounted below the level of the operators' eyes and so arranged that the light will not strike the eyes of the operator opposite. Adjustable arms are sometimes used, but are objectionable unless arranged so that it is impossible to set the light so that the rays shall strike the eye of any of the operators. Individual machine lights are needed only where sewing is done on very dark clothes. For work on light materials abundant illumination can be easily secured by a well planned system of general lighting.

Manufacturers:

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The Benjamin sewing machine reflector illustrated at the left is recommended for use with power sewing machines. By means of this reflector, light is directed to the working plane where it is needed. Usually it is best used by attaching it to a Benjamin angle socket which in turn is supported by a ⅜ in. conduit that is held in a horizontal position by whatever supporting fixture the particular conditions necessitate.—Adv.



Faries Mfg. Co., Decatur, Ill.
Goldman Sav-a-Lite Co., 111 W. 23rd St., New York, N. Y. "Sav-a-Lite."
Hinsdill Electric Co., 225 River St., Troy, N. Y. "Hinsdill."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv., pages 1266-1269.)
LOCALIZED LIGHTING CORP., 540 W. 58th St., New York, N. Y. "Anderson." (See display adv., page 1275.)
Morse, Frank W., 289 Congress St., Boston, Mass.
Polly Mfg. Co., Milwaukee, Wis.

LIGHTS, STAGE, MISCELLANEOUS.—Special forms of lighting fixtures or equipment used for obtaining theatrical effects, such as colored illumination and special or spectacular imitations of natural lighting and lightning, are often employed on the stage. The equipment may include clusters or strips of incandescent lamps, or arc lamps arranged singly or in batteries in concealed locations and provided with color screens or permanently colored lamp bulbs or lenses. The standard stage lighting equipment is listed separately under borders, bunches, clusters, footlights, spotlights and strips.

Manufacturers:

Chicago Stage Lighting Co., 112 N. La Salle St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Fundamental requirements in stage lighting are met by "X-Ray" border lights, bunches, clusters, footlights, strips, etc. See classifications. Also adv. page 1405.—Adv.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Strachan, Inc., R. & H., 395 Fulton St., Brooklyn, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York.

LILLIE.—Trade name for power plant evaporators manufactured by the Wheeler Condenser & Engineering Co., Carteret, N. J.

LILLIE CO., DEXTER P.—Indian Orchard, Mass. Manufacturer of cotton wiping waste. President and treasurer, D. P. Lillie; secretary, L. H. Baker.

LILLIPUT.—Trade name for electric blasting equipment manufactured by the Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

LILLIPUT.—Trade name for portable arc lamp manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

LILY BRAND.—Trade name for tapes manufactured by F. C. Barton, 65 Worth St., New York, N. Y.

LIMIT GAGE.—Limit gages are used extensively in adjusting and inspecting electrical apparatus. They are usually double-ended gages. For external measurements of short distances they are marked "go on" at one end and "not go on" at the other. For internal measurements one end will "go in" and the other end will "not go in." They are made with certain limits over and under the standard measurement and all parts passing inspection must be within these limits. Micrometer gages are sometimes used as limit gages for very accurate measurements. See Gages, micrometer.

LIMIT SWITCH.—A switch used on elevators, cranes, hoists, etc., and automatically operated by the car or moving element to open the circuit when the limit of travel has been reached. See Switches, limit, elevator, crane and hoist.

LIMO-SEDAN.—Trade name for battery fan manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

LINCOLN.—Trade name for demand meters manufactured by the Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.

LINCOLN.—Trade name for storage batteries for automobile ignition and lighting manufactured by the Hinsdill Electric Co., 225 River St., Troy, N. Y.

LINCOLN.—Trade name for lighting fixtures and parts manufactured by the Lincoln Mfg. Co., 716 Erskine St., Detroit, Mich.

LINCOLN BRASS WORKS.—2067 12th St., Detroit, Mich. Manufacturers of washing machine drains.

LINCOLN ELECTRIC CO., THE.—Cleveland, Ohio. Manufacturer of motors and electric arc cutters. President and treasurer, J. C. Lincoln; vice-president, J. F. Lincoln; secretary, J. W. Meriam. Main office, E. 38th St. and Kelley Ave., Cleveland, Ohio. Branch offices, 53 W. Jackson Blvd., Chicago, Ill.; Baltimore, Md.; Boston, Mass.; Buffalo, N. Y.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Hartford, Conn.; Detroit, Mich.; Minneapolis, Minn.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Syracuse, N. Y.; Toronto, Ont., Can.

LINCOLN MFG. CO.—716 Erskine St., Detroit, Mich. Manufacturer of lighting fixtures and parts. Business established 1919. President, R. S. Aspinwall; vice-president and sales manager, J. Kahen; secretary and treasurer, N. Silberstein.

LINCOLN METER CO., LTD.—243 College St., Toronto, Ont., Can. Manufacturer of demand meters. President, Paul M. Lincoln; vice-president, S. L. B. Lines.

LINDBLAD, K. F. M.—Boston, Mass. Manufacturer of adjustable lighting fixtures.

LINDCRAFT STUDIOS.—Jamaica Ave. and 125th St., Richmond Hill, N. Y. Manufacturers of lighting fixtures and portable electric lamps. Business established 1919. Paul Wilson, manager.

LINDHOLM METAL STAMPING CO., INC.—107-115 Erie St., Camden, N. J. Manufacturer of grease cups.

LINDSLEY BROS. CO.—Spokane, Wash. Producer of cedar poles and fir crossarms. Business established 1895. President, C. P. Lindsley; vice-president, E. A. Lindsley; secretary, L. J. Harman; manager, A. C. Yoder. Main office, Peyton Bldg., Spokane, Wash. Plants, Minneapolis, Minn.; Priest River, Idaho; Sand Point, Idaho; Nakusp, B. C., Can. Branch offices: St. Louis, Mo.; Pittsburgh, Pa.; Winnipeg, Man., Montreal, Que., Can. General sales agents: Joslyn Mfg. & Supply Co., Chamber of Commerce Bldg., Chicago, Ill.

LINDSTROM, SMITH CO.—Chicago, Ill. Manufacturer of electric household appliances. Business established 1906. President and treasurer, C. O. Lindstrom; secretary, Charles Endorf, Jr. Main office and factory, 3212-3238 W. Lake St., Chicago, Ill. Branch office and warehouse, 41 Union Sq., New York, N. Y.

LINE-A-TIME MFG. CO., INC.—Rochester, N. Y. Manufacturer of illuminated copy holders.

LINE-CONNECTING POLE, TROLLEY, FOR PORTABLE TOOLS AND LAMPS.—In work on electric railway track the drills, grinders and other tools used are frequently driven by electric current taken from the source supplying power to the cars. When this source is an overhead trolley it is necessary to have some quick and easy means of connecting to it without interfering with the operation of the cars. One of the most common forms used is a wooden pole with a heavy copper hook on one end which may be hooked over the trolley easily and as easily removed on the approach of the car. A thoroughly insulated wire connects the bare copper hook at the top with the lower end of the pole where a connection is made with the terminals of the machine to be operated. The same outfit is used to connect clusters of lamps needed to facilitate night work on crossings, curves, etc. The other side of the tool or lamp circuit is connected to the track.

LINE CONSTRUCTION, ELECTRIC RAILWAY OVERHEAD.—See Overhead line construction of electric railways.

LINE-DROP COMPENSATOR. — See Compensators, line-drop.

LINE MATERIAL CO.—South Milwaukee, Wis. Manufacturer of pole-line hardware, guy anchors, lightning arresters, etc. Business established 1911. President, F. L. Sivyer; vice-president and sales manager, L. E. Hendee; secretary, J. C. Stuessi; treasurer and general manager, W. D. Kyle. Branch offices, 93 State St., Albany, N. Y.; 207 I. W. Hellman Bldg., Los Angeles, Cal.

LINE TROUBLES, TELEPHONE.—A few of the more common trouble conditions on telephone lines are defined below.

Crossed. Wires of different lines connected, usually producing cross-talk.

Dead Ground. Zero resistance leak, or nearly zero, to ground.

Grounded. An unduly large leakage to ground.

Noisy Line. Caused by some unbalanced condition and by the presence of a disturber.

Short-Circuited or Shorted. A leak between wires of a circuit severe enough to interfere with working it.

Solid or Permanent. This means that the trouble stays on.

Swinging. This means that the trouble is intermittent, like the swinging of a wire.

LINEMEN PROTECTOR CO.—850 Penobscot Bldg., Detroit, Mich. Manufacturer of linemen's protective equipment. Business established (about 1910). Factory, Akron, Ohio.

LINEMEN'S BAGS, BELTS, BLOCKS, BOOTS, CARTS, CLAMPS, CLIMBERS, GLOVES, KNIVES, PLIERS, PROTECTORS, SHIELDS, STAGES, STRAPS, VISES, WRENCHES.—See these respective items.

LINEN TAPE.—See Tape, linen.

LINES OF FORCE OR OF MAGNETIC INDUCTION.—In any magnetic field, such as that produced by a magnet or by a wire or coil in which a current is flowing, the magnetic force or induction manifests itself in definite directions popularly called "lines of force." The presence and shape of these lines of force or of magnetic induction can be demonstrated by placing a sheet of paper over the magnet and sprinkling fine iron filings on it which will arrange themselves in regular curves between the poles and indicate the direction of the magnetic induction and by their density or relative number in different positions of the field the magnetic flux density or the intensity of the field at these places.

LINES, TELEPHONE. — Telephone lines are divided into a number of classes. One method of classifying is according to the method of construction, which gives three classes, aerial, open wire, and underground. The aerial line is any telephone line which is carried overhead, usually on poles. It may be aerial cable or open wire line. The open wire line is carried on insulators on poles. The wire is usually bare. Underground telephone lines are almost always in lead-covered underground cable and are carried underground in conduits.

There are also a number of other classifications of lines depending upon their purpose, associated apparatus, length, class of service given, etc. These are listed below.

Artificial Line. An assembly of resistances, condensers, and inductances arranged to duplicate with more or less fidelity the conditions of an actual line. These properties are usually uniformly distributed in the actual line, but lumped at regular intervals in the artificial line.

Balanced Line or Circuit. Telephone lines suffer from electrical disturbances coming from outside causes. Most of them are eliminated if each wire of the pair bears the same relation to the disturber that the other bears. Each wire must have equal leakage, inductance, and capacitance to earth and to the source of disturbance, and equal conductor resist-

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ance. If a coil is connected from one wire to earth, it may be necessary to balance it by connecting an equal coil from the other wire to earth.

Drop Line. The wires which reach from the main line lead to the subscriber's building, usually one span.

Extension Line. A subscriber line in a private branch exchange.

Grounded Line. (a) A single-wire ground-return telephone line. (b) Any telephone line which is in trouble because of a ground or connection to earth.

Individual Line. A subscriber line in a public exchange which serves one telephone instrument of the subscriber, with perhaps an extension station.

Loading Line Section. Part of a telephone line as divided off for loading purposes.

Lock-Out Party Line. A party line whose instruments are arranged to prevent eavesdropping. All stations except the one in use are locked out of service as long as the connection lasts. It is seldom used, because it is not practical.

Long-Distance Line. A long-distance line is a toll line which connects the larger and more important centers and forms the network for the long-haul toll business.

Metallic-Circuit Line. A telephone line composed of two wires, as contrasted with a single-wire earth-return line.

Negative Line and Positive Line. The two line wires in the subscriber line in an automatic system. So named because normally these polarities of battery are on the wires.

Normal Lines. These are the lines leading from the connector banks to the incoming subscriber lines of an automatic system, usually at the jacks of the line switch. They are named negative normal and positive normal for the two talking wires, and private normal for the third wire which (like the sleeve wire in a manual system), protects the connection. The line normals get their names from the normal polarity of battery on them.

Order Wire or Call Circuit. In a multi-office manual system, the A operator needs to pass the call number to the B operator. It is usually done over an order wire (of two conductors). There is one order wire per B operator, though she may handle many trunks. The B operator assigns the trunk number over the order wire (tells the A operator which trunk to use).

Party Line. To save wire and outside plant, as well as switchboard space, several subscribers are placed on the same line. More than ten or twelve on one line cannot get even fair service, though cases are known in which as many as twenty were thus connected.

Private Line. A line connecting two or more telephone stations only, and not capable of being connected to the public system. It is useful for particular cases where secrecy is necessary, or where there is much business between certain stations.

Subscriber Line. A telephone line which connects a telephone instrument to the switchboard. The possessive form is now generally omitted.

Toll Line. A telephone line connecting two exchanges and for the use of which a toll or fee is charged.

Trunk Line. A telephone line which connects the parts of a telephone exchange, for example, two offices or two kinds of switches in the same office. There are the following kinds of trunk lines.

Outgoing Trunk Line. The end of a trunk line at the place where it receives traffic. This applies to a one-way trunk.

Incoming Trunk Line. The end of a one-way trunk line in the place to which it delivers traffic.

Two-Way Trunk. A trunk which may be used for calls in either direction. Most used between a main office and a PBX or a suboffice.

Tandem Trunk Line. A tandem trunk line is one which passes through an intermediate B board between the A board and the B board where it reaches the called line. It is used more in automatic systems.

LININGS FOR ELECTRIC FURNACES.—The intense heat developed in the electric furnace makes it necessary that the furnace be lined with material of special character capable of resisting the high temperature. The lining must in some process have special chemical characteristics as well. Some linings are applied in plastic form like a cement or mortar. In others the lining consists of special refractory bricks with joints cemented. Also see Refractories, electric furnace lining.

Manufacturer:

Betson Plastic Fire Brick Co., Inc., Rome, N. Y.

LININGS, SOCKET.—Tubular insulating linings assembled between socket interiors and the enclosing shells if the latter are of metal. These linings are made of fiber or some form of treated insulating paper. The lining is generally made in two pieces, one which fits within the cap, the other within the body of the socket. They serve to protect the current-carrying parts of the socket body or terminals from grounds and short-circuits through contact with the outer metal shell or cap.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Elastoid Fibre Co., The, Waltham, Mass.
Standard Fibre Co., 11 Miller St., Somerville, Mass.

LINK.—Trade name for electrically operated pianos manufactured by the Link Piano Co., Inc., 183 Water St., Binghamton, N. Y.

LINK-BELT.—Trade name for friction clutches, electric hoists, cranes and silent power transmission chains, manufactured by the Link-Belt Co., 329 W. 39th St., Chicago, Ill.

LINK-BELT CO.—Chicago, Ill. Manufacturer of power transmission, elevating and conveying machinery and accessories. Incorporated 1880. President and treasurer, Charles Piez; vice-presidents, Staunton B. Peck, Alfred Kauffman, A. C. Johnston; secretary, B. A. Gayman. Main office, 329 W. 39th St., Chicago, Ill. Factories, Philadelphia, Pa.; Chicago, Ill.; Indianapolis, Ind.; Toronto, Ont. Branch offices, 299 Broadway, New York, N. Y.; 49 Federal St., Boston, Mass.; 1501 Park Bldg., Pittsburgh, Pa.; Central National Bank Bldg., St. Louis, Mo.; 547 Ellicott Sq., Buffalo, N. Y.; 2nd National Bank Bldg., Wilkes-Barre, Pa.; Robson-Pritchard Bldg., Huntington, W. Va.; 429 Kirby Bldg., Cleveland, Ohio; 4210 Woodward Ave., Detroit, Mich.; 418 S. 3rd St., Minneapolis, Minn.; 306 Elmhurst Bldg., Kansas City, Mo.; 820 1st Ave., S., Seattle, Wash.; 1st and Stark Sts., Portland, Ore.; 168 2nd St., San Francisco, Cal.; 163 N. Los Angeles St., Los Angeles, Cal.; Canadian Link-Belt Co., Ltd., Toronto, Ont., Can. Sales representatives, S. L. Morrow, 720 Brown-Marx Bldg., Birmingham, Ala.; Lindrooth, Shubart & Co., Boston Bldg., Denver, Colo.; F. Wehle, Starks Bldg., Louisville, Ky.; C. O. Hinz, Hibernia Bank Bldg., New Orleans, La.

LINK KEY.—Trade name for fixture chain link tool manufactured by the Mayhew Tool Co., Williamstown, Pa.

LINK PIANO CO., INC.—183 Water St., Binghamton, N. Y. Manufacturer of electrically operated pianos. Business established 1916. President, E. A. Link.

LINKS, CONNECTING, FOR HEAVY CHAIN, ETC.—Repairs in heavy hoisting and other chains are often necessary in the field where forging equipment is not at hand. For making these repairs several forms of connecting links are made. Such links are usually made split, the two halves being fastened together by bolts, rivets or other simple mechanical means.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chain Products Co., The, 3924 Cooper Ave., Cleveland, Ohio.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

LINKS, PULL CHAIN INSULATING.—Due to the danger from accidental grounds through a person using the fixture in bath rooms, kitchens, and basements, pull chains for sockets in these fixtures are sometimes provided with an insulating section which forms a link in the chain and effectively insulates the accessible portion.

Manufacturers:

Harrigan, Thomas B., Woodstock, Va.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

LINKS, PULL CHAIN SPLICING.—These links are generally some form of bent brass clip fashioned to grip any ball of a pull socket chain. They are used for splicing to change the length of or to repair a broken chain.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Harrigan, Thomas B., Woodstock, Vt.
Hubbell, Inc., Harvey, Bridgeport, Conn.
McKenney & Waterbury Co., 181 Franklin St., Boston, Mass. "Malton."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

LINKS, REINFORCING, MESSENGER STRAND.—Reinforcing links are usually made of wrought iron bent into an open link with eyelets at the open ends. A bolt passed through the eyelets closes the link. They are used to take the strain off the messenger clamp at corners and turns in the line.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

LINOLAC.—Trade name for insulating varnish manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

LINOLITE.—Trade name for portable electric lamps manufactured by I. P. Frink, Inc., 239-43 10th Ave., New York, N. Y.

LINOTAPE.—Trade name for cordage manufactured by the John W. Gottschalk Mfg. Co., Lehigh Ave. and Mascher St., Philadelphia, Pa.

LINOTAPE.—Trade name for oiled tape manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

LINOTYPE POT HEATERS.—See Heaters, electric, linotype pot.

LINTERN.—Trade name for electromagnetic sander for overhead cranes manufactured by the Nichols-Lintern Co., 8464 Lorain Ave., Cleveland, Ohio.

LION.—Trade name for electric blasting apparatus manufactured by the Aetna Explosives Co., Inc., 120 Broadway, New York, N. Y.

LION.—Trade name for storage batteries and battery repair shop equipment manufactured by the Guaranteed Battery Co., 2017-2025 Lucas Ave., St. Louis, Mo.

LION.—Trade name for electrical tapes and sleevings manufactured by the Hoffman-Corr. Mfg. Co., 312 Market St., Philadelphia, Pa.

LION.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

LION.—Trade name for packing manufactured by the James Walker & Co., Ltd., 46 West St., New York, N. Y.

LION ELECTRICAL APPLIANCE CO., INC.—360 Morgan Ave., Brooklyn, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1919. President and treasurer, Max Schaffer; vice-president and secretary, O. Kupferman.

LIONEL CORP., THE.—48-52 E. 21st St., New York, N. Y. Manufacturer of transformers and electrical toys. Business established 1900. President, I. Lionel Cowen; treasurer, A. J. Scharps; sales manager, Mark Harris. Factory, Irvington, N. J.

LIONITE.—Trade name for aluminous abrasive manufactured by the General Abrasive Co., Inc., College Ave., Niagara Falls, N. Y.

LIPMAN REFRIGERATING WORKS.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric pumps and refrigerators. President, C. E. L. Lipman; secretary and treasurer, E. Lipman.

LIPMAN REFRIGERATOR CAR & MFG. CO.—Beloit, Wis. Manufacturer of electric refrigerating machines, air compressors and garage pumps. President, C. E. L. Lipman; secretary and treasurer, E. Lipman. Main office, Beloit, Wis. Factories, Beloit, Wis., South Beloit, Ill. Branch office, 228 Monadnock Block, Chicago, Ill.

LIPPINCOTT-CARWEN CORP. — Erie Ave. and Richmond St., Philadelphia, Pa. Manufacturer of armature winding machines and special machinery. President, Alfred H. Lippincott; vice-presidents, F. Hazard Lippincott and Charles H. Quimby; secretary, A. A. Cavanaugh.

LIPPINCOTT GLASS CO.—Alexandria, Ind. Manufacturer of arc lamp globes. President, W. J. Lippincott; vice-president, Philip Hinkle; secretary, J. T. Lippincott; treasurer, S. L. O'Bryant; general manager, H. N. McEwen.

LIQUID CARBONIC CO., THE.—Chicago, Ill. Manufacturer of oxyacetylene welding outfits and lead burning outfits. President, A. R. Brunker; vice-presidents, C. R. Bull, T. E. Brown, B. D. Baur; vice-president and secretary, W. K. McIntosh; treasurer, C. Y. Richmond; general sales manager, T. B. Harned, Jr. Main office and factory, 31st St. and Kedzie Ave., Chicago, Ill. Branch offices, New York, N. Y.; Boston, Mass.; Pittsburgh, Pa.; Cincinnati, Ohio; Milwaukee, Wis.; Philadelphia, Pa.; Minneapolis, Minn.; Atlanta, Ga.; St. Louis, Mo.; Kansas City, Mo.; Dallas, Tex.; Memphis, Tenn.; Toronto, Ont., Can.

LIQUID HEATERS, ELECTRIC. — See Heaters, water and liquid, miscellaneous.

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LISTER & CO. (CANADA), LTD., R. A.—Toronto, Ont., Can. Manufacturer of portable and farm lighting and power plants, internal combustion engines and generators. Business established 1867. President, George A. Lister; vice-president, secretary, treasurer and general manager, W. J. Ellis; sales manager, J. W. Jamieson. Main office, 58 Stewart St., Toronto, Ont., Can. Factory, Dursley, England. Branch office and warehouse, Wall St., Winnipeg, Man., Can.

LISTER-BRUSTON.—Trade name for automatic electric lighting and power plants made by R. A. Lister & Co. (Canada), Ltd., 58 Stewart St., Toronto, Ont.

LITE-ARM.—Trade name for clamp lamps manufactured by the Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill.

LITE-A-WHILE.—Trade name for switch manufactured by the Adsit Laboratories, 825 Hennepin Ave., Minneapolis, Minn.

LITEFINDER.—Trade name for radium beads, buttons and tacks for switches manufactured by the Lightfinder Sales Corp., Inc., 14 W. 17th St., New York, N. Y.

LITE UNIT.—Trade name for lighting fixtures manufactured by the Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.

LITER.—The metric unit of liquid volume. Abbreviated l.; 1 l.=1,000 cu. cm. = 1 cubic decimeter = 1.0566 quart (liquid).

LITSCHER LITE CORP.—1138-40 Monroe Ave., Grand Rapids, Mich. Manufacturer of farm lighting and power plants. President, C. J. Litscher; vice-president, F. V. Rowe; treasurer, D. A. Blodgett; secretary, H. J. Bennett; general manager, L. W. Heath; sales manager, R. B. Harvey.

LITTLE BEAUTY.—Trade name for electric flatiron manufactured by the American Electrical Heater Co., Woodward, Burroughs & Cass Aves., Detroit, Mich.

LITTLE BEN.—Trade name for electric vacuum cleaners manufactured by the Clements Mfg. Co., 609 Fulton St., Chicago, Ill.

LITTLE GEM.—Trade name for rosettes manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

LITTLE GEM.—Trade name for sewing machine motors manufactured by the Racine Electric Co., Bridge and Ontario St., Racine, Wis.

LITTLE GIANT.—Trade name for electric hoists manufactured by the Brown Clutch Co., Sandusky, Ohio.

LITTLE GIANT.—Trade name for electric drills and grinders manufactured by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

LITTLE GIANT.—Trade name for electrically operated peanut and grain threashers manufactured by Heebner & Sons, Lansdale, Pa.

LITTLE GIANT.—Trade name for motor-driven ice cream freezers manufactured by Henry G. Lange, 162 N. May St., Chicago, Ill.

LITTLE GIANT.—Trade name for motor-driven hammers manufactured by the Little Giant Co., Mankato, Minn.

LITTLE GIANT.—Trade name for gear and pinion pullers manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

LITTLE GIANT.—Trade name for expansion sleeves manufactured by the Stannard Mfg. Co., 379 Allen St., Springfield, Mass.

LITTLE GIANT CO.—Mankato, Minn. Manufacturer of motor-driven hammers. President, George M. Palmer; vice-president, John Nyquist; secretary and treasurer, W. D. Willard; general manager, O. M. Hatcher.

LITTLE GIANT TOOL BOX CO.—32 Beverly St., Boston, Mass. Manufacturer of tool boxes and chests.

LITTLE HUSKY.—Trade name for lighting and power plant manufactured by the Matthews Engineering Co., Sandusky, Ohio.

LITTLE HUSTLER.—Trade name for toy motors manufactured by the Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.

LITTLE JEFF.—Trade name for toy transformers, manufactured by the Jefferson Electric Mfg. Co., 426-430 S. Green St., Chicago, Ill.

LITTLE RHODY.—Trade name for flashlights manufactured by the Providence Electric Mfg. Co., 23 Broad St., Providence, R. I.

LITTLE SIGNAL MAN.—Trade name for automobile signals manufactured by the Chicago Automatic Signal Co., 56 W. Randolph St., Chicago, Ill.

LITTLE TWENTY.—Trade name for electrolier snap switch manufactured by the Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.

LITTLE WONDER.—Trade name for electric water heater manufactured by the National Electric Water Heater Corp., Times Bldg., New York, N. Y.

LITTLEFORD BROS.—453 E. Pearl St., Cincinnati, Ohio. Manufacturers of distribution boxes, melting pots, tanks and other plate and sheet steel products. Business established 1882. Roger S. Littleford, general manager.

LIVE.—In electrical work, a term used to designate any circuit or apparatus that is operating or electrically energized, contrasted with any which is idle or not energized and therefore said to be "dead." Thus there is the term "live wire," which is a conductor in actual use or connected to a circuit having current flowing in it or at least potential applied to it.

L. M. T.—Trade name for lamp guards manufactured by the L. M. T. Lamp Saving Device Co., 168 Bridge St., Springfield, Mass.

L. M. T. LAMP SAVING DEVICE CO.—168 Bridge St., Springfield, Mass. Manufacturer of lamp guards.

LOAD.—The output of a machine or of other apparatus. With motors, the load is the mechanical power output; with d-c. generators it is the electrical power output; with a-c. generators and transformers it is the kilovolt-ampere output, or the electrical power output with the power-factor of this output specified in either case.

LOAD, ANTI-INDUCTIVE, CONDENSIVE, CONNECTED, INDUCTIVE, NON-INDUCTIVE AND MAXIMUM.—These different kinds of power loads are described under the respective headings: Anti-inductive load, Condensive load, Connected load, etc.

LOAD BOXES.—See Testing outfits, watt-hour meter; also Loads, artificial or phantom.

LOAD CURVES.—Load curves are curves or graphs representing the variation of load with respect to time. It is very important to know what this variation is at different times of the day, week, month and year. Load curves for power plants and particularly central stations are probably the most widely used and most important. These are usually drawn by plotting the plant power load or demand in kilowatts against the time in hours. They show graphically at what periods of the day the load is heavy and light. The operators at the plant are thereby enabled to know from the curve that at a certain time it will be necessary for them to have sufficient steam available to "bring in" another generator to supply the energy that will be demanded. The load curve also permits making various studies to improve the plant efficiency, to raise the general economy by showing when high loads should be reduced and low loads added to, and what conditions must be designed for in new plants, lines and substations.

In a similar way load curves are drawn for telephone systems to show the number of calls that are handled during any portion of the day. Electric railways, both for street and interurban service, also try to obtain load or traffic curves, although on extensive street-railway systems this is a very difficult task if the effort is made to show the number of passengers actually carried.

In many industrial plants or particular departments thereof it is sometimes desired to know the total load or actual performance from hour to hour. This can in many cases be determined by taking a load curve of the kilowatt input to the power circuits of the plant or the input of the motors driving the department or particular machine under investigation. A curve-drawing wattmeter gives such a record, the kilowatt values being fairly proportional to the actual load or output of the plant, department or machine.

Load curves, while most often showing load variation from hour to hour and intervening fractions thereof (as recorded by a graphic or curve-drawing wattmeter), may also be plotted to show the load variation from day to day or month to month. As the time unit is increased it is more customary to plot average values of load per unit time considered than to show the actual fluctuation for small fractions of that time unit. For instance, a yearly load curve usually shows the average load for each month, instead of the daily average load throughout all the days of the year. If the curve has only a few points, as twelve in the above case, it is drawn as a series of straight lines connecting these points, since the probable shape of the actual average load curve cannot be determined from so few points.

When a load curve has been plotted it usually resembles a cross-section of a mountain range and adjoining country, consequently the high loads are commonly "peaks" (the highest load the "peak load") and the low loads "valleys." If the load can be shifted to cut down the peaks and raise the valleys, the economy of operation can in practically all cases be substantially increased. The ideal load curve is a horizontal line, that is, constant load. Such a load has 100% load-factor. Also see Load-factor.

LOAD-FACTOR.—The ratio of the average power to the maximum power during a certain period of time is called the load-factor of the machine, plant or system considered. The average power is taken over a certain period of time, such as a day, a month, or a year, and the maximum is taken as the average over a short interval of the maximum load within that period. In each case, the interval of maximum load and the period over which the average is taken should be definitely specified, such as a "15-minute daily" load-factor. The proper interval and period are usually dependent upon local conditions and upon the purpose for which the load-factor is to be used.

LOAD-FACTOR IN ELECTRICAL CONSUMPTION.—The use of electricity in houses, stores and factories varies with the requirements of the occupants. The total amount used in a residence, for example, is equivalent to about two hours' use per day of the largest amount taken at any one time.

The ratio of actual consumption in kilowatt-hours to the total possible consumption, if electricity were used continuously at the rate of the maximum demand, is called the load-factor of a consumer. It is expressed as a percentage. Thus a six-hour user has a load-factor of 6/24 or 25%. Or if his maximum demand were 10 kw. and his monthly consumption were 1,800 kw-hr. per month, his load-factor would be 1,800/(10x30x24)=25%; this is his monthly load-factor. If there were certain months when his consumption was less than 1,800 kw-hr. and his total annual consumption was 17,520 kw-hr., his annual load-factor would be 17,520/(10x8,760)=20%. The annual load-factor is generally used in making rates for large users.

LOAD LOSSES, STRAY.—Losses occurring as the result of load on a machine which cannot be measured. They are, in the main, eddy-current losses in the armature conductors, short-circuit losses in coils undergoing commutation in commutator machines and extra iron losses brought about by the load.

LOAD, TELEPHONE OPERATOR'S.—The number of originating calls handled by an operator. The unit is the flat-rate non-trunked call. Trunked calls take more time and labor and count for more than one call each. Other kinds of calls require other amounts of work. "Equating factors" are used in calculating the reasonable load that an operator may be expected to take care of or "carry." The busy-hour load is the number of calls which originate in the most busy hour of the day.

LOADERS, CAR OR WAGON, MOTOR-DRIVEN, BUCKET OR BELT TYPES.—These conveyors are used for loading such materials as coal, sand, gravel and stone. The machine has a continuous belt or bucket conveyor which runs over a frame that carries the belt from the ground to a point above the wagon where the belt or buckets drop this load. It is backed into the pile of material and either loads itself by pushing into the pile or the buckets or belt are loaded by scraping, raking or shoveling the material by hand. The motor-driven machines are advantageously used where electric power is available, the power being conducted to the machine by a long flexible cable. They save much labor in loading bulk material onto trucks or cars.

Manufacturers:

Barber-Greene Co., Aurora, Ill. "B-G."
Brown Portable Conveying Machinery Co., 10 S. La Salle St., Chicago, Ill. "Auto-Piler."
Galion Iron Works & Mfg. Co., The, Galion, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio.
Lakewood Engineering Co., Cleveland, Ohio. "Tier-Lift."
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.

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Maroa Mfg. Co., Maroa, Ill. "Boss."
Portable Machinery Co., Inc., Passaic, N. J.

LOADING COILS, TELEPHONE, PUPIN.—Coils placed in series with the conductors of a telephone line to correct the attenuation. They were invented by Dr. M. I. Pupin, and are often called Pupin coils. They are used to improve transmission and are employed extensively on long lines. These coils are made in torroidal form and have two windings per coil, each winding being connected in series in the two wires of a line. They are placed at intervals of about eight miles in open-wire circuits and from 1 to 2.5 miles in cable. Several coils are usually assembled in a single iron case, resembling somewhat a transformer case.

Manufacturers:

Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

LOADING OF TELEPHONE LINES.—Loading is practiced on telephone lines for the purpose of increasing the transmission efficiency of long lines, by altering the normal reactance of the circuit. The most common method of loading is by using inductance coils at intervals to add to the normal inductance in the circuit and thus compensate for the excessive capacitance. These loading coils may be connected in series with the lines, called series loading, or connected across the line, called shunt loading. Also see Loading coils.

LOADS, ARTIFICIAL OR PHANTOM.—A phantom or artifical load is a device for furnishing a load current to instruments being tested, from a source of lower potential than that of the circuit to which the potential windings of the instrument are connected. In the commercial types the low voltage is obtained by a transformer connected across the line. The current coils of the instrument being tested are connected in series with a variable resistance across the transformer secondary. The secondary is wound in sections arranged so that they may be cut in or out to obtain variation in the secondary voltage. The load current is varied in large steps by changing the secondary voltage, in small steps by the variable resistance. The transformer and resistance are generally mounted together in one case and used either as a portable device or on the test table.

Manufacturers:

STATES CO., THE, 71 Francis Ave., Hartford, Conn. An artificial load for meter testing is here provided, adjustable to all conditions which may arise. Three forms of tables embodying the load are supplied: 1—Form LS for testing single phase meters, or polyphase meters by testing the elements singly or with current coils in series: 2—Form LD for testing single and polyphase meters as in LS, but with two meter positions; 3—Form P, arranged particularly for polyphase work. The left hand illustration shows



Form LS



Type F

arrangement of Form LS equipment. Various types of portable "phantom" loads are also furnished. One of these, Type F, is shown in right hand illustration. It is designed particularly for use in testing a-c. watthour meters by the rotating standard test-method. It is small, light, easily adjustable, non-inductive, and economical of energy, with closely fixed load steps.—Adv.

Ward Leonard Electric Co., Mt. Vernon, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

LOBEE PUMP & MACHINERY CO.—111-119 Dearborn St., Buffalo, N. Y. Manufacturer of circulating and bilge pumps. Business established 1899.

LOCAL ACTION.—Electrochemical action or corrosion caused by short-circuited galvanic couples, the constituents of which are the metal, impurities in the same, and a fluid moistening the two. Under these circumstances, the more corrodible of the two materials acts as an anode, the less corrodible as cathode, and a short-circuited current is generated which passes through the moistening fluid from anode to cathode, and flows in the reverse direction through the metallic contact of the two materials. This current corrodes rapidly and locally the anode, or more corrodible constituent, and thus etches or defaces the material. When local action is present in primary and storage cells it accelerates the disintegration of the electrode materials.

LOCALIZED LIGHTING CORP.—540 W. 58th St., New York, N. Y. Manufacturer of self-adjusting arms and lighting fixtures. Business established 1917 as Franklin Specialty Mfg. Co. President and treasurer, Robert D. H. Anderson; vice-president, Robert W. Anderson; secretary, Solomon Shapiro.

LOCATORS, CONDUIT AND PIPE.—A device for detecting the presence of concealed metal conduit or pipe, usually by the disturbance of a magnetic field evidenced by means of a sensitive magnetic needle or compass. An exploring coil and telephone receiver may also be used with a method of applying a high-frequency oscillation to the conduit or pipe system.

Manufacturers:

Electric Specialty Mfg. Co., Cedar Rapids, Iowa. "Wireless."

LOCDROP.—Trade name for elevator annunciators manufactured by the Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.

LOCK.—Trade name for grease cups manufactured by Lunkenheimer Co., Cincinnati, Ohio.

LOCK FAST.—Trade name for attachment plugs manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

LOCK SHELL.—Trade name for sockets and switches manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

LOCK SWITCHES, BURGLAR ALARM.—See Switches, burglar alarm, lock or key cutout.

LOCKE.—Trade name for cable hanger manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

LOCKE, FRED M.—Victor, N. Y. Manufacturer of insulators.

LOCKE INSULATOR CORP.—Baltimore, Md. Manufacturer of insulators and insulator accessories. Business established 1894. President, Donald Symington; vice-presidents, F. H. Reagan, J. F. Symington, W. G. Hoffman, Jr.; secretary, J. F. Douty, Jr.; treasurer, W. G. Hoffman, Jr.; general manager, F. H. Reagan; sales manager, D. H. Osborne. Main office, Maryland Trust Bldg., Baltimore, Md. Factories, Baltimore, Md., and Victor, N. Y. Branch office, Woolworth Bldg., New York, N. Y. Sales representatives, James C. Barr, 24 State St., Boston, Mass.; Electric Service Supplies Co., Philadelphia, Pa., and Chicago, Ill.; G. E. Watts, Chandler Bldg., Atlanta, Ga.; Charles L. Ward, 907 Sharp Bldg., Kansas City, Mo.; Pacific States Electric Co., San Francisco, Cal., Seattle, Wash., Portland, Ore.; O. H. Davidson Equipment Co., 1633 Tremont St., Denver, Colo.

LOCKING ATTACHMENTS.—See Attachments, locking, for switches.

LOCKING GUARDS.—See Guards, lamp, locking.

LOCKING SOCKETS.—See Sockets, locking.

LOCKING SWITCHES.—See Switches, locking, flush.

LOCKNUTS, CONDUIT.—Thin octagonal threaded fittings used on the ends of rigid conduit as jamb nuts to lock conduit fittings against corresponding conduit bushings and secure a permanent and rigid joint. They are used largely in conduit boxes and cabinets for securing industrial metal reflectors rigidly to the conduit fixture stem, etc.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Central Nut Lock Co., 332 S. Michigan Ave., Chicago, Ill. "Condulocknut."
Cleveland Wrought Products Co., The, West 58th St., Cleveland, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Franks Mfg. Co., Rock Island, Ill.
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Illinois Malleable Iron Co., 1301-1825 Diversey Pkwy., Chicago, Ill.
Krayben Metal Products Co., Inc., 138 Prince St., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. Locknuts manufactured by the National Metal Molding Co. are made from stamped steel, and are cut and threaded by machines. After being tested for uniformity of size and threading, they are treated with the special sherardizing process. This insures the threading, as well as the body of the locknut, to be protected from rust or other destructive forces. Locknut sizes range from ¼-in. to six ins. They are octagonal in shape and easy to grip with a wrench. See display adv. pages 1302-4.—Adv.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv., page 1308.)
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Fullman" locknuts, sizes ⅜ to 1-in., are made of special composition steel.



"Fullman" Locknut

Sizes 1¼ to 8-in. are of best grade malleable iron and cast in "rib" design. All sizes are sherardized to prevent rust.—Adv.

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."
WALKER BROS. & HAVILAND, Otis Bldg., Philadelphia, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

LOCKS, AUTOMOBILE.—Absolute prevention of theft of automobiles is practically impossible. Locks for automobiles are therefore designed primarily to make theft as difficult as possible by making the car unmanageable or attracting attention to theft in other ways. The locks are generally of the cylinder or tumbler variety and all parts are sufficiently heavy to make it impossible to break the lock by striking it, or cutting the metal with wire cutters. For coupes, or other closed electric vehicles, the door is always provided with a tumbler lock. There are several locks which fasten on the steering column. They either release the wheel from the steering column or lock it in one position so that it cannot be turned. Another type is made of a heavy piece of iron, shaped like a chain link, which is fastened around the tire of either of the front wheels, giving the car an eccentric motion if it is towed or driven. Another device is used which locks the gears in neutral.

Manufacturers:

Bradsto Appliances, Inc., 65 Main St., Buffalo, N. Y. "Yell-O-Gurad."
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Corbin Cabinet Lock Co., New Britain, Conn.
K-W Ignition Co., The, E. 30th St. and Chester Ave., Cleveland, Ohio. "K-W Autolock."
Long Distance Spark Plug Co., Birmingham, Ala. "Stop Thief."
Moss-Schury Mfg. Co., Inc., 444-446 Woodbridge St., E., Detroit, Mich.
Nulock Mfg. Corp., 1639 Broadway, New York, N. Y. "Nulock."
Phelps Guardant Time Lock Co., 114-118 Liberty St., New York, N. Y.
Recording Devices Co., The, 5th and Norwood Sts., Dayton, Ohio.
Warner Electric Co., Muncie, Ind. "Wheel-tilt."

LOCKS, LAMP.—Lamp locks are simple devices to prevent the theft of lamps by locking them in place. If these are lamps hung over city streets, the lock is usually of the padlock type and is mounted on the pole, being then commonly called a pole lock; for these see Locks, pole. For incandescent lamps used in interior lighting the lock is usually a part of the socket, the latter being specially designed and

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called a locking socket; for these see Sockets, locking. In some cases the lamp is locked in place by having a locked lamp guard or cage surrounding it; for these see Guards, lamp, locking.

LOCKS, METER.—To prevent tampering with a service meter or with meter connections a locking device is generally used. In nearly all cases this consists of a soft metal seal which must be broken to get at the meter or its connections. For these devices see Seals, meter.

LOCKS, POLE.—To prevent tampering with outdoor switching equipment, hoisting ropes of street lamps, and other similar equipment, weather-proof locks are used. Generally they are galvanized to resist rust and the keyhole is either covered or placed in the bottom of the lock so that rain or sleet cannot drive into it.

Manufacturers:

Fraim-Slaymaker Hardware Co., 1st St., West End Ave., and 2nd St., Lancaster, Pa. "Autoloc."

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv., page 1278.)

LOCKS, TIME, ELECTRIC SIGNALING.—Time locks are commonly operated mechanically by a clock mechanism, which is set to permit opening at a certain time. Where they are operated in connection with a protective system the signals are electrically operated, generally registering at some central point, as the police headquarters or those of the protective agency in whose system they are connected. They are arranged to give the signal when the lock is being tampered with so that an investigation of the cause may be immediately made.

LOCKS, TIME-RECORDING, ELECTRIC.—Locks fitted with electric contacts which are closed each time the key is inserted making a permanent record on a distant clock-operated recording sheet. These locks are used to check the time of arrival and departure of employees; the recording impulse may be arranged to also actuate an alarm within the night hours and thus signal any attempt at unauthorized entry, as in the locks described above.

Manufacturers:

Corbin Cabinet Lock Co., New Britain, Conn.

International Business Machines Co., Ltd., Royce St. and Campbell Ave., West Toronto, Ont., Can. "International."

Phelps Guardant Time Lock Co., 114-118 Liberty St., New York, N. Y.

LOCKWOOD & ALMQUIST, INC.—218 E. 42nd St., New York, N. Y. Manufacturer of electric clocks and elevator dispatchers. President, R. L. Lockwood; vice-president and treasurer, F. G. Almquist; secretary, J. C. Myers.

LOCO LIGHT.—Trade name for locomotive headlights and locomotive headlight generating sets. Made by the Loco Light Co., 139 S. East St., Indianapolis, Ind.

LOCO LIGHT CO., THE.—139 S. East St., Indianapolis, Ind. Manufacturer of locomotive headlights and locomotive headlight generating sets. Business established 1915. President, Arthur R. Baxter; vice-president and treasurer, Howard H. Tomlinson; secretary, Charles R. Fant; general manager, R. L. Mack.

LOCOMOTIVE.—Trade name for electric washing machines manufactured by the Brantford Washing Machine Co., Ltd., 72 Colborne St., Brantford, Ont., Can.

LOCOMOTIVE.—Trade name for automobile headlights manufactured by the Glazier Headlight Corp., 25-27 Otsego St., Rochester, N. Y.

LOCOMOTIVE.—Trade name for electric washing machines manufactured by the Locomotive Electric Washing Machine Co., Belleville, Ill.

LOCOMOTIVE CRANE CO.—Bucyrus, Ohio. Manufacturer of electric cranes.

LOCOMOTIVE ELECTRIC WASHING MACHINE CO., THE. — Belleville, Ill. Manufacturer of electric washing machines. Business established 1919. President, F. J Tecklenburg; vice-president and treasurer, H. M. Dittoe; secretary and general manager, A. H. L. Klemme; sales manager, C. H. Branditz. Sales representative, Kimball Electric Co., 23 W. 37th St., New York, N. Y.

LOCOMOTIVE PANTOGRAPHS. — See Pantographs, trolley collector.

LOCOMOTIVE SUPERHEATER CO. — New York, N. Y. Manufacturer of steam superheater and pipe coils. Main office, 30 Church St., New York, N. Y. Branch office, 122 S. Michigan Ave., Chicago, Ill.

LOCOMOTIVES, ELECTRIC. — Electric locomotives are machines for hauling cars on tracks, the tractive force being obtained from electric motors mechanically connected to the driving wheels. The principal parts of electric locomotives are the running gear, motors, control apparatus, brake equipment and cab. The running gear, consisting of frames, wheels, axles and spring rigging, is of symmetrical arrangement as to wheels, so that operation in either direction is equally effective. The motor-control apparatus and air-brake compressor with control valves are mounted in the cab. Two control stations are provided in the cab so that the locomotive may be operated in either direction with equal facility.

The electric locomotive differs fundamentally from the steam locomotive in that it is not an independent and self-contained prime mover, but transforms electrical energy received from an outside source into mechanical energy. It is, therefore, entirely free from the limitations of the steam locomotive as to boiler capacity, so that the strength of draft-rigging and of rolling stock, and the length of sidings are the only limits to the amount of power that may be concentrated in one electric locomotive.

Electric locomotives of all types possess certain advantages over the steam locomotive, such as ability to operate in either direction with equal riding qualities and view of track, and, by reason of the multiple-unit control equipment, two or more may be operated together by one crew, giving any desired concentration of power, all easily and surely controlled by one engine man.

The flexibility of the electric locomotive is greater than that of the steam locomotive, because of the double-end design, the multiple-unit control, the relatively short time in shop per annum for inspection and overhauling, having no fires or boilers to clean, and being ready for work as soon as contact is made with the power distribution system.

Various methods are employed in mounting the motors on electric locomotives and connecting them to the driving axles. In some designs the motor armatures are mounted directly on the axles, resulting in the gearless type of locomotives. Another common design follows street-railway practice and has the motors as a whole mounted on the trucks with the motor armatures connected to the driving axles through gearing. In other designs the motors are mounted above the axles by means of gearing. In still other designs the motors are mounted above the axles on the locomotive frame and drive auxiliary shafts by means of gearing or connecting rods, the driving wheels being connected to these auxiliary shafts by main rods. The driving wheels are connected together by side-rods as in steam locomotives.

Combinations of the above designs of motor mounting and connection to driving axles are also used so that there is no general standard method of mounting the motors on electric locomotives or of connecting them to the driving axles. The requirements of the various classes of service on railways, such as freight, passenger and switching, are so different that it is quite probable that there will always be different designs of motor mounting and connection to driving wheels, in order to economically and efficiently meet these different conditions in much the same manner as is now the practice in steam locomotive design.

The number of motors installed on electric locomotives is variable, depending on the allowable weight per driving axle, design of mechanical drive employed between the motors and the driving axles, the mounting of the motors, and the total tractive power of the locomotive desired. On locomotives in which the motors are mounted on the frame and geared to the axles or where the motors are mounted directly on the axles, the limitations of space between wheels determines the maximum output of each motor so that four or more motors are usually required to obtain the desired tractive power. Where the motors are mounted on the locomotive frame above the axles, and side-rods or gears are used in connection with auxiliary shafts to transmit the tractive forces, the motors may be of larger size and capacity than where mounted between wheels, so that two motors may be sufficient to give the desired tractive power.

Electric locomotives may be classified in several ways: according to their current supply, into direct current, single-phase or three-phase; according to their drive, into gearless, geared, or side-rod; according to their service, into passenger, freight and switching, industrial service, and mining service. The principal subdivisions as to service are treated below.

LOCOMOTIVES, ELECTRIC, INDUSTRIAL.—Locomotives designed for use around industrial works are of various types depending on the character of the work they are to perform. If this is switching of standard railroad cars, the locomotives correspond to the railroad switching type listed above. If used for hauling work cars from one part of the plant to another, they are often of the narrow-gage type and resemble more closely the types used for mine service (see below); like mine locomotives they are equipped either with overhead trolley or storage batteries. If the hauling is done without tracks, the locomotive is usually called a tractor (see Tractors, electric).

Manufacturers:

Atlas Car & Mfg. Co., The, Cleveland, Ohio.

Baker R & L Co., Cleveland, Ohio. "BRL".

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E industrial locomotives are of the single or double truck type with one motor mounted on each axle and vary in weight from 4 to 50 tons or more, for gauges varying from 18 in. up to 56½ in. Storage battery locomotive motor equipments are designed to operate from 85, 170 or 200 volts. Equipments for the trolley and third rail type are designed for operation from 250, 500 and 600-volt, d-c. circuits. Units in service in various industries are illustrated in Bulletin 44251. The electric locomotive is admirably adapted to fulfill transportation requirements of all industries, having many advantages over other methods, as steam locomotives, animal haulage and hand trucks. The inter-factory haulage of large manufacturing plants that consist of buildings scattered over considerable areas, can be most satisfactorily and economically handled by small electric locomotives. Other G-E contributions to modern material handling methods are portrayed on page 1210.—Adv.

Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill. "Goodman."

Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.

Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio.

McGuire-Cummings Mfg. Co., 111 W. Monroe St., Chicago, Ill.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, MINING, GATHERING.—Gathering locomotives are designed especially for collecting loaded cars from the faces of rooms and entries and hauling them to a parting where the main haulage locomotives can pick them up. They are used in rooms that are being worked temporarily, where it would be uneconomical to install a trolley wire. Trolley construction is also difficult because of the low headroom, lack of adequate support and presence of moisture. There are two types of gathering locomotives which are used to overcome this difficulty, the conductor-cable-reel and the traction-reel locomotives. The conductor-cable-reel locomotive runs into rooms on temporary steel or wooden rails. It carries a reel on which is wound flexible insulated cable, one end being connected to the locomotive circuits and the other end attached temporarily to the trolley in the main haulage way. Single-conductor cable is used where the track is constructed to give a return circuit, otherwise double-conductor cable is necessary. The reel is usually driven by a separate motor, so as to be independent of the wheels. Traction-reel locomotives have a motor-driven reel on which a steel cable is wound. They are used where the headroom is not sufficient for the locomotive to enter or where the track will only support the loaded cars. The locomotive stays on the cross-entry track with the brakes set, and the cable is hooked to a loaded car, which is drawn out when the reel motor operates. This type of gathering locomotive is also used with storage-battery locomotives.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

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GENERAL ELECTRIC CO., Schenectady, N. Y. The latest G-E gathering locomotive embodies several improvements over types formerly in use. Braking is done electrically from a controller which has a three-position indicator and can be set forward, braking and reverse. Semi-elliptic leaf type springs with an equalizing bar transmit any change in wheel load, making an equal distribution of weight on drivers over uneven tracks and reduce derailment troubles. The tires are demountable and the cable reel follows an improved design. (Bulletin 64200.) General information on G-E service to coal mines on page 1212.—Adv.

Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill. "Goodman."

Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio. "Armorplate."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, MINING, STORAGE-BATTERY.—The use of storage-battery locomotives for mining service has been increasing, especially for the gathering locomotives. Their use is most advantageous in mines where trolley construction is very difficult, or where the presence of excess moisture would give very high leakage of current. Recent improvements in the batteries have made them sufficiently rugged for the rough service. Both the lead cells and Edison cells have been used successfully. The general construction features for this type of locomotive are about the same as the trolley type, except that special provision is made for carrying the battery. They have an efficiency of about 60 to 66% between the battery and locomotive wheels.

Battery charging is provided for by having charging panels at convenient points in the haulage way. Where it is possible to charge the battery during noon hour, or where other short-time intermediate boosting charging can be accomplished, the capacity and thus the size of the battery can be reduced.

Manufacturers:

Atlas Car & Mfg. Co., 1289 Marquette Rd., Cleveland, Ohio.

Automatic Transportation Co., 2933 Main St., Buffalo, N. Y. "Automatic."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E storage battery locomotives were among the first in this field and their success for gathering and haulage has proved their correctness in design and principle. Their use is advocated wherever the haulage conditions are favorable. Made in several sizes and equipped to suit particular requirements. G-E engineers will gladly advise in the selection of this type of locomotive, kind of battery, etc. See page 1212. This company is prepared to furnish also complete equipment for battery charging. Motor generator sets and panels for this service are described in Booklet Y-1364. Combined trolley and storage battery locomotives are also available, which charge storage battery when operating from trolley and the change from trolley to battery operation is made simply by throwing a switch.—Adv.

Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill. "Goodman."

Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.

Ironton Engine Co., The, Ironton, Ohio. "Ironton."

Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio. "Armorplate."

Mancha Storage Battery Locomotive Co., 1909 S. Kingshighway, St. Louis, Mo. "Mancha's Electric Mule."

Vulcan Iron Works, 730 S. Main St., Wilkes-Barre, Pa.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, MINING, TROLLEY.—Mining locomotives are almost always of the d-c. type, designed to operate on 250 or 500-volt circuits. The service is somewhat similar to industrial switching service and the equipment is selected for using the same general methods. The series type of motor is invariably used, as it has very good speed-torque characteristics. The weight of the locomotives varies from 3 to 30 tons, the larger sizes generally being made in tandem form or as two locomotives, each having two motors. Three-motor locomotives are made in a single unit and are used on some heavy work, but the largest percentage of locomotives have only two motors. Commutating-pole motors are generally used as they increase the commutator and brush life. The motor frames are of cast steel and are split approximately horizontally so as to make the motor accessible for inspection and repairs. The motor is suspended from the lower part of the general frame so that the locomotives are generally but little higher than the wheel diameter. Cast iron wheels with chilled treads or with steel tires, and axles of high-grade forged steel are used.

The trolley arm is sometimes made of two members which gives the desired height with a very short pole that may be turned around in a very narrow space. Trolley-line constructions is generally difficult because of the lack of adequate support. Gathering locomotives, which see, are often used, therefore, in places other than the main haulage way.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. This company's experience in mine locomotive manufacture dates back thirty years. The G-E mine locomotives of the earliest types, still in active service, prove that the severe conditions of mine work have been met. The 2-motor locomotive is considered standard and is made with either inside or outside frame. Exceptionally strong and efficient brakes are a G-E feature. The motors used are of the latest type, designed for overloads and severe service, built with ball bearings and suspended from the axle with springs. Detailed information on this line will be supplied from G-E Sales Offices listed on page 1223. See Locomotives, electric, mining, gathering, and Locomotives, electric, mining, storage battery, for general information on these types.—Adv.

Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill. "Goodman."

Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio. "Armorplate."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, FOR RAILROAD PASSENGER AND FREIGHT SERVICE.—Electric passenger locomotives for trunk-line railroad service must have sufficient weight on the driving wheels and tractive power so that heavy trains up to 1200 tons in weight may be accelerated and hauled at high speeds up to 65 miles per hour on the level and, when operated on mountain divisions with somewhat lighter trains, at 25 miles per hour on 2% grades. These requirements call for a locomotive capable of exerting high continuous tractive effort over a wide range of speeds. Essential features of passenger locomotives are guiding trucks at each end to ease the entrance into curves, thus providing good riding qualities and relieving the track structure of excessive stresses.

Electric freight locomotives, which start and haul heavy trailing loads, up to 4000 tons or more, at speeds up to 30 miles per hour on level or low grades and on mountain divisions at 15 to 18 miles per hour on grades up to 2%, require great weight on driving wheels and motors capable of exerting continuously very large tractive efforts. Guiding trucks are desirable on freight locomotives that are operated at 25 miles per hour or over, for the same reasons as set forth in connection with passenger locomotives. For application and advantages see Railroad electrification.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. Today the steam locomotive is outclassed in power, flexibility, reliability, ease of control, economy, comfort to the passengers and in substantially every feature, by the electric locomotive. Although the electric locomotives manufactured by the General Electric Company all follow certain well established principles of construction, no one type can be called standard as each must be designed to meet the needs of the particular service for which it is intended. The largest type for heavy freight service built by this company is a 280-ton locomotive. A 265-ton, 3000-volt gearless passenger locomotive is described in Bulletins 44102 and X497. Bulletin 4870A describes a 100-ton unit for passenger and freight service, and a 50-ton for interurban roads is described in Bulletin 44101. See page 1206 for further reference to G-E service in electric transportation.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, FOR RAILROAD SWITCHING.—Electric switching locomotives for railroad service are characterized by sufficient weight on driving wheels and motor capacity to develop high continuous tractive power at relatively low speeds, up to about 15 miles per hour, and must be capable of withstanding the heavy buffing and pulling shocks incident to switching service. Switching locomotives, operating at comparatively low speeds, do not require guiding trucks in the running gears, and are usually built with all wheels as drivers. This enables the development of the rated tractive force with minimum total weight of locomotive. The cabs of switching locomotives are usually of the "steeple" type to permit the engineman a good view of the track when operating in either direction without changing his seat.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. A standard type of locomotive has been designed to meet service conditions where trains of medium weight are to be hauled over tracks which do not include excessive grades. While the standard unit is known as the 25-ton type, its weight may vary between 22 and 45 tons. In general, the equipment comprises four 40 to 75 hp. motors with type M or K control. Where two locomotives are to be operated together, multiple unit cable couplers are supplied. However, various motor equipments and designs can be furnished, the capacity, type, and characteristics of which will depend entirely upon the conditions of service. (Bulletin 44250.) See adv. pages 1203-1223.—Adv.

Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill. "Goodman."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

LOCOMOTIVES, ELECTRIC, TOY AND MINIATURE.—Toy electric locomotives are commonly made in miniature imitation of the various electric locomotives or the standard steam types. They are equipped with universal motors for operation on either direct or alternating current and usually operate at a low voltage, either from batteries or a toy transformer connected to the regular lighting circuit. They are used in connection with the several types of toy electric railways that are so popular. Other miniature locomotives similar to the usual toy types, but generally a little larger and more expensively finished are used for advertising as a moving attraction for window displays in electric shops and other stores. They are very effective in attracting attention of grown-ups as well as children.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Ives Mfg. Co., Bridgeport, Conn.

Lionel Corp., The, 48-52 E. 21st St., New York, N. Y. "Lionel."

LOCUST PIN CO., INC., THE.—Front Royal, Va. Manufacturer of insulator pins, brackets and pole steps. President, I. K. Gruver; secretary, C. A. Kidd; treasurer and general manager, B. J. Hillidge.

LOEFFELHOLZ CO.—170-182 Clinton St., Milwaukee, Wis. Manufacturer of brass, bronze and aluminum castings, trailer and train connectors, valves, etc. President, John W. Suetterle; vice-president, L. Roberts Taylor; secretary, John J. Miller.

LOETSCHER-RYAN MFG. CO.—Rock Island, Ill. Manufacturer of electric heating devices.

LOGARITHMIC DECREMENT.—The logarithmic decrement of an oscillating wave or of an oscillating galvanometer needle is the natural logarithm of the ratio of

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two successive maxima in the same direction. It is of much importance in radio work. Also see Decrement, logarithmic.

LO-GLO.—Trade name for electric egg testers, incubators and brooders manufactured by the Lo-Glo Electric Incubator Co., 76 Greenwich St., New York, N. Y.

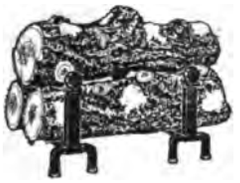
LO-GLO ELECTRIC INCUBATOR CO., INC.—76 Greenwich St., New York, N. Y. Manufacturer of electric incubators, brooders and egg testers. President, F. H. Sawyer; treasurer, H. B. Smith; secretary, Henry Ware Jones.

LOGS, ELECTRICALLY ILLUMINATED AND HEATED.—Heating equipment designed to be set in fireplaces and provided with luminous electrical heating elements in the form of incandescent bulbs or open wire-wound coils. They are built quite similar to gas logs but are made to appear to glow rather than burn with a flame. Besides those used in the fireplace there are portable types built to imitate a small fireplace in appearance; for the latter see Fireplaces, electric.

Manufacturers:

Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."

STRAIT & RICHARDS, INC., Fabyan Place, Newark, N. J. The electric "Glolog" is an indestructible electric log in which the heating element consists of resistance coils. These coils, which are made of the best resistance wire, are artfully hidden in the crevices of the bark so as to be hardly visible until the current is turned on. Then they glow with a cheerful radiance and at the same time give off powerful and far reaching heat rays. The log is 20 ins. long and consumes 2000 watts (other



The "Glolog"

sizes to order). It operates on either a-c. or d-c. It is wired to operate on all classes of circuits, any phase, two or three wire. It is not a lamp socket device. At least No. 10 wire circuits are required. The log is made of hard-burned fire clay with the color fired in. The heating element may be easily renewed, although this is seldom necessary. It is safe, dustless, rugged and odorless. No vent or flue is required. —Adv.

Universal Electric Stage Lighting Co., 20 W. 50th St., New York, N. Y.

LOGWAY.—Free navigation of streams for logging purposes is provided by law in some states making it necessary to provide a passage for logs over or through a water-power or other dam. In order that the water used shall not be excessive, they are usually made very narrow and booms are provided to guide the logs into the logway. A very gradual incline is provided and the amount of water flowing is usually regulated when the sluice is not being used.

LO-LITE.—Trade name for low-voltage transformers manufactured by the Bertrand F. Miller Co., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

LOMBARD, WHITE CO.—38 Harlow St., Worcester, Mass. Manufacturer of electric washing machines. President, W. P. White; treasurer, J. P. Ashey.

LONERGAN CO., J. E.—211-215 Race St., Philadelphia, Pa. Manufacturer of boiler, steam and gas engine specialties. President, J. E. Lonergan; vice-president, William E. Lonergan; secretary, A. St. C. Tomes; treasurer, W. E. Crofton.

LONG-BELL LUMBER CO.—Kansas City, Mo. Manufacturer of treated and untreated wood blocks, poles, ties and lumber. Established, 1875. President, R. A. Long; vice-presidents; F. J. Bannister, M. B. Nelson, J. H. Foresman and J. D. Tennant; secretary, R. T. Dempsey; treasurer, F. J. Bannister; sales manager, M. B. Nelson. Main office, R. A. Long Bldg., Kansas City, Mo. Branch offices, New York City; Memphis, Tenn.; Amarillo, Tex.; Dallas, Tex.; Detroit, Mich.; Cleveland, Ohio; Indianapolis, Ind.; Chicago, Ill.; St. Louis, Mo.; Wichita, Kans.; Houston, Tex. Mills, Arkansas, Louisiana, Mississippi, Texas, California.

LONG DISTANCE.—Trade name for spark plugs manufactured by the Long Distance Spark Plug Co., Birmingham, Ala.

LONG DISTANCE SPARK PLUG CO.—Birmingham, Ala. Manufacturer of spark plugs and automobile locks. President, Raymond M. Jones; vice-president, Z. L. Nabers; secretary and treasurer, George T. Stafford.

LONG DISTANCE TELEPHONE.—A term applied to toll telephone systems for communicating between points a long distance apart. The switchboard equipment for such service is different from that used for ordinary conversation.

LONG-HENKEL MFG. CO.—S. W. Cor. 3rd and Buttonwood Sts., Reading, Pa. Manufacturer of automatic chucking machines. Business established 1918. President, William F. Henkel; vice-president, Clayton L. Hafer; secretary, Albert J. Wagner; treasurer and general manager, Cleve. E. Long.

LONG SAUT.—Trade name for cable clamps manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

LONG-SHUNT CONNECTION.—A compound wound d-c. motor or generator may be connected long shunt by connecting the shunt field winding to the machine terminals. This places the shunt field in shunt around the armature and series field combined, whether the latter is all on one side of the machine or half connected on the positive and half on the negative side. In a short-shunt machine the shunt field is connected across the armature only.

LOOKOUT BOILER & MFG. CO.—Chattanooga, Tenn. Manufacturer of boilers and structural steel for outdoor substations, etc.

LOOM CLAMPS.—See Clamps, loom.

LOOM, CONDUIT.—See Tubing, flexible fabric or nonmetallic conduit.

LOOMFLEX.—Trade name for nonmetallic tubing manufactured by the American Circular Loom Co., 90 West St., New York, N. Y.

LOOP, RADIO.—See Antenna, radio.

LOOPS, FIXTURE.—See Fixture fittings and parts.

LOOPS, METER, FOR PANELBOARDS.—Often in connection with panelboards it is desirable to insert a watt-hour meter in the main circuit to determine the consumption of the tenant or section of a building supplied by that panelboard. With the ordinary panelboard this cannot be done as the main switch terminals connect directly to the branch circuit switches through copper busbars and taps. A meter loop may be put on the paenlboard in these cases and the copper straps from the main switch terminals then connect to an auxiliary set of terminals to which the "line" side of the meter is connected. The wires running from the "load" side of the meter then connect to another pair of terminals which have strap connections to the busbars of the panelboard. Meter loops may be applied to practically all standard forms of panelboards.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv., pages 1262-1265.)

METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.

LOOSE TWIST.—Trade name for lightning conducting cable manufactured by the George E. Thompson Lightning Rod Co., Inc., Owatonna, Minn.

LOPULCO.—Trade name for pulverized fuel equipment manufactured by the Combustion Engineering Corp., 11 Broadway, New York, N. Y.

LORD & CO., LEE H.—Box 693, Peoria, Ill. Producer of crossarms, ties, poles, etc. Business established 1896.

LORECA.—Trade name for reel cable for mine locomotives, arc welding outfits and wherever cables are subjected to hard usage, made by the Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

LORICATED.—Trade name for interior rigid metallic conduit, conduit couplings, nipples, elbows, etc., manufactured by the Garland Mfg. Co., West Pittsburgh, Pa.

LOOSE COUPLER, RADIO.—See Couplers, loose, radio.

LOS ANGELES PRESSED BRICK CO.—Frost Bldg., Los Angeles, Cal. Manufacturer of fire brick. Factories, Los Angeles, Alberhill and Santa Monica, Cal. F. A. Harrison, general manager.

LOSSES, MACHINE.—The energy losses in a machine which appear in the form of heat and cause a temperature rise within the machine. They are of three general classes; viz.: (1) friction of bearings, brushes and air; (2) iron losses due to hysteresis and eddy currents and (3) copper losses due to current through the resistance of the windings. Also see Hysteresis loss; Eddy current loss; Copper loss.

LO-TEST.—Trade name for linemen's rubber gloves manufactured by the Wilson Rubber Co., 1216 Garfield Ave., S. W., Canton, Ohio.

LOUD SPEAKING TELEPHONE.—A telephone which may be heard at considerable distance from the receiver. These telephones have a lower resistance and usually operate on a higher voltage than ordinary telephones. See Telephones, loud speaking, for further details and listings of manufacturers.

LOUGH BROS.—90 West St., New York, N. Y. Manufacturers of brass, bronze, aluminum and die castings.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION.—Secretary, I. G. Marks, 323 Chartes St., New Orleans, La.

LOUISIANA METAL CABINET WORKS.—1019 Bienville St., New Orleans, La. Manufacturer of sheet steel cabinets, switchboards, panelboards, cutout boxes, signs, etc. Business established 1916. General manager, R. J. Holzer.

LOUISVILLE ELECTRIC MFG. CO., INC.—31st and Magazine Sts., Louisville, Ky. Manufacturer of motors, generators and portable electric tools. Business established 1920. President, Charels E. Willey; vice-president, James F. Willey.

LOUISVILLE MACHINE MFG. CO., THE.—Louisville, Ohio. Manufacturer of electric coffee mills and meat choppers. Business established 1904. President, A. L. Keim; vice-president, treasurer and general manager, Paul F. Loichot; secretary and sales manager, A. Rodgers. Main office and factory, Louisville, Ohio. Branch office, 11 E. 125 St., New York, N. Y.

LOVE.—Trade name for electric automobile heaters manufactured by the Suburban Lighting Co., Toledo, Ohio.

LOVEJOY AUTOMATIC DOOR OPENER CO.—Laramie, Wyo. Manufacturer of electrically operated door openers. Business established 1919. President and general manager, E. F. Lovejoy; vice-president, Nellie Lovejoy; secretary and treasurer, C. D. Spalding.

LOVELL & CO., F. H.—Arlington, N. J. Manufacturers of letter boxes and conduit hangers.

LOV LITE.—Trade name for lighting fixtures manufactured by the Liberty Lamp & Shade Co., 103 Court St., Brooklyn, N. Y.

LOWELL INSULATED WIRE CO.—171 Lincoln St., Lowell, Mass. Manufacturer of insulated wires. Business established 1903. President, John J. Hogan; vice-president, George M. Harrigan; treasurer, general manager and sales manager, Reuben Dunsford.

LOWELL WRENCH CO.—Worcester, Mass. Manufacturer of ratchet wrenches, drills and die stocks. John H. Dodge, general manager. Sales representatives, A. W. Secor, 76 Fulton St., New York, N. Y.; F. Somers Peterson Co., 57 California St., San Francisco, Cal.

LOXODOGRAPH.—An electrical instrument used to record the course of a vessel at sea, which combines the action of magnetism and photography to produce the record.

LOXON.—Trade name for locking lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

LSA.—Trade name for ball bearing manufactured by the Langhaar Ball Bearing Co., Aurora, Ind.

LSCO.—Trade name for commercial lighting unit manufactured by the Lighting Studios Co., 220 W. 42nd St., New York, N. Y.

LUBRICANTS, COMMUTATOR. — See Compounds, commutator lubricating.

LUBRICANTS, CONDUIT FISHING.—See Soapstone, pulverized.

LUBRICATE.—To apply a lubricant, such as oil, grease or graphite, so as to make smooth or to reduce the friction between moving parts of machinery.

LUBRICATION.—Power-plant lubrication embraces all lubrication of bearings for moving parts of engines, turbines, auxiliaries, generators, motors, shafting and minor mechanisms. It also provides for the

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distribution and treatment of the lubricant. Restricted feed lubrication, for small journals and minor mechanisms of larger machines, is accomplished by oil cups, which are filled from time to time. There are many modifications of this type of lubricator. Ring oilers, rings encircling the journal and dipping in an oil bath or reservoir which is usually included within the lower bearing casing, are employed for small high-speed engines and many types of slow-speed heavy machines, such as compressors, motor-generator sets, exciters, etc. There are many types of oil well, siphon, wick, and centrifugal lubricators.

For the large machines, such as turbines and main generators, the oil is commonly fed to the bearings under pressure, by gravity under light or high pressure. For step and thrust bearings of heavy machines high pressure is required. The supply may be separate for each machine or one system may supply many machines. The oil is circulated through the bearings through a filter and perhaps a cooler to a storage tank of up to several hundred gallons capacity. Filtering of oil is important. It assures clean, efficient oil and increases the life of the lubricant enormously. Oil filters may be individual for each engine or turbine unit or may be centralized for the entire plant. Also see Lubricators; Oil and grease cups; Oil, lubricating; Oilers, engineers', dynamo and motor tenders'; Oiling devices; Oiling systems, circulating or continuous; Oil filters, dehydrators and purifiers.

LUBRICATORS, CYLINDER.—These are devices for feeding oil into an engine cylinder against the steam pressure. There are a number of types used, but practically all consist essentially of a steam-tight brass cup with a pipe connection and valve. The cup is attached to the steam chest or supply pipe below the throttle. The cup is filled with oil and the valve opened. The full steam pressure to which the oil is subjected is equal to the cylinder pressure and the lubricant is permitted to gravitate through the valve into the cylinder. Various modifications, some of them involving hydrostatic pressure in addition to the steam pressure, are employed in these devices.

Manufacturers:

Carleton Co., The, 170 Summer St., Boston, Mass. "Big 4."
Faul Co., William J., 133 Front St., New York, N. Y.
Greene, Tweed & Co., 109 Duane St., New York, N. Y.
Griffiths & Sons, James A., 1315-17 Buttonwood St., Philadelphia, Pa.
Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill.
Keystone Lubricating Co., Philadelphia, Pa. "Keystone."
Lunkenheimer Co., The, Cincinnati, Ohio. "Beacon", "Mars", "Paragon", "Premier", "Alpha", "Colonel", "Independent", "Invincible", "Junior", "Major", "Marvel", "Senior", "Universal".
Manzel Brothers Co., 327 Babcock St., Buffalo, N. Y. "Manzel."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
McCullough Mfg. Co., 2632 Central Ave., Minneapolis, Minn.
Ohio Grease Co., The, Loudonville, Ohio. "Ohio."
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Sherwood."
Swain Lubricator Co., 443 W. 37th St., Chicago, Ill. "Swain."
Williams Valve Co., The D. T., Cincinnati, Ohio.

LUBRICATORS, FORCE-FEED.—These devices consist of an automatic pump which takes oil from a reservoir and forces it into the steam supply pipe. The pump is directly driven from the engine. The rate of feed can be controlled by adjusting the length of the stroke of the pump piston. There are a number of such systems operating on this general principle.

Manufacturers:

Detroit Lubricator Co., Trumbull, Lincoln, Marquette and Viaduct, Detroit, Mich. "Detroit."
Greene, Tweed & Co., 109 Duane St., New York, N. Y. "Multiplus", "Rochester."
Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill. (Also electrically driven.)
Lunkenheimer Co., The, Cincinnati, Ohio. "Alpha", 'Invincible", "Marvel", "Universal."
Madison-Kipp Corp., Waubesa St., Madison, Wis. "Oil-Kipps."
Manzel Brothers Co., 327 Babcock St., Buffalo, N. Y. "Manzel."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
McCullough Mfg. Co., 2632 Central Ave., Minneapolis, Minn.
Powell Co., William, Cincinnati, Ohio.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.
Vulcan Engineering Sales Co., 1765 Elston Ave., Chicago, Ill. "Hanna."

LUCAS.—Trade name for track frogs, crossings, switches, switch stands, etc., manufactured by the Cleveland Frog & Crossing Co., Cleveland, Ohio.

LUCERO.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

LUCEY MFG. CO.—New York, N. Y. Manufacturer of turbogenerators and portable lighting and power plants. Main office, Woolworth Bldg., New York, N. Y. Factories, Houston, Tex., and Chattanooga, Tenn. Branch offices, 1515 E. 7th St., Los Angeles, Cal; Kohl Bldg., San Francisco, Cal.; Oliver Bldg., Pittsburgh, Pa.; Mason Bldg., Houston, Tex.; Beaumont, Tex.; Shreveport, La.

LUCKOW PROCESS.—An electrolytic method for the production of a salt at the anode, utilizing an electrolyte of an alkali salt and an anode of the metal of which the salt is to be produced. The cathodic alkali reacts with the salt dissolved at the anode to form hydroxide of the anode metal, the hydroxide being removed, washed and dried. Compounds which have been produced commercially by methods of this kind are white lead, cuprous oxide, chrome yellow, and lead peroxide.

LUCO.—Trade name for bar solder manufactured by the Thomas F. Lukens Metal Co., 238 N. 4th St., Philadelphia, Pa.

LUDLUM ELECTRIC FURNACE CORP.—Watervliet, N. Y. Manufacturer of electric furnaces. President, Edwin Corning; secretary, H. E. Batchelor. Main office and factory, Watervliet, N. Y. Branch office, 1237 W. Washington St., Chicago, Ill.

LUDLUM STEEL CO.—Watervliet, N. Y. Manufacturer of magnet, electric and other steels. Business established 1854.

LUFKIN RULE CO., THE.—Saginaw, Mich. Manufacturer of measuring tapes and rules for electricians, etc. President and general manager, Fred Buck; vice-president and treasurer, Theodore Huss; secretary, H. F. Krauss. Main office, Saginaw, Mich. Factories, Saginaw, Mich., and Windsor, Ont., Can. Branch offices, 106 Lafayette St., New York, N. Y.

LUGS, CABLE AND WIRE, CAST OR WROUGHT.—It is difficult to connect a stranded cable or large solid conductor directly to a switch or machine terminal or busbar. In construction practice this is always done by fastening a special terminal lug to the end of the cable or conductor. The lug is a short piece of copper or brass with one end in the form of a threadless pipe cap or socket, which gradually tapers down to a flattened rectangular or circular section at the other end. The flattened end is drilled for slipping over a stud or bolt to which it is secured by a nut or pair of nuts. The cable or wire is placed in the pipe end or socket and a soldered joint made. These lugs are usually cast, but sometimes wrought from heavy tubing; they are made in numerous sizes and shapes, some having offsets or making angle connections. They are used for making connections on switchboards, transformers and large machinery. The similar devices used on smaller wires are called wire terminals; for these see Terminals, wire, miscellaneous.

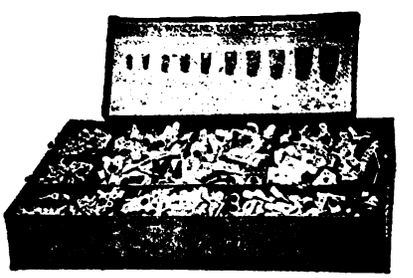
Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
Converter Sales Co, Inc., 116 Market St., Newark, N. J. ("King" for motion-picture lamp house.)
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eby Mfg. Co., H. H., 13th and Wallace Sts, Philadelphia, Pa. "E B."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv., page 1261.)
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv., page 1260.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.
Frankel Connector Co., Inc., Hudson and Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich. "Becco."
Minnesota Electric Co., 309 2nd Ave., Minneapolis, Minn.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. "Multi."
MUTUAL ELECTRIC & MACHINE Co., 858 Fort St., West, Detroit, Mich. "Cold flowed" lugs. Because of their method of formation, these lugs have greater mechanical strength than



"Cold Flowed Lugs"

the tubular type. Their flat contact surface, which equals a milled surface, insures perfect contact, and they require approximately only 50% of the solder necessary with other lugs, same capacity. "Cold flowed" lugs are made in three sizes only, 60, 100 and 200 amps. capacity. We also manufacture a complete line of tubular lugs, 30-amps, to 1050-amp. capacities, inclusive. To those who use or sell any quantity of lugs, we recommend our lug assortment cabinet. There are ten compartments, each containing a quantity of lugs of one of the different sizes. This



Lug Assortment Cabinet

cabinet is a wonderful convenience providing the means of keeping all lugs in one container, showing at a glance which sizes are running low and enabling one to select in a moment just the lug or lugs wanted. As a time saver it will soon pay for itself. Also see display adv. page 1285.—Adv.

PATTON-MAC GUYER CO., Providence, R. I. We manufacture a complete line of standard and special cable lugs and terminals. Correct design, smooth contact surfaces and ample copper capacity insures maximum conductivity. Descriptive bulletin upon request.—Adv.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
Rome Mfg. Co., Rome, N. Y. "Rome."

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SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv., page 1323.)

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Stevens Tank & Tower Co., 9-23 Center St., Auburn, Me. "Dirigo."

TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv., pages 1282-1283.)

TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., The, Bantam, Conn. Catalogs copper terminal lugs of all standard



T. V. Copper Terminal Lug

styles in capacities from 30 to 5000 amp.—Adv.

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

Worcester Electric & Mfg. Co., Worcester, Mass.

LUKENS METAL CO., THOMAS F.—238 N. 4th St., Philadelphia, Pa. Manufacturer of solder and babbitt metal for electrical purposes.

LUMALITE.—Trade name for luminous attachments for lamp sockets, etc., manufactured by the Leonard Watch Co., 10 S. Wabash Ave., Chicago, Ill.

LUMBER, INSULATING, MISCELLANEOUS COMPOSITION.—These materials are noninflammable, insulating compositions, very hard and durable and can be sawed and drilled like ordinary lumber. They are supplied in slab or board form in several dimensions and thicknesses, and are used for various electrical purposes, mainly in the construction of high-tension switch-house equipment, such as switch and circuit-breaker barriers, switch cells, bus compartments, etc.

LUMECO GENUINE.—Trade name for babbitt metal for electrical purposes manufactured by the Thomas F. Lukens Metal Co., 238 N. 4th St., Philadelphia, Pa.

LUMEN.—The lumen is the unit of luminous flux, equal to the light flux emitted in a unit solid angle by a source of one candlepower (1 international candle.). The unit solid angle, called a steradian, is the angle that would be formed at the center of a sphere by the vertex of a cone whose base occupied $1/(4\pi)$ times the surface of the sphere; in a sphere there are 4π steradians. Consequently a source of one mean spherical candlepower emits 4π lumens $= 12.57$ lumens.

The Illuminating Engineering Society and the American Institute of Electrical Engineers recommend that lamps be rated as to output in lumens instead of candlepower. The latter is an expression of luminous intensity (usually in the horizontal direction or some other specified direction) and not of the total light or luminous flux output. Also see Luminous flux.

LUMEN BEARING CO.—Buffalo, N. Y. Manufacturer of bronze and brass castings, bars, bushings, etc.

LUMINA.—Trade name for illuminating glassware manufactured by the Hocking Glass Co., Lancaster, Ohio.

LUMINESCENCE.—Any emission of light occurring at low temperatures and not ascribable directly to incandescence. It can be produced in several ways, such as the glow of glass in evacuated tubes when subjected to electric oscillations of high frequency, or by exposure to light, when some is absorbed and emitted again.

LUMINOUS ARC LAMPS.—See Lamps, arc, metallic flame, magnetite or luminous.

LUMINOUS ELECTRIC RADIATOR.—A portable heating device that emits a pleasant glow while heating. See Heaters, electric, air or space, or radiators, luminous type.

When writing to manufacturers please mention the

E M F ELECTRICAL YEAR BOOK

LUMINOUS ATTACHMENTS AND COMPOUNDS.—See Attachments, luminous for switch buttons, etc. Compounds, luminous.

LUMINOUS FLUX.—Luminous flux is radiant power evaluated according to its capacity to produce the sensation of light. Luminous flux may be thought of as light output or the radiant flow of light energy issuing from a luminous source. It is measured in lumens, the lumen being the flux emitted in a unit solid angle (or steradian) by a point source of one candlepower. The modern method of rating lamps is in lumens instead of candlepower.

To laymen the ideas of luminous flux and the lumen are unfortunately found difficult to grasp, largely because they involve reference to a unit solid angle. A clearer conception may be derived by considering light to consist of rays issuing from the source in various directions. If each ray is conceived to represent a definite unit quantity of light, then the number of rays emitted or radiating from the source will represent the total light output (total luminous flux.) Having a standard light source, such as one candlepower, the number of unit rays of light sent out in a unit conical beam would constitute a unit quantity of light output (or lumenous flux) which unit is called the lumen. If the total surface of a sphere is divided into 12.57 $(=4\pi)$ equal areas and these reconstructed into circles of equal area, each of these circles will form the base of a unit cone, one which has at its apex a unit solid angle. Light rays, however, are not actually assigned any definite unit or standard value so that the lumen, or the light emitted in such a standard unit cone as above described and constituting the unit of light flux, does not represent a specific number of light rays. The latter may aid nevertheless in giving a clearer conception of luminous flux and the lumen.

LUMINOUS INTENSITY.—The luminous intensity of a point source of light is the solid angular density of the luminous flux emitted by the source in the direction considered; or it is the flux from that source per unit solid angle. The unit solid angle is the angle formed by the vertex of a cone at the center of a sphere, in whose surface the base of the cone lies, the base of which cone occupies $1/(4\pi)$ surface of the sphere. The international candle is the unit of luminous intensity used in the United States, Great Britain, France and numerous other countries.

LUMINOUS SIGN SALES CORP.—Chicago, Ill. Manufacturer of electric signs and sign lighting equipment. President and treasurer, S. L. Herzog; vice-president, William Peterson; secretary and sales manager, A. M. Mittenberg. Main office, 431 S. Dearborn St., Chicago, Ill. Factories, Chicago, Ill.; San Francisco, Cal. Sales representatives, Skirboll Bros., 502 Standard Theatres Bldg., Cleveland, Ohio; H. A. Therneau, 726 St. Peter St., New Orleans, La.; Novelty Electric Sign Co., 165 Eddy St., San Francisco, Cal.

LUMINOUS SPECIALTY CO.—236-238 S. Meridian St., Indianapolis, Ind. Manufacturer of lighting fixtures and specialties. Business established 1915. President, John S. Scott; vice-president and general manager, Herbert E. Cave; secretary, Charles S. Walker.

LUMINOUS SWITCH BUTTONS AND PLATES.—See Switch buttons and plates, luminous.

LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO.—St. Louis, Mo. Manufacturer of electric lighting fixtures. Business established 1902. President, Edwin F. Guth; vice-presidents, G. S. Watts, R. V. Owen; secretary, C. M. Wempner; treasurer and general manager, Oscar D. Guth; sales manager, Joe Chassaing. Main office and factory, 2615 Washington Ave., St. Louis, Mo. Branch offices, Boston, Mass.; Pittsburgh, Pa.; Philadelphia, Pa.; Atlanta, Ga.; New Orleans, La.; Cincinnati, Ohio; Detroit, Mich.; Minneapolis, Minn.; Kansas City, Mo.; Los Angeles, Cal.; Portland, Ore.; 108 S. LaSalle St., Chicago, Ill.; 50 Church St., New York, N. Y.

LUM-VITRO.—Trade name for porcelain enameled switch plates made by the Luminous Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

LUNA.—Trade name for illuminating glassware manufactured by the H. Northwood Co., 36th and Wetzel Sts., Wheeling, W. Va.

LUNGMOTOR CO.—711 Boylston St., Boston, Mass. Manufacturer of resuscitation apparatus. Business established 1913. President, C. B. Thomas; treasurer, Thomas Hadley; general manager, Louis D. Jones.

LUNKENHEIMER CO., THE.—Cincinnati, Ohio. Manufacturer of valves, injectors, valves and other steam specialties. Business established 1862. President, Eshelby F. Lunken; vice-presidents, David C. Jones, H. Frederick Schaefer, Alfred J. Jupp; secretary, Charles A. Brown; treasurer, Lawrence J. Bradford. Main office and factory, Cincinnati, Ohio. Branch offices, 136 High St., Boston, Mass.; 568 W. Washington Blvd., Chicago, Ill.; 129-135 Lafayette St., New York, N. Y.; 211 Camp St., New Orleans, La.; 355 5th Ave., Pittsburgh, Pa.; 116 New Montgomery St., San Francisco, Cal.

LUNOE & SOULE.—622 79th St., Brooklyn, N. Y. Manufacturers of automobile signals.

LUSTRE ART GLASS CO.—Maspeth, Long Island, N. Y. Manufacturer of illuminating glassware.

LUTHY PRODUCTS CORP.—1170 Broadway, New York, N. Y. Manufacturer of hydrometers and battery fillers.

LUX.—A unit of illumination equal to one lumen incident per square meter. It is equivalent to 0.0001 phot or 0.0292 footcandle.

LUX MFG. CO.—Newark, N. J. Manufacturer of incandescent lamps. President, A. T. Baldwin; vice-president, O. Foell; secretary, R. M. Schwarz; treasurer, A. T. Baldwin. Main office, 123-133 E. Kinney St., Newark, N. J. Branch offices, 1328 Broadway, New York, N. Y.; 160 N. Wells St., Chicago, Ill.

LUXSOLITE.—Trade name for street lighting fixtures manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LUXUAL.—Trade name for illuminating glassware manufactured by the Gill Glass Co., Inc., Amber and Venango Sts., Philadelphia, Pa.

LUZERNE RUBBER CO., THE.—Trenton, N. J. Manufacturer of rubber tubes, rods, battery jars and other hard rubber products. Business established 1905. President, Bruce Bedford; secretary and treasurer, C. Dudley Wilson. Main office and factory, Trenton, N. J. Branch office, 564 W. Monroe St., Chicago, Ill.

LYHNE.—Trade name for portable lamps manufactured by the Beers Sales Co., 1 Hudson St., New York, N. Y.

LYHTAN.—Trade name for gas-filled tungsten incandescent lamps manufactured by the Electric Lamp & Products Co., 512-514 Paterson Plankroad, Jersey City, N. J.

LYHTAN ELECTRIC LAMP CO.—591 Central Ave., Jersey City, N. J. Manufacturer of incandescent lamps. President, Anton C. Eggers; vice-president, John H. Goetze; secretary, Dr. C. E. Moehle; treasurer, Otto F. Kappelmann.

LYNN LEATHER WASHER & MAT CO.—East Lynn, Mass. Manufacturer of leatherheads for nails, washers, etc.

LYON.—Trade name for respirator manufactured by the Cleveland Breathing Machine Co., 1833 E. 13th St., Cleveland, O.

LYON.—Trade name for tinners' shears manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

LYON & HEALY.—245 S. Wabash Ave., Chicago, Ill. Manufacturers of electrically operated pianos. President, M. A. Healy; vice-president, C. Healy; secretary and treasurer, C. R. Fuller.

LYON FURNACE.—A type of electric furnace designed for the reduction of iron ore to pig iron; operated for some time in California.

LYON METALLIC MFG. CO.—Aurora, Ill. Manufacturer of boxes, shelving, cabinets, etc.

LYONS.—Trade name for storage batteries manufactured by the Lyons Storage Battery Co., Inc., Stephen Girard Bldg., Philadelphia, Pa.

LYONS STORAGE BATTERY CO., INC.—Philadelphia, Pa. Manufacturer of storage batteries for automobile ignition, starting and lighting. President, A. H. Lyons; secretary, E. M. Gillespie; treasurer, G. W. Younkman. Main office, Stephen Girard Bldg., Philadelphia, Pa. Branch office, Kimball Bldg., Chicago, Ill.

LYTESTRONG.—Trade name for shafting hangers manufactured by the Bond Foundry & Machine Co., Manheim, Lancaster, Pa.

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M

M.—Symbol for mutual inductance or coefficient of mutual inductance. The form m is also a symbol for mass and is the symbol for a unit magnetic quantity or a unit magnetic pole. It is also an abbreviation for meter, a unit of length, and for minute, a unit of time.

M. A.—Trade name for casting copper manufactured by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

M. & W.—Trade name for tungsten incandescent lamps manufactured by the M. & W. Co., Springfield, Mass.

M. & W. CO.—30 Taylor St., Springfield, Mass. Manufacturer of tungsten incandescent lamps. Business established 1912. President, treasurer and general manager, C. F. Munder; vice-president, C. A. Wiegand; secretary, K. F. Wiegand.

MABEY ELECTRIC & MFG. CO.—968 Ft. Wayne Ave., Indianapolis, Ind. Manufacturer of electric heating appliances. Charles W. Mabey, owner.

MAC.—Trade name for pocket ammeters and battery testers made by the Metric Appliance Co., 299 Broadway, New York, N. Y.

MACALLEN CO., THE.—16 Macallen St., Boston, Mass. Manufacturer of fixture insulators and other insulating joints. Business established 1892. Vice-presidents, Louis McCarthy and Louis B. McCarthy; secretary, Gardner W. Prouty; treasurer and general manager, Louis McCarthy; sales manager, Walter A. Graham.

MACBETH.—Trade name for color identification and daylight lamps made by the Artificial Daylighting Co., 227 W. 17th St., New York, N. Y.

MACBETH ARC LAMP CO.—Philadelphia, Pa. Manufacturer of photographic lamps.

MACBETH-EVANS GLASS CO.—Pittsburgh, Pa. Manufacturer of illuminating glassware. Business established 1869. President and treasurer, Thomas Evans; vice-president, Howard S. Evans; secretary, George D. Macbeth; sales manager, J. E. Capen. Main office, Chamber of Commerce Bldg., Pittsburgh, Pa. Factories, Charleroi, Pa.; Elwood, Ind.; Bethevan, Ind.; Toledo, Ohio. Branch offices, New York, N. Y.; Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; San Francisco, Cal.; Macbeth-Evans Glass Co., Ltd., Toronto, Ont., Can.

MACBETH ILLUMINOMETER.—Trade name for portable photometer manufactured by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

MACDONALD CELL.—A type of cell for the electrolytic production of bleach liquor.

MAC GILLIS & GIBBS CO., THE.—Milwaukee, Wis. Manufacturer of cedar poles, posts and railway ties. Business established 1902. President and general manager, J. E. Gerich; secretary and sales manager, M. Sperry; treasurer, E. Koester. Main office, 1201-09 Wells Bldg., Milwaukee, Wis. Yards, Gladstone, Mich.; Minnesota Transfer, Minn.; Duluth, Minn. Branch offices and warehouses, Gladstone, Mich.; Minneapolis (Minnesota Transfer), Minn. District offices, 613 Railway Exchange Bldg., Chicago, Ill.; Escanaba National Bank Bldg., Escanaba, Mich.; 515 Lyceum Bldg., Duluth, Minn.

MACHEN ELECTRIC MFG. CO.—Bridesburg, Philadelphia, Pa. Manufacturer of electrical wiring specialties. Business established 1920. President, treasurer and sales manager, Charles H. Machen; secretary, Hart A. Stoddard. Main office and factory, 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa. Branch offices, 280 Broadway, New York, N. Y.; 549 W. Washington St., Chicago, Ill.; 213 E. Jefferson Ave., Detroit, Mich.

MACHINEBRONZE.—Trade name for bronze bars and bushings manufactured by the Lumen Bearing Co., Buffalo, N. Y.

MACHINE, CHARGING.—Charging machine is the name given to a charging generator used in a telephone exchange. It is a d-c. generator used for charging the main battery. For telephone service this generator must not make much noise, for it is usual to charge the battery at the same time that it is being used for conversation.

MACHINE, D-C.—A motor converting d-c. energy into mechanical energy, or a generator converting mechanical energy into electrical energy in the form of direct current. See Generators, d-c., and Motors, d-c.

MACHINE, ELECTRICAL.—A machine which transforms (1) mechanical energy into electrical energy, or (2) electrical energy into mechanical energy, or (3) electrical energy of certain qualities into electrical energy of the same or different qualities. These of the first group are called generators; of the second, motors; and of the third, converters, dynamotors, phase modifiers, etc. Electric machines may be classified into electrostatic and electromagnetic, depending upon the principles employed in their operation. See Electrostatic machines; Machines, dynamoelectric; Generators; Magneto; Motor.

MACHINE, ELECTROSTATIC.—See Electrostatic machines.

MACHINE, ENCLOSED AND OPEN.—A definition of electrical machines as to the relative amount of enclosure. See under Motor, electric.

MACHINE, RATING OF.—In electrical machines, the rated output as stamped on the name plate, based on the maximum load the machine can carry under prescribed test conditions.

MACHINE, STATIC.—An electrostatic machine. See Electrostatic machines.

MACHINERY, SPECIAL ELECTRICAL.—This classification is intended to include machines built to meet special, exceptional, or peculiar requirements of manufacturers, central stations, electric railways, telephone companies, testing or research laboratories, etc. Such machines are built to order on drawings and specifications furnished by the purchaser, as a rule. Some of the manufacturers that make a specialty of such machinery are also prepared to design details of the machines or the machines as a whole.

Manufacturers:

Levi, Benjamin, 355 W. Broadway, New York, N. Y.

MACHINERY FOR MANUFACTURE OF SMALL PARTS FOR FIXTURE FITTINGS, BATTERIES, ETC.—Much of the machine work on small metal parts used in the manufacture of electrical devices and supplies may be done on special machinery. Such machinery is sometimes automatic or semiautomatic and is particularly adaptable to quantity production. The usual operations performed by the machines are drilling, threading, facing, turning, pointing, rounding, etc. Many small parts of fixture fittings, battery and instrument terminals, switches, sockets and other wiring devices, appliances, etc., are made on such machines at low cost and at high speed.

Manufacturer:

Baird Machine Co., The, Bridgeport, Conn.

Long-Henkel Mfg. Co., S. W. Cor. 3rd and Buttonwood Sts., Reading, Pa. ("Jackson" automatic chucking machine.)

MACHINES, DYNAMOELECTRIC.—Machines utilizing the principle of electromagnetic induction for the conversion of mechanical energy into electrical energy in the form of electric currents, or the reverse, by having relative motion between electric conductors and a magnetic field or by changing the magnetic flux passing through one or more coils by the movement of a part of the machine.

Dynamoelectric machines usually consist of two principal parts, a field magnet through which the magnetic field is produced and an armature upon which are the conductors that carry the main current. To utilize the principle of electromagnetic induction in changing from one kind of power to another, the armature may rotate with respect to the field magnet, or the reverse, or both may rotate so as to produce relative motion between them, or an iron structure with uniformly spaced projections may rotate, thus causing the flux through the coils of the armature winding to pulsate, as in the inductor type alternator. In any case, a change of the magnetic flux linked with an electric current is accompanied by mechanical motion of one or more parts.

Classification. Dynamoelectric machines changing energy from mechanical to electrical are called generators, and those changing electrical energy into mechanical are called motors; occasionally one machine may combine both motor and generator elements, as in what are called "dynamotors." They may also be classified by the character of the current as direct-current or alternating-current machines.

D-c. machines may again be subdivided according to the manner of producing the field excitation into separately excited machines receiving their exciting current from a separate source; shunt machines, having an exciting winding in shunt with the armature or load winding; series machines, having an exciting winding in series with the armature; and compound machines, having both a series and shunt exciting winding. D-c. machines nearly always have a rotating armature provided with a commutator for keeping a unidirectional current in the external circuit. Brushes bear on the commutator to make electrical connections to the armature.

A-c. machines are of two general types, the synchronous, which run at fixed speeds and frequencies, and the asynchronous or induction, whose speeds or frequencies change with the load. The synchronous machines are always excited by direct current, usually through a separately excited winding, while the asynchronous commonly have alternating exciting current in the same winding with the load current. Asynchronous machines are used more as motors than as generators, the induction motor being the most common type.

Development. The principle of electromagnetic induction upon which all dynamoelectric machines operate was discovered by Faraday in 1831 when he found that the starting and stopping of a current in one circuit produced a current in an adjacent circuit. This was followed by the discovery that moving a coil past the poles of a magnet, or the reverse, also produced a current. He then developed his disk dynamo in which a copper disk was revolved between the poles of a permanent magnet and a current created in an external circuit through one brush bearing on the periphery of the disk and another on the shaft. Other forms using rotating coils were tried by Faraday and other investigators. Most machines were equipped with commutators so as to get unidirectional currents.

The use of electromagnets instead of permanent magnets was patented by Wheatstone and Cooke in 1845, a combination which permitted the building of machines of much larger power. Such magnets were separately excited but a scheme providing for self excitation by the machine's own current was patented by Hjorth in 1855. Series windings were first used. Wheatstone proposing a shunt circuit for excitation in 1867, and compound windings being used about the same time.

In 1865 Pacinotti used a toothed ring for an armature core and put on it a closed-coil winding, previous windings being of the open-coil type. A smooth-core ring armature with a closed-coil winding was developed independently by Gramme in 1870. This type of winding with a many-segment commutator gave a much steadier current than that previously obtained. The shuttle-wound armature was brought out by Siemens in 1856 and was modified by von Hefner Alteneck in 1873 into a uniformly wound drum with a closed-coil winding giving the same result as the Gramme ring armature. The subsequent development of the d-c. machine has been mainly in the refinement of details, the most important additions being the introduction of interpoles or commutating poles to improve commutation and of compensating windings to neutralize armature reaction.

A-c. generators were developed along

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with d-c. machines, the inductor type being an early form, some being self-excited, others separately excited, but were not at first used as much as the d-c. generators. The synchronous operation of alternators was discovered by Wilde in 1868, a principle now applied in parallel operation. With the later development of the a-c. transformer, the induction motor and the synchronous converter, the use of alternating currents greatly increased for the transmission, distribution and utilization of electrical energy, so that now a-c. generators greatly exceed d-c. generators in individual and combined capacities.

Electric motor development began with Faraday's discovery of electromagnetic rotation in 1821 and Barlow's invention of his wheel in 1823. Henry used the attraction by electromagnets to produce rotation in 1831. The fact that a dynamoelectric machine can function either as a generator or as a motor seems to have been discovered by Lens in 1838, and a multipolar motor was constructed by Jacobi in this same year. A generator transmitting power to a motor was exhibited in Vienna in 1873, and subsequent development of the d-c. motor has been almost parellel with that of the d-c. generator. In 1888, Ferraris showed how to produce a rotating magnetic field by two alternating currents that differ in phase. Tesla brought out the same idea independently and applied it in the induction motor, which has increased greatly in use since 1890. Other types, such as the repulsion motor and other induction motors with commutators, have been developed but have a more limited application than the straight induction motor.

MACHINES, MOTOR-DRIVEN, MISCELLANEOUS.—There will be found separately listed elsewhere in this book a large number of electrically driven machines. It was the intention to list only those machines which are furnished with electric motor drive as standard equipment. However, there is a very large number of machines normally equipped for belt or direct engine drive which can also be obtained complete with electric motor for individual drive. All such machines are included under this classification. A complete list of such machinery would include practically all machines used in machine shops, such as shapers, planers, lathes, milling machines, etc.; in woodworking shops, such as saws, planers, jointers, etc.; in textile mills, flour mills, cement and clay working plants, and in practically every industry. The following listings are by no means complete. They include chiefly firms manufacturing distinctively electrical machinery or other machinery used by the electrical industry.

Manufacturers:

American Machinery Co., Inc., 330 N. 12th St., Philadelphia, Pa. ("Philadelphia" sealing machines, "American" carton folding.)

American Sharpening Machine Co., Inc., 184 W. Washington St., Chicago, Ill. ("Green Automatic," "American Junior" razor blade sharpening machines; "American," "American Duplex" key cutting machines.)

Anstice & Co., Inc., Josiah, Rochester, N. Y. ("Sterling" potato masher.)

Bartlett & Snow Co., The, C. O., Cleveland, Ohio. (Car pullers, cement and and clay working machinery, foundry sand handling equipment, etc.)

Becker Milling Machine Co., 53 Franklin St., Boston, Mass. (Milling.)

Blake Electric Mfg. Co., Boston, Mass. ("Schwartz" guider.)

Brandeil Co., The. Union Central Tower, Cincinnati, Ohio. "Brandeil." (Concrete making machines.)

Brown & Sharpe Mfg. Co., Providence, R. I. (Milling machines.)

Bucher-Smith Co., East Liverpool, Ohio. (Key seaters.)

Covington Machine Co., Covington, Va. (Shears, bending rolls.)

Davenport Machine Tool Co., 167 Ames St., Rochester, N. Y. ("Davenport" screw machine.)

Dunn Mfg. Co., W. E., Holland, Mich. (For manufacturing concrete products.) "Dunn."

Excelsior Tool & Machine Co., East St. Louis, Ill. ("Excelsior" shears, lathes, etc.)

Franklin Machine Co., Providence, R. I. (Transmission and spun silk machinery.)

Fuller-Lehigh Co., Fullerton, Pa. (Cement pulverizing.)

Garvin Machine Co., The, Spring and Varick Sts., New York, N. Y. (Milling, die slotting, spindle drill press, screw.)

Gisholt Machine Co., 1241 E. Washington Ave., Madison, Wis. (Lathes.)

Gould & Eberhardt, Newark, N. J. (Gear cutting machinery.)

Gump Co., B. F., 431 S. Clinton St., Chicago, Ill. ("Ideal" flour mill machinery.)

Hadfield-Penfield Steel Co., The, Bucyrus, Ohio. (Clay working, bakery, cement, rotary driers, etc.)

Hall Kitchen King Co., 909 Mutual Life Bldg., Philadelphia, Pa. "Kitchen King."

Heebner & Sons, Lansdale, Pa. ("Little Giant" and "Pennsylvania," peanut and grain threshers.)

Houston, Stanwood & Gamble Co., The, Cincinnati, Ohio. (Lathes.)

Johnson Automatic Sealer Co., Ltd., Battle Creek, Mich. (Packaging and wax wrapping machines.)

Lange, Henry G., 162 N. May St., Chicago, Ill. (Glass beveling.)

Lippincott-Carwen Corp., Erie Ave. and Richmond St., Philadelphia, Pa.

Mattison Machine Works, Rockford, Ill. (Woodworking, molders, veneer trimmers, etc.)

Maxim Mfg. Co., 700 W. 22nd St., Chicago, Ill. "Sinteelo." (Butter cutting and potato mashing machines for hotels and restaurants.)

Mereen-Johnson Machine Co., Minneapolis, Minn. (Box making machinery.)

Mills & Brother, Thomas, 1301-1311 N. 8th St., Philadelphia, Pa. (Lemon and orange reamers.)

Murray, W. B., N. Winchester & Wabansia Aves., Chicago, Ill. (Artificial flower making machines.)

Myers Machine Tool Corp., Columbia, Pa. ("Myers" lathes, presses, etc.)

National Bundle Tyer Co., Blissfield, Mich. ("Saxmayer" tying machines.)

Newark Engineering & Tool Co., 476-482 18th Ave., Newark, N. J. ("Nerco" filing machines, etc.)

Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. (Sheet metal machines.)

Oliver Instrument Co., Adrian, Mich. (Filing and lapping.)

Patten Co., Paul B., Salem, Mass. (Railroad ticket destroyer.)

Peerless Equipment Co., Hanover, Pa. "Peerless." (Armature repairing.)

Pratt & Whitney Co., 111 Broadway, New York, N. Y. (Milling and wood working machinery.)

Pratt & Whitney Co. of Canada, Ltd., Dundas, Ont., Can. (Milling and wood working machinery.)

Sly Mfg. Co., The W. W., 4700 Train Ave., Cleveland, Ohio. "Sly Line."

Smith Co., The T. L., Old Colony Bldg., Chicago, Ill. ("Smith" concrete mixers.)

Smurr & Kamen Machine Co., 328 N. Albany St., Chicago, Ill. (Wire working machinery.)

Sprague Canning Machinery Co., 222 N. Wabash Ave., Chicago, Ill. (Labeling machines, scalders, etc.)

Stecher Co., Inc., The Charles, 2301 Knox Ave., Chicago, Ill.

Stimpson Equipment Co., Felt Bldg., Salt Lake City, Utah. (Flotation.) "Janney."

Stokes Machine Co., F. J., 17th and Cambria Sts., Philadelphia, Pa. (Tablet, powder filling, mixing and other pharmaceutical machinery.)

Western Iron & Foundry Co., Wichita, Kans. (Portable bar shear.)

Whitney & Son, Inc., Baxter D., Winchendon, Mass. (Wood shaper, saw bench, mortisers, boring machine, planers, etc.)

MACKINTOSH.—Trade name for electric centrifugal machines made by the S. S. Hepworth Co., 2 Rector St., New York, N. Y.

MACK MOLDING CO.—Little Falls, N. J. Manufacturer of molded insulation. President, K. W. Macksey; vice-president, W. R. Macksey; treasurer, D. S. Kendall.

MAC-LAR BATTERY CO., INC.—146 3rd St., Detroit, Mich. Manufacturer of storage batteries for automobile lighting and starting. Business established 1918. President, W. L. Malotte; vice-president, E. A. Bowman; secretary, W. J. Clarke; treasurer, L. A. Steele; sales manager, C. J. Larsen.

MACLEOD CO., THE.—Cincinnati, Ohio. Manufacturer of oil burners and sand-blast equipment. Business established 1897. President and treasurer, Walter Macleod; vice-president, S. C. Macleod; secretary, James Shields; general manager William A. Hext. Main office and factory, 2232 Bogen St., Cincinnati, Ohio. Sales representatives, Joseph M. Brown Co., Pioneer Bldg., Chicago, Ill.; C. H. Small Co., Monadnock Bldg., San Francisco, Cal.; Gaffron Sales Co., 25 Park Pl., New York, N. Y.

MACRAE, HECTOR C.—314 St. Paul St., Baltimore, Md. Manufacturer of storage batteries and boat lighting equipment. Business established 1895.

MADISON-KIPP CORP.—Waubesa St., Madison, Wis. Manufacturer of force feed lubricators and oiling devices. Business established 1898. President, T. A. Coleman; vice-president, T. E. Coleman; secretary, A. X. Merx; treasurer, J. A. Coleman.

MAGAZINE.—Trade name for grinding wheel dressers manufactured by the Desmond-Stephan Mfg. Co., Urbana, Ohio.

MAGAZINE FUSE.—A fuse in which several fusible elements have been so placed that when the one in use is blown another can be connected into the circuit by turning some part of the fuse casing. Also called multiple fuse and repeater fuse. It may be either a cartridge or plug type fuse and in either case is classed among renewable fuses. See Fuses, cartridge, renewable; also Fuses, plug, renewable.

MAG-CHARGER.—Trade name for magneto chargers manufactured by Paul G. Niehoff & Co., Inc., 232-242 E. Ohio St., Chicago, Ill.

MAGFIXER.—Trade name for magneto tester and remagnetizer manufactured by the Stahl Rectifier Co., 1401-5 W. Jackson Blvd., Chicago, Ill.

MAGIAN.—Trade name for lighting units manufactured by the Pennsylvania Sales & Export Co., 1414 S. Penn Sq., Philadelphia, Pa.

MAGIC.—Trade name for belt dressing manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

MAGIC EARPHONE.—Trade name for hearing device for the deaf manufactured by E. B. Meyrowitz, Inc., 520 5th Ave., New York, N. Y.

MAGIC PAIN RELIEVING LAMP CO.—544 Garfield Ave., Chicago, Ill. Manufacturer of therapeutic lamps.

MAGNAVOX CO., THE.—Oakland, Cal. Manufacturer of amplifiers and telephones. President and general manager, F. M. Steers; vice-president, J. C. Sperry; secretary and treasurer, E. B. Folsom; sales manager, W. R. Davis. Main office and factory, 2725 E. 14th St., Oakland, Cal. Branch offices, 616 Mission St., San Francisco, Cal.; 219 McDermott Bldg., Seattle, Wash.

MAGNESIA ASSOCIATION OF AMERICA.—702 Bulletin Bldg., Philadelphia, Pa. Manufacturer of boiler and pipe coverings.

MAGNET.—A body possessing the property of magnetism. The name is derived from Magnesia, where the iron ore (lodestone), possessing the property was first discovered. A magnet is almost invariably made of some form of iron. Magnets are usually classified as permanent and temporary. A permanent magnet is invariably made of hard steel and retains its magnetism indefinitely. Magnets in watt-hour meters, many direct-current measuring instruments, magneto generators, telephone receivers, etc., are permanent magnets. Temporary magnets are those that retain their magnetism only while the magnetizing force is present. They are usually made of soft iron or mild steel. Electromagnets are temporary magnets whose magnetism is developed by an electric current through a coil of wire around an iron core; this coil constitutes the magnetizing or exciting winding. Solenoids are electric coils without iron cores, usually in the form of a helix, that possess the properties of an electromagnet but not so strongly as when an iron core is included.

MAGNET.—Trade name for friction tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

MAGNET CHARGERS.—See Magnetizers and remagnetizers.

MAGNET, COMPOUND.—A number of single magnets parallel to one another and having similar poles together. This group or compound magnet is stronger in proportion to its bulk and weight than a single magnet.

MAGNET CORES.—See Cores, electromagnet.

MAGNET METERS.—Trade name for magnetic testing apparatus manufactured by Holz & Co., Inc., 18 Madison Ave., New York, N. Y.

MAGNET POLES.—The points or surfaces of a magnet at or on which the hypothetical substance magnetism is concentrated are called magnet poles. According to the conception of magnetic induction, magnet poles may be defined as those parts of the magnet at which the lines of induction enter and leave. A magnetized body thus has two poles, where the lines enter the south-seeking or south pole,

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and where the lines leave the north-seeking or north pole. In the definition of electromagnetic units, point poles are assumed. These are hypothetical poles having all of the magnetism concentrated at a point. Such poles are practically represented by the poles of a thin and long bar of steel. A unit magnet pole is defined as that pole which will exert a force of one dyne upon a like and equal pole at a distance of one centimeter in a vacuum. It has no name.

MAGNET STEEL.—See Steel, magnet.

MAGNET WINDERS. — See Winders, electromagnet.

MAGNET WIRE.—Insulated wire used for winding electromagnet coils. It may be cotton or silk-covered or enameled, or enameled and cotton or silk-covered; occasionally asbestos-covered wire is also used on magnets. See Wire, magnet (three types).

MAGNETA.—Trade name for electric clocks manufactured by the Magnetic Clock Co., 37-39 E. 28th St., New York, N. Y.

MAGNETIC AGING.—See Magnets, permanent.

MAGNETIC BRIDGE.—An adaptation of the magnetic shunt for use as a bridge for duplex submarine cable operation, consisting of an inductive shunt arranged with three arms, two fixed and one adjustable. Also see Magnetic shunt.

MAGNETIC CHUCK.—See Chucks, magnetic.

MAGNETIC CIRCUIT. — The complete path of the line of magnetic induction is called a magnetic circuit. It may be a closed magnetic circuit when it consists entirely of magnetic material, as in a transformer. An open magnetic cricuit is one composed partly of magnetic and partly of nonmagnetic material.

MAGNETIC CLOCK CO., THE.—37-39 E. 28th St., New York, N. Y. Manufacturer of electric clocks and time stamps. Business established 1918. Sole owner, H. L. Morath.

MAGNETIC CLUTCH.—A device for obtaining a grip upon some moving part, as a shaft, and operated by an electromagnet. For further details and manufacturers, see Chucks, magnetic.

MAGNETIC COMPASS.—A light permanent bar magnet pivoted so that it can swing freely in a horizontal plane serves as the magnetic compass. The interaction between the earth's magnetic field and that due to the magnetic needle of the compass orients it so that one of its ends, called the north or north-seeking, always points approximately to the north.

MAGNETIC CONTACTORS. — See Contactors, magnetic.

MAGNETIC DECLINATION.—The angle of variation of the compass needle from a due north and south line, caused by the magnetic poles of the earth not coinciding with the geographic north and south poles.

MAGNETIC DEGREE.—One 360th part of the angle subtended at the axis of a dynamoelectric machine by a pair of adjacent field poles. In a two-pole machine the magnetic and mechanical degrees are equivalent; in a four-pole machine there are two magnetic degrees for each mechanical degree; in a six-pole machine three magnetic for each mechanical, etc. The term electrical degree is sometimes used in place of magnetic degree, to which it is equivalent.

MAGNETIC FIELD.—The space surrounding a magnet is permeated with a property which will exert a mechanical force upon a magnet or magnetic substance. Such a space is a magnetic field. The intensity of a magnetic field at a point is measured by the force it exerts upon a unit magnet pole placed at that point. The unit of magnetic field intensity is the gauss. Its symbol is H.

The magnetic field about a magnet or electromagnet can be readily shown by laying a sheet of glass or cardboard over the magnet and sprinkling iron filings on the sheet. On tapping the latter the filings arrange themselves in the lines of magnetic induction (commonly called lines of force). The magnetic field is the region within which the filings show they are acted on by the magnet.

MAGNETIC FIELD AT CENTER OF CIRCULAR COIL.—When the diameter of a coil is large in comparison with its length, the field intensity at the center of the coil is 0.2π NI/r gausses, if I is in amperes and r, the radius, is in centimeters.

MAGNETIC FLUX.—The total magnetic induction through a plane at right angles to the lines of induction is called magnetic flux. Its symbol is Φ and the relation between B and Φ is $\Phi = BA$, where A is the area in sq. cm. and B is the average induction per sq. cm. If B is given per sq. in. then A must be in sq. ins. Magnetic flux is very commonly spoken of as the total number of lines of force (or induction), in a magnetic circuit.

Magnetic flux is practically measured by the e. m. f. induced in a coil of known number of turns and known area when it is made to cut the flux rapidly. The magnetic flux Φ developed by a current of I amperes through a coil of N turns in a magnetic circuit whose reluctance is R oersteds is : $\Phi = 1.257$ NI/R.

MAGNETIC FLUX DENSITY.—The magnetic flux, or number of lines of force, passing through a unit area of cross-section of a magnetic field. See also Magnetic flux; Magnetic induction.

MAGNETIC INDUCTION.—The development of magnetism in a magnetic body when it is introduced into a magnetic field is called magnetic induction.

Specifically, magnetic induction is defined as the product of the magnetic permeability by the magnetic intensity. Its symbol is B and algebraically $B = \mu H$. The unit of magnetic induction is the maxwell per square centimeter; it has no other generally accepted name. Magnetic induction is also called flux density, and is often defined as the number of lines of force (or induction), per unit area.

MAGNETIC INTENSITY AROUND A STRAIGHT WIRE.—When a current of I amperes flows through a straight wire the magnetic field is in the form of concentric cylinders with the wire as their axis. The direction of the magnetic lines is in the direction of the fingers if the wire is clasped with the right hand, the thumb being extended in the direction of the current flow. The intensity at a point d cm. distant from the wire is $0.2I/d$, when I is in amperes.

MAGNETIC LEAKAGE.—Stray magnetic lines of force which in a generator do not pass through the armature or in a transformer through the secondary coil, and so do no useful work.

MAGNETIC LINES.—A magnetic field is commonly thought and spoken of as consisting of lines, the number of which that cut a plane at right angles to the magnetic induction is a measure of the field intensity. They are imaginary lines and are commonly called "magnetic lines of force"; "magnetic lines" or "lines of induction" are better names. The idea of lines of force originated from the lines of magnetic induction observed when iron filings are sprinkled over a sheet of glass placed on a magnet.

MAGNETIC MFG. CO.—Milwaukee, Wis. Manufacturer magnetic separators and pulleys. Business established 1916. President, treasurer and general manager, R. H. Stearns; secretary, J. P. Bethke; sales manager, G. H. Fobian. Main office and factory, 774 Windlake Ave., Milwaukee, Wis. Branch offices, 1501 Monadnock Bldg., Chicago, Ill.; 380 Union Arcade, Pittsburgh, Pa.; 707 Franklin Trust Bldg., Philadelphia, Pa.; 1626 Chemical Bldg., St. Louis, Mo. Sales representatives, William J. Cullen, 141 Centre St., New York, N. Y.; George F. Crivel & Co., Elliott Square Bldg., Buffalo, N. Y.

MAGNETIC PERMEABILITY. — That property of magnetic substances which affects the degree of magnetization attainable through them. It corresponds to conductivity of electrical conductors. See Permeability for further details.

MAGNETIC POTENTIAL. — This is a quantity analogous to electric potential. The magnetic field intensity at any point P in space due to a point pole of m units d cm. distant from the given point is m/d^2. It requires an expenditure of m/d ergs of work to bring a unit pole from an infinite distance up to the given point. The magnetic potential of point P is m/d. This is plainly analogous to electric potential which is q/d.

MAGNETIC PULLEYS. — See Pulleys, magnetic separating.

MAGNETIC RELUCTANCE.—The ratio of the magnetomotive force to the resultant flux is called the reluctance of a magnetic circuit. It corresponds to resistance in an electric circuit, but does not represent a resistance to the flux in the sense of dissipating its energy. See Reluctance.

MAGNETIC SATURATION. — As the magnetizing force applied to a magnetic substance is increased the flux density first increases much more rapidly than the magnetizing force, but as the latter becomes very large the flux density increases more slowly and after a certain point it increases much less slowly than the magnetizing force. This point is commonly called the saturation point. It is not an absolutely definite value in most cases, depending on the material and its treatment. Practical saturation is reached in most iron and steel samples at about or below 100 ampere-turns per inch. Absolute saturation, beyond which no increase in flux density occurs regardless of further increase in the magnetizing force, is reached at about 10,000 ampere-turns per inch or above.

MAGNETIC SCREENS. — These are shields of soft iron interposed between a magnetic field and the apparatus or instrument to be protected from the inductive action of the field. Electrical measuring instruments are often enclosed in a soft iron case which prevents the penetration of external magnetic lines into the mechanism of the instrument and hence prevents their disturbing the true reading of the instrument.

MAGNETIC SEPARATOR.—A machine for removing iron ore from the foreign matter with which it is mixed, by a powerful electromagnet. A similar device is used to separate iron filings and cuttings from rubbish or from other non-magnetic metals with which the iron may be mixed. For further details and manufacturers see Separators, magnetic or iron.

MAGNETIC SHUNT. — An adjustable choke coil of low resistance and high inductance used in submarine cable telegraphy to make the recorder respond more promptly. At the beginning of a current impulse nearly all of the current passes through the recorder, but as the signal is sustained changes to the shunt. It is said to increase the speed about 12%.

MAGNETIC SOCKETS. — See Sockets, magnetic holding.

MAGNETIC STORMS.—Disturbances affecting the magnetic compass, and telephone and telegraph circuits using the earth for a return circuit and other similar grounded electrical circuits. They usually occur simultaneously with brilliant displays of the aurora borealis and are supposed to be caused by, or an accompaniment of, storms or spots on the sun. In some cases the induced earth currents are so severe as to interrupt all long-distance telegraph communication between cities in certain directions and it is claimed, to even burn out telegraph instruments.

MAGNETIC SUBSTANCES. — With reference to their behavior when introduced into a magnetic field, substances are classified as magnetic and nonmagnetic. Just as some substances conduct electricity more readily than others, so some substances are more permeable, or permit the development of a magnetic flux more easily than others. Substances within which magnetism can be developed more readily than in free space are called magnetic substances. Pure iron is the most easily magnetized and, due to its relative cheapness, is invariably used where a path of low magnetic reluctance is desired. Some other magnetic substances are nickel, cobalt and certain alloys of manganese known as Heusler alloys. Most substances possess no magnetic properties which distinguish them from air or free space. Their presence in a magnetic field produces no effect. Such substances are called nonmagnetic. Also see Permeability; Diamagnetic bodies; Paramagnetic bodies; Ferromagnetic bodies.

MAGNETIC TESTING APPARATUS AND INSTRUMENTS, MISCELLANEOUS.—The ordinary magnetic tests of iron and steel are for two classes of determinations. B-H curves and permeability tests, and the hysteresis and eddy-current losses. The determinations of the B-H curve and of permeability are made in several ways utilizing four general methods. Three of these methods are suited for shop tests where the accuracy required is not so great and the apparatus used in these tests will be found discussed under Permeameters.

The apparatus used in laboratories for precision measurement employs the ballistic method, a method in which the sample is wound with a secondary or test coil connected in series with a ballistic galvanometer, measurement being made by noting the deflection of the galvanometer when the current in the primary or magnetizing coil is changed in value or reversed. The standard set up for this test includes an iron yoke, standard solenoid, ballistic galvanometer, ammeter, storage battery variable resistances and switches. This determination may also be used for determining the hysteresis loss. The core loss may be determined by measuring the

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power loss by means of a wattmeter, the only special apparatus required being a coil of two windings within which the specimen is placed.

Other special apparatus is used for determination of the hysteresis loss which operates on the following principle. The test sample is mounted between the poles of a permanent magnet, the magnet being pivoted at the center of rotation. The test sample is rotated at a slow speed, producing a deflection of the pivoted magnet, this deflection being a measure of the hysteresis loss. This principle is modified in some types, the magnet rotating and the sample remaining stationary or the permanent magnet may be replaced by an electromagnet.

Manufacturers:

Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Holz & Co., Inc., 18 Madison Ave., New York, N. Y. "Magnet Meters."
Hoyt Electrical Instrument Works, Penacook, N. H. "Hoyt."
McDonnell Odometer Co., 3501-03 S. Kedzie Ave., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.

MAGNETISM.—Magnetism is a property exhibited by iron, steel, cobalt, nickel and to a lesser degree by numerous other substances. A magnetized body shows two characteristic properties. It tends to set itself in a definite direction when placed in a magnetic field, illustrated by the magnetic needle in the earth's field, and it tends to attract other magnetic substances, such as iron filings.

The region in the vicinity of a magnet is a field of force which can be mapped by placing a sheet of paper above the magnet and sprinkling iron filings on the paper. The filings will arrange themselves in curved lines between certain regions in the magnet known as magnetic poles. If a magnet is suspended so that it is free to rotate and another magnet is brought near it, like poles are found to repel each other and unlike poles attract each other. If free to do so, poles will move along the lines of force of a magnetic field, opposite poles moving in opposite directions.

The region around a conductor carrying an electric current is also found to be a field of magnetic force, the lines of which encircle the conductor. This can be demonstrated with a compass needle or, in the case of a large current, with iron filings. If the conductor is in the form of a long coil or solenoid with a large number of turns of insulated wire through which the current is flowing, the magnetic field in its interior will be of great intensity. An iron core placed in this field will become strongly magnetized. If the current ceases to flow, the iron will lose most of its magnetism. If a hard steel core is used, much of the magnetization will be retained, the steel becoming a permanent magnet. The important relation between an electric current and a magnetic field was discovered by Oersted about 1820.

Any electric charge in motion has been shown to produce a magnetic field, the intensity of which depends on the magnitude of the charge and upon its velocity. According to the electron theory, a current in a conductor is a stream of negative electrons in motion. If we assume that each atom of matter has electrons revolving around it like planets around the sun, each atom will have a magnetic field perpendicular to the plane of rotation of the electrons. In an unmagnetized substance the planes of rotation of the electrons vary in direction in a haphazard manner and no external magnetic field is produced. In a magnetized body the planes of rotation of the electrons are turned more or less in some particular direction and the external magnetic field becomes apparent in the vicinity of the body.

The fact that there is a magnetic field around a conductor in which a current is flowing led to the important discovery by Faraday, in 1831, that an electric current can be induced in a conductor by changing the intensity of the magnetic field passing through a closed circuit. This current is in one direction when the field increases and in the opposite direction when the field decreases. This is the principle of the generator, the transformer and many other important electrical devices.

The magnetic field of the earth is probably due to electron discharges in the atmosphere and in the earth's crust.

MAGNETISM, RESIDUAL.—See Residual magnetism.

MAGNETITE ANODES.—Plates or slabs of fused iron oxide, which are conducting enough to be used as anodes, and are practically unattacked in many electrolytic solutions. They are made by fusing ferric oxide mixed with a small amount of silica (2 to 5%) in an electric furnace. The product is magnetic iron oxide, Fe_3O_4, containing a little silica uniformly combined. When cast it must be cooled very slowly to prevent cracking; when cold it is somewhat brittle, but has an electrical conductivity of about 10,000 mhos. It has been found very useful as an unattackable anode in metallic sulphate solutions, whereby electrolysis removes metal from the solution and leaves an equivalent amount of sulphuric acid in its place. Sometimes the anodes are cast hollow and lined with electrodeposited copper, to distribute current more uniformly to the whole surface of the anode.

MAGNETIZATION CURVE OF A MACHINE.—A curve showing the relation between the field current or the field ampere-turns of an electric machine and the voltage generated at no load. Also called the open-circuit or no-load saturation curve and the no-load characteristic. See Saturation curve.

MAGNETIZATION CURVES.—These are graphical representations of the relation between magnetizing force and flux density produced. They are often called B-H curves. They are platted on cross-section paper and show the variation of flux density with magnetizing force. These curves give valuable information concerning the magnetic properties of substances, especially of iron and steel.

MAGNETIZERS AND REMAGNETIZERS.—Permanent magnets are extensively used in telephone and automobile magnetos and in electrical instruments. They are magnetized by making them a part of the magnetic circuit of an electromagnet. In time they may become weak and are remagnetized in a similar manner. The instruments for this work are called magnetizers or remagnetizers, according to their purpose, and are simply electromagnets, with suitable polefaces, designed to produce a field of the required strength. They are ordinarily made for bench work; however, for remagnetizing the magnets of rotating-field magnetos there are portable types which may be held against the pole-faces of the magneto while they are in the machine to avoid the trouble involved in removing them. These magnets are sometimes remagnetized by setting the armature coils in the proper position relative to the poles and energizing them; the coils must be energized a number of times if the magnets are to be brought to their original strength, as the field set up by these coils is weak. Another form of magnetizer is used for bar magnets. It is simply a solenoid of length about double that of the bars to be magnetized, which are inserted within the solenoid just like a core before the current is applied.

Manufacturers:

Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.
Electric Equipment Co., Inc., 1240 S. Hope St., Los Angeles, Cal.
Electro Magnetizer Co., 830 Market St., San Francisco, Cal.
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
Liberty Electric Corp., Port Chester, N. Y.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill. "Mag-Charger," "Niehoff Magnetizer."
Quality Electrical Products Co., 907 E. 15th St., Kansas City, Mo. "Quality Products."
Simplex Magneto Co., Inc., 1790 Broadway, New York, N. Y.
Stahl Rectifier Co., 1401-5 W. Jackson Blvd., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."

MAGNETIZING FORCE.—The magnetizing force is equal to the magnetomotive force per unit length. It is also called the magnetic field intensity. Its symbol is H. The unit is the gilbert per centimeter, or ampere-turn per inch.

MAGNETO.—A small electric generator having permanent magnet fields. It may be driven by hand and used for telephone ringing or for testing out circuits or, when mounted on an automobile, driven by the engine and used for ignition purposes. For further details and manufacturers, see Generators, magneto (three types).

MAGNETO.—Trade name for packings for piston, valves, etc., manufactured by Randolph Brandt, 70 Cortlandt St., New York, N. Y.

MAGNETO PARTS.—The very wide use of magnetos for ignition systems of automobiles, motorcycles, airplanes and stationary engines, and for telephone ringing and miscellaneous purposes, has brought about development of numerous types and these require a large number of parts both for new equipment and as replacement. Some manufacturers specialize in the production of magneto parts, making them in large quantities to be assembled by the automobile manufacturers, or sometimes other manufacturers of ignition devices. Many of the magneto makers also produce and carry a large supply of suitable parts for replacement purposes and for sale to other manufacturers. One part that is often made in this way is the permanent field magnet, which unless carefully made loses its strength and requires early replacement. The transformer coils which form a part of the high-tension units are of a special construction and are often made by a transformer or coil specialist. This is also true of the armature. Then there are small cams which operate contacts depending on the armature position, gears to drive the armature, distributer gears, brushes and contact fingers, couplings and other such parts, all of which are frequently made by specialists.

Manufacturers:

American Bosch Magneto Corp., Springfield, Mass. "Bosch."
American Swiss Magneto Co., The, 6182 Fernwood Ave., Toledo, Ohio.
Apollo Magneto Corp., Kingston, N. Y. (Armatures.)
Bailey Mfg. Co., The, Union City, Ind.
Chapin Co., Charles E., 201 Fulton St., New York, N. Y.
Climax Motor Devices, Chagrin Falls, Ohio. "Climax."
Crosby Co., The, Buffalo, N. Y.
Grossman Auto Parts Co., White Plains, N. Y. "Gapco."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
Karge-Baker Corp,, Phoenix, N. Y. "Karge."
Lauraine Magneto Co., Inc., Long Island City, N. Y. "Lauraine."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Parker White Metal & Machine Co., South Erie, Pa.
Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."
Slocum, Avram & Slocum Laboratories, Inc., Woolworth Bldg., New York, N. Y. "Flexite."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

MAGNETO TELEPHONES.—See Telephones, wall, magneto type.

MAGNETO TESTING SETS.—This term is applied both to testing sets using a magneto for the source of energy, as in certain fault finders, insulation testers, etc., and to sets designed for the testing of magnetos, especially magnetos used in automotive equipment. For further information regarding these two classes of sets and for manufacturers see Testing sets, portable, magneto and bell type; Testing sets, portable, magneto and telephone type; Testers, automobile.

MAGNETOGRAPH.—Trade name for oxyacetylene cutting machines manufactured by the Davis-Bournonville Co., Jersey City, N. J.

MAGNETOGRAPH.—Trade name for electric time stamps manufactured by the Magnetic Clock Co., 37-39 E. 28th St., New York, N. Y.

MAGNETOMOTIVE FORCE.—The magnetic fields in most electromagnetic machines and apparatus are produced by electric currents. The ability or power of the current to develop magnetism depends upon the current strength and the number of turns in the coil or solenoid through which it flows. Magnetomotive force may thus be defined as the magnetizing ability of a coil through which a current flows. For

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a long solenoid it is equal to I.257NI gilberts, where N is the number of turns in the solenoid and I is the current in amperes. The practical unit of magnetomotive force is the ampere-turn, which see. Also see Difference of magnetic potential. More broadly, magnetomotive force may be defined as the total magnetizing power in a magnetic circuit which sets up the magnetic flux and overcomes the reluctance; in other words, it is to a magnetic circuit what electromotive force is to an electric circuit. The abbreviation for magnetomotive force is m.m.f. Its symbol is $\mathcal{F}$

MAGNETS, LIFTING, CRANE OR HOIST TYPE.—The lifting magnet is a powerful electromagnet operated by a crane in much the same manner as an ordinary lifting crane hook. It is essentially a coil of wire encased in a steel shell. The style of shell depends largely upon the use to which the magnet is to be put. Such magnets receive extremely hard usage and are consequently constructed to withstand violent shock and abrasion. The commonest type is circular and is adapted to a number of uses, such as handling pig iron, large castings, scrap, plates, kegs of nails, etc. These crane magnets vary in size from a diameter of 36 to 65 ins. The lifting capacity varies markedly with the material handled. For instance, a 36-in. magnet will lift 20,000 lbs. of billets and slabs, 600 lbs. of boiler plate or 200 lbs. of lamination scrap. In the round type the coils must be extremely well protected; therefore they are usually waterproofed and entirely encased in metal. To prevent overheating of the coils the upper shell is ribbed to give a large cooling surface. Sometimes additional surface is provided by a hole in the center of the shell.

Another form, particularly adapted to handling pipes, rails, structural steel, beams or similar pieces which may be piled to present a long flat surface, consists of one or two magnet units. These units have a coil wound upon a core in the same manner as the ordinary electromagnet, but are equipped with special pole-faces. These poles are heavy plates, triangular in form, fastened to the core at the apex of the triangle, the base of the triangle being the surface of contact for the material lifted. The holding power of a magnet is greatest when the metal held by it completes the magnetic circuit by bridging the gap from pole to pole. This can be accomplished in this type of magnet when the pieces to be handled are of greater length than that between the pole-faces, this being the only form of material it is designed to handle. Where two units are used they are usually mounted to travel along a beam to vary the distance between units, the beam being suspended from a traveling crane. Special designs are sometimes used for lifting beams, flat plates, etc., the magnet being particularly adapted to a peculiar size or form of piece.

Lifting magnets have come into extensive use in steel and iron works, foundries, steel and iron shipping yards and docks, etc. They save a great deal of labor and time in handling of pig iron, scrap, rails, structural material and other iron products that prove difficult by ordinary methods, not only because of the weight but more on account of the awkward shape or rough and irregular surface of much of this material. One magnet will handle as much pig iron as an entire gang of men doing it by hand and without accidents, which are common in the manual method. They have been used with success for everything in iron but large castings, and have even been employed to salvage iron from barges that were sunk.

Manufacturers:

Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Lifting Magnets are manufactured in both the circular and the rectangular types. Circular type magnets are designed especially for handling raw material and stock of irregular size and shape, although they are often used efficiently for handling certain kinds of finished products. Generally speaking, however, where finished products and regular shapes are handled exclusively, rectangular magnets are used. The exclusive patented spool construction in C-H Magnets permits a shorter mean length of turn in the coil winding, cuts magnetic leakage to a minimum, and insures maximum lifting capacity per unit of weight of material used. An absolutely tight joint between the spool and the magnet case eliminates all dead air space and insures the rapid radiation of heat. Since the rise of coil temperature is a limiting feature in magnet design, the careful provision for rapid heat radiation from C-H Magnets is important. It accounts for the high all-day efficiency. As nearly all lifting-magnet troubles are traceable to moisture in one form or another, the importance of the absolute weatherproof construction used in C-H Magnets is apparent. It is just as necessary to guard against the entrance of moisture-laden air into the magnet structure as it is to guard against moisture in the form of rain, snow and dew. C-H



C-H Lifting Magnet

Magnets are first fully assembled and, with all parts in their proper position, are subjected to a baking process until all traces of moisture in the interior of the magnet are eliminated. Air is then exhausted from the magnet casing by the vacuum process and a hot filler is forced into the interior under heavy pressure. This filler permeates every crevice of the magnet and on cooling forms a permanent, elastic, air-tight seal which possesses high moisture-repelling and excellent insulating properties. All lifting magnets are designed for operation on direct current circuits only. Standard C-H Lifting Magnets are designed for operation on 220-volt service. Magnets can be wound for 110-volt service, if desired. See display adv. pages 1225-1230.—Adv.

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.

K & B Co., 495-497 N. 3rd St., Philadelphia, Pa.

Magnetic Mfg. Co., 774 Windlake Ave., Milwaukee, Wis.

OHIO ELECTRIC & CONTROLLER CO., Cleveland, Ohio. Ohio Mill Type Lifting Magnets have indestructible asbestos insulated coils and unbreakable outer rings with no through holes. Terminals and leads are well protected. Ohio magnets are waterproof and have low temperature rise and therefore have good all day lifting capacity.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."

MAGNETS, LIFTING, HAND AND PORTABLE.—For handling quantities of small pieces of iron, such as small castings, bolts, nuts, screws, nails, washers, etc., portable lifting magnets are sometimes used. Such devices are also used to separate such parts from nonmagnetic materials with which they have become mixed or for quickly picking up such articles that have been spilled from their containers.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Hand Magnets are manufactured for use on either 110 or 220-volt d-c circuits. A trigger is mounted under the handle; this operates a strong quick make-and-break snap switch concealed in the cast aluminum yoke cover. Pulling the trigger toward the handle closes the switch. See display adv. pages 1225-1230.—Adv.

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

OHIO ELECTRIC & CONTROLLER CO., THE, 5900 Maurice Ave., Cleveland, Ohio.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

MAGNETS, PERMANENT. — Permanent magnets form a part of most electrical measuring instruments and are used extensively as field magnets for both automobile and telephone magnetos. They are usually of hard, high-carbon magnet steels. (For further information regarding this steel see Steel, magnet.) The form of the magnet is determined partly by its use and partly by the physical characteristics of permanent magnets. All permanent magnets have a tendency to demagnetize themselves. This is particularly noticeable in short bar magnets. The longer the bar the less is the demagnetizing effect, and if bent into a horseshoe form this effect is even more decreased. This demagnetizing effect in horseshoe magnets seems to be decreased by increasing the magnetic leakage across the gap between the poles; consequently the poles are usually as large and the air gap as small, as possible. Other causes of loss in magnetism are mechanical shock, large changes in temperature, contact with magnetic iron, and exposure to an external demagnetizing force. In use there occurs a decrease in strength, due probably to one of the above causes, a phenomenon called aging. This is quite undesirable in magnets used in meters and therefore aging is often specially induced by mechanical means before the magnets are put into use in the instrument. The more common methods of aging are heating in a steam bath and repeated tapping. Before being magnetized the formed steel is usually annealed to relieve internal stresses set up by the heat-treating processes.

The methods of magnetization differ with the type of magnet. Bar magnets are magnetized by placing them within a solenoid about twice as long as the bar. Horseshoe magnets receive their magnetization by making them a part of the magnetic circuit of a horseshoe electromagnet. Usually they are placed with their pole-faces in contact with the poles of the magnet.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.

Holz & Co., Inc., 18 Madison Ave., New York, N. Y.

Indiana Steel Products Co., Valparaiso, Ind.

Leich Electric Co., Genoa, Ill.

St. John, Thomas M., East Windham, N. Y.

Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.

Utica Fire Alarm Telegraph Co., Utica, N. Y.

MAGNIPHONE CO., THE.—29 E. Madison St., Chicago, Ill. Manufacturer of hearing devices for the deaf. Business established 1914. President, Albert E. Coy; secretary, E. M. Miller.

MAGNO.—Trade name for ignition wire manufactured by the Electrical Alloy Co., Morristown, N. J.

MAGNOLIA.—Trade name for sheet packing manufactured by the Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.

MAGNOLIA METAL CO.—New York, N. Y. Manufacturer of babbitt metal. Main office and factory, 113-115 Bank St., New York, N. Y. Branch offices, Fisher Bldg., Chicago, Ill.; Pacific Bldg., San Francisco, Cal.

MAGNUS ELECTRIC CO., INC.—109 Broad St., New York, N. Y. Manufacturer of attachment plugs and switch box covers. Business established 1919. President, treasurer and general manager, Max Manheim; vice-president, C. M. Manheim; secretary, M. E. Comerford.

MAIL-O-METER. — Trade name for motor-driven sealing, stamping and counting machines manufactured by the Mailometer Sales Co., 3469 E. Jefferson Ave., Detroit, Mich.

MAILOMETER SALES CO. — Detroit, Mich. Manufacturer of motor-driven sealing, stamping and counting machines. President, Benjamin S. Warren; vice-president, Walter E. Parker; secretary, R. M. Dyar; treasurer, Wetmore Hunt. Main

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office and factory, 3469 E. Jefferson Ave., Detroit, Mich. Branch offices, 39 S. La Salle St., Chicago, Ill.; 823 Pulitzer Bldg., New York, N. Y.; 310 American Bank Bldg., Kansas City, Mo.; 620 Victoria Bldg., St. Louis, Mo.

MAIMIN CO., INC., H.—247-251 W. 19th St., New York, N. Y. Manufacturer of electric cloth cutting machines. President, H. Maimin; vice-president, M. Maimin; secretary and treasurer, D. S. Maimin.

MAIN.—Trade name for battery charging sets manufactured by the Main Electric Co., Cleveland, Ohio.

MAIN ELECTRIC CO.—Cleveland, Ohio. Manufacturer of farm lighting plants, generators and battery-charging equipment. Business established 1911. President, treasurer and general manager, M. E. Main; vice-president, Carl J. Main; secretary, J. H. Redette. Main office and factory, Cleveland, Ohio. Branch office, Pittsburgh, Pa.

MAIN-LINE RELAY.—In telegraphy, a relay responding to a small current in the main line circuit, which controls a local circuit operating the sounder.

MAIN-POWER-LIGHT.—Trade name for farm lighting plants manufactured by the Main Electric Co., Cleveland, Ohio.

MAINE.—Trade name for generators, motors, hoists and special machines manufactured by the Maine Electric Co., Inc., 35 Commercial St., Portland, Me.

MAINE ELECTRIC CO., INC., THE.—Portland, Me. Manufacturer of motors, generators, electric hoists and special machines. Business established 1898. President and general manager, James P. Phillips; secretary and treasurer, H. M. Wilson. Main office and factory, 35 Commercial St., Portland, Me. Branch office, 30 Church St., New York, N. Y. Sales representatives, Kearfott Engineering Co., 95 Liberty St., New York, N. Y.

MAINS.—The principal wires or cables leading from the distributing centers in a building, plant or other electrical installation and serving as the distribution system from which branch circuits lead off to the lamps, motors, heaters and other electricity-using devices. In a very large building or similar installation, heavy feeders lead from the main switchboard or service board to the principal distributing centers, from which the mains lead to the panelboards.

In central-station power and lighting distribution systems the mains are the wires or cables led out from the distribution center which is supplied by a feeder. They are the circuits from which service taps are made. In d-c. service they are usually large cables buried in conduit. Alternating-current systems have both primary and secondary mains and as the primary mains operate at a higher voltage than d-c. mains, the conductors are usually smaller.

MAINTENANCE.—The care and upkeep of electrical or other equipment as distinguished from the original installation of the equipment or the making of considerable additions. No matter how perfect the apparatus nor how good the installation, it is useless to expect continued good results if the plant is not properly maintained. This requires a certain amount of continued intelligent care, inspection and replacement, the details of which depend on the equipment. In maintenance work best results are secured by a carefully laid out schedule providing for periodical inspection of various parts of the equipment, daily or after a certain number of days, or weeks, or after a certain mileage, as the case may be. Haphazard inspection is never reliable.

Revolving machines must have their bearings well supplied with lubricant at all times. Those with commutators or slip rings should be watched to correct poor brush contact, grooving of commutators, high mica or other causes of excessive sparking, worn out brushes, and stiff or dirty brush rigging. Machines should occasionally be blown free from copper or carbon dust by means of compressed air or by a hand bellows. This applies especially to the commutation if of the undercut type, also to the ventilating ducts in the stator and rotor, if such are provided.

Switchboard and control apparatus should be gone over for loose or worn parts; circuit breakers and switches, whether of air or oil-immersed type, for correct setting, free operation and condition of contacts; knife-blade switches and all fuses for clean and firm contact. The better the contact in all cases, the less the useless waste of energy in heat and the smaller the danger of failure under emergency. Excessively high temperature is a danger signal on any piece of electrical apparatus. Instruments and meters should be checked occasionally for accuracy.

Arc lamps require regular trimming and replacement of electrodes. With incandescent lamps it has usually been found economical to throw away old blackened lamps even though not actually burnt out and to replace them with new ones on account of the much higher efficiency of the latter. The importance of cleaning regularly all lamps and globes or shades is not generally appreciated. Smoke and dust accumulating on the lamps, glassware and other reflecting accessories may reduce the amount of light actually received from the unit by 50 or more per cent, but in no way reduce the power consumed by the unit.

Transmission lines, distribution lines and all overhead circuits should be patrolled for damage from storms and falling trees, for broken insulators and defective poles or crossarms and for general safety in relation to the surroundings.

Railway cars, both city and interurban, and electric locomotives, require frequent and careful inspection on account of the severe conditions under which they operate. Frequency of inspection is often based on the mileage covered. Motors, controllers, special switching mechanism and trolleys as well as the nonelectrical parts, as brakes, wheels and axles, bearings, etc., require careful examination. Tracks must be gone over for worn rails, poor joints and loose bonding; trolley wires for worn wire, broken insulators and loose guy wires; third rails for poor joints, damaged insulators and worn sections.

The same principle applies in a lesser degree to special or individual equipment, such as on the automobile or in the home. An occasional intelligent inspection will often times be the means of discovering defects which, if uncorrected, would later cause considerable annoyance and possibly damage by interrupting the service.

While systematic inspection is highly important, it is of course, understood that an efficient maintenance department or engineer will see to it that any defects discovered by the inspection are corrected promptly and intelligently.

The cost of regular maintenance is usually included as a regular operating expense. A great deal of equipment gradually wears out in spite of the best possible maintenance, as a steam boiler in a power plant, so that it ultimately must be wholly replaced even though parts of it, such as the grates and part of the tubes, have already been renewed; the cost of such a complete replacement is usually met by a depreciation reserve fund, to which contributions are made annually so that at the end of the estimated useful life of the equipment it may be replaced without calling for new capital as would be required for new extensions. The exact dividing line between the maintenance and depreciation funds is not clearly defined, some accountants charging certain renewal costs to maintenance and others charging the same to the depreciation fund.

MAJESTIC.—Trade name for electric photograph driers manufactured by the Eastman Kodak Co., Rochester, N. Y.

MAJESTIC.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MAJESTIC.—Trade name for electric heating devices manufactured by the Majestic Electric Development Co., 656 Howard St., San Francisco, Cal.

MAJESTIC.—Trade name for electric iron manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

MAJESTIC DETERMINATOR.—Trade name for current indications manufactured by the Majestic Electric Development Co., 656 Howard St., San Francisco, Cal.

MAJESTIC ELECTRIC DEVELOPMENT CO.—San Francisco, Cal. Manufacturer of electric heating devices. President, E. N. Brown; vice-president, M. H. Shoenberg; secretary and sales manager, T. D. MacMullen; treasurer and general manager, E. N. Brown. Main office, 656 Howard St., San Francisco, Cal. Factories, San Francisco, Cal., and Philadelphia, Pa. Branch offices and warehouses, 21st and Grand Ave., Kansas City, Mo.; 1705 Alleghany Ave., Philadelphia, Pa.

MAJESTIC ELECTRIC MFG. CO.—806 N. 12th St., St. Louis, Mo. Manufacturer of switches, sockets and other wiring devices. Business established 1919. President, Charles Smercina; secretary, T. R. Thomas.

MAJOR.—Trade name for switchboards, panelboards, etc., manufactured by the Frank Adam Electric Co., 3650 Windsor Pl., St. Louis, Mo.

MAJOR.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MAJOR ELECTRIC CO., M. E.—Wilkes-Barre, Pa. Manufacturer of armature and field coils. President and treasurer, M. E. Major; general manager, E. A. Tippanry.

MAKUTCHAN.—Trade name for roller bearings manufactured by the William E. Pratt Mfg. Co., 190 N. State St., Chicago, Ill.

MALDEN.—Trade name for incandescent lamps manufactured by the Re-New Lamp Co., Malden, Mass.

MALLEABLE IRON FITTINGS CO.—Branford, Conn. Manufacturer of pipe fittings. Business established 1864. Secretary, L. J. Nichols; treasurer and general manager, Alfred E. Hammer.

MALLETS, LEAD AND RAWHIDE, ELECTRICIANS'—Mallets consisting of handles of the usual form provided with heads of cast lead or tightly rolled rawhide combining weight with relative softness to avoid marring finished surfaces.

Manufacturer:

Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.

MALLINCKRODT CHEMICAL WORKS.—St. Louis, Mo. Manufacturers of chemicals for photographic, analytical and technical purposes. Main office, St. Louis, Mo. Branch office, Mallinckrodt Bldg., New York, N. Y.

MALLO.—Trade name for motor-driven cream whipper manufactured by the White-Stokes Co., Inc., 150 W. Lake St., Chicago, Ill.

MALTON.—Trade name for splicing links manufactured by the McKenney & Waterbury Co., 181 Franklin St., Boston, Mass.

MANCHA STORAGE BATTERY LOCOMOTIVE CO.—St. Louis, Mo. Manufacturer of storage battery locomotives for mines, industrial plants, quarries, lumber yards and metal mines. President, Raymond Mancha; secretary, Carson W. Smith; treasurer, Harrie S. Shaver. Main office, 1909 S. Kingshighway, St. Louis, Mo. Branch offices, 621 9th St., Huntington, W. Va.; 609 Chamber of Commerce Bldg., Pittsburgh, Pa. Sales representatives, Joseph B. Noros Co., Miller Bldg., Scranton, Pa.; Powley & Townsley, Excelsior Life Bldg., Toronto, Ont., Can.; Northwestern Engineering & Sales Co., 1017 Alaska Bldg., Seattle, Wash.; Hendrie & Bolthoff Mfg. & Supply Co., 1621 17th St., Denver, Colo.

MANCHA'S ELECTRIC MULE.—Trade name for storage battery mine locomotive manufactured by the Mancha Storage Battery Locomtive Co., 1909 S. Kingshighway, St. Louis, Mo.

MANDICO.—Trade name for sign receptacles manufactured by the Manufacturers' Distributing Co., 30 Church St., New York, N. Y.

MANDIGRIP.—Trade name for girder hook for electricians manufactured by the Manufacturers' & Inventors' Electric Co., 29 Gold St., New York, N. Y.

MANDRELS, UNDERGROUND CONDUIT.—The test usually applied to determine whether underground conduit ducts are continuous and unobstructed is by rodding with a mandrel. A mandrel is inserted in the duct and a conduit rod, several feet long, is attached to it. This rod is inserted for its length and another rod attached, this process being repeated until the mandrel has passed through the section and come out at the next manhole. Various types of mandrels are used, some hollow and smooth with sharp cutting edges, others fitted with numerous sharp projections, some of the different types being known as hedgehogs or pick-ups. The mandrels are of cross-sectional size and shape to correspond closely to the section of the duct used.

Manufacturer:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.

MANGANESE.—A gray brittle metal. Symbol Mn.; at. wt. 55.0; sp gr. 7.7. It is produced chiefly in the form of the ferroalloys, ferromanganese and spiegeleisen, but some metallic manganese is also made by reduction in the electric furnace or by the Thermit process. It is used as an alloying element in manganese steel, manganese bronze, etc.

MANGANESE DIOXIDE.—This compound whose chemical symbol is MnO_2, is obtained from the ore pyrolusite. In the electrical industry it is used extensively as a depolarizer in certain types of primary cells, such as the Leclanché and modifications thereof, including practically all dry cells. For this purpose it is usually mixed with granulated carbon and serves to ab-

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sorb the hydrogen formed during action of the cell on closed circuit but is not permanently changed by the process. Manganese dioxide is also used in certain processes for the manufacture of oxygen gas.

Manufacturers:

Carbo-Hydrogen Co. of America, Benedum-Trees Bldg., Pittsburgh, Pa.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Mallinckrodt Chemical Works, St. Louis, Mo.

MANGANIN WIRE. — See Wire, resistance.

MANGLES.—See Ironing machines, electric, household; Ironing machines, electric, laundry.

MANHATTAN.—Trade name for electric bath cabinets manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

MANHATTAN.—Trade name for electric door openers, attachment plugs, receptacles, polarity indicators, etc., manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

MANHATTAN.—Trade name for border lights manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

MANHATTAN BRASS CO.—332 E. 28th St., New York, N. Y. Manufacturer of portable lamps, lighting fixtures, fixture fittings and parts, adapters, etc. Business established 1865. President, treasurer and general manager, Gilbert M. Smith; vice-president, Henry W. Hayden; secretary, Emil F. Gennert.

MANHATTAN DISTRIBUTING CO.—Transportation Bldg., Chicago, Ill. Manufacturer of commercial lighting units. Partnership, Herbert O. Tomlinson and Edward T. Downs.

MANHATTAN ELECTRICAL SUPPLY CO., INC.—New York, N. Y. Manufacturer of electric heating and cooking appliances, telegraph sets and accessories, electric wiring devices, indicating instruments, fire and burglar alarms and other electrical specialties. Business established 1890. President, J. J. Gorman; vice-presidents, B. H. Ellis and J. F. Baisley; secretary, E. Whitmore; treasurer, B. H. Ellis. Main office, 17 Park Pl., New York, N. Y. Factories, Jersey City, N. J. and Ravenna, Ohio. Branch offices, 1106 Pine St., St. Louis, Mo.; 114 S. Wells St., Chicago, Ill.; 604 Mission St., San Francisco, Cal.

MANHOLE COVERS, FRAMES, GUARDS, PUMPS.—See Covers, manhole; Frames, manhole; Guards, manhole; Pumps, manhole.

MANHOLES, UNDERGROUND CONDUIT SYSTEM.—Manholes are provided in a conduit system for the purpose of installing or removing cables. They are placed at intersections as a means of joining the two conduit lines, and to provide a place for junction boxes. The manhole is usually made with brick walls and concrete top and bottom. The top is reinforced by steel work to give it the necessary strength to sustain street traffic. A connection to the sewer is very desirable where possible to save time in pumping out manholes. The dimensions must be such as to give ample space for cable training on the walls and for splicing work where high-tension cables are involved. In straight-away manholes 4 ft. x 6 ft. is a common size, while at intersections 6x6 ft. or 7x7 ft. is often required. The headroom is 6 ft., except in small manholes with few cables where 5 ft. 6 ins., is sometimes provided. Also see Covers, manhole; Frames, manhole; Guards, manhole; Pumps, manhole.

MANIFOLD HEATERS.—See Heaters, electric, automobile.

MANISTEE IRON WORKS CO.—Manistee, Mich. Manufacturer of condensers, steam and electric pumps. Main office and factory, Manistee, Mich. Branch offices, Chicago, Ill.; Milwaukee, Wis.; Detroit, Mich.; Cincinnati, Ohio; Cleveland, Ohio; Toledo, Ohio; Kansas City, Mo.; St. Louis, Mo.; St. Paul, Minn.; Pittsburgh, Pa.; Philadelphia, Pa.; New York, N. Y.; New Orleans, La.; Birmingham, Ala.; Dallas, Tex.; Denver, Colo.; Salt Lake City, Utah; Cedar Rapids, Iowa; San Francisco, Cal.

MANNING, BOWMAN & CO.—Meriden, Conn. Manufacturer of electrical household appliances. Business established 1849. President, treasurer and general manager, George E. Savage; secretary, Albert W. Savage; sales manager, R. P. Tracy. Main office and factory, Meriden, Conn. Branch offices, 200 5th Ave., New York, N. Y.; 216 N. Michigan Ave., Chicago, Ill.; 150 Post St., San Francisco, Cal.

MANNING, MAXWELL & MOORE, INC.—New York, N. Y. Manufacturer of electric cranes, injectors and other steam specialties. President, J. M. Davis; vice-presidents, H. D. Carlton and P. M. Brotherhood; secretary and treasurer, F. M. Kreiner. Main office, 119 W. 40th St., New York, N. Y. Branch offices, 27 N. Jefferson St., Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; St. Louis, Mo.; Pittsburgh, Pa.; Cleveland, Ohio; New Haven, Conn.; Cincinnati, Ohio; Buffalo, N. Y.; Syracuse, N. Y.; Detroit, Mich.; Milwaukee, Wis.; San Francisco, Cal.; Seattle, Wash.

MANNING PAPER CO., JOHN A.—P. O. Drawer 87, Troy, N. Y. Manufacturer of rope paper, press, counter and insulating boards. Business established 1846. President and general manager, John A. Manning; vice-president and sales manager, Louis K. Southard; secretary and treasurer, Eugene Warren.

MANOMETER.—A bent glass tube partially filled with mercury, used to measure the pressure of gases; also used to designate various types of pressure gages.

MANROSS & SONS, F. N.—Forestville, Conn. Manufacturers of hair springs for electrical instruments. Business established 1877.

MANSBRIDGE. — Trade name for condensers for telephone, telegraph, radio and all kinds of ignition and signaling service manufactured by the Electric Specialty Co., 233 N. Elm St., Cresco. Iowa.

MANSFIELD—Trade name for mine trolley clamps manufactured by the Ohio Brass Co., Mansfield, Ohio.

MANSFIELD ELECTRIC HARDWARE CO. — Mansfield, Ohio. Manufacturer of electrical boxes and cabinets.

MANSFIELD LOCK WASHER CO.—Mansfield, Ohio. Manufacturer of metal washers. President, W. H. Davey; vice-president, C. F. Ackerman; secretary-treasurer, A. E. Witter. Main office and factory, Mansfield, Ohio. Branch offices, New York, N. Y.; Chicago, Ill.; Detroit, Mich.; Nashville, Tenn.; St. Paul, Minn.; San Francisco, Cal; Los Angeles, Cal.; Seattle, Wash.; El Paso, Tex.

MANSFIELD TIRE & RUBBER CO., THE.—Mansfield, Ohio. Manufacturer of rubber tires for electric vehicles and trucks.

MANSON LUMBER CO.—101 Border St., East Boston, Mass. Manufacturer of crossarms and fixture blocks. Business established 1865. President and general manager, James T. Manson; vice-president and treasurer, Frederick T. Manson; secretary, William N. Custer.

MANSON TAPE.—Trade name for insulating tape manufactured by the Okonite Co., Canal St., Passaic, N. J.

MANSURE CO., E. L.—1605 Indiana Ave., Chicago, Ill. Manufacturer of lamp shade fringes.

MANUFACTURERS' & INVENTORS' ELECTRIC CO.—29 Gold St., New York, N. Y. Manufacturer of telegraph sounders and girder hooks for electricians. President and general manager, T. J. Smith; vice-president, treasurer and sales manager, A. H. Smith; secretary, A. S. Herring.

MANUFACTURERS DISTRIBUTING CO.—St. Louis, Mo. Manufacturer of electric washing machines. Business established 1911. President, N. D. Thompson, Jr.; vice-president, H. M. Thompson; secretary and treasurer, L. H. Thompson; sales manager, Leslie P. Huey. Main office, 403 Fullerton Bldg., St. Louis, Mo. Branch offices, 2959 W. Harrison St., Chicago, Ill.; 5904 Euclid Ave., Cleveland, Ohio.

MANUFACTURERS' DISTRIBUTING CO. — 30 Church St., New York, N. Y. Manufacturer of sign receptacles.

MANUFACTURING, ELECTRICAL. — The manufacturing branch of the electrical industry comprises all establishments engaged in the design, development and production of all forms of electrical apparatus and accessories and supplies used in all of the industries, including the public utilities and agriculture, in all of the professions, in the world of commerce and in the home.

The preparation of even a general analysis of electrical manufacturing is beset with many difficulties because of the many ramifications of the industry. There is, first, one large group of manufacturers whose efforts are confined entirely to the production of strictly electrical supplies and equipment. For this one group alone, the range of the products manufactured is wider than that of the products of any other industry.

Another group of manufacturers, virtually comprising an industry by themselves, are engaged in the production of electrical equipment for automobiles, such as spark plugs, magnetos, etc.

There is still another group of manufacturers whose product although strictly classified as mechanical, or nonelectrical, is used exclusively by the electrical industry either in the manufacture of electrical products or in the installation or application of electricity in some form. Examples of concerns in this class are manufacturers of metal fixture parts, porcelain manufacturers, manufacturers of steam-electric power station equipment, etc.

Such manufacturers must rightfully be included in any general survey of the manufacturing branch of the electrical industry, although no attempt at a complete census has ever been made previous to the analysis by the editors of the EMF ELECTRICAL YEAR BOOK. This analysis indicated a total of approximately 10,000 manufacturers, both electrical and those closely affiliated, as mentioned above. Of this number, approximately one-half are electrical manufacturers.

Considering only the concerns that can be classed as strictly electrical, the total investment as of January, 1921, was $550,000,000. The number of employees engaged in manufacturing was over 200,000 and the value of products for 1920 was about $2,600,000,000.

It is difficult to give a clear idea as to the diversity of electrical products, other than to state that there are upwards of 2500 separate and distinct classifications of products. This, of course, does not take into consideration the countless varieties and types of each general classification.

There are at least 50 major lines of products, each one of which would be an industry in itself, if not related to the others. In general, electrical products are usually classified according to the services for which they are intended. Such classifications, with the value of the products for each year 1920, are as follows: Industrial, $350,000,000; transportation, $200,000,000; transmission, $150,000,000; generation, $150,000,000; and merchandise, $1,750,000,000. This latter represents only electrical apparatus used in the consumption and utilization of electrical energy in the household, in the commercial field and on the farm, and the material and devices necessary in the wiring of buildings for such apparatus.

The principal items which go to make up the huge merchandising volume of $1,750,000,000, are as follows: Fixtures, shades, reflectors, $245,000,000; incandescent lamps, standard size, $105,000,000; miniature lamps, $45,000,000; washing machines, $72,000,000; vacuum cleaners, $45,000,000; portable lamps, $50,000,000; domestic heating appliances, $22,000,000; flashlights and renewal batteries, $20,000,000; fans, $20,500,000. Supplies included in the total comprise: Wire, lamp cord, etc., $140,000,000; wiring devices, switches, sockets, plugs, $85,000,000; porcelain knobs, tubes, cleats, $15,000,000; bells, bell-ringing transformers, annunciators, etc., $7,500,000; pole-line material $8,000,000; conduit, rigid, flexible, and fittings, $35,000,000; fuses, $8,000,000.

No attempt is made here to present complete statistics on the production of electrical manufacturers. Wherever such data are available they have been included in the definition of each separate product, of which there are over 3000 listed throughout this volume and arranged alphabetically. Likewise, attention is directed to each specific product for detailed information regarding its design, function and its manufacturers.

Early Development. The electrical manufacturing industry, though gigantic, is of comparatively recent origin. Except as applied to the telegraph, such electrical apparatus as existed four decades ago were popularly regarded as little more than scientific toys.

Electric apparatus first appeared among the classified industries in the government census of 1850, when two establishments, engaged primarily in the manufacture of electromagnetic instruments, were reported with products valued at $5,100. In the census of 1860 there were four establishments with products valued at $59,000. In the census of 1879 there were 76 establishments reported as engaged in the manufacture of electrical apparatus and supplies, including telephone and telegraph apparatus. These establishments gave employment to 1,271 employees and their products were valued at $2,655,036. The industry increased at a rapid rate during the next 35 years.

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It was in 1879 that Edison started the manufacture of incandescent lamps in his laboratory at Menlo Park. This was the beginning of the great Edison group of industries which, together with the Thomson-Houston group, formed the nucleus of the present industry. Previously, a number of establishments devoted to the manufacture of telegraph, telephone and arc lighting equipment had been formed, but these were of little or no historical significance, with the exception of the machine shop of Charles Williams, Jr., in Boston, Mass., where Alexander Graham Bell carried on his experiments and where the telephone was invented in 1876. This factory was absorbed by the Western Electric Co. in 1881.

Generators for supplying current required for the operation of incandescent circuits were also manufactured at the Menlo Park laboratory. The first Edison generator was known as the Jumbo and was the forerunner of a long series of steam-electric generator sets of constantly increasing size and capacity. The Edison interests were first incorporated as the Edison Electric Lighting Co., with a capital stock of $300,000. The demand for the generators soon taxed the capacity of the Menlo Park plant to such an extent, that in 1881 a factory was established in New York City. A short time later the lamp factory was moved to Harrison, N. J. In 1884 the Edison Machine Works, with a capital of $200,000 was incorporated, and in the same year the lamp business was separately organized under the name of the Edison Lamp Works.

In 1885 the Edison Electric Tool Co. was organized with a capital of $25,000 and a separate corporation established for manufacturing shafting, belts, hangers, etc. Other related companies established about the same time were the Edison Co., for manufacturing isolated lighting equipment, and the Sprague Electric Railway & Motor Co., for the production of stationary motors and apparatus for street railways. In 1890 all of these companies were associated and combined into a single organization known as the Edison General Electric Co.

Coincidently, the American Electric Co. was established in 1880 with a small factory at New Britain, Conn., to manufacture the arc lamp machines of Elihu Thomson. In 1883 the American Electric Co. was reorganized as the Thomson-Houston Electric Co. This concern, during the next few years, acquired a number of smaller companies, among them being the Van Depoele Co., the Brush Electric Co., the Schuyler Electric Co., and the Excelsior Electric Co. In 1892 these two groups of companies (Edison and Thomson-Houston) were formed into the present General Electric Co.

In 1886 the Westinghouse company was started in Pittsburgh and in 1891 it absorbed the United States Electric Light Co. and the Consolidated Electric Co. The Westinghouse Machine Co. and other companies have since been merged into the Westinghouse Electric & Mfg. Co. The Western Electric Co. and many other prominent electrical manufacturing companies have also had very interesting histories.

In connection with the figures on the estimated output for 1920 already given above, it may prove of interest to give data on the growth of electrical manufacturing since the Bureau of the Census began to keep separate records on this branch of manufacturing, that is, 1879. Until 1904 the figures were not as complete. Since 1899 the census of electrical manufacturers has been taken every five years. The 1919 figures have not yet been published.

The Census Bureau's reports cover manufacturing plants engaged in the production of distinctively electrical apparatus, and do not include many products used exclusively, or almost so, by the electrical industry, such as: Glass and procelain insulators, glass battery jars, illuminating glassware, etc.; poles, crossarms and poleline hardware; copper, iron and other wire, and much similar equipment included in this book and in 1920 totals cited above. The census figures are as follows:

	1879	1889	1899
Number of establishments.	78	189	581
Capital .....$	1,509,758	$ 18,997,337	$ 83,659,924
Value of products.....	2,655,036	19,114,714	92,484,435
	1904	1909	1914
Number of establishments.	784	1,009	1,030
Persons engaged.	71,485	105,600	144,712
Capital $174,066,026		$267,844,432	$355,724,756
Value of products.....	140,809,369	221,308,563	335,170,194

The value of products given above does not include the value of electrical machinery, apparatus and supplies made in establishments primarily engaged in other industries; in 1914 this additional amount was $24,261,961.

MANZEL BROTHERS CO.—327 Babcock St., Buffalo, N. Y. Manufacturer of lubricators.

MARATHON ELECTRIC MFG. CO.—Wausau, Wis. Manufacturer of motors. President, J. S. Alexander; vice-president, A. P. Woodson; treasurer and general manager, Austin Kimble; secretary, F. D. Timlin.

MARBLE.—A name given to limestone of a crystalline variety consisting mainly of calcium carbonate, which is sufficiently compact to take a high polish. Pure marble is white, but the presence of iron oxide or other impurities gives it different colors, which exhibit pleasing effects but decrease its insulating value. It is frequently treated with molten wax or linseed oil after all the moisture has been expelled, and its dielectric properties are thus much improved, although it is usually discolored by the process. It has a dielectric strength of about 6500 volts per mn. and its resistivity is from 10^8 to 10^{10} ohm-cm. Marble is used extensively for low-tension switchboard panels, switch bases, barriers, etc.

MARBLE-CARD ELECTRIC CO.—Gladstone, Mich. Manufacturer of d-c. motors and generators. President, W. L. Marble; vice-president, F. H. Van Cleve; secretary and treasurer, J. T. Jones; manager, John F. Card.

MARBLE, FINISHED, FOR SWITCHBOARDS, PANELS, BASES, ETC.—Marble that is specially selected for freedom from metallic veins is used extensively for switchboard panels, isolated panels, switch bases, etc., where the voltage between live parts exceeds that for which slate may be used and especially if it lies between 750 and 3300 volts. It is also used for lower voltages in such cases where the attractive general appearance, coloring and polish of marble is deemed of sufficient importance to warrant its higher cost compared with slate. It is not used as extensively as slate for switch bases, terminal blocks, border strips, and bus supports, since the insulating properties of slate suffice for most such uses. Marble is furnished in standard thicknesses from 1 to 2 ins. and in slabs ranging in numerous standard dimensions up to 42 ins. wide and 72 ins. long. For small manufacturers of switchboards, contractors and other users of electrical marble on a small or moderate scale it is usually furnished with the panel surface hone-finished and polished and the edges smoothed, beveled and polished. Such panels are ready for drilling and are often called switchboard blanks. Barriers between switches or circuit breakers on marble boards are also of marble and have both faces finished, the corners rounded and the edges beveled.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.

DAVIS SLATE & MFG. CO., 610-618 E. 40th St., Chicago, Ill., and 127-131 Shaftesbury Ave., Toronto, Ont., Can. "Samson."

Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.

Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.

PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.

Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

MARBLE, UNFINISHED, FOR SWITCHBOARDS, PANELS, ETC.—Manufacturers of switchboards and other electrical equipment making extensive use of marble sometimes purchase the marble in unfinished slabs of standard size. They undertake to surface, bevel and finish the marble themselves (and sometimes to cut it), before drilling and polishing. If suitable equipment and skilled men for this purpose are available and can be kept steadily employed, it may be possible to effect some economy through being able to purchase the unfinished marble at a lower price than the finished slabs.

Manufacturers:

DAVIS SLATE & MFG. CO., 610-618 E. 40th St., Chicago, Ill., and 127-131 Shaftesbury Ave., Toronto, Ont., Can. "Samson."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

MARCHAND.—Trade name for wire clamps manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

MARCHAND ELECTRICAL WORKS, LTD.—55 Cote St., Montreal, Que., Can. Manufacturer of motors. President and managing director, U. A. Leduc; secretary and treasurer, J. E. Lamothe.

MARCHESE PROCESS.—One of the early unsuccessful attempts at the electrolytic production of copper directly from matte.

MARCO.—Trade name for farm and power lighting plants manufactured by the Marmon Chicago Co., 2234 S. Michigan Ave., Chicago, Ill.

MARCO POWER & LIGHT CORP.—2230 Michigan Ave., Chicago, Ill. Manufacturer of farm lighting and power plants. Business established 1918. President and general manager, C. E. Gambill; vice-president, H. A. White; secretary, R. H. Ripley; treasurer, Willoughby Walling; sales manager, E. L. McDonald.

MARCONI, GUGLIELMO (WILLIAM).—An Italian inventor and electrical engineer, born near Bologna, Italy, April 25, 1874, of mixed parentage, his father being Italian and his mother Irish. After studying under Rosa at Leghorn, he entered the University of Bologna, where he came under the influence of Professor Righi, who had long been interested in the study of Hertzian waves. As early as 1890 Marconi, then a boy of but 16 years, began experimenting on his theory that those electromagnetic waves would readily pass through various substances without the aid of ordinary metallic conductors and saw possibilities of using them for the transmission of messages. He improved the coherers that had been made by Onesti and Branly, and in 1895, at Griffone, near his home, made several successful experiments in wireless transmission.

The following year, having failed to interest the Italian government in his inventions, he went to England and appealed to the postal authorities. Sir William Henry Preece, engineer and electrician-in-chief of the English postal telegraph service, had experimented a few years previously along similar lines and declared Marconi's system successful, but of limited application. The Italian minister of marine now took up tests and in a short time both Italy and England adopted Marconi's radio system for their navies. Marconi was the first to perfect the crude appliances that had been used in early experiments in this field and the first to patent the application of the electromagnetic waves to the purposes of actual telegraphy as distinguished from mere signaling.

The Marconi Wireless Telegraph Co., Ltd., was organized in 1897 and two years later Marconi had the satisfaction of seeing messages exchanged across the English Channel, with the operating stations 32 miles apart.

Later he began work on the problem of transatlantic radio telegraphy and in February, 1902, while on board the steamship Philadelphia, bound for the United States, he received worded messages over a distance of 1,550 miles and signals 2,099 miles. On Dec. 21, 1902, within two years after he began experimenting on transocean telegraphy, the first transatlantic radio message was received from Table Head. A limited commercial service was established across the Atlantic in 1907. A shorter system between Bari (Italy) and Antivari (Montenegro), had been opened to the public two years previously. Step by step distances were increased, as the apparatus was perfected and made more powerful, until now there seems to be almost no limit.

As early as 1904 Marconi started the first ocean daily newspaper, the news being supplied by radio, on ships of the Cunard line. In 1906 he brought out a directive system and a new persistent or undamped-wave system for radio, both of which were quickly adopted. An improved detector was produced in 1910, which was followed by a duplex apparatus allowing one message to be sent and another to be received at the same time, on the same apparatus. His system is now in use by hundreds of mercantile marine ships and numerous naval vessels. Marconi's numerous inventions and tireless efforts for the improvements of radio communication have been recognized

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by the several nations, including the United States, many honors and special orders having been bestowed on him. Among these are the Nobel prize for physics in 1909 and a life membership in the Italian Senate conferred in 1912. When Italy entered the World War, in 1915, he offered his services and was placed in charge of its radio service. He was also a member of the Italian mission to the United States in 1917. He is still actively at work on further radio developments.

MARCUSON, E.—70 Cortlandt St., New York, N. Y. Manufacturer of storage batteries. Business established 1909. E. Marcuson, sole owner.

MARINE.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MARINE AND NAVAL APPLICATIONS OF ELECTRICITY.—The applications of electricity for this service fall into three distinct systems, lighting, power and signaling. In the early installations the lighting system was the most important, especially the searchlight which is the oldest application, dating back approximately 50 years. Today the applications of the electric motor make the power system more extensive and are the cause of the increased size of generating units. Development of reliable apparatus for transmitting important signals has led to a greater use of electric current for interior communication.

Generating Equipment. The generating plants used at the present time for the ordinary lighting of cargo steamers consist usually of two 15-kw. d-c. units operating at 115 volts. For vessels largely employing electric motor auxiliaries the voltage is increased to 230. The present method of driving the generators for these steamers is largely by reciprocating steam engines. This is probably traditional, as such engines have been so widely used for ship propulsion, but the greatly increased use of steam turbines has caused a leaning toward the use of direct-connected turbine sets for small generators and in the larger sizes toward reduction-gear turbines.

On navel vessels the generating sets are usually of larger capacity and direct-connected or geared turbine drive is approved. Direct-current generators at 250 volts in relatively small sized sets (300 to 500 kw.), are disposed in separate compartments, usually three, or half the total number in each engine room. They are arranged so that a two-wire 250-volt system for power, and 125-volt for lighting is available at the switchboard. See separate article on Switchboards, marine and naval.

Wiring Systems. In general marine applications employing direct current, either the two-wire or three-wire full metallic system similar to land practice is employed. Alternating current, when used, is distributed on a 60-cycle, three-phase, three-wire system. Naval applications sometimes required duplication of the feeders, but generally the feeders from the switchboard supply parts of the vessel adjacent to them. A special feeder is led from the main distribution switchboard to the radio room for the supply of electrical energy to the motor-generator set. An auxiliary power source is always supplied for this equipment also. All feeders for motors must be unbroken from switchboard to motor panel and for lighting to the distribution cabinet which it feeds. All lighting circuits in the turret and powder spaces are duplicated and so arranged that, should the ship's power fail, they may transfer automatically to storage batteries located in the turret.

The greatest advance in the development of wiring methods has to do with the protection of the conductors. It was early discovered that the insulation was affected not only by salt air and salt water but that condensation played an important part. Wood molding was first used as a protection and this was soon changed to metal conduits or pipes, but even in these the water of condensation, caused by the passage of the conduit through two or more compartments at widely differing temperatures, was nearly always present. While conduit is still used in many places, the use of steel-armored cable is much favored. This cable, which has several modifications in design and application, is described more completely under wire and cable, marine and naval.

The armored conductors are fastened by clips directly to the steel structure wherever possible. For the protection of watertight compartments special brass tubes are arranged for packing around the armored cable. Special bushings are used where the cable passes through a deck or nonwater-tight bulkhead.

Lighting System. Good practice dictates the use of tungsten lamps ranging in size from 25 to 1,000 watts. The majority of merchant vessels provide 110-volt d-c. circuits, while for the navy 125 volts is standard. In distributing current for lighting it is of importance to arrange the circuits so that no interruption of the service may be required in those circuits which are necessary for the operation of the vessel. This requires separate circuits to be carried to various parts of the ship, many of which are not in use while the ship is under way and are therefore deenergized to minimize fire risk.

On naval vessels the lighting circuits are divided into two groups, one for battle purposes and the other for general lighting. The division is made so that the handling of the vessel will be comfortable during an engagement and yet not aid the enemy. Usually the battle circuits are all those below the protective deck and only outlets from these circuits are run above for plugging in hand portables or battle lanterns. Further lighting protective service is afforded to important machinery compartments by circuits fed from storage batteries, which come into play automatically if all the generators in the ship are deranged or the steam supply suddenly shut off.

Passenger vessels carrying fifty or more passengers are required to provide auxiliary electrical energy for maintaining the lighting of living quarters, exits, boat stations, and engine rooms for at least six hours after the main generating plant has ceased to operate. Two methods are allowed, the use of storage batteries which is the accepted practice and the employment of a gasoline generating set. Both the batteries and the generator should be located well above deck.

Fixtures used on naval vessels are generally of the steam-tight guarded type, with special fixtures for the quarters. They are of much heavier construction than those used in merchant service. About 3,000 lights are required for a modern battleship or cruiser. The tendency in both classes of service is to abandon to a great extent all bulkhead or bracket fixtures and use overhead fixtures. Low headroom necessitates a very shallow fixture and in some cases they are even recessed into the ceiling. The tendency is also to avoid the use of wood or metal in fixtures for merchant service and use some insulating material, such as porcelain or molded insulation. Also see Lights, cargo.

Searchlights are usually provided on vessels 300 ft. or more in length. They are used somewhat for signaling in the navy, but generally for lighting purposes, to illuminate the sides of the ship for safety and also to pick out distant objects and channels. They are almost always of the arc type. Also see Searchlights.

Power System. The general tendency for power systems is towards the use of 230-volt d-c. circuits for merchant ships and 250-volt for naval vessels. The motors used are usually made under navy specifications or under special restrictions to give full protection under all conditions. There are several types used, which depend on their use and location, but the general requirements of motor and control equipments are similar. Open, semienclosed, ventilated, water-tight and explosionproof constructions are all used. They are almost always d-c. motors, except where electric propulsion is used when polyphase induction motors are employed. Alternating current has been used for other power service on some turbine-driven vessels with good results.

The use of oil engines for propulsion instead of steam and the development and standardization of electric motors has led to their application to engine-room auxiliaries. In such locations special protection is given the apparatus. These auxiliaries consist largely of pumps of various types, forced-draft fans, etc. Another important application of electrical energy is the operation of the steering gear. This may have a motor direct-connected or power may be transmitted through a hydraulic pump. An electric rudder indicator is attached to the rudder stock and indicates in the different navigating stations the angle the rudder makes with the hull.

Gun control on naval vessels is an important use of power. Guns of 8-in. caliber and over mounted in turrets are motor-controlled. The turrets are revolved by constant-speed motors operating through gears which function on the principle of a number of small oil plunger pumps, giving a smooth positive motion. This same type of control is used for loading, training and elevating all the large guns. All turrets are kept under forced draft by blowers to prevent burning powder or flame from reaching the magazines.

Anchor windlasses, including a motor and control appliances, are used for lowering and weighing the anchors. Various systems of control have been used, but the contactor system seems to be in most favor. For handling stores and for miscellaneous deck hoisting electrically equipped winches and capstans are employed. Boat cranes mounted on the main or upper deck are used for raising and lowering the boats, and have a control similar to the turret-gun control. Ventilation of the entire ship is also accomplished by electrically operated fans which force the air through a system of ducts. There are a number of other motor applications on ships, some of the most important being ammunition hoists, gyroscopic compasses and stabilizers (which see), operation of water-tight bulkheads and hatches, coal and ash hoists, air compressors, refrigerating machines, printing presses, laundry machines, lathes and other workshop machines, meat choppers, dough mixers, ice-cream freezers and many other kitchen appliances.

Heating has also been successfully accomplished by electricity. Experiments have been made using electric ranges in the galley, but they have not yet been widely adopted. Electric bake ovens have been employed with success and are now being extensively used in the navy. Small heating units are also installed in the conning tower, control tower, chart house, crow's nest and similar places where the running of long leads of steam piping would be disadvantageous.

The use of electricity for ship propulsion is rapidly increasing. This very important application of electric power to vessels is described under Ship propulsion, electric.

Signaling Systems. This item refers essentially to the interior communication systems of the vessel, although it also includes signaling between ships. Radio communication is now used almost to the exclusion of visual methods for this purpose and is definitely required on all vessels carrying fifty or more persons. Where visual signaling is employed it is customary to provide a lantern fitted with a Fresnel lens and a 50-cp. incandescent lamp. This is operated by a telegraph key. Occasionally searchlights, fitted with a special shutter, which may be opened and closed at intervals to simulate dots and dashes, are employed for this purpose.

When the interior communication is by electrical means the circuits for all systems are controlled from a switchboard located in a special compartment below the protective deck. Three sources of supply are provided on naval vessels, one from the ship's generators, one from a special motor-generator giving a reduced voltage and one from storage batteries used in emergencies. There are a number of devices included in the signaling system, the most important of which are described under Signaling systems, naval, also marine. There are also other electrical devices, such as special indicators for telling of the operation of water-tight doors, running lights (see Telltales, marine), engine speed, etc. Torpedo firing is also accomplished electrically by special circuit-closing keys located above deck and in the torpedo room.

MARINE ANNUNCIATORS, BELLS AND BUZZERS.—See Annunciators, marine; Bells, marine; Buzzers, electric, marine.

MARINE BOXES.—See Boxes, marine, outlet and junction .

MARINE COMPASSES. — See Compass, magnetic; Compasses, gyroscopic.

MARINE ELECTRIC CO.—195 Fremont St., San Francisco, Cal. Manufacturer of marine fittings and fixtures. Business established 1836. President, L. E. Helm; general manager, C. W. Goodwin; sales manager, H. I. Zemansky.

MARINE FIXTURES. — See Fixtures, lighting, marine.

MARINE HARDWARE - EQUIPMENT CO.—South Portland, Me. Manufacturer of bronze castings, guy thimbles, turnbuckles, etc.

MARINE PANELBOARDS.—See Panelboards, marine.

MARINE PLUGS, PUSH BUTTONS AND RECEPTACLES.—See Plugs, marine; Push buttons, marine and water-tight; Receptacles, marine.

MARINE SIGNALING SYSTEMS. — See Signaling systems, marine.

MARINE STEERING GEAR.—See Steering gear, marine, electrically operated.

MARINE SWITCH. — A switch, totally enclosed and made water-tight to protect the metal parts from the action of salt water or moist atmosphere, and used prin-

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cipally on shipboard. For further details and manufacturers see Switches, marine and waterproof.

MARINE TELEGRAPHS. — See Telegraphs, ship.

MARING WIRE CO.—Muskegon, Mich. Manufacturer of insulated magnet wire. Business established 1919. President and general manager, Fritz L. Meeske; vice-presidents, Albert Maring, A. E. Holton; secretary, E. C. Farmer; treasurer, C. B. Van Dyke. Main office and factory, Clay and 8th Sts., Muskegon, Mich. Branch office, 176 Federal St., Boston, Mass. Sales representative, R. W. Lillie Corp., 30 Church St., New York, N. Y. H. A. Strickland, 844 Book Bldg., Detroit, Mich.

MARION.—Trade name for hand operated stokers, soot blowers and other power plant specialties manufactured by the Marion Machine, Foundry & Supply Co., Marion, Ind.

MARION ELECTRICAL MFG. CO.—24 Cliff St., Jersey City, N. J. Manufacturer of spark coils. President, Mrs. Allen A. Dittmar; secretary and treasurer, Allen A. Dittmar.

MARION INSULATED WIRE & RUBBER CO.—Marion, Ind. Manufacturer of insulated wires and cables. President, Robert J. Spencer, Sr.; vice-president, C. A. Michaels; secretary, L. A. Lillard; treasurer, Robert J. Spencer, Jr.; general manager, J. F. Auten. Main office and factory, Marion, Ind. Branch office, 541 W. Washington Blvd., Chicago, Ill.

MARION MACHINE, FOUNDRY & SUPPLY CO.—Marion, Ind. Manufacturer of hand-operated stokers, soot blowers, gas engines and other power plant specialties. President, C. C. Chamberlin; secretary and treasurer, Henry L. Erlewine. Main office, Marion, Ind. Branch offices, Tulsa, Okla.; Nowata, Okla.; Wirt, Okla.; Drumright, Okla.; Wilson, Okla.; Ardmore, Okla.; Burkburnette, Tex.; Breckenridge, Tex.; Ranger, Tex.; Eldorado, Kans.; Paola, Kans.; Scottdale, Pa.

MARION MALLEABLE IRON WORKS, THE.—Box 568, Marion, Ind. Manufacturer of guy clamps, jacks and other malleable iron castings. President, E. B. Leigh; vice-presidents, Edwin F. Leigh and W. H. Mitchell; secretary, treasurer and general manager, Edwin F. Leigh.

MARION ROTARY PUMP CO.—Hardwick, Vt. Manufacturer of electric pumps. President, C. H. Whitcher; vice-president, Dr. A. D. Ferris; secretary, Frank T. Taylor; treasurer, J. A. Galligher; sales manager, W. S. Cobb. Sales representatives, Morse Pump & Engine Works, Wakefield, Mass.; Marion Pump Co., Hardwick, Vt.

MARIS BROS.—56th St. and Grays Ave., Philadelphia, Pa. Manufacturers of electric cranes and hoists.

MARK MFG. CO.—Chicago, Ill. Manufacturer of rigid metallic conduit. Business established 1888. Main office, 111 W. Washington St., Chicago, Ill. Mills, Indiana Harbor, Ind.; Zanesville, Ohio; Evanston, Ill. Branch offices, 3148 Equitable Bldg., New York, N. Y.; 538 Oliver Bldg., Pittsburgh, Pa.; 1308 Commerce Bldg., Kansas City, Mo.; 404 Security Bldg., Los Angeles, Cal.; 701 Maison Blanche Bldg. Annex, New Orleans, La.; 608 Andrus Bldg., Minneapolis, Minn.

MARKO & CO., INC., PAUL M.—1402-12 Atlantic Ave., Brooklyn, N. Y. Manufacturer of storage batteries. Business established 1907. President and treasurer, Paul M. Marko; vice-president, Alfred Hoefler; secretary and sales manager, John F. Martin, Jr.; general manager, Thomas Brady.

MARLO.—Trade name for bells and buzzers manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

MARLOW MFG. CO.—1836 Euclid Ave., Cleveland, Ohio. Manufacturer of electric washing machines. Business established 1919. Partnership; S. L. Guggenheim and S. D. Guggenheim.

MARMO.—Trade name for electric pumps made by the Marion Rotary Pump Co., Hardwick, Vt.

MARMON CHICAGO CO., THE.—2234 S. Michigan Ave., Chicago, Ill. Manufacturer of farm and power lighting plants. President, C. E. Gambill; secretary, R. H. Ripley; treasurer, W. B. Walling.

MAROA MFG. CO.—Maroa, Ill. Manufacturer of motor-driven car loaders, sand riddles and electric circuit testers. President, James R. Morgan; vice-president, George Conover; secretary, treasurer and general manager, James A. Worsham.

MARQUETTE ELECTRIC ENGINEERING CO.—222 W. Austin Ave., Chicago, Ill. Manufacturer of switchboards. President, H. R. Harvey; vice-president, Paul Augustinus; secretary, S. A. Hohman.

MARS.—Trade name for cylinder lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MARS-BRIGHT.—Trade name for flashlight batteries made by the Bright Star Battery Co., 310 Hudson St., New York, N. Y.

MARSH & CO., JAMES P.—114-124 S. Clinton St., Chicago, Ill. Manufacturer of gages, valves and steam specialties. Business established 1865. President, Orville W. Thompson; vice-president, Myron D. Thompson; secretary and sales manager, Robert A. Campbell; treasurer, William Yaeger.

MARSH ENGINEERING WORKS, LTD.—Belleville, Ont., Can. Manufacturer of electric hoisting machinery. Business established 1846. President and general manager, L. W. Marsh; vice-president, J. A. Marsh; secretary and treasurer, F. H. Henry; sales manager, A. F. White. Exclusive distributors, Mussens, Ltd., Montreal, Que., Can.; Toronto, Ont., Can.; Vancouver, B. C., Can.; Winnipeg, Man., Can.

MARSHALL'S. — Trade name for linemen's protective equipment manufactured by the Linemen Protector Co., 850 Penobscot Bldg., Detroit, Mich.

MARTALEX MFG. CO., INC. — 450 E. 148th St., New York, N. Y. Manufacturer of electric toys. Business established 1919. President, Martin Fogel; vice-president, secretary and treasurer, Alexander Ascher.

MARTIN.—Trade name for rotary converters manufactured by the Northwestern Electric Co., 408 S. Hoyne St., Chicago, Ill.

MARTIN & SONS, H. P. — Owensboro, Ky. Manufacturers of conduit and pipe benders and vises. Partnership of H. P. Martin, William H. Martin, Charles L. Martin and Clarence F. Martin.

MARTIN BROS.—618 Manhattan Bldg., Duluth, Minn. Manufacturers of cedar poles, posts and railway ties. Business established 1900.

MARTIN-COPELAND CO. — 101 Sabin St., Providence, R. I. Manufacturer of electric soldering irons. President, E. W. Martin; vice-presidents, L. C. Martin, S. D. Humphrey; treasurer, W. C. Martin; general manager, L. C. Martin.

MARTIN GRATE CO.—345 S. Dearborn St., Chicago, Ill. Manufacturer of boiler furnace grates. President, W. S. Burling; secretary, G. W. Tracey.

MARTIN VIBROPLEX.—Trade name for telegraphic sending machine manufactured by the Vibroplex Co., 825 Broadway, New York, N. Y.

MARTINDALE ELECTRIC CO., THE.—11737 Detroit Ave., Cleveland, Ohio. Manufacturer of commutator stones, insulating varnish and soldering paste. Business established 1913. President and general manager, E. H. Martindale; vice-president, H. McFarland; secretary, A. M. Lloyd; treasurer and sales manager, F. Z. Marty. Sales representatives, Filer-Smith Machinery Corp., Winnipeg, Man., Can.; Lyman Tube & Supply Co., Montreal, Que. and Toronto, Ont., Can.; Electrical Equipment Co., Louisville, Ky.

MARVEL. — Trade name for electric thermostats and motors manufactured by the American Thermostat Co., 226 Jelliff Ave., Newark, N. J.

MARVEL. — Trade name for tungsten, gas-filled, incandescent lamps manufactured by the Brite Lite Lamp Mfg. Co., Inc., 214 Oxford St., Providence, R. I.

MARVEL.—Trade name for electric sterilizers manufactured by the Capital Novelty Co., 138 N. 12th St., Lincoln, Neb.

MARVEL.—Trade name for motor-driven blowers and ventilating sets made by the Electric Blower Co., 352 Atlantic Ave., Boston, Mass.

MARVEL.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MARVELITE.—Trade name for luminous compounds manufactured by the Cold Light Mfg. Co., 18th and Blake Sts., Denver, Colo.

MARVIN ELECTRIC DRILL CO. — 443 State St., Binghamton, N. Y. Manufacturer of electric drills. President, C. F. Hotchkiss; vice-president and treasurer, D. Walker Wear.

MASCO.—Trade name for storage batteries manufactured by the Milwaukee Auto Specialty Mfg. Co., Inc., 711 Chestnut St., Milwaukee, Wis.

MASCOT.—Trade name for radio condensers, keys, etc., manufactured by J. H. Bunnell & Co., 32 Park Place, New York, N. Y.

MASKS, WELDERS'.—See Helmets and face masks or shields, welders'.

MASON.—Trade name for safety tread made by the American Mason Safety Tread Co., 125 Perry St., Lowell, Mass.

MASON.—Trade name for safety switches manufactured by the Trumbull Vanderpoel Electric Mfg. Co., Bantam, Conn.

MASON MFG. CO., A. G.—7817 St. Clair Ave., N. E., Cleveland, Ohio. Manufacturer of electric sewing machines. President and general manager, W. W. Chase; vice-president and secretary, A. S. Rodgers; treasurer, J. C. Sanderson.

MASON REGULATOR & ENGINEERING CO., LTD., THE. — Montreal, Que., Can. Manufacturer of electric pumps, blowers, gages, meters, controlling devices, etc. Business established 1905. President, Eldon Macleod; vice-president, Cameron Macleod; secretary, Frank A. Morrison; treasurer and general manager, H. L. Peller. Main office and factory, 135-53 Dagenais St., Montreal, Que., Can. Branch office, 145 Wellington St., W., Toronto, Ont., Can.

MASON REGULATOR CO. — Dorchester Center, Boston, Mass. Manufacturer of electric pump governors. Business established 1882. President, C. W. McConnel; secretary and sales manager, F. A. Morrison; treasurer and general manager, Eldon Macleod. Main office, 1190 Adams St., Dorchester Center, Boston, Mass. Factories, Boston, Mass., San Francisco, Cal., Montreal, Que., Can. Branch office, 503 Mission St., San Francisco, Cal.

MASS.—The mass of a body may be defined as measured matter. That is, the mass of a body is the ratio of the quantity of the matter in that body to the quantity of matter in another body, which is chosen arbitrarily as the unit. Masses are compared by comparing their weights, or in other words, by balancing the forces of gravity on the two masses compared. The standard in the metric system is the kilogram, which see. The standard mass was chosen equal to the mass of one cubic decimeter, 1,000 cubic centimeters, of water at the temperature of its greatest density, 4°C. Since the force of gravity is not constant over the face of the earth, a kilogram mass will not be attracted by the earth with the same force at every point. A mass which will counterbalance a kilogram mass at one point on the earth's surface will counterbalance it at every other point. The mass of a body does not depend upon its position with reference to the earth.

MASS ACTION LAW. — The principle that the chemical activity of one constituent or ingredient of a reacting mixture is modified by the relative amount of it present, so that a weak reagent in large amount may be chemically as active as a strong reagent in small amount. Where the two reagents act in opposite directions, the effect of a strong reagent in small concentration acting in one direction may be neutralized by the effect of a weak reagent in large concentration acting in the other direction. This principle was discovered by Guldberg and Waage.

MASSACHUSETTS. — Trade name for electric and turbine driven blowers, ventilating fans and air conditioning apparatus manufactured by the Massachusetts Blower Co., Howard St., Watertown, Mass.

MASSACHUSETTS. — Trade name for magnet wire made by the Massachusetts Electric Mfg. Co., 11 Margin St., West Lynn, Mass.

MASSACHUSETTS BLOWER CO.—Watertown, Mass. Manufacturer of electric and turbine-driven blowers, ventilating fans and air conditioning apparatus. Business established 1901. President and general manager, W. E. Barnes; secretary, E. T. Sargent; treasurer, J. H. Champ. Main office and factory, Howard St., Watertown, Mass. Branch offices, 247 Atlantic Ave., Boston, Mass.; 376 Lafayette St., New York, N. Y.; 1229 S. Michigan Ave., Chicago, Ill.; Cleveland, Ohio. Sales representatives, W. I. Collier, Baltimore, Md.; Central Supply Co., Minneapolis, Minn.; Federal Steam Specialty Co., Oklahoma City, Okla.; Felt, Derrah & Williams, Salt Lake City, Utah; Smith & Lewis, Philadelphia, Pa.; M. C. Beman, Brisbane Bldg., Buffalo, N. Y.; Golden Gate Mfg. Co., Montreal, Que., Can.

MASSACHUSETTS ELECTRIC MFG. CO.—11 Margin St., West Lynn, Mass. Manufacturer of magnet wire.

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MASSACHUSETTS MACHINE SHOP, INC.—87 Albany St., Boston, Mass. Manufacturer of metal washers.

MASSACHUSETTS OILLESS BEARINGS CO.—518 Main St., Worcester, Mass. Manufacturer of oilless bearings. Business established 1904. President, George E. Parker; treasurer, George E. Parker, Jr.

MASSACHUSETTS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Secretary, J. E. Wilson, 263 Summer Street, Boston, Mass.

MASSAGE VIBRATORS.—See Vibrators, massage, electric, household type; Vibrators, electric, massage, masseurs'.

MASSEY.—Trade name for rheostat controllers manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

MASSEY CONCRETE PRODUCTS CORP.—Chicago, Ill. Manufacturer of concrete trolley and transmission poles and lighting standards. President, J. S. Hobson; vice-president and secretary, F. V. Shannon; vice-president, C. Gilman; treasurer, B. F. Landers. Main office, 521 Peoples Gas Bldg., Chicago, Ill. Branch offices, 50 Church St., New York, N. Y.; Oliver Bldg., Pittsburgh, Pa.; Candler Bldg., Atlanta, Ga.; Harry's Station, Dallas, Tex.; 925 S. 6th St., W., Salt Lake City, Utah.

MASSILLON.—Trade name for feed water heaters manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

MAST.—A tall wooden pole, like a ship's mast, sometimes used in radio work, to support the antenna. See Antenna supports, wood pole or mast.

MAST.—Trade name for lightning rods manufactured by the Mast Lightning Rod Co., 929 Reibold Bldg., Dayton, Ohio.

MAST, FOOS & CO.—Springfield, Ohio. Manufacturers of electric pumps. President, W. H. Rayner; vice-president, A. S. Rodgers; secretary, treasurer and general manager, F. R. Burton; sales manager, G. D. Morrett. Sales representatives, Crain Pump & Lumber Co., Philadelphia, Pa.; Reineke Wagner Pump & Supply Co., Pittsburgh, Pa.; George A. Clark & Son, Minneapolis, Minn.; Woodin & Little, San Francisco, Cal.; Poison Implements Co., Seattle, Wash., Stauffer-Eshleman Co., New Orleans, La.

MAST LIGHTNING ROD CO.—929 Reibold Bldg., Dayton, Ohio. Manufacturer of lightning rods, President, L. L. Mast; secretary, treasurer and sales manager, C. O. Mast. Factory, West Milton, Ohio.

MASTARM FITTINGS.—Mastarm fittings consist of a number of special pulleys, mounting bases, clamps, crossarms, insulators, etc. These fittings also include the reinforcing members, strain arms, supporting rod or guy, etc. The pulleys are used at both ends of the mastarm and are arranged for pipe and pole mounting; they are sometimes made in conjunction with the pipe receptacle and bracing member. Swivel and cutout pulleys which open the lamp circuit or cut out the lamp on lowering are much used. This greatly facilitates cleaning and repairing on live circuits.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MASTARMS, STREET LIGHTING.—Mastarms are iron pipe arms which extend out from a pole from 6 to 20 ft. and are used to support a lighting unit, either an arc lamp or now more commonly an incandescent lamp. They require special bracing to prevent excessive swaying in the wind. This is provided by clamping a reinforcing triangle or bracing member on the pipe and running two strain rods from the lamp end to the pole through the special member. They are sometimes made with iron scrolls and other decorative features. Ropers and pulleys are provided for lowering the lamp for cleaning or renewal. Mastarms are used principally in suburban and small town lighting systems where there are numerous dense and low trees on the sides of the street and the lamps must be hung near the center to prevent the dark shadows from the foliage that would result if the lamps mounted at the curb. Center span construction is sometimes used for this purpose, but it requires a pole on each side of the street, whereas mastarm construction requires only one pole.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Buffalo Specialty Co., 375 Ellicott St., Buffalo, N. Y. "Duplex."
Creaghead Engineering Co., Cincinnati, Ohio.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
HUBBARD & CO., Pittsburgh, Pa. Peirce mastarms for street lighting are made in four styles and in any length up to 16 ft. They are all furnished hot galvanized. See Hubbard catalog, pages 186 to 190. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MASTER.—Trade name for electric garage pumps and air compressors manufactured by the Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.

MASTER.—Trade name for automobile lighting and starting storage batteries manufactured by the Mac-Lar Battery Co., Inc., 146 3rd St., Detroit, Mich.

MASTER.—Trade name for motors, generators, electric grinders, etc., manufactured by the Master Electric Co., 460 Bacon St., Dayton, Ohio.

MASTER.—Trade name for motor-driven motion-picture machines manufactured by the Master Machine Tool Co., Inc., New York, N. Y.

MASTER.—Trade name for electrical primers for internal-combustion engines manufactured by the Master Primer Co., 34 Larned St., E., Detroit, Mich.

MASTER CLOCKS.—See Clocks, electric, master and secondary.

MASTER ELECTRIC CO.—133 S. Jefferson St., Chicago, Ill. Manufacturers of electrotherapeutic high-frequency apparatus. Business established 1918.

MASTER ELECTRIC CO., THE.—460 Bacon St., Dayton, Ohio. Manufacturer of motors, generators, electric grinders and farm utility power stands. Business established 1920. President and general manager, E. P. Larsh; vice-president and sales manager, F. O. Kirkpatrick; secretary, R. S. Shonk; treasurer, S. A. Brown.

MASTER MACHINE TOOL CO., INC.—New York, N. Y. Manufacturer of motor-driven motion-picture machines.

MASTER PRIMER CO.—34 Larned St., E., Detroit, Mich. Manufacturer of electrical primers for internal-combustion engines. President, F. S. Larabee; vice-president, F. M. Sackett; secretary, treasurer and general manager, E. T. Daniels.

MASTER SWITCHES.—See Switches, master.

MAT FINISH.—A dull, dead or lusterless finish of any material as contrasted with a polished finish. In electroplated articles it is obtained by having the surface unburnished. In painted surfaces the effect is secured by dabbing or stippling the paint instead of spreading it evenly by the brush which gives a glossy surface. The mat finish of surfaces exposed to very brilliant light sources eliminates the serious glare from specular reflection so commonly noticed where lamps that are inadequately screened are used.

MATCHLESS.—Trade name for electric gas lighter manufactured by the Safety Gas Lighter Corp., Roanoke, Va.

MATCHLESS BRASS MFG. CO.—57 Jay St., Brooklyn, N. Y. Manufacturer of fixture fittings. President, F. M. Brooks; secretary, A. J. Brooks.

MATEER & CO., F. W.—226-232 W. Ontario St., Chicago, Ill. Manufacturer of motor-driven laundry machinery. Business established 1893. President and treasurer, F. W. Mateer; secretary, E. G. Mateer; sales manager, R. M. Johnson.

MATES, TRACK SPECIAL WORK.—The term applied to the piece of street-railway track special work which lies in the same track and directly opposite to a switch. The switch and mate are designed to work together, the switch controlling the direction of traffic and carrying the wheel load on one rail of the track, while the mate carries the wheel load on the opposite rail. Mates are constructed from a variety of materials and in a number of different ways. For further information see Track work, special.

MATHER.—Trade name for flexible shaft couplings manufactured by the Charles Bond Co., 617-19 Arch St., Philadelphia, Pa.

MATHIAS-HART CO.—516 Atlantic Ave., Boston, Mass. Manufacturer of linemen's rubber gloves, insulated tools, rubber mats and matting. Business established 1907. Partnership, Robert Mathias and George H. Hart.

MATISSE CORP., C. & A.—116th St. and East River, New York, N. Y. Manufacturer of reflectors. Business established 1888. President, Edward Lyndon; 1st vice-president, Carl A. Matisse, 2nd vice-president, Albert C. Matisse; secretary, Oscar A. Matisse; treasurer and general manager, Louis E. Barnes.

MATLOCK.—Trade name for cable roller manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

MATS FOR SWITCH PLATES.—Wood, fiber, rubber or other mats, which are raised borders on which the switch plate is mounted are sometimes used to protect the wall surrounding the switch plate from becoming soiled and dirty. They are used for flush switches and receptacles, and may be used with or without outlet boxes.

Manufacturers:

Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

MATTE.—An intermediate product obtained in the smelting of sulphide ores of certain metals, especially copper, lead and nickel. In each case it is a crude metal containing more or less sulphur and requires to be further purified.

MATTER.—Matter may be variously described as "the stuff out of which things are made," "anything which occupies space," or "anything which can affect the senses." Though useful, none of these definitions tell us anything about the ultimate nature of matter. From chemical investigation we know that there are between 80 and 90 elements of which all known chemical compounds are composed. The idea that these elements are modifications of some fundamental form of matter, the nature of which remains to be discovered, is a fascinating one.

The study of chemical reaction leads to the atomic theory that matter is made up of certain ultimate particles which enter into combination with other atoms. According to the electron theory, the atom is a complicated structure consisting of a nucleus around which a number of electrons are in constant motion. The theory also has been advanced that matter is composed entirely of electric charges and that inertia, or mass, is merely a manifestation of electrical inertia.

As far as we know, no matter can be created or destroyed by any human agency. Substances may be combined chemically to form other substances, or a substance may be separated into its components, but the total quantity of matter after the change is exactly the same as before. This principle is known as the "conservation of matter."

MATTHEWS & BROTHER, INC., W. N.—St. Louis, Mo. Manufacturer of electrical specialties. President and treasurer, W. N. Matthews; vice-president, Martin J.

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Wolf; vice-president and secretary, Claude L. Matthews. Main office, 2912 Easton Ave., St. Louis, Mo. Factories, St. Louis, Mo.; Rockford, Ill.; Dayton, Ohio; Middletown, Ohio; Indianapolis, Ind. Branch offices, 19 S. Wells St., Chicago, Ill.; San Francisco, Cal.; 50 Church St., New York, N. Y.; Denver, Colo.; Salt Lake City, Utah; El Paso, Tex.

MATTHEWS CO., THE.—Port Clinton, Ohio. Manufacturer of marine and farm lighting and power plants. Business established 1892. President and general manager, S. J. Matthews; vice-president, F. C. Thorn; secretary and treasurer, George B. True. Exclusive distributor, Keroel Sales Co., Cleveland, Ohio.

MATTHEWS ENGINEERING CO.—Sandusky, Ohio. Manufacturer of automatic lighting and power plants. Business established 1912. President, J. W. W. Wellington; secretary, treasurer and general manager, M. C. Cosgray.

MATTHEWS FULL AUTOMATIC.—Trade name for electric and power plants manufactured by the Matthews Engineering Co., Sandusky, Ohio.

MATTHIESSEN & HEGELER ZINC CO.—LaSalle, Ill. Manufacturer of sulphuric acid, zinc bars, sheets, etc.

MATTING, BURGLAR - ALARM. — Contact-making matting intended to be placed in front of doors, safes, etc., and designed to close a burglar-alarm circuit when a slight weight or impression is placed on the mat, as by any one stepping on it. Also see Floor treads, contact-making.

Manufacturers:

PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

MATTING, INSULATING AND NON-SLIPPING.—Much of the danger attendant to the operation of electrical equipment is eliminated if the workmen or operators are well insulated from the ground. Rubber insulating matting is often used to cover the floor surrounding generators, transformers, switchboards and other high-voltage apparatus with exposed live parts, thereby providing at least part of the necessary insulation to any one working around them. It is sometimes necessary that the mat be more than insulating, as a part of the hazard is the possibility of slipping. Abrasive compounds mixed into a firm base of rubber are sometimes used instead of the rubber compound alone, especially where the possibility of slipping is the greater danger, which may be around any machinery.

Manufacturers:

American Abrasive Metals Co., Hudson Terminal Bldg., New York, N. Y. "Vulcalun."
Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Empire Rubber & Tire Corp., N. Clinton Ave., and Mulberry St., Trenton, N. J.
Goodall Rubber Co., Inc., 11th and Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Perfection."
New York Belting & Packing Co., 91-93 Chambers St., New York, N. Y.
Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. Rubber mats for use in front of switchboards. Made of highest quality rubber compound. U. S. switchboard mats give a sure foothold, prevent slipping and provide insulating qualities more than adequate for safety of the operator. Supplied either corrugated or plain. —Adv.
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

MATTING, STREET AND INTERURBAN CAR.—A floor covering for the aisles of cars to provide an easily renewable wearing surface, a sure footing and a comparatively dry surface during times of wet or sloppy streets. Made in several types, such as woven fibrous material, linoleum, interlocked rubber pieces, joined links of metal, interspersed with nonslip wearing pieces, etc. Street-railway cars are usually provided with aisle and floor matting of closely spaced hard wooden strips, generally maple.

Manufacturers:

Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.
Diamond Rubber Co., The, Akron, Ohio.
Empire Rubber & Tire Corp., N. Clinton Ave., and Mulberry St., Trenton, N. J.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Perfection."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

MATTISON MACHINE WORKS.—Rockford Ill. Manufacturers of motor-driven rubbing and polishing, sanding and other woodworking machines. President, A. M. Mattison; vice-president, John A. Barnes; secretary and treasurer, C. L. Mattison; sales manager, Joseph O'Leary. Main office and factory, Rockford, Ill. Branch offices, 209 S. State St., Chicago, Ill.; 602-603 Times Bldg., New York, N. Y.; American Exchange National Bank Bldg., Greensboro, N. C. Sales representatives, Baxter D. Whitney & Son, Inc., Winchendon, Mass.

MATTOCKS, LINE CONSTRUCTION.—A special form of pick largely used for digging and grubbing in pole-line construction. It is made in two principal types, each having a double-ended steel head with a socket in the middle into which a long handle fits. One type has a blade at each end, one blade being like an adz and the other like a narrow ax; this is commonly called the cutter mattock. The other common type has a pick at one end and an adz at the other; this is called a pick mattock.

MAUTNER LAMP MFG. CO.—55 Mercer St., New York, N. Y. Manufacturer of portable electric lamps. Business established 1920. Sales representatives, Kindt Katz & Co., New York, N. Y.; George Bordfeldt & Co., New York, N. Y.

MAXIM MFG. CO.—700 W. 22nd St., Chicago, Ill. Manufacturer of electric labor-saving devices for hotels and restaurants.

MAXIMETER.—Trade name for indicating maximum demand meter manufactured by the Mineralac Electric Co., 1045 Washington Blvd., Chicago, Ill.

MAXIMUM DEMAND. — See Demand, maximum.

MAXIMUM DEMAND INDICATORS OR METERS.—See Indicators, excess demand; Meters, demand.

MAXIMUM LOAD.—The maximum load of any machine or apparatus is the load used as a basis in determining the rating of the machine. It is that load which, if applied continuously or for a stated period, will produce a temperature rise that, superimposed upon a standard ambient temperature, will not exceed the maximum safe operating temperature of the insulation used.

MAXIMUM STARTING CURRENT.—The greatest value reached by the current in starting a motor. It is much higher than the full-load running current and in all but small motors must be limited by the use of series resistors or resistors in the motor secondary, by fractional voltage coils or autostarters or by special design of the motor or its starting equipment. See Starters, motor.

MAXIMUM VALUE.—The maximum value of an alternating current or e.m.f. is the peak value of the wave. If the fluctuations of the current or e.m.f. are represented by a clock diagram, then the maximum value (also called "crest" value) is the value represented by the rotating vector. Maximum values of alternating e.m.f. are important in practice, since danger to life and liability to breakdown of insulation depends on it. See Crest voltmeter.

MAXIMUM VALUE OF E. M. F.—Also called "crest value." The highest value reached by the e. m. f. in an alternating-current wave; the voltage at the top of the wave.

MAXOHM.—Trade name for resistance units manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

MAXOLITES.—Trade name for reflectors manufactured by the Central Electric Co., 316 S. Wells St., Chicago, Ill.

MAX-SON. — Trade name for insulator pins manufactured by R. Thomas & Sons Co., East Liverpool, Ohio.

MAXUM.—Trade name for grounding devices manufactured by the Fairmount Electric & Mfg. Co., 59th and Woodland Ave., Philadelphia, Pa.

MAXUM. — Trade name for telephone mouthpiece manufactured by the F. A. Weeks Mfg. Co., 93 John St., New York, N. Y.

MAXWELL.—The unit of magnetic flux is the maxwell. It is the flux through unit area at a point where the induction is unit, or it is the flux in a medium of unit permeability at a point where the intensity is one gauss. A m.m.f. of one gilbert acting in a magnetic circuit whose reluctance is one oersted produces a flux of one maxwell.

MAXWELL CO., THE R. C.—Trenton, N. J. Manufacturer of electric signs. William Bach, manager. Main office and factory, 413 E. State St., Trenton, N. J. Branch office, 17 S. New York Ave., Atlantic City, N. J.

MAXWELL ENGINEERING & MFG. CO.—New York, N. Y. Manufacturer of substations, high-tension switching equipment and pole-line hardware. President and sales manager, M. P. Maxwell; vice-president and general manager, Robert A. Sandt; treasurer, H. A. Hall. Main office, 61 Broadway, New York, N. Y. Factories, Philadelphia, Pa. and Brooklyn, N. Y. Branch offices, 261 Franklin St., Boston, Mass.; 1055 Old Colony Bldg., Chicago, Ill.

MAXWELL, JAMES CLERK. — Scottish physicist, born at Edinburgh, Scotland, 1831, and died in 1879. He was educated at the Academy and University of Edinburgh. He held the professorship of natural philosophy in Marischal College, London, 1860-65, and become professor of experimental physics at Cambridge in 1871. In 1859 he published an essay on the "Stability of the Motion of Saturn's Ring;" in 1871, "Theory of Heat;" and in 1873, a "Treatise on Electricity and Magnetism." In the last work, which has become a classic, he rejected the theory of electrical action at a distance, and sought to explain all electrical and magnetic phenomena as the results of local strains and motions in a medium whose contiguous parts only act on one another by pressure and tension. He devoted attention to the perception of color, and was the first to make color sensation the subject of measurement. He also made investigations on the kinetic theory of gases. Maxwell's studies in electricity and magnetism anticipated, purely from the mathematical standpoint, some of the most important subsequent developments, notably in radio communication. In his honor the unit of magnetic flux is called the maxwell.

MAXWELL PER SQUARE CENTIMETER.—One maxwell per square centimeter is the unit of magnetic flux density. This is sometimes also called the gauss.

MAYER CO., LEON.—237 Center St., New York, N. Y. Manufacturer of lighting fixtures and indoor brackets.

MAYHEW.—Trade name for drills, pliers, reamers and other tools manufactured by Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y.

MAYHEW CO.—867 Meinecke Ave., Milwaukee, Wis. Manufacturer of farm lighting plants and utility power stands, motor-generators for battery charging and switchboards.

MAYHEW STEEL PRODUCTS, INC.—New York, N. Y. Manufacturer of drills, pliers, reamers and other tools. Business established 1856. President, J. W. Thurber; vice-president and sales manager, J. B. Parsons; secretary, L. S. Brown; treasurer, H. W. Hatch. Main office, 291 Broadway, New York, N. Y. Factories, Shelburne Falls, Mass.; Watson, Mass.; Hopewell, Va. Branch offices, 30 Warren St., New York, N. Y.; 508 Mission St., San Francisco, Cal.

MAYHEW TOOL CO.—Williamstown, Pa. Manufacturer of fixture chain link tools.

MAYTAG CO., THE. — Newton, Iowa. Manufacturer of internal-combustion engines and electric washing machines. Business established 1894. President, F. L. Maytag; vice-president, L. B. Maytag; secretary, treasurer and general manager, E. H. Maytag; sales manager, J. B. Bond. Main office and factory, Newton, Iowa. Branch offices and warehouses, Kansas City, Mo.; Indianapolis, Ind.; Portland, Ore.; Minneapolis, Minn.; Philadelphia, Pa.; Winnipeg, Man., Can.

MAZDA C-3.—Trade-mark for photographic lamp manufactured by the Nela Specialties Division, National Lamp Works of General Electric Co., Nela Park, Cleveland, Ohio.

MAZZOLINI ARTCRAFT CO.—4424 Payne Ave., Cleveland, Ohio. Manufacturer of electric lighting fixtures and portable lamps. Business established 1904. Partnership.

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generally small instruments that may be carried in a pocket or leather case. They have a segment of a graduated circular ring with a leveling device mounted on a small telescope. The angle between the horizontal and the telescope when the top of the pole is being sighted gives an indication on the graduated ring which will give the height of the pole directly in feet.

MEASURING INSTRUMENTS, ELECTRICAL.—See Instruments, electrical measuring.

MEASURING REELS AND OUTFITS.—See Wire measuring reels and outfits.

MEAT CHOPPERS AND SLICERS.—See Choppers, meat and food, electric; Slicers, meat, electric.

MECHANICAL APPLIANCE CO., THE.—Milwaukee, Wis. Manufacturer of electric grinders, exhaust fans, motors, generators, etc. Business established 1901. President, Louis Allis; vice-president, R. G. Kellogg; secretary, Edward P. Allis; treasurer, O. F. Pihl, Jr.

MECHANICAL EQUIVALENT OF HEAT.—Since heat is a form of energy, the unit of heat is a form of energy. The unit of heat must have a definite value when translated into ergs or foot-pounds, the mechanical units. The mechanical equivalent of heat is the number of mechanical units of energy in one heat unit. Experiments of Joule, Rowland and others have determined these relative values. They are: 1 calorie = 4.184 joules; 1 B. t. u. = 777.64 foot-pounds; for the ordinary calculations 4.2 and 778 are sufficiently accurate values of these equivalents. Other interesting relations are the following: 1 horsepower-hour = 2546 B. t. u.; 1 kilowatt-hour = 3413 B. t. u.

MECHANCIAL SPECIALTIES & MFG. CO.—1619 N. Washtenaw Ave., Chicago, Ill. Manufacturer of bakelite and washing machine gears. Partnership, Samuel McCallen and C. B. Hale.

MECHANICAL SWITCHING SYSTEM.—Trade name for automatic telephone switchboard apparatus manufactured by the Western Electric Co., 195 Broadway, New York, N. Y.

MECKEL, FRED L.—9-13 E. 13th St., Chicago, Ill. Manufacturer of telephone and telegraph construction tools and material. Proprietor, Fred L. Meckel.

MECO.—Trade name for marine fixtures and fittings manufactured by the Marine Electric Co., 195 Fremont St., San Francisco, Cal.

MECO.—Trade name for oxy-acetylene welding and cutting apparatus and supplies manufactured by the Modern Engineering Co., 23rd and Walnut Sts., St. Louis, Mo.

MEDACO.—Trade name for high-frequency generators manufactured by the Medical Appliance Corp., 631 Pennsylvania Ave., N. W., Washington, D. C.

MEDART PATENT PULLEY CO., INC.—St. Louis, Mo. Manufacturer of power transmission machinery. Business established 1879. President and general manager, Walter R. Medart; secretary, J. E. Henry; sales manager, E. T. Cregler. Main office and factory, Potomac and De Kalb Sts., St. Louis, Mo. Branch office and warehouse, Cincinnati, Ohio. District office, 130 N. Wells St., Chicago, Ill.

MEDICAL APPLIANCE CORP.—631 Pennsylvania Ave., N. W., Washington, D. C. Manufacturer of high-frequency generators and violet-ray apparatus. Business established 1920. President, G. W. Shook; vice-president, Capt. A. E. Drake; secretary, W. P. Benson; treasurer, Dr. G. D. Parsons.

MEDICAL BATTERIES.—The term medical battery is loosely applied to an apparatus for producing a moderately high-voltage, high-frequency current for medical purposes. The usual form consists of an induction coil with a battery of a few dry cells mounted in a case so that the outfit may be conveniently carried about. To the secondary of the coil is connected a pair of terminals or electrodes which the patient may hold in his hands or which may be applied to other parts of his body. Such sets are used in certain electrotherapeutic work.

Manufacturers:

Bachelet Medical Appliance Co., Inc., 32 E. Strand St., Kingston, N. Y. "Bachelet Wave."
Betz Co., Frank S., Hoffman St., Hammond, Ind. "Ideal," "Granger's," "Ward's," "Cedergren."
Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Brooklyn Medical Battery & Instrument Co., Inc., 991 Madison St., Brooklyn, N. Y.
Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell," "Auto-Kure," "Home."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Hearn & Harrison, 418 Notre Dame St., West, Montreal, Que., Can.
International Battery Co., Inc., 453-455 Broome St., New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Home," "Manhattan," "Apollo," "Household."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Milo-Bar Bell Co., The, 301 Diamond St., Philadelphia, Pa. "Gal-Far."
Novo Mfg. Co., Inc., 424 33rd St., New York, N. Y. "Novo."
Pilling & Son Co., G. P., 23rd and Arch Sts., Philadelphia, Pa.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Voltamp Electric Mfg. Co., 407-409 N. Paca St., Baltimore, Md "Voltamp."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

MEDICATORS, AIR, ELECTRIC.—These are usually small devices for producing a current of medicated air. They are used in stores, offices and residences. The device consists of a small electric fan for producing the air current and a vaporizing device which may include an electric heater. The liquid vaporized may have antiseptic properties or merely a pleasant odor, depending on the aim to be achieved.

Manufacturers:

Claxo Co., The, Iowa City, Iowa.
Comfort Electric Atomizer Co., The, 959 1st Ave., New York, N. Y. "Comfort."

MEESE & GOTTFRIED CO.—San Francisco, Cal. Manufacturer of belt tighteners and other power transmission apparatus. President, Constant Meese; secretary and treasurer, F. Gottfried. Main office and factory, 660 Mission St., San Francisco, Cal. Branch offices, Los Angeles, Cal.; Portland, Ore.; Seattle, Wash.; Vancouver, B. C., Can.

MEESECO.—Trade name for belt tighteners manufactured by the Meese & Gottfried Co., 660 Mission St., San Francisco, Cal.

MEFCO.—Trade name for shade holder manufactured by H. G. McFaddin & Co., 38 Warren St., New York, N. Y.

MEFCOLITE.—Trade name for semi-indirect lighting units manufactured by H. G. McFaddin & Co., 38 Warren St., New York, N. Y.

MEGGER.—Trade name for megohmmeters, ohmmeters and insulation testing sets manufactured by James G. Biddle, 1211-13 Arch St., Philadelphia, Pa.

MEGOHMMETERS.—This is a type of portable deflection ohmmeter specially adapted for the measurement of high resistances, such as insulation. One much used form is a permanent-magnet movable-coil type of instrument without control springs. The movable element consists of two coils, one of which is connected through a resistance directly to the terminals of a magneto which forms a part of the instrument. The other coil of the movable element is connected in series with the unknown resistance and then to the terminals of the magneto. When the unknown resistance is open, or infinite, the reaction between the current in one coil and the field of the permanent magnet deflects the movable element to one extreme position of the scale. When a finite resistance is connected in series with the other coil, some current will flow through it and as the coils are differentially wound, this current will tend to produce a deflection in the opposite direction. The distance to which the pointer will deflect will depend upon the ratio of the currents in the two coils and hence upon the unknown resistance. The instrument is calibrated by means of known resistances and its indications are independent of the magneto-voltage fluctuations. The megohmmeter is useful in all insulation resistance measurements where the value of the resistance is desired. Also see Ohmmeters.

Manufacturers:

Beck Bros., 3648 N. 2nd St., Philadelphia, Pa.
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Megger" testing sets for testing insulation resistance of interior wiring cables, generators motors, transformers, switchboards, insulators and other electrical apparatus. Direct reading in ohms. Dead-beat. Hand dynamo in same case with ohmmeter, so that no battery or outside current supply is needed. Various ranges up to 5000 megohms.—Adv.



"Megger" Testing Set

Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)

MEIER ELECTRIC & MACHINE CO.—136 S. Meridian St., Indianapolis, Ind. Manufacturer of battery charging panels. President and treasurer, Frank L. Meier; vice-president, M. A. Meier; secretary, R. T. MacFall.

MEIROWSKY BROS.—11 McPherson Pl., Jersey City, N. J. Manufacturers of mica and mica products and other insulating materials.

MEISEL PRESS MFG. CO.—944-948 Dorchester Ave., Boston, Mass. Manufacturer of motor-driven printing presses and gears. President, C. A. Meisel; treasurer, O. C. F. Meisel.

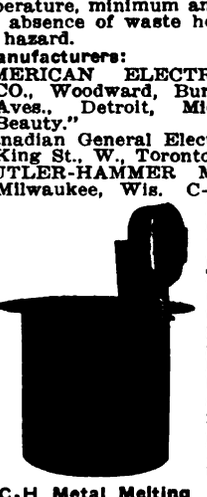
MELEADY.—Trade name for loom boxes manufactured by Clemence Bros., 164 Linden Ave., Irvington, N. J.

MELIORATE.—Trade name for terminals and connectors manufactured by the Standard Scientific Co., 9 Barrow St. New York, N. Y.

MELTERS, METAL, ELECTRICALLY HEATED.—These devices are most commonly in the form of a pot with an electric heating element in the bottom. For this reason they are often called electric metal melting pots. They are usually designed for melting metals whose melting points do not exceed about 600° F., such as lead, tin, solder, type metal, Babbitt metal, pewter, etc. Triple-heat units are frequently supplied, the high heat being used to bring about quick fusion, while the lower heats serve to keep the metal molten. These melters are available in several sizes, but seldom exceed a metal capacity over 200 lbs. Such outfits are much used in engraving shops, electrotype foundries, print shops, bearing factories, etc.; electric solder-melting pots are used in electric plants and establishments where considerable soldering is done. The advantages of electric melters are uniformity of metal temperature, minimum amount of oxidation loss, absence of waste heat, freedom from fire hazard.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs and Cass Aves., Detroit, Mich. "American Beauty."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Metal Melting Pots are manufactured in both the bench and portable types. They are designed to melt down at the proper temperature all soft metals, such as lead, tin, solder, babbitt, etc. They are limited to a maximum temperature of 550° F. The portable type is made in 10 and 25-lb. sizes with a maximum temperature of 440° F. Its current requirements are well within the rating of an ordinary lighting circuit. It consists of two containers made of strong sheet steel placed one within the other. The space between the containers is provided with a packing of insulation which prevents loss of heat through radiation. C-H Type H Heater Units are used and



C-H Metal Melting Pot—Bench Type

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are welded to the bottom of the inner container. The bench type pot is standardized in three sizes—50, 100 and 150 lb. capacity—and is constructed practically the same as the smaller portable type, except that the heater units are of the flat seamless steel type, immersed directly in the metal, with the lead arm coming over the rim of the pot. C-H Automatic Control Equipment, consisting of a dynamic thermometer and a suitable control panel, may be supplied with these heaters, if desired. See display adv. pages 1225-1230.—Adv.

Electric Heating & Mfg Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

Fort-ified Mfg. Co., 14th and Agnes Sts., Kansas City, Mo. "Fort-ified."

GENERAL ELECTRIC CO., Schenectady, N. Y. Automatic regulation of heat is the principle feature of the G-E self-regulating metal melter for melting lead, solder, babbitt and similar metals. The heating element being of wire, with the positive temperature coefficient, its resistance rises proportionately with temperature rise, and the current is thereby limited. Heat insulation insures efficiency. These pots can be furnished in 30, 100, and 400-lb. sizes. (See Bulletin 69703.) See adv. pages 1203-1223.—Adv.

MELTERS, WAX, ELECTRICALLY HEATED.—Wax melters are employed in the engraving industry to melt the wax used in building up the forms from which electrotypes are made. They are also used to melt the wax used for sealing packages and letters. In the latter type a small trigger controls the dropper valve. The heaters are usually copper pots with a heating element in the bottom. Two or three heats are provided, the high heat being used to bring the wax up to the melting point quickly and the lower heats to maintain it in a plastic condition ready for instant use. Some melters are arranged to operate with a heat-regulating device to maintain the proper temperature.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs and Cass Aves., Detroit, Mich. "American Beauty."

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E electrically heated compound melting pots with cartridge type, three-heat units which permit rapid initial heating and low current input to maintain working temperature. (Bulletin 69109.) See adv. pages 1203-1223.—Adv.

National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C.

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

Vulcan Electric Heating Co., 107 W. 13th St., New York, N. Y.

MELTING POINT.—The temperature at which a substance fuses or changes from a solid to a liquid state. In scientific work it is usually recorded in degrees centigrade. It forms one of the reliable tests for the determination of metals or their purity. For melting points (usually abbreviated m. p.) of various metals, see listing of the individual metal.

MELTING POTS, ELECTRIC, METAL.—See Melters, metal, electrically heated.

MELTING POTS, LEAD AND SOLDER. Lead and solder melting pots are cast iron pots generally from 5 to 8 ins. in diameter. They are arranged to be heated in several ways. A few have electrical heating elements, but this is not very common. Ordinarily the pot is set in the top of a portable fire pot which may burn kerosene, gasoline or charcoal. Often a small tripod is furnished for holding the pot and a blow torch or a gas flame is used to heat the lead. They are used by electricians in soldering heavy splices, tinning large cables and busbar joints, wiping joints on lead-covered cables, etc.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs and Cass Aves., Detroit, Mich. "American Beauty."

Ashton Mfg. Co., 184 Emmet St., Newark, N. J. "Red-Hot."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.—See Melters, metal, electrically heated. See display adv. pages 1225-1230.—Adv.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See Melters, metal, electrically heated.)—Adv.

HERBST, PAUL W., Chicago, Ill. We specialize in melting pots made of heavy cast iron, with steel handles. Write for complete information. (See display adv. page 1258.)

Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.

Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

MEMCO.—Trade name for transmission line equipment manufactured by the Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y.

MENDELL MFG. CO.—Mattapoisett, Mass. Manufacturer of switches, switchboards, panelboards, etc. President and treasurer, Charles S. Mendell; vice-president, John D. Mendell; secretary, Ferdinand A. Wyman.

MENO.—Trade name for rust solvent manufactured by Peter H. Frasse & Co., 417 Canal St., New York, N. Y.

MENOMINEE.—Trade name for electric fans and motors made by the Tideman Electric Mfg. Co., Cairo, Ill.

MEPHISTO.—Trade name for wood boring tools manufactured by the W. A. Ives Mfg. Co., Wallingford, Conn.

MERACO.—Trade name for radio equipment manufactured by the Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y.

MERCER.—Trade name for electric ironing machine manufactured by the Western Appliance Mfg. Co., 1405 L. C. Smith Bldg., Seattle, Wash.

MERCER LAMP & SHADE CO.—120 Hamilton Ave., Trenton, N. J. Manufacturer of portable lamps and lamp shades. Business established 1921. Sole owner, Joseph Pentz.

MERCHANDISING, ELECTRICAL, ANALYSIS OF SUCCESSFUL METHODS FOR.—The definition of merchandising is "buying and selling," so we may say that electrical merchandising covers the buying and selling of any electrical product. Usage has, however, given it a different meaning in the past three or four years, and this term has come to be applied in the industry only to those products that are of a resale nature, that is, electrical products which are distributed through the wholesaler and the retailer.

Electrical merchandising, whether it be wholesale or retail, consists of three functions—buying, selling and co-ordination. Considered briefly, the fundamentals of buying are market, prices and quality; of selling are store, stock and service; of co-ordination are maintenance, measurement and management.

The fundamentals of store are location and equipment; of stock are comprehensiveness, ease of inspection, quality, and sale in retail quantities. Service has three degrees; minimum service, ordinary service, and special service. The first degree consists of merely a sales force; the second of deliveries, credit and fair prices. As competition becomes keen we have the highest degree of service or special service. This is divided into two classes, static selling and dynamic selling. Static selling consists of sending goods on approval, repairing, expert advice, special deliveries, and conveniences to customers in the form of telephones, writing facilities, comfortable chairs, etc. Dynamic or creative selling is the highest expression of electrical merchandising. It takes into account every contact that the dealer can have with his public. These contact points may be divided into five general divisions: Store, exterior, publications, newspaper advertising and window display.

The Store. Under the subject of store we must consider first the personnel. As the sales force is the end of the distribution trail great care must be exercised in selection and training. They should be courteous, careful, energetic, neat, loyal, honest, intelligent and economical. They must know the stock, where to find it, the talking points, prices, and must understand salesmanship.

Store arrangement is an important factor in the successful operation of a retail electrical store. A study of the habits of the public in moving about the store has led to some very interesting conclusions: If the space from sidewalk to rear wall is divided into 100 points, the entrance is worth 16½; the windows 30; the right longitudinal half 27½; the left longitudinal half 26; the front half 33½, and the rear half 20. This indicates the importance of the windows and entrance. It also shows the value of locating the lamps and other especially popular devices toward the rear of the store, in order to equalize the sales value of all floor space.

Briefly speaking, there are two principal types of store, the "hardware" type and the "jewelry" type. The former is the better for most localities. With the latter, elegance in fittings predominates, giving an impression of exclusiveness. This type is appropriate only in notable well-to-do localities. In addition to these two types of stores, there may be mentioned smaller stores where the "home" idea predominates and where buffets, dining tables and other home furnishings are used largely in lieu of store fixtures.

It has been found advantageous in deep stores to use a runner of rubber or coco mat as it seems to have a psychological effect in drawing the prospective customer toward the rear of the store. Small rugs under vacuum cleaners give atmosphere to the displays and break the monotony of a bare floor.

The colors of the walls should be toned down toward the ceiling, that is, the wainscoting should be of a darker tone than the walls. The ceiling should be very light, preferably a white or cream. Ceiling fixtures should not be displayed on the ceiling of the store but should be shown in shadow boxes arranged along one of the walls.

Pillars and posts can be given sales value by placing shelves around the upper portion and a seat lower down; by having shelves or a glass case around them extending down to counter height; by placing mirrors or a small floor case around them. A liberal number of flush receptacles should be provided on all display tables to facilitate showing the devices in operation.

A small platform built in a corner of the store offers a valuable "stage setting" for the display of vacuum cleaners, etc. In large stores it is desirable to install a model kitchen or laundry with all the electrical devices connected up.

Small stores can sometimes gain more space by building a mezzanine floor and utilizing it for either an office or for fixture display. Many large stores are providing a room with a telephone and writing facilities for the convenience of their customers. Finishing touches are sometimes given by having a few canaries in decorative cages at various points in the store; by installing an electric fountain; by providing deep upholstered chairs or by a motor-operated phonograph.

A summary of the store suggestions follows. Combine artistic and economic arrangement. Plan aisles to lead customers. Place related articles near each other. Display devices where they can be easily handled. Place staple goods in rear of store. Provide for systematic stock keeping. Use small tables. Aim for both convenience and sales value.

The fixtures must be of an attractive, uniform finish. The display on top of show cases should be trimmed regularly. Counter cards should always be neat and, when they hold small items of stock, should be kept replenished. A table should be put near the front, having on it the leader that is being pushed for the week. The shelving must be kept attractively trimmed. The telephone places the dealer in touch with every one in his community and can be used advantageously in systematic sales talks to prospective customers.

The employment of factory demonstrators from time to time provides a stimulus to trade. It is important to instruct the sales force to close every sale with a demonstration to the customer of some other device that he or she might use profitably. The giving of noveities at appropriate times, such as at anniversaries of the opening of your store, Christmas or New Year, will have an excellent effect.

Exterior Contacts. Under the exterior group of contacts with the public is, first, the personality of the owner. This includes his standing in the community, his identification with public interest, his membership in local organizations, his sociability, reputation for financial stability, good credit, etc.

The location of the store should be given a great deal of study and while no general recommendations can be made for the electrical store, observations lead to the conclusion that the best paying stores are generally located either on, or near the main traffic stream. Just how far to go

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in the matter of expense in locating on the principal thoroughfares is solely for individual consideration. The buying power of the community, the number of pedestrians passing each day, the proximity to theaters, department stores, post offices and street-car stops are items which should be carefully considered before a decision is reached.

The exterior of the store is important in making contact with customers. Windows should be large and clean. The front should be kept freshly painted. There should be not more than one step up to the floor line. If the elevation is greater, a ramp should be built.

The sidewalk should be kept free from obstructions and from snow and ice. If there is a trap door in the sidewalk it should be used only at a time of day when there are few passers-by. The owner should see that the whole exterior of the building is kept neat in appearance. The firm name should be on a sign extending across the store front above the windows.

Outside employees sent into residences should be courteous, careful in their work, and neat in their personal appearance. Signs on the delivery van furnish a moving display that reaches all of the community. Car cards are advantageous as an exterior advertising medium; they permit localizing of the advertising; they are seen day and night and the readers are generally in a receptive mood. These cards permit the free use of color and are furnished by most manufacturers. Lantern slides and motion pictures can also be obtained from many manufacturers. Poster boards and sign boards are used to a limited extent by electrical retailers. Exhibit booths for fairs, shows, etc., can be constructed in spare time and preserved for future use in preference to making mediocre temporary structures for each occasion.

Publications and Advertising. In estimating the value of the contact established by publications, emphasis is placed upon the importance of direct mail advertising or a systematic use of the mails in sales promotion. It must be based on a good mailing list kept strictly up-to-date. This list may be compiled from telephone directories, club lists, record of customers, exchange with merchants of other lines, etc. Booklets, folders, blotters, etc., should also be enclosed in packages, monthly statements, placed on counters, and given out personally. Stationery should be uniform in color and type and if possible a slogan should be coined and used on all printed matter.

Posters and signs should be used tastefully in store interior and windows, and should be replaced when soiled. Calendars are valuable as they occupy a prominent position in the home for a year. Newspaper advertising should be timely, forceful, direct and truthful. Its appearance is dependent upon the illustration, type and layout. Generally speaking, the headline should be a direct "telegraphic" statement and the same style of type should always be used for the signature. In laying out an advertisement it is well to leave plenty of white space around it in order to make it stand out well. Consistent advertisers can make arrangements with the papers to retain a preferred position.

Window Displays. Window display is the most valuable advertising medium at the dealer's command. Consideration should first be given to the permanent trim. This phase of the subject takes in the shape, size, floor, backgrounds, lighting and accessibility. In general, the window frontage should be as great as possible. If the store is narrow, adequate window space may be secured by making narrow but very deep windows. Two small windows with a central entrance are preferable to one larger window with a side entrance. In case the store has too large a window and alterations are not permitted, movable spacers may be provided so that two separate displays can be made at the same time. No lettering, gold leaf or otherwise, should be put on the window glass within the line of vision, with the single possible exception of the firm name in letters not over one inch high.

Many modern show windows have the window floor level with the store floor in order that clothes washers, ironers, dishwashers, ranges and other large merchandise may be seen from the same angle as when in use in the home. When this is done, a movable platform should be provided to bring the floor of the window a foot and a half higher, when it is desired to show small appliances. Linoleum makes a satisfactory floor covering. A small tile pattern is effective for showing kitchen appliances. This may be varied with a hardwood pattern and a rug design. These three patterns can be kept on the floor of the window one above the other unless the window is larger than the average.

The window background should extend above the line of vision from the sidewalk and should be of a light color, such as a French gray. A dark-colored background tends to cause reflections in the glass. Satisfactory backgrounds can be constructed from composition board suitably paneled.

It behooves the electrical dealer to pay particular attention to his window lighting. This should be brilliant but the light sources must be concealed. Many surprising and spectacular effects can be obtained by spotlighting and the use of color screens. A valance should be used, extending across the top of the windows; this affords a means for concealing the lighting equipment.

The display itself should be designed so that it has sales as well as advertising value. The attractiveness of a show window depends upon the proper use of color, arrangement, cleanliness, neat window cards, and good lighting. The timeliness of a window takes into consideration not only the season and weather but current events, such as national advertising campaigns, national holidays and local events.

The window must be changed frequently, with regularity and by a responsible person. The display and price cards used should be professional work—not that of an amateur. Color is one of the most valuable helps that the window dresser has, but it should be used with discrimination and taste.

Red suggests heat; yellow indicates light. Orange is a warm color as it consists of red and yellow; green is a cool color as is also blue. Purple is a mourning color and should not be used. A French gray is the best color for displaying table appliances.

Co-ordination. In the co-ordination of retail buying and selling, maintenance is represented by salaries, repairs, legal expenses, taxes, supplies, dues, postage, rent, insurance, workmen's lost time, investments, telephones, transportation, light, heat, power, bad debts, depreciation, tools, and travel. Measurement which is really another word for management, consists of observation, planning and execution.

Manufacturing is changing the form of a product while merchandising is changing the place of a product. Merchandising is, therefore, somewhat analagous to a transportation system, and like a railroad has its danger signals. Some of these are slow turnovers, too much credit on books, difficulty in obtaining bank accommodations, dissatisfied customers, loss of regular customers, trend of street traffic away from store, accumulation of obsolete stock, lack of new customers, absence of popular interest in window display, too many bad debts, diversion of customers to competitors.

An electrical jobber has been defined as one who sells electrical goods at wholesale, who issues a catalog and has salesmen on the road. Briefly the points of contact that the jobber has with the dealer are traveling salesmen, house salesmen, catalogs, sales letters, house organs, display room, trade journals, merchandising and sales conferences, newspapers, demonstrations, mail publicity and exhibits.

The Goodwin Plan. In 1917 William L. Goodwin, of California, offered a plan to the industry for the co-ordination of efforts to sell the public the electrical idea. An important feature was a campaign of education conducted principally through trade papers, trade organizations and other channels. Its object was to co-ordinate the various interests in the electrical industry and to bring them together in harmonious action, so that there might be established retail distribution of electrical materials at fair prices to the consumer, and a fair profit to all parties taking part in the transaction.

The basis of the plan is: That each individual owes a responsibility to the organization representing his branch of the industry; that the organization owes a similar responsibility to its members, and that the organization representing each branch of the industry owes a responsibility to all other organizations in the industry. This is to the end that problems may be discussed with a view to the interest of all, thereby providing a basic plan for most adequately and efficiently serving the American public and for extending the activities of the electrical industry in the great undeveloped field before it. The objects of the plan are to intensify development in present fields; extend the industry to undeveloped fields, and to develop greater efficiency in industry.

Not only is the electrical industry indebted beyond measure to Mr. Goodwin for his vision in promulgating this sound and comprehensive idea, but also for his untiring efforts in securing its adoption. The Goodwin Plan was the greatest single contributing factor to success that has attended electrical merchandising in the past few years.

MERCHANDISING, ELECTRICAL, PRESENT STATUS AND PROSPECTS OF.—Within the past few years the sale of electrical merchandise has been given a tremendous impetus by four causes: The Goodwin Plan; scarcity of labor, particularly in the home; the practice of merchandising principles in the industry; and a realization on the part of the public of the importance of electrical conveniences. This is shown by the following statistics on a few household electrical appliances: Washing-machine sales — 1909, (approximately) $225,000; 1914, (approx.) $1,000,000; 1918, (approx.) $25,000,000; 1919, (approx.) $50,000,000; 1920, (estimated) $75,000,000 to $100,000,000, representing the sale of about 700,000 machines. Electric vacuum-cleaner sales—1914, $1,300,000; 1918, $11,000,000; 1919, $20,000,000; 1920, (estimated) $30,000,000 to $40,000,000; statistics from 1916 to 1918 are not available. Heating devices sold in 1909, $1,500,000; 1914, $3,500,000; 1917, $7,000,000; 1918, $10,000,000; 1919, $18,000,000; 1920, from $25,000,000 to $30,000,000. Flatirons are the largest single item in the last group; the estimate for 1920 is 2,500,000 irons with list price of $17,500,000. Electric range sales—1919, (estimated) $25,000,000; 1920, (estimated) $50,000,000; 1921, (anticipated) $75,000,000; 1922, (anticipated) $100,000,000.

The total electrical business in California is estimated at $45 per capita and the sales throughout the country in 1920 at about $18 per capita. This would make a total electrical business of approximately $2,000,000,000. Some of the larger items included in this figure and not mentioned previously are: Fixtures, shades, reflectors, $245,000,000; wire lamp cord, etc., $140,000,000; incandescent lamps, $153,000,000; electric signs, displays and flashers, $110,000,000; automobile electrical supplies, $175,000,000; motors (100 hp. and under, except fractional-horsepower), $100,000,000; storage-battery replacements, $120,000,000; electric toys (wholesale value), $35,000,000. The sum of $245,000,000 has been added to cover the labor charges in wiring contracting sales.

Approximately 150,000 people are said to be employed in electrical merchandising and contracting and there is an investment in this branch of the business of about $175,000,000. While a large number of hardware, department and jewelry stores handle electrical appliances, the principal business is done through the 6,721 electrical contractor-dealers in the United States and Canada; the 3,410 central stations with a retail department, and the 1,093 central stations doing an electrical contracting business.

The potential market in the United States is indicated by the early return from the 1920 census, which gives a population of 105,683,108. There are 54,816,209, or 51.9%, living in incorporated communities of more than 2500 inhabitants; 9,864,196, or 9.3%, are living in smaller incorporated communities; and 41,002,703, or 38.8%, are living in country districts. There are 20,481,700 dwellings in the United States, of which 14,190,540 are not yet wired for electricity. Of the latter, 4,993,490 are within territory covered by central-station service. There are 6,362,502 farms in the United States and 340,000 electric farm-lighting plants are in use.

It is estimated that the country needs new buildings as follows: 1,300,000 residences; 450,000 factories; 6,000 hotels; 5,500 apartment buildings; 20,000 churches and theaters; 14,000 railway stations and freight sheds. All these and many other much needed buildings will each call for more or less electrical equipment.

MERCHANT & EVANS CO.—2035 Washington Ave., Philadelphia, Pa. Manufacturer of lead bars, etc. Branch offices, New York, N. Y.; Baltimore, Md.; Atlanta, Ga.; Cleveland, Ohio; Wheeling, W. Va.; Chicago, Ill.; St. Louis, Mo.; Kansas City, Mo.

MERCO.—Trade name for overload relays manufactured by Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.

MERCURY.—A silver white metal, the only metal that is liquid at ordinary temperatures. Symbol Hg; at. wt. 200.0.; sp. gr. 13.6; m. p. -39.5° C.; b. p. 357° C. The principal ore is the native sulphide HgS, called cinnabar, the ores in general containing only a few pounds of mercury per ton. The metal is obtained by removal of the sulphur by roasting, followed by distillation and condensation of the mercury. The chief producing countries are Spain, Italy, Austria, and the United States. The United States production is about one-fifth

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of the world's total, and amounted in 1919 to 726 metric tons. The metal is sold in iron flasks containing 75 lbs.

The principal uses are in the extraction of gold and silver from their ores by amalgamation, in making thermometers, barometers and other scientific instruments, in making paints, especially for shipbottoms, and in making denotating caps. In electrochemistry it has extended use as an electrode in certain cells, particularly chlorine-caustic soda cells, its value in most cases being due to its property of readily amalgamating with other metals. It is also used in mercury arc rectifiers and lamps, in mercury flotation meters, mercury contact cups, etc.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

General Scientific Equipment Co., North Philadelphia, Pa.

Globe Chemical Co., 722 Ridgeway Ave., Cincinnati, Ohio.

MERCURY. — Trade name for time switches made by the Mercury Time Switch Co., 2230 E. Canfield Ave., Detroit, Mich.

MERCURY ARC RECTIFIERS.—See Rectifiers, mercury arc.

MERCURY BAROMETER.—An instrument for determining the weight or pressure of the atmosphere and also used as an aid to predicting weather changes, to determine heights, etc. The principal form consists of a graduated glass tube containing mercury. See Barometers.

MERCURY MFG. CO. — 4118 S. Halsted St., Chicago, Ill. Manufacturer of electric tractors. President, A. G. Lennard, Sr.; vice-president and general sales manager, John R. Bensley; secretary-treasurer, O. T. Henkle. Sales representatives, J. S. Kunkle, Bourse Bldg., Philadelphia, Pa.; F. W. Cook, 721 E. 28th St., Minneapolis, Minn.; Conrad Hibbeler, 244 Engineers Bldg., Cleveland, Ohio; K. A. Wood, 10 High St., Boston, Mass.; William H. Fernholz, Mack Block, Milwaukee, Wis.; A. W. Leet, 816 Union Trust Bldg., Detroit, Mich.; H. Lee Reynolds Co., 1st National Bank Bldg., Pittsburgh, Pa.; H. W. Moore & Co., 18th and Wazee Sts., Denver, Colo.; Stanley D. Barkman; Steefel Bldg., Albany, N. Y.; Harry W. Faunt Le Roy, 525 Calvert Bldg., Baltimore, Md.; Truck & Tractor Co., Inc., 25 Church St., New York, N. Y.; Duncan Industrial Supply Co., 214 N. 6th St., St. Louis, Mo.; W. J. Etchen, 305 Huntington Bank Bldg., Columbus, Ohio; Thew & Carley, Inc., 1108 Farnam St., Omaha, Neb.; Andrew Fitzpatrick, 1003 Louisiana Guarantee Title Bldg., New Orleans, La.; James F. Spencer, 256 Main St., Buffalo, N. Y.; Sam G. Moyers, Croom, Fla.

MERCURY RADIO APPLIANCE CO.—672 Broadway, Brooklyn, N. Y. Manufacturer of radio equipment. Business established 1918. President, H. Bernstein; vice-president and general manager, H. Wanderer; treasurer and sales manager, L. W. Berns.

MERCURY TIME SWITCH CO.—2230 E Canfield Ave., Detroit, Mich. Manufacturer of time switches. Business established 1919. President, E. A. Burns; vice-president, Ray J. Burns; secretary, Guy A. Miller; treasurer and general manager, George E. Gallagher.

MERCURY VAPOR LAMPS.—See Lamps, mercury vapor.

MEREDITH CEDAR CO., J. P.—Memphis, Tenn. Producer of cedar poles. President, J. P. Meredith. Branch offices and warehouses, Nashville, Tenn.; Lebanon, Tenn.; Woodville, Ala.; Hollywood, Ala.; Bowling Green, Ky.; Russellville, Ky.

MEREEN-JOHNSON MACHINE CO. — 4401 Lyndale Ave., N.; Minneapolis, Minn. Manufacturer of motor-driven wood saws and box making machinery. Business established 1906. President and general manager, Charles Johnson; vice-president, Guy C. Johnson; secretary and sales manager, William H. Ellinger; treasurer, Nils N. Nylander.

MERIDIAN.—Trade name for globe net manufactured by Hamblin & Russell Mfg. Co., Worcester, Mass.

MERMAID. — Trade name for motor-driven dish-washers manufactured by the Mermaid Dish Washer Co., 61 Hubbard St., Middletown, Conn.

MERMAID DISH WASHER CO.—61 Hubbard St., Middletown, Conn. Manufacturer of motor-driven dishwashers. President and general manager, Frank E. Walcott; vice-president, secretary and treasurer, S. C. Stivers.

MERRELL CO.—Toledo, Ohio. Manufacturer of farm lighting plants.

MERRILL.—Trade name for physicians' electric vibrator manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

MERRILL & CO., WILLIAM B. — 3368 Washington St., Boston, Mass. Manufacturers of metallic packing for piston rods and valve stems of stationary and marine engines, pumps, compressors, etc. Business established 1888. President, William B. Merrill.

MERRILL MFG. CO.—50 State St., Boston, Mass. Manufacturer of nonrenewable plug fuses. Business established 1918. President, M. H. Merrill; vice-president, B. E. Appleton; secretary, A. T. Baldum; treasurer, T. B. Sweeny.

MERRIMAC CHEMICAL CO. — Boston, Mass. Manufacturer of battery chemicals.

MERRIMACK.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

MERRITT CO., S. W.—133rd St. at 12th Ave., New York, N. Y. Manufacturer of lighting and power plants.

MESA CO., FERNANDO C.—Colt St. and Chancellor Ave., Irvington, N. J. Manufacturer of wiring devices. General sales representatives, W. Douglas Woolley, Inc., 1170 Broadway, New York, N. Y.

MESCO.—Trade name for electric heating appliances, switches, battery connectors and other electric wiring devices manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

MESCO, JR.—Trade name for battery fan outfits and wireless keys manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

MESCOLITE. — Trade name for hand lamps manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

MESKER & CO., GEORGE L.—1st and Ingle Sts., Evansville, Ind. Manufacturers of iron lamp posts. Business established 1870. George L. Mesker, sole owner; general manager, Henry F. Koch; sales manager, Walter J. Stumpf.

MESKERLITE. — Trade name for iron lamp posts manufactured by George L. Mesker & Co., 1st and Ingle Sts., Evansville, Ind.

MESSENGER CLAMPS, GRIPS, HANGERS.—See Clamps, messenger; Grips, messenger; Hangers, cable and messenger.

MESSENGER GRIPS.—See Grips, messenger.

MESSENGER WIRE OR STRAND.—A strong wire or stranded cable, usually of steel, used to carry or sustain electrical wires on cables of less mechanical strength that are suspended from it by cable or catenary hangers of several types. It is used chiefly to support spans of lead-covered telephone cable, or the contact conductor on trolley wire in catenary overhead construction for electric railways. See Strand, galvanized steel.

MESTA MACHINE CO. — West Homestead, Pa. Manufacturer of steam and gas engines, malleable castings, gears, rolling mill machinery, etc. Secretary, H. F. Wahr. Main office and factory, West Homestead, Pa. Branch offices, Oliver Bldg., Pittsburgh, Pa.; Munsey Bldg., Washington, D. C.

METAL. — An element having luster known as metallic. This property is found to be associated with great opacity and a very high index refraction to light. Some elements have nearly a metallic luster and there are all gradations from feebly or semimetallic (silicon, selenium, arsenic) to full metallic (gold, silver, iron). Elements with semimetallic luster are sometimes called semimetals; there is really no sharp dividing line. The present tendency is to call all those semimetals metals which are capable of forming commercial alloys with the metals. Examples are: boron, silicon, titanium, all of which form ferro-alloys.

Data, uses and other interesting facts about the principal metals will be found under the name of each metal.

METAL & THERMIT CORP.—New York, N. Y. Manufacturer of tungsten metal and welding alloys. President, W. T. Graham; vice-president and secretary, Hubert E. Rogers; treasurer, R. H. Ismon; general manager, Dr. F. H. Hirschland; sales manager (Thermit Dept.), William R. Hulbert; sales manager (Metals and Alloys Dept.), Arthur F. Braid. Main office, 120 Broadway, New York, N. Y. Factories, Jersey City, N. J.; Chrome, N. J.; Wyandotte, Mich.; East Chicago, Ind. Branch offices, 7300 S. Chicago Ave., Chicago, Ill.; 1427 Western Ave., Pittsburgh, Pa.; 329 Folsom St., San Francisco, Cal.; 141 Milk St., Boston, Mass.; 15 Emily St., Toronto, Ont., Can.

METAL LACQUERS. — See Lacquers, metal.

METAL MELTERS.—See Melters, metal, electrically heated.

METAL MOLDING. — This material, which has come into extensive use, is now largely replacing the older form of wood molding and also finding other new applications. It is now usually designated as metal raceway by some organizations, especially those dealing with the National Electrical Code. For further details and manufacturers see Raceways or moldings, metal, surface wiring; also see Raceways or moldings, metal, fittings for.

METAL PRODUCTS CO., INC.—549 W. Washington St., Chicago, Ill. Manufacturer of resistance wire, brass, copper and nickel bars, rods, sheets and tubing. President, W. J. Mason; secretary, L. W. Hendrie; treasurer, G. G. Souerdry.

METAL SPECIALTIES MFG. CO.—338-352 N. Kedzie Ave., Chicago, Ill. Manufacturer of automobile electrical specialties. Business established 1905. President, John H. Lee; secretary, L. W. Golder; treasurer, John Berg; sales manager, N. H. Oliver. Sales representative, Joseph St. Mars, 701 Sterling Bank Bldg., Winnipeg, Man., Can.

METAL SPINNING LATHES.—See Spinning lathes, metal, motor-driven.

METALLIC CIRCUITS.—Those electrical circuits which do not use the earth as a part of the circuit, though they may be grounded for special purposes. The term is used particularly in reference to telephone and telegraph lines, to distinguish the all-metal circuit from that employing the earth as one side of the circuit or as a return. The metallic circuit is much less subject to disturbance and interruption from stray earth currents due to so-called magnetic storms or similar natural effects and also those due to induction from neighboring electrical circuits that are also grounded.

METALLIC CONDUCTORS.—All substances conducting electricity at ordinary temperatures which do so without decomposition. In the last analysis, all substances may be said to conduct to some degree, but the above definition is supposed to exclude insulators, and to apply only to those materials which conduct so well that they cannot be used as insulators. Since elements conduct without decomposition, all which conduct well are said to have metallic conductivity. This includes most of the semimetals. Alloys also conduct similarly, without decomposition; also many metallic compounds, such as oxides, sulphides, etc. are to be classed as metallic conductors, for example, cast magnetic iron oxide.

METALLIC FOG.—A mist or vapor which forms around the cathode when electrolyzing fused metallic salts. It is composed of fine globules of liquid metal, just as ordinary fog is composed of fine particles of water. It is probably formed by the deposited metal being initially in very fine condition, which saturates the electrolyte in contact with the cathode with metallic vapor; this moves away from the cathode into a region of slightly lower temperature, and condenses as the fog. The immediate surface of the cathode is warmer because of the concentration there of the electrolyzing current, with consequent local heating effect. The fog floats over toward the anode, where it may recombine actively with the anion, thus reducing the ampere efficiency obtained. Usually, the higher the temperature the greater the amount of fog; the minimum occurs if electrolysis takes place close to the melting point of the electrolyte.

METALLIC MFG. CO.—544 W. 35th St., Chicago, Ill. Manufacturer of flexible arms for portable lamps and fixture fittings. Partnership, Albert Cohn and Louis Debs.

METALLIC SIGN LETTER CO.—433 N. Clark St., Chicago, Ill. Manufacturer of metal letters for signs.

METALLO GASKET CO.—New Brunswick, N. J. Manufacturer of gaskets and asbestos packing for flange joints. President and treasurer, Zeno Schultes; vice-president, George Geipel; secretary, Stanley S. Geipel.

METALS, CONTACT.—Metals and alloys used for the contact points of relay springs, vibrators, bells, etc. Platinum is generally considered to be the best, but is too expensive to use everywhere, and is restricted to places where an arc is drawn. Pure silver is sometimes used; 90% silver

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and 10% gold is an alloy much used in automatic switches. Another alloy contains approximately 75% gold, 21% silver and 4% platinum. Tungsten is also being used quite largely as it does not pit easily and is much cheaper than the rarer metals.

METAPHRAM.—Trade name for regulators manufactured by the National Regulator Co., 208-12 S. Jefferson St., Chicago, Ill.

METCO.—Trade name for switchboards manufactured by the Metropolitan Electric Mfg. Co., Boulevard & 14th St., Long Island City, N. Y.

METEOR.—Trade name for lubricating device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

METER.—The unit of length in the metric system; 1 meter=100 centimeters=1000 millimeters=0.001 kilometer=39.37 inches =3.28 feet. Also see under Units, systems of.

METER BOXES.—See Boxes, meter protective.

METER BRACKETS.—See Brackets, instrument and meter.

METER DIALS AND GEARS.—See Dials, watt-hour meter; Gears and pinions, meter and instrument.

METER, FREQUENCY.—See Frequency meters.

METER LOOPS.—See Loops, meter, for panelboards.

METER, POWER-FACTOR—See Power-factor meters.

METER SEALS.—See Seals, meter.

METER TESTING OUTFITS.—See Testing outfits, meter.

METER TESTING OUTFITS, WATT-HOUR.—See Testing outfits, watt-hour meter.

METERS, AIR AND GAS.—There are several common (nonelectrical) forms of meters used for the measurement of air and gases. They are used to a limited extent in power plants for measuring the quantity of air supplied for the cooling and ventilating systems for the generators and sometimes transformers. In gas-burning plants they are also used to measure the total supply to the boilers or engines. They are used more widely in other industries, such as with blowers for ventilating systems in large buildings, manufacturing plants, mines, etc. Gas meters are also used to measure the byproduct gas from coke ovens and blast furnaces, and are used by gas plants to measure the total supply and individual customers' consumption.

One of the simplest types used is the bellows meter, which usually has a pair of leather bellows operating two diaphragms. The movement of the diaphragms measures off volumes of gas, which are fairly accurate if the pressure and temperature are reasonably constant. Another type, used in measuring large volumes, operates by measuring the differential pressure between two pressures at different points in a supply line. The pressure difference is either obtained by means of an orifice or in straight pipes by modifications of the Pitot and Venturi tubes. Formerly a type known as the wet meter was used for large gas-works service, operating somewhat like a rotary engine. These have largely been replaced by the electric gas meter, which is described and listed under Gas meters, electrically operated.

Manufacturers:

Bacharach Industrial Instrument Co., 7000-6 Bennett St., Pittsburgh, Pa.
Bailey Meter Co., 2015 E. 46th St., Cleveland, Ohio.
Builder's Iron Foundry, Providence, R. I.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.—See Gas Meters, electrically operated. See display adv. pages 1225-1230.—Adv.
Foxboro Co., Inc., The, Foxboro, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
H. S. B. W.—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Republic Flow Meters Co., 2240 Diversey Blvd., Chicago, Ill. "Republic."
Sloan, Inc., A. H., Moffet Bldg., Detroit, Mich.
Union Water Meter Co., 33 Hermon St., Worcester, Mass. "Union."

METERS, AMPERE.—See Ammeters (eleven types).

METERS, BATTERY AND POCKET.—See Ammeters, battery and pocket; Voltmeters, battery and pocket.

METERS, CURRENT.—These instruments are designed for measuring the flow of water in a canal, flume or other stream. For further details and manufacturers see Current meters.

METERS, DEMAND.—Demand meters are instruments which record the greatest sustained amount of power or current that is delivered to the receiving circuit. They are divided into two classes, instantaneous recording and indicating, and time-lagged indicating meters.

In the first type the deflection is proportional to the power (or current, if at constant potential) being delivered at that instant. Instruments which make a continuous line record, like a graphic wattmeter, are in this class. Another type records the consumption at regular intervals only and does not give the intervening consumption. Meters which merely indicate the maximum demand during some fixed interval without recording the actual time of the demand are also included in this class. One other form makes a record on a tape or chart every time the disk of the watt-hour meter has made the same number of revolutions. The time intervals between these marks are irregular, the marks being closest when the demand is greatest.

In the second class, the time-lagged indicating meters, the maximum demand is indicated only if it extends over a predetermined interval of time, such as 10 or 15 minutes. No record of the time of occurrence of the demand is made. There are two general classes of these instruments, those in which the motion of the indicator slows down towards the end of the deflection, and those in which the speed of the moving element is always proportional to the load, as in a watt-hour meter. In the first class one type of meter has a control spring which opposes the deflection. When a heavy load is applied the spring torque is small and the movement is rapid. As the deflection increases the counter torque of the spring increases with a consequent diminution in the speed of the movable element. Another meter of this class consists of a U-shaped tube with a bulb at each end, the bend being filled with sulphuric acid. One of the bulbs is surrounded by a resistor through which the current passes. The heating due to the current expands the air in that bulb, forcing the acid up into the other tube and into an overflow tube which is the indicating tube. The full load is indicated in about 40 minutes with 90% of full load registering in four minutes; this is known as the Wright demand indicator.

In the second subclass, those in which the speed is proportional to the load, a much used form consists of a wattmeter element combined with a watt-hour meter. The wattmeter element moves a pointer over a scale to indicate the maximum demand, but its indication is limited by an escapement mechanism on the watt-hour meter. This gives a speed of indication which is always directly proportional to the load, but the time interval required for the indication is the same for all loads.

The class of meters which record the highest number of kw-hr consumed within a given period by means of an attachment to the watt-hour meter are now the most common. Indicators that operate only when the demand is in excess of that contracted for are called excess indicators; see Indicators, excess demand.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chamberlain & Hookham Meter Co., Ltd., 243 College St., Toronto, Ont., Can. "Lincoln."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.) "Wright."
Lincoln Meter Co., Ltd., 243 College St., Toronto, Ont., Can.
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. "Graphometer." "Printometer." "Maximeter." (See display adv. page 1310.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, FEED-WATER.—Feed-water meters are used to indicate the flow of water to the boilers in a power plant and register the total amount used. The meters are generally of the "flow meter" type in which a differential pressure is produced by an orifice placed in the supply line, the variation in pressure being proportional to the rate of flow. By properly locating the pressure connections on both the inlet and outlet sides of the orifice, the principle of a Venturi tube is obtained. In one form of meter these pressures are applied to the interior and exterior of a liquid-sealed bell, which responds by moving as a frictionless piston. This motion is transmitted to an inking arm which moves over a rotating dial and thus a permanent record of the flow is given. The weir principle is also used, especially in connection with open tank heaters. The operation of this type is described under Meters, water.

Manufacturers:

Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y. "Hammond."
Bailey Meter Co., 2015 E. 46th St., Cleveland, Ohio.
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Hoppes Mfg. Co., The, Belmont & Larch Sts., Springfield, Ohio.
H. S. B. W.—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Union Water Meter Co., 33 Hermon St., Worcester, Mass. "Union."
Webster & Co., Warren, Camden, N. J.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.
Yarnall-Waring Co., Mermaid Ave., Chestnut Hill, Philadelphia, Pa. "Yarway."

METERS, FLOW, PORTABLE.—This type of meter is designed to meet the demand for a portable indicating test flow meter. It may be used to measure the flow of steam, water, air, gas, oil or other fluid in any diameter pipe and under any condition of temperature and pressure usually found in commercial practice. It is also very useful as a testing meter to check other flow meters in service. The meter consists of a U-tube with glass legs which are filled for part of their height with mercury. Located centrally with respect to the glass tubes is a flat metal scale calibrated in tenths of inches. The meter is usually provided with a strong wooden carrying case. The method of making observations is to take simultaneous readings of the mercury levels in the U-tube, pressure, etc., and from curves furnished with the meter the corresponding flow is determined.

METERS, OIL.—Oil meters are used to indicate the flow and measure the total amount of oil consumed by an engine or burner. They are used in oil-burning power plants and provide an accurate check of the rate of flow and consumption of any one or of all burners or engines. In some form the oil passes first through a strainer and then into a measuring chamber. In the latter it operates an oscillating disk, the spindle of which is connected to a totalizing register through a train of gears. Each oscillation of the disk displaces a definite quantity of oil which then passes out of the meter into the feed pipe. The speed of the oscillations is therefore proportional to the rate of flow and is indicated on a dial while each revolution representing a definite quantity actuates the totalizing or recording register.

Manufacturers:

Bailey Meter Co., 2015 E. 46th St., Cleveland, Ohio.
Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind.
Builder's Iron Foundry, Providence, R. I.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
H. S. B. W.—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Sloan, Inc., A. H., Moffet Bldg., Detroit, Mich.

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Union Water Meter Co., 33 Hermon St., Worcester, Mass. "Union."
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

METERS, STEAM FLOW.—Steam-flow meters are used widely in many steam power plants to indicate the steam output of boilers and consumption of engines, turbines, pumps, etc. There are two general types of steam-flow meters; area meters and velocity meters. Area meters are those in which a disk or cup partially closes an opening through which the steam is passing. The disk or cup is so shaped that as the demand for steam increases the increase in pressure drop past the disk or cup causes it to move from its seat and open up a larger area for the steam passage until the pressure drop is reduced and the disk or cup is again in equilibrium. This movement is transmitted to an indicating and recording device which shows the pounds of steam flowing per hour. The velocity meters are of the Venturi, Pitot and orifice types and consist of a device which will accurately measure the difference between two high initial pressures. The simplest forms of indicating devices consist of glass U-tubes containing water or mercury. Other instruments which give a permanent record have various differential gages installed to measure the pressure difference on both sides of an orifice. One type has a liquid-sealed bell with one pressure applied to the interior and the other to the exterior. The bell has a frictionless piston motion corresponding to the difference in pressures and by properly shaping the bell its motion is made directly proportional to the rate of flow.

Steam-flow meters are used to indicate and record the production of steam by separate boiler units, the steam consumption of turbine, and other steam-consuming appliances, and its distribution to separate departments or units in an industrial plant, or to customers to whom steam is sold. These meters are also used on various kinds of heaters and air conditioners, etc., and to measure the steam taken from bleeder turbines.

Manufacturers:

American District Steam Co., N. Tonawanda, N. Y. "Adsco."
Bailey Meter Co., 2015 E. 46th St., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
H. S. B. W.-Cochrane Corp., 17th St & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Mason Regulator & Engineering Co., Lt., The, 135-53 Dagenais St., Montreal, Que., Can.
Republic Flow Meters Co., 2240 Diversey Blvd., Chicago, Ill. "Republic."

METERS, TELEPHONE, CALL-COUNTING.—Telephone call-counting meters are instruments used to count and record the number of calls made by any subscriber and also to count the calls handled by any or all operators in a study of traffic conditions. They are sometimes made removable to fit into a receptacle that is permanently located on the switchboard, and are only inserted at such periods as it is decided to make a count of the calls. The meter is operated by the operator by pressing a small handle for each completed originating call. Other forms of meters are also used, one being a meter that is placed on the subscriber's telephone and is operated by the subscriber after the called number is obtained. The operator listens to see whether the subscriber registers the call when asked to do so. The number of calls show up on several small wheels having the numbers placed on the rims.

Manufacturers:

Gray Telephone Pay Station Co., 16-30 Arbor St., Hartford, Conn.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Veeder Mfg. Co., Sargeant & Garden Sts., Hartford, Conn.

METERS, TELEPHONE, LONG-DISTANCE CALL-MEASURING.—These meters are used to measure the length of toll or long-distance calls. They supplant the former method of using an ordinary clock for this purpose. They are devices containing a clock and are mounted flush with the top surface of the keyboard. The time of starting a conversation and the time of finishing are very accurately timed and recorded with but little effort on the part of the operator. These meters are generally placed between two operator's positions on the toll board so that only one meter is needed for the two operators.

Manufacturers:

Calculagraph Co., Hudson Terminal Bldg., New York, N. Y. "Calculagraph."
National Mfg. & Printing Co., Olney, Ill.

METERS, WATER.—Water meters are extensively used in electric power plants and in industrial plants where electric power is used. In some cases they are used to measure and record the total plant supply, in others the total supply exclusive of that for the condensers, and occasionally to measure separately the cooling water used for condensers. Water-power plants sometimes make an extensive use of meters to measure the consumption of water wheels and turbines. They are also used in steam plants to measure the cold boiler feed water, and the water used for general plant service or special purposes. In other industries they are used in connection with various processes and on washing and cleaning tanks, etc. The meters are of two principal types, the "flow meter" and the weir meter.

In the flow meter an orifice is inserted in the pipe line and arranged to produce a differential pressure on the inlet and outlet sides of the orifice which is proportional to the rate of flow. By suitably locating taps to measure this pressure the principle of a Venturi type meter is obtained. In one form of meter pressure tubes from the inlet and outlet sides of the orifice connect to the interior and exterior of a liquid-sealed bell, which responds to the difference between these pressures. The bell is so shaped that its motion is directly proportional to the rate of flow. The motion of the bell is transmitted to an inking lever which records the flow on a paper disk.

The weir meters are more accurate over a wider range of flow than the flow meters and they are widely used to indicate, record and integrate the flow of water at or near atmospheric pressure. A meter tank is required, in which all of the water passes through a V-notch weir. Different methods are used to measure the water, one of which has a small weighing vessel, suspended by a spring back of the weir which contains just enough water at each unit of height to draw the spring in exact ratio to the rate of flow. The pen and recorder are attached to this device. Another form has two differently shaped displacing vessels on a lever arm, which move as the height of water increases, so as to always maintain equal buoyant forces on the two members. This motion of the lever arm is transmitted to the recording device

Manufacturers:

Bailey Meter Co., 2015 E. 46th St., Cleveland, Ohio.
Builder's Iron Foundry, Providence, R. I.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Republic Flow Meters Co., 2240 Diversey Blvd., Chicago, Ill. "Republic."
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. (hot water). "Tyler's."
Union Water Meter Co., 33 Hermon St., Worcester, Mass. "King." "Nilo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

METERS, WATT-HOUR.—A watt-hour meter is an instrument for the practical measurement of electrical energy in watt-hours or kilowatt-hours. It is used chiefly for determining the total energy supplied to a consumer in a definite period, such as a month. According to operating principles watt-hour meters may be divided into three classes: electrodynamometer, mercury flotation, and induction types.

Since the electrodynamometer watt-hour meter has a commutator and is used almost entirely on d-c. circuits it is also known as the d-c. meter or commutator meter. The mercury flotation type is also made for d-c. circuits only and the induction type can be used only on a-c. circuits.

Commercially, watt-hour meters are known by the kind of circuits for which they are intended. The trade names are switchboard meter, house and general service meter, totalizing meter, single-phase and polyphase meters, prepayment meter, and rotating standard or test meter.

Electrodynamometer or Commutator Meter. Like the electrodynamometer, this meter consists of two sets of coils, one set fixed in position while the other is mounted on a staff between jeweled bearings so that it can rotate freely. Connection to the rotatable coil is made through a commutator of silver by means of two wire brushes. The rotatable coils are made of small wire of many turns and in service are connected directly across the line; the current through these coils is thus proportional to the e.m.f. of the circuit. The fixed coils are made of comparatively few turns of heavy wire and are connected in series with the circuit when in service; the current through these coils is the load current. As the actuating torque is proportional to the product of the currents in the rotatable coils and fixed coils, it is proportional to the product of the load e.m.f. and current, and hence to the power. The speed of rotation is proportional to the torque and hence the number of rotations of the disk in any interval of time is proportional to the product of the power and time, or the energy (watt-hours) that has passed.

On the shaft of the rotatable coil is mounted a disk of aluminum which rotates between the poles of two magnets. As the disk rotates eddy currents are induced. These eddy currents absorb energy from the circuit and hence retard the speed of rotation so that the meter registration is always proportional to the energy that has passed. Through a system of gears, known as the register, the number of rotations are indicated on a dial, which, however, is calibrated in watt-hours or kilowatt-hours. The commutator motor meter is made for two-wire and three-wire circuits and for all standard voltages.

Mercury Motor Meter. The physical principle of operation of the mercury meter is essentially the same as that of the electrodynamometer type. It does not, however, have a commutator. The meter is actuated by a load current which reacts with the magnetic field produced by a current that is proportional to the e.m.f. of the circuit. The movable element of the meter consists of a solid copper disk floating on mercury. The voltage element consists of a coil with an iron core spanning the disk at right angles to its plane. The magnetic flux due to the voltage-coil current penetrates the disk at two points diametrically opposite. The load current flows from one terminal across the mercury and disk to a diametrically opposite terminal. The reaction between this current and the magnetic flux due to the voltage-coil current produces a torque on the disk which is proportional to the power. The speed of the disk is retarded in exactly the same way as in the electrodynamometer type.

Induction Watt-Hour Meter. The induction meter, like all watt-hour meters, consists of two elements which carry currents proportional to the load or circuit voltage and current, respectively. The interaction between the magnetic fields due to these two currents produces a torque on a disk which is proportional to the power.

The coils in an induction meter are all fixed in position and have iron cores. They are so located that the alternating currents flowing in them produce a shifting magnetic field which cuts the disk, inducing eddy currents therein. The resulting reaction produces a torque on the disk which is proportional to the power. The speed of the disk is retarded by two permanent magnets exactly as in the electrodynamometer type. Induction type meters are rugged, and light. Unless specially provided with compensating coils, induction meters give reliable results only on the frequency for which they are designed. They are made for two-wire and three-wire single-phase circuits and for polyphase circuits. For metering energy on high-voltage and large-current circuits, voltage and current transformers are used.

Brushes for watt-hour meters are usually made of phosphor-bronze wire or strips silvered over at the points of contact. Round brushes have less friction than flat ones. The pressure of the brushes on the commutator is due to the tension of a spring or the force of gravity. This pressure may be varied by means of adjusting screws.

The Commutator of a watt-hour meter is usually made by forcing a piece of silver tubing over a fiber bushing on the shaft. The tube is then sawed into the proper number of segments which are held in place by fiber rings. One make of meter has a commutator made of gold.

Bearings. The upper bearing of practically all watt-hour meters is a steel polished pin in a recess. In one form the pin is a part of the shaft and projects upward into the recess, which is drilled into a bushing fastened in the frame. In the other form the pin is a part of a removable screw and projects downward into a bush-

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ing in the top of the shaft. Oil-soaked billiard cloth or felt keeps the bearing lubricated.

With the exception of the mercury motor meter, the lower bearing of all watt-hour meters consists of some form of pivot or ball bearing resting on a jewel. Sapphire and diamond jewels are used exclusively. Experience has shown that it is good practice to oil the lower bearings at regular intervals with a high grade of watch oil.

The Registering Mechanism or Register is that part of the watt-hour meter mechanism consisting of the wheel meshing with the worm gear or pinion on the shaft, the reducing train of gears, dial train of gears and dials. There are two types of registering mechanism in use, the dial and cyclometer. In the dial form the figures are marked on circular dials over which the hands attached to the arbors of the dial train of gears move. In this type the hands move continuously, the motion being in the ratio of ten to one.

In the cyclometer form of register, the figures are stamped on the rim of the registering gears, which project through openings in the face of the register. In some forms of cyclometer registers, the indicating gears move by steps and hence the friction is variable, being greatest when the whole train is being shifted.

Drag Magnets. These are two permanent magnets of horseshoe form by means of which a counter torque is developed on the disk of a watt-hour or ampere-hour meter. The magnets are usually adjustably mounted with their poles on opposite sides of the disk and as it rotates eddy currents are induced, producing a counter torque.

The long time accuracy of registration of watt-hour meters is intimately connected with the permanence of the pole strength of these magnets, as a change of 1% in the field strength will affect the accuracy by 2%. The best magnets are made of a high grade of tungsten steel. Short-circuits in the current coils of d-c. meters are liable to alter the pole strength, hence it is good practice to mount them as far from the current coils as the design will permit.

Lagging of Watt-Hour Meters. By this term is meant the adjusting of the voltage-coil circuit so that the voltage-coil flux shall lag exactly one-quarter of a period behind the current-coil flux on circuits of unity power-factor. This is a necessary condition for correct registration on circuits of power-factor other than unity.

In the electrodynamometer type of watt-hour meter this is accomplished by shunting some of the series current through a noninductive resistance. Induction type watt-hour meters are lagged by surrounding the voltage-coil core by a short-circuited coil of a few turns of high-resistance wire. The resistance of the coil is adjusted until the time-phase displacement of the two fluxes is one-quarter of a period.

Friction or Light-Load Compensation. To secure correct registration on light load, all types of watt-hour meters are provided with what is known as "friction" or "light-load" compensation. The compensating torque for d-c. meters is obtained by connecting a small coil in series with the armature circuit and mounting it near the armature with its plane parallel to the current coils. The compensation may be varied by changing the position of this coil with reference to the armature or by varying the number of active turns.

Induction type watt-hour meters are compensated on light load by some form of device actuated by the voltage coil which produces a shifting magnetic field. The simplest form of this device, and the one most commonly used is a short-circuited coil of one turn adjustably mounted under the voltage-coil core. As the flux varies through this coil, it generates a current which retards the changes in the flux in that portion of the core immediately above the coil. This retardation unbalances the main flux which produces the same effect as a shifting field. The position of the coil or stamping can be changed to vary the compensation.

Creeping. A meter that has been overcompensated, or in case the voltage has increased above normal, will be rotated slowly by the compensation torque, even when there is no current in the load coils. This is known as "creeping." Meters that are subjected to vibration will also creep.

Full-Load Adjustment. Correct speed of a watt-hour meter at full load is secured by adjusting the retarding effect of the drag magnets. This adjustment is made in one of two ways. On some makes the magnets are moved nearer to or farther from the edge of the disk. When the magnets are moved outward nearer the edge, the meter slows down and vice versa. Another method of securing the same effect is to shunt some of the magnetic flux through a soft iron adjustable nut just above the two adjacent poles of the two magnets.

Per Cent Registration. By this term is meant the ratio of the energy registered to that actually passed through the meter, expressed in per cent. This is also called the percentage of accuracy.

Meter Constants. The energy that passes through a watt-hour meter merely rotates the movable element and by means of the register the number of rotations within a given interval of time is registered on the dial. Since the number of rotations is proportional to the energy that has passed, the dial is graduated in watt-hours instead of rotations. The numerical relation between the energy passed and one rotation of the disk, or one division on the dial is known as the meter constant. The numerical value of these constants will depend upon the design of the meter and the units in which the energy is expressed. The principal constants are: Register or dial constant, gear ratio, watt-hour constant, watt-second constant, test constant.

Register Constant is the number by which the meter reading must be multiplied to obtain the registration. It is used principally on high-capacity meters and is marked on the dial, hence also the name dial constant.

Gear Ratio is the number of rotations of the disk for one rotation of the first dial hand. It is not an energy constant.

Watt-Hour Constant is the number of watt-hours that must pass through the meter to produce one rotation of the disk. It has a definite value for each type and capacity of meter, and has different values for different makes.

Watt-Second Constant is the energy in watt-seconds that produces one rotation of the disk. It is equal to 3600 times the watt-hour constant.

Test Constant. This constant is assigned by the manufacturer for converting the counted revolutions of the disk into watt-hours. It is usually some multiple of the energy or watt-hour constant.

METERS, WATT-HOUR, HOUSE AND GENERAL SERVICE, D-C.—These meters are for low voltages and usually of low (5 to 10 ampere) current capacity for measuring the energy consumed by residence lighting circuits, small stores or other low power installations. They are made for two-wire and three-wire circuits for d-c. service.

Meters for this service are either of the commutator or mercury-motor types described above. They are not as widely used as single-phase meters for the same class of service for the reason that a very small percentage of the d-c. load in a city is for house or low power service. However, in some office buildings in these sections separate meters of this type are used for each tenant.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont.,

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind. Duncan Model E D-C. Watt-Hour Meter has been on the market



Model E D-C. Watt-Hour Meter

for twenty years and is very extensively used in the central stations and isolated plants of the United States, as well as many foreign countries. For further information write for catalog of complete line.—Adv.

GENERAL ELECTRIC CO., Schenectady, N. Y. The C-6 watt-hour meter is of the commutating type, operating on the dynamometer principle. It is particularly strong and accurate, possessing a high torque in addition to many other excellent features, the result of many years' experience in meter manufacture. It is built self-contained in ratings up to 600 amp. 2-wire or 300 amp. 3-wire. (Bulletin 4721A.) See adv. pages 1203-1223.—Adv.

Roller-Smith Co., 233 B'way, New York.

SANGAMO ELECTRIC CO., Springfield, Ill. Manufacturer of the well known type D-5, d-c., service and switchboard 2 and 3-wire watt-hour meters. These meters are built on the mercury-motor principle and have inherent advantages resulting from the flotation of the moving system in mercury, that cannot



Sangamo Watt-Hour Meter, Type D-5

possibly be equaled by any other type of direct-current meter. D-5 meters are built in all capacities from 10 amps. up, capacities above 10 amps. being shunted, resulting in great convenience and flexibility in installation and enormous simplification in care, maintenance and testing.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, HOUSE AND GENERAL SERVICE, SINGLE-PHASE.—These are induction meters designed for operation on single-phase circuits. They are made for either two-wire or three-wire circuits. The two-wire meter is the most common as it is the simplest and when two are properly connected to a three-wire circuit the algebraic sum of their registrations gives the correct amount of energy supplied to both branches, no matter whether balanced or unbalanced.

The three-wire single-phase meter consists of two series or current elements and one voltage element. The current elements are connected to the outside wires, one to each, and the voltage element may be connected across the outside wires, or between one outside wire and the neutral. The first method of connection is the more common, as a meter so connected gives more accurate registration. A three-wire single-phase meter with voltage coil connected between outside wires registers correctly only on balanced circuits. When the voltage coil is connected between one outside wire and neutral, it registers correctly only when the circuits are balanced and the power-factor is unity, a condition seldom met in practice. Two two-wire meters are preferable for unbalanced three-wire circuits.

Meters of this type are very widely used for residential service, most of which is low-voltage two and three-wire distribution. They are of very rugged construction and are less expensive than d-c. meters of the same rating.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

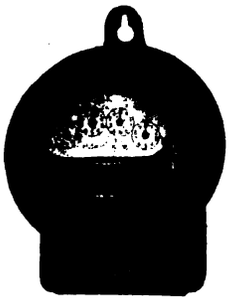
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont.,

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind. Duncan Model M2 A-C. Watt-Hour Meter is especially designed to take care of every present-day requirement in central station service. Its potential loss is slightly less than one watt; torque, 40 millimeter-grams; weight of moving element, 10 grams; ratio of torque to weight, 4 to 1—this being higher than is obtainable by any other meter in use—and which is responsible for the extreme and continued accuracy of this instrument; and it maintains its accuracy throughout such changes in frequency, power-fac-

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tor, temperature and pressure, as are met with in every day service. For



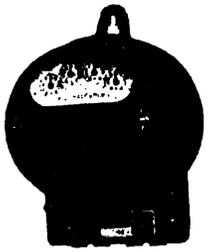
Model M2 A-C. Watt-Hour Meter

further information write for catalog of complete line.—Adv.

GENERAL ELECTRIC CO., Schenectady, N. Y. Type I-14 meters developed after much experimentation to produce a single-phase watt-hour meter of high initial and sustained accuracy, of simple construction and pleasing appearance and which can be built in a wide range of capacities. Constructed in sizes from 5 to 300 amp. with 110 volts, two-wire; 220 volts, two-wire and 220 volts, three-wire. (Bulletin 46201A.) See adv. pages 1203-1223.—Adv.

Roller-Smith Co., 233 Broadway, New York, N. Y. "Columbia."

SANGAMO ELECTRIC CO., Springfield, Ill. While the principle of operation of Sangamo Type H a-c. watt-hour meters is not essentially different from other induction type meters, the type H meter embodies many refinements in construction that have increased both the initial and sustained accuracy and



Sangamo Watt-Hour Meter, Type H

greatly facilitated the work of adjustment and decreased the cost of labor and repairs. From the standpoint of accuracy, permanence and durability, the type H meter is unexcelled as evidenced by the many satisfied users throughout the world. Literature sent on application.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, PORTABLE OR "ROTATING STANDARD."—These meters are essentially the same as service meters except as to register, connections, case and refinement in construction. The ordinary register is omitted and a long pointer, attached directly to the upper end of the staff, moves over a dial divided into 100 equal parts. It is thus possible to read to 1/100 of a rotation. Two other dials are provided which register the total number of rotations. The wide range of currents for which the meter must be designed necessitates a modification in the current coils and their connections. This is accomplished by making the current coils in sections and mounting the sections so that they can be connected in series or in parallel. These meters should be carefully handled and often checked. The d-c. meters in particular must be used with care if accurate results are to be expected. When the meter is used it should be placed with the plane of the current coils parallel to the earth's magnetic field, and at least 3 ft. from current-carrying conductors.

Portable a-c. watt-hour meters give much better results than d-c. meters. Nevertheless, they have the same limitations as the corresponding service meters. When used with current transformers care must be taken to see that the contacts do not introduce more than the normal resistance into the secondary circuit and thus change the ratio and phase angle.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. Type IB-5 Portable Test Meter, rated 1 to 10 amp., designed to facilitate the maintenance of low-capacity meters on central station lines. For higher capacities the IB-6 rated 1, 5, 10, 50 and 100 amp. may be used, which permits testing meters up to 150-amp. capacity. (Bulletin 46291A.) Also type CB-5 Thomson d-c. portable test meters, described in Bulletin 46390. See adv. pages 1203-1223.—Adv.

Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.

Roller-Smith Co., 233 B'way, New York.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

METERS, WATT-HOUR, POWER SERVICE, POLYPHASE.—The ordinary polyphase meter for this service is merely a combination of the two elements of two single-phase meters in one instrument. The two disks are mounted on the same shaft and each is actuated by a current in one wire and the voltage between that wire and the common return. Two sets of drag magnets are common, but only one registering mechanism.

When installing polyphase meters care must be taken to see that both elements will rotate the disk armatures in the positive direction on circuits whose power-factor is above 0.5. Since most loaded apparatus has a power-factor above 0.5, a simple check upon the correctness of the connection is to connect both the voltage and current elements to the circuit and then while the meter is in operation open the voltage coil circuit of one element at a time. If when one element is open the disk rotates in the positive direction, it is an indication that the meter is properly connected. The above is not a safe check unless it is known that the power-factor is above 0.5.

Most power service consists of three-phase three-wire circuits and the three-wire meters are therefore by far the most common. These meters are made self-contained for circuits up to about 500 volts usually, and for current ratings up to 300 amperes. They are often installed on distributing boards or switchboards, especially in cases of large consumers who have a transformer vault and switching room of their own. The very large consumers are generally provided with 5-ampere 110-volt meters and these are used with suitable current and potential transformers.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can

Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont.

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

Ferranti Meter & Transformer Mfg. Co., Ltd., 26 Noble St., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. The principal characteristics of the single phase Type I-14 meter are embodied in the polyphase meter Type D-6. The latter has been designed expressly for use on polyphase systems, either balanced or unbalanced. This meter is accurate, simple, rugged, convenient to install and test, and contains many special features designed to simplify the work of installation, test and upkeep. Furnished self-contained in ratings up to 150 amp., 550 volts. (Bulletin 46253.) See adv. pages 1203-1223.—Adv.

Roller-Smith Co., 233 Broadway, New York, N. Y.

SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, SERVICE, PREPAYMENT.—This is a watt-hour meter to which has been added a device which by the insertion of a coin permits the closing of the circuit and keeping it closed until the energy paid for has been consumed, when it automatically opens it. For convenience they are generally arranged to receive several coins at a time and the circuit is opened only when the last coin is used. It is finding extended use in apartment buildings whose tenants frequently change, or for a shifting population, as in a summer-resort district. By the use of prepayment meters the monthly reading of meters is eliminated, station bookkeeping is greatly simplified and revenue is secured where otherwise its collection would be uncertain and difficult.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont.,

Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. The standard type I-14 single phase meter has been combined with a suitable prepayment mechanism to form the Type IP-5 prepayment meter. Its mechanical features embody durability with simplicity of operation and give an assurance of accuracy with protection against fraudulent manipulation, while the best materials are used throughout. Furnished in 5, 10 and 15 amp. sizes for single-phase service, 25-133 cycles and 110, 220 volts, two-wire; and 220 volts, three-wire. (Bulletin 46208.) See adv. pages 1203-1223.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, SWITCHBOARD AND TOTALIZING, D-C.—These are central-station meters of much larger capacity than those installed in consumers' premises. They are mounted on the switchboard and register all of the energy distributed from the station. One prominent make of large-current d-c. meter is an electrodynamometer type watt-hour meter of special design. The voltage element consists of two spherically wound armatures mounted on the same shaft. The current element consists of four circular coils placed on opposite sides and near the two armatures. The armature and field coils are so connected that the currents in one set flow in a direction opposite to that in the other set, that is, they are astatic. The drag magnets are also arranged astatically and for further protection from the influence of stray magnetic fields are enclosed in a laminated, soft iron case. Two types of these meters are manufactured, the difference being due to the construction of the current coils, which in the lower capacity meters are circular and in the higher capacity meters are of the bus-bar type. The former is made for currents from 50 to 1500 amperes and the latter for currents from 2000 to 10,000 amperes. Both are made for two and three-wire circuits and for voltages ranging from 100 to 600 volts.

Another large-current-capacity meter has been placed on the market using shunts to increase its range in the same way that the range of a d-c. ammeter is increased. The current element consists of four comparatively large coils surrounding a rather elongated cylindrical armature. The conductors are large and of low resistance. The use of shunts introduces complications which may result in variable errors.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can

Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. Thomson static watt-hour meters constructed to minimize the effect of external magnetic fields so generally encountered when dealing with large d-c. circuits. The materials used in construction are of the finest quality, while the same high standard is carried out in design, workmanship and finish. Furnished in various capacities. (Bulletin 46209.) See adv. pages 1203-1223.—Adv.

Roller-Smith Co., 233 Broadway, New York, N. Y. "Columbia."

SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, SWITCHBOARD AND TOTALIZING, POLYPHASE.—Energy on polyphase circuits may be measured by two-wire single-phase meters. In an n-wire system n-1 meters will be

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necessary. When two-wire single-phase meters are used on polyphase circuits the current coils are connected in series with the line wires, one in each, and the voltage coils are connected between these wires to which the current coils are connected and the remaining wire, which is considered as the common return. No current coil is connected to this common return. Thus for metering energy on three-wire three-phase circuits, two single-phase meters or the equivalent are necessary.

Polyphase meters are a combination of two single-phase elements in one instrument. The coils are connected as for two single-phase instruments. They are generally made for three-wire circuits. Many switchboard instruments, however, are required to be used on four-wire three-phase circuits. The ordinary polyphase meter cannot be used as three single-phase meter elements would be required. Four-wire meters are therefore made for this class of service. Although these instruments are used for large energy measurements, they are only made self-contained in small sizes. Both current and potential transformers are generally used and the meters are made for secondary currents of five amperes.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can. "C & H."
DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type DS-6 (metal cover) and DS-7 (glass cover) meters, built expressly for this service. They are accurate, well built and have a neat finish and embody many convenient features to aid in testing, adjusting or repairing. (Bulletin 46253.) See adv. pages 1203-1223.—Adv.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WATT-HOUR, SWITCHBOARD AND TOTALIZING, SINGLE-PHASE.—The switchboard totalizing watt-hour meters for single-phase central stations do not differ essentially from other single-phase watt-hour meters. Their range is increased by the use of voltage and current transformers and the employment of a dial constant by means of which the registration is multiplied to give the correct amount of energy. In such cases a 5-ampere meter is generally used. They are not very widely used as most single-phase loads are fairly small.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.
DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type IS-4 meters with metal covers which have the essential features of the Type I-14, single-phase, watt-hour meters for house service, but made for switchboard mounting. The Type 1S-5 meters with glass covers are made for similar service and differ from the type IS-4 only in housing and finish. (Bulletin 46201A.) See adv. pages 1203-1223.—Adv.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

METERS, WIRE.—See Wire-measuring reels and outfits.

METRIC APPLIANCE CORP. — 299 Broadway, New York, N. Y. Manufacturer of pocket ammeters and battery testers. Business established 1919. President, Albert W. Franklin; vice-president, David Kassel; secretary and treasurer, Morris B. Kassel.

METROPOLITAN.—Trade name for cable clips manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

METROPOLITAN.—Trade name for injectors manufactured by the Hayden & Derby Mfg. Co., 119 W. 40th St., New York, N. Y.

METROPOLITAN.—Trade name for fuse plugs manufactured by the Metropolitan Device Corp., 1250 Atlantic Ave., Brooklyn, N. Y.

METROPOLITAN. — Trade name for stage footlights manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

METROPOLITAN DEVICE CORP.—1250 Atlantic Ave., Brooklyn, N. Y. Manufacturer of fuse plugs.

METROPOLITAN ELECTRIC MFG. CO.—Long Island City, N. Y. Manufacturer of switches, switchboards, panels, panelboards, receptacles and other wiring devices. Business established 1893. President, Charles L. Eidlitz; vice-president, P. J. Shelley; secretary and general manager, J. J. Wesley; treasurer, E. M. Fishner; sales manager, E. S. White. Main office and factory, East Ave. & 14th St., Long Island City, N. Y. Branch offices, Real Estate Trust Bldg., Philadelphia, Pa.; 250 Devonshire St., Boston, Mass.

METROPOLITAN ELECTRIC PROTECTIVE CO.—130 W. 26th St., New York, N. Y. Manufacturer of fire alarm and burglar alarm apparatus and systems. Business established 1901. President and general manager, S. B. Hess; vice-president, E. Goldberger; secretary and treasurer, S. Goldberger.

METROPOLITAN ELECTRICAL PRODUCTS CO.—1250 Atlantic Ave., Brooklyn, N. Y. Manufacturer of power distribution and service equipment. President, Thomas E. Murray, Jr.; vice-president, J. B. Murray.

METROPOLITAN ENGINEERING CO. OF CANADA, LTD.—90 Sherbourne St., Toronto, Ont., Can. Manufacturer of fuses, sheet metal stampings, boxes and cabinets for electrical purposes, etc. Business established 1912. J. C. Noise, sales manager.

MEYBERG CO., LEO J.—428 Market St., San Francisco, Cal. Manufacturer of portable electric lamps and radio sets. Business established 1910. Leo J. Meyberg, sole owner.

MEYBERG CO., THE.—633 S. Grand Ave., Los Angeles, Cal. Manufacturer of lighting fixtures, fixture fittings, etc. President, Moritz Meyberg; vice-president, Eugene J. Meyberg; secretary, E. James Meyberg.

MEYCOLITE.—Trade name for lighting fixtures manufactured by the Meyberg Co., 633 S. Grand Ave., Los Angeles, Cal.

MEYER BROS.—Toronto, Ont., Can. Manufacturers of electric ironing machines. Business established 1884. Main office, 99-101 Queen St., E., Toronto, Ont., Can. Branch office, 403 St. James St., Montreal, Que., Can.

MEYERCORD CO.—133 W. Washington Blvd., Chicago, Ill. Manufacturer of decalcomania transfers. President, George R. Meyercord; vice-president, J. Cort Walker; secretary and treasurer, A. L. Johnson.

MEYROWITZ, INC., E. B.—520 5th Ave., New York, N. Y. Manufacturer of electrotherapeutic apparatus. Business established 1876. President, E. B. Meyrowitz; vice-president, E. du P. Meyrowitz; secretary and general manager, W. N. Cook; treasurer, R. A. Meyrowitz; sales manager, H. G. Herold.

MF.—Abbreviation for microfarad or one-millionth of a farad, which see.

Mg.—The form Mg is the chemical symbol for the metallic element magnesium.

MIAMI.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

MIBROCO.—Trade name for mica, vulcanized fiber, packing and asbestos products manufactured by Mikesell Bros. Co., 156 N. LaSalle St., Chicago, Ill.

M. I. C.—Trade name for black insulating varnish manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

MICA.—Mica is a refractory mineral generally recognized as in many ways the most superior insulating material known to the electrical industry, its resistivity varying from 0.5 to 130×10^{12} ohm-cm. The best grades of mica are found in India, with Canadian grades next and domestic varieties last. The domestic grades are satisfactory for nearly all insulating purposes except for commutators, the softer Canadian grades being required for that service. Mica consists of the double silicate of aluminum and magnesium, combined with varying proportions of potash, soda and other impurities. It crystallizes in laminated forms and may be split into very thin sheets. Mica has a high dielectric strength, a disruptive strength of 40,000 to 100,000 volts per mm., and it is suitable for withstanding high temperatures.

MICA & MICANITE SUPPLIES CORP.—1465 Broadway, New York, N. Y. Manufacturer of mica and mica products. President, Moritz Bergl; vice-president and general manager, William Snyder; secretary, Nathan April; treasurer, Frank Hales.

MICA-ASBEST.—Trade name for sealing cement manufactured by the Dielectric Mfg. Co., St. Louis, Mo.

MICA-COATED PAPER. — See Paper, mica-coated.

MICA CO. OF CANADA, LTD.—2 Lois St., Hull, Que., Can. Manufacturer of ground mica and compressed mica products. Business established 1911. President and managing director, E. G. Rykert; vice-president, H. S. Ross; secretary, treasurer, and general manager, J. E. Eastlake. Factories, Hull, Que., Can., and St. Regis Falls, N. Y.

MICA, COMPOSITION, SHEET, TUBING, ETC.—Mica products are made with various compositions and characteristics, depending upon the substances combined with it and the binder used. The smaller the proportion of binder and combining substance the more nearly the characteristics of the product approach those of pure mica, given above under Mica. It is often combined with paper and cloth, using a cement or shellac binder and is made into tape and other forms used on armature coils, etc. Ground mica is often mixed with asbestos and other substances and made into molded compositions in a variety of shapes, such as tubes, sheets, and other forms with metal inserts.

Manufacturers:

American Mica Co., Newton Lower Falls, Mass. "Micabeston."
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., Valparaiso, Ind. Raw mica in all forms. Uncut or cut sheet mica of all grades including domestic, North Carolina, India or Amber qualities can be furnished in assorted sizes. Micabond tubing, a composition of built up mica made to any requirements in round, square, oval, hexagonal and other special shaped sizes, special heat proof tubes for spark plugs, gas engines, etc., specially treated tubes and bushings for equipment, immersed in oil. For other Chicago Mica Co. products see display advertisement on page 1320.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Meirowsky Bros., 11 McPherson Pl., Jersey City, N. J. "Royal."
Mica & Micanite Supplies Corp., 1465 Broadway, New York, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y. "Micanite."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Mica-Rite."
NEW ENGLAND MICA CO., Waltham 54, Mass. "Peerless." (See display adv. page 1320.)
New York Mica & Mfg. Co., Auburn, N. Y.
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.
Preston Mica Co., Robert K., 804 Monadnock Block, Chicago, Ill. "Prestonite."
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Tar Heel Mica Co., The, Plumtree, N. C.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1398.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MICA, COMPRESSED, CUT, PLATE, RINGS, SHEET AND TUBING.—Mica in the natural state does not exist in large sheets. To make up the mica plate the raw mica is split into fine layers and the small pieces built up by overlapping into the larger sheets. The usual process of

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manufacture is briefly as follows: The small sheets are held together by a binder, usually shellac in the grades used for electrical purposes, which is applied to the sheets that are then compressed under high pressure and temperature for from 10 to 30 minutes. They are then suddenly cooled by water circulating through the press. The sheet thus produced is hard and stiff and is milled and cut to form commercial mica plate. The plate is made into sheet, rings, or built up in rolls for tubing. It is used for insulating commutator segments, rheostats, electric heating appliances and similar devices where its high dielectric strength and heat-resisting qualities make it very desirable.

Manufacturers:

American Mica Co., Newton Lower Falls, Mass. "Micabeston."
Carolina Mineral Co., Inc., Penland, N. C.
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Clay Electric Co., 3303 N. 12th St., Philadelphia, Pa.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Keene Mica Products Co., Keene, N. H.
Liberty Mica Co., 79 Sudbury St., Boston, Mass. "Red Line."
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
Meirowsky Bros., 11 McPherson Pl., Jersey City, N. J. "Royal."
Mica & Micanite Supplies Corp., 1465 Broadway, New York, N. Y.
MICA CO. OF CANADA, LTD., 2 Lois St., Hull, Que., Can.
Mica Insulator Co., 68 Church St., New York, N. Y. "Micanite."
Mica Insulator Co., Victoriaville, Que., Can.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
NEW ENGLAND MICA CO., Waltham 54, Mass. "Peerless." (See display adv. page 1320.)
Phonograph Appliance Co., 174 Wooster St., New York, N. Y.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Tar Heel Mica Co., The, Plumtree, N. C.
Wallingford Bros., Ltd., Perkins, Buckingham, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MICA FUSES.—See Fuses, telephone and telegraph, mica.

MICA, GROUND.—Mica is ground into various degrees of fineness to be used in mixtures with asbestos or other materials. It is molded in that form into various shapes for use in electrical products. The ground mica is also mixed with oil and grease for certain lubricating compounds. Another use of ground mica is in annealing processes where it is used in exactly the same manner as charcoal or bonedust.

Manufacturers:

Asheville Mica Co., Biltmore, N. C.
Blake, Edward, Newdale, N. C.
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
English Mica Co., Spruce Pine, N. C.
Granite State Mica Co., East Cambridge, Mass.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Keene Mica Products Co., Keene, N. H.
MICA CO. OF CANADA, LTD., 2 Lois St., Hull, Que., Can.
Munsell & Co., Eugene, 68 Church St., New York, N. Y. "Munsell's."
New York Mica Products Co., 68 Murray St., New York, N. Y.
Preston Mica Co., Robert K., 804 Monadnock Block, Chicago, Ill.
Tar Heel Mica Co., The, Plumtree, N. C.

MICA INSULATOR CO.—New York, N. Y. Manufacturer of insulating materials. President, Lewis W. Kingsley; vice-president, Edward C. Wood; treasurer, George S. Leary. Main office, 68 Church St., New York, N. Y. Factory, Schenectady, N. Y. Branch office, 542 S. Dearborn St., Chicago, Ill.

MICA INSULATOR CO.—Victoriaville, Que., Can. Manufacturer of insulating materials.

MICA INSULATORS.—See Insulators, molded mica.

MICA MFG. CO., THE.—135 Johnson St., Brooklyn, N. Y. Manufacturer of mica washers, bushings, etc.

MICA PRESSES.—See Presses, mica.

MICA, RAW, UNCUT AND CUT.—Mica is mined in small blocks which are composed of many layers of extremely small thickness. The mica as mined is called raw mica and may contain some impurities. The highest grades of mica are quite clear and free from impurities. Mica containing iron is not suitable for electrical purposes; however, the presence of the other common impurities, such as silicate of magnesium, and vegetable spores, does not render the mica unsuitable to most electrical purposes. Mica containing silicate of magnesium is called amber, that containing vegetable spores, domestic. Raw mica is furnished to manufacturers either in block or uncut form, or cut into plate or sheets of any desired thickness.

Manufacturers:

American Mica Co., Newton Lower Falls, Mass.
Asheville Mica Co., Biltmore, N. C.
Blake, Edward, Newdale, N. C.
Carolina Mineral Co., Inc., Penland, N. C.
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond Drill Carbon Co., The, 53 Park Row, New York, N. Y.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
Huse & Son, Ltd., Joseph, 80 North St., Boston, Mass.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Liberty Mica Co., 79 Sudbury St., Boston, Mass.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
Mikesell Bros. Co., 156 N. LaSalle St., Chicago, Ill. "Mibroco."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Munsell & Co., Eugene, 68 Church St., New York, N. Y. "Munsell's."
NEW ENGLAND MICA CO., Waltham 54, Mass. "Peerless." (See display adv. page 1320.)
Preston Mica Co., Robert K., 804 Monadnock Block, Chicago, Ill.
Rogers-Pyatt Shellac Co., 81 Water St., New York, N. Y.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
STORRS MICA CO., P. O. Box N, Owego, (Tioga Co.) N. Y. Block mica, all sizes and qualities, original cases. Imported from India, Argentina, Brazil, Africa. Suitable for various electrical requirements. Wholesale quantities.—Adv.
Tar Heel Mica Co., The, Plumtree, N. C.
Wallingford Bros., Ltd., Perkins, Buckingham, Que., Can.

MICA SPLITTING MACHINES.—These machines cut the raw mica blocks into thin sheets, the cutting being done by thin knife blades mounted in the machine. They are used in the manufacture of commercial mica plate and produce a more uniform product than can be done by hand.

Manufacturers:

Benninghofen & Sons, C., Hamilton, Ohio.
Ransom & Randolph Co., The, 518 Jefferson Ave., Toledo, Ohio.

MICA, TELEPHONE PROTECTOR.—Mica is very largely used in making telephone protectors. It is generally built up into sheet form and for some purposes is furnished in rectangular strips having a very fine groove lengthwise of the strip; a very fine fuse wire is then placed in the groove and suitable terminals placed at the end. Other thin sheets of mica, with holes in them, are used between carbon blocks to separate them a given distance and to prevent the opening from filling up with dust.

Manufacturers:

Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.

MICA VESUVIUS.—Trade name for spark plugs manufactured by A. R. Mosler & Co., Mt. Vernon, N. Y.

MICABESTON.—Trade name for mica products manufactured by the American Mica Co., Newton Lower Falls, Mass.

MICABOND.—Trade name for mica insulating materials manufactured by the Chicago Mica Co., 11-21 Water St., Valparaiso, Ind.

MICANITE.—Trade name for mica insulating materials manufactured by the Mica Insulator Co., 68 Church St., New York, N. Y.

MICARITE.—Trade name for mica plate, paper, pressboard, cloth, tape and tubing manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

MICARTA.—See Bakelite-micarta.

MICHIGAN ELECTRIC SPECIALTY CO.—Muskegon, Mich. Manufacturer of lightning arresters. Business established 1905. President, F. S. Chapman; secretary and treasurer, V. A. Chapman. Main office, Muskegon, Mich. Branch office, 1225 Wells Bldg., Milwaukee, Wis.

MICHIGAN INDEPENDENT TELEPHONE & TRAFFIC ASSOCIATION.—President, C. E. Tarte, Grand Rapids, Mich. Secretary, R. A. Vivian, Grand Rapids, Mich.

MICHIGAN LUBRICATOR CO.—3643 Beaubien St., Detroit, Mich. Manufacturer of oil and grease cups, oiling devices, etc. Business established 1883. President, A. L. McMeans; 1st vice-president, John B. Corliss; 2nd vice-president, Robert Davidson; secretary, Frederick N. Stocking; treasurer, Robert Lindsay.

MICHIGAN MOTOR SPECIALTIES CO.—44-50 Mt. Elliott Ave., Detroit, Mich. Manufacturer of automobile specialties, metal stampings, screw machine products, etc. Charles W. Beck, president.

MICHIGAN SECTION, N. E. L. A.—Secretary, Herbert Silvester, Ann Arbor, Mich.

MICHIGAN STAMPING CO.—Detroit, Mich. Manufacturer of conduit boxes. President, John H. French; vice-president, Henry P. Cope; secretary and treasurer, Walter F. Tant; manager (Electrical Dept.) A. B. Hoffman.

MICHIGAN WASHING MACHINE CO.—Muskegon, Mich. Manufacturer of electric washing machines. President, Charles H. Kimball; secretary, George Thorton; treasurer, C. B. W. Cunningham; general manager, George Thorton; sales manager, I. J. Riding.

MICRA.—Trade name for illuminating glassware manufactured by Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.

MICROFARAD.—A much used unit of capacitance. It is one-millionth of a farad, the standard unit of capacitance. The farad is not much used because it is too large. The capacitance of but few condensers exceeds 10 microfarads. The abbreviation mf. is in common usage.

MICRO-FONE-O-GRAPH.—Trade name for radio phonograph music transmitter manufactured by the Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J.

MICROMETER.—See Gages, micrometer.

MICROPHONES.—Microphones are instruments for transmitting sounds or for intensifying feeble sounds. They operate on the principle that the transition resistance between loosely joined electrical conductors decreases as they are pressed together. The most common microphones or microphone cells, as they are also called, employ granular carbon between two electrodes. One electrode is connected to a sensitive diaphragm which is vibrated by the sound waves. A current is passed between the electrodes, which varies in proportion to the pressure variation or in proportion to the sound waves. Microphones are used in telephone transmitters, dictating outfits, detectors of various sorts, etc.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. (hand)
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.
Globe Phone Mfg. Co., Reading, Mass.

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Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

MIDDLE WEST GEOGRAPHIC DIVISION, N. E. L. A.—President, O. H. Simonds, Dubuque Electric Co., Dubuque, Ia. Secretary, Rex H. Fowler, 510 Crocker Bldg., Des Moines, Ia.

MIDGET.—Trade name for electric cigar lighter manufactured by the Duralectric Corp., Mt. Tabor Bldg., Jamestown, N. Y.

MIDGET.—Trade name for motor-driven cloth cutting machines manufactured by the Eastman Machine Co., Washington & Goodell Sts., Buffalo, N. Y.

MIDGET.—Trade name for switchboard ammeters and voltmeters manufactured by the Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.

MIDGET.—Trade name for toy transformers manufactured by the Jefferson Electric Mfg. Co., 426-430 S. Green St., Chicago, Ill.

MIDGET.—Trade name for electric toy iron manufactured by the Northern Electric Co., 542 St. Clair St., Chicago, Ill.

MIDGET.—Trade name for water-tube boilers manufactured by the Page Boiler Co., 815-819 Larrabee St., Chicago, Ill.

MIDGET.—Trade name for solderless connector for fixture work manufactured by Alexander B. Simpson, 152 E. 53rd St., New York, N. Y.

MIDGET.—Trade name for lamp lowering pulleys manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MIDGET.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

MIDLAND.—Trade name for electric cigar lighters manufactured by the Davenport Mfg. Co., Davenport, Iowa.

MIDLAND WOOD TURNING CO.—2035 W. Harrison St., Chicago, Ill. Manufacturer of floor lamps. Proprietor, S. Gold.

MIDNIGHT SUN.—Trade name for floodlight projectors manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

MIDWAY.—Trade name for electric forge blowers manufactured by the Champion Blower & Forge Co., Lancaster, Pa.

MIDWEST ENGINE CO.—Indianapolis, Ind. Manufacturer of motor and steam-driven pumps and steam turbines. Business established 1871. President, John G. Wood; vice-president, F. L. Atwood; secretary and treasurer, H. W. Griffith; sales manager, Lon R. Smith. Factories, Indianapolis, Ind., Anderson, Ind. Branch offices, Birmingham, Ala.; Baltimore, Md.; Boston, Mass.; Cleveland, Ohio; Denver, Colo.; El Paso, Tex.; Houston, Tex.; Kansas City, Mo.; Los Angeles, Cal.; Little Rock, Ark.; New Orleans, La.; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; Salt Lake City, Utah; St. Louis, Mo.; St. Paul, Minn.; Seattle, Wash.; Tulsa, Okla.; Medicine Hat, Alta., Can.; 111 Broadway, New York, N. Y.

MIDWEST MFG. CO.—117 N. Wells St., Chicago, Ill. Manufacturer of wire drawing, pipe threading and other dies. President, John A. King; secretary, John C. Gollinet; treasurer, Anton Pecha.

MIDWEST-WAIT. — Trade name for steam turbines manufactured by the Midwest Engine Co., Indianapolis, Ind.

MIEHLE.—Trade name for motor-driven printing presses manufactured by the Miehle Printing Press & Mfg. Co., 14th & Robey Sts., Chicago, Ill.

MIEHLE PRINTING PRESS & MFG. CO.—14th & Robey Sts., Chicago, Ill. Manufacturer of motor-driven printing presses.

MIGRATION OF IONS.—The traveling of assumed ions in a solution towards the electrodes, thus carrying through the electrolyte the applied electrolyzing current. It is also an attempted explanation of how the ions get from the body of the electrolyte to the two electrodes, and thus provide a continuous supply of ions to be liberated at the electrodes. The explanation assumes the flow or migration to anticipate their liberation at the electrodes, and in fact to be the prime mechanism of the conduction of current through the electrolyte. The more modern explanation is that the electrolyte conducts in the same way as a metallic conductor, that it is not dependent on any movement of the ions, that electrolysis takes place at the electrodes, and that the chemical changes there produced cause the diffusion of abnormal chemical compounds away from the electrodes into the body of the electrolyte, thus virtually explaining the appearance of the ions at the electrodes as a result of the passage of the current and not its predetermining condition or cause.

MIKESELL BROS. CO.—156 N. LaSalle St., Chicago, Ill. Manufacturers of mica, vulcanized fiber, packing and asbestos products. President, H. S. Mikesell; vice-president, D. B. Mikesell; secretary and treasurer, F. S. Mathews; general sales manager, Niel Mikesell. Factory, Wabash, Ind.

MIL.—One-thousandth part of an inch. The diameters of wires are often given in mils. Also see Circular mil.

MIL-FOOT.—A unit of cylindrical volume much used for wires. It is a cylinder one mil in diameter and one foot long. The mil-foot is used as a unit wire, especially when giving resistivity in English units.

MILADY'S.—Trade name for electric iron manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

MILAMMETER OR MILLIAMMETER.—See Ammeters, milli, or milammeters.

MILBRAD.—Trade name for traveling step ladders manufactured by the John Calander Mfg. Co., 629-33 Jackson St., St. Paul, Minn.

MILBURN CO., THE ALEXANDER.—Baltimore, Md. Manufacturer of electric industrial floodlights and oxyacetylene welding and cutting apparatus. Business established 1907. President, A. F. Jenkins; vice-president, Aaron Brylawski; secretary and treasurer, A. W. Carr. Main office and factory, 1420-28 W. Baltimore St., Baltimore, Md. Branch offices, 51 E. 42nd St., New York, N. Y.; Bourse Bldg., Philadelphia, Pa.; 202 Martin Bldg., Pittsburgh, Pa.; 1012 Kimball Bldg., Chicago, Ill.; 268 Market St., San Francisco, Cal.

MILBURN WAGON CO., THE.—3134 Monroe St., Toledo, Ohio. Manufacturer of electric pleasure and commercial vehicles Business established 1834. President, H. W. Suydam; vice-president, Otto Marx; secretary, F. D. Suydam, Jr.; treasurer, F. H. Dodge; sales manager, R. S. Woodhull. Sales representatives, Automotive Products Corp., Woolworth Bldg., New York, N. Y.; Hartman Pacific Commercial Co., 80 Wall St., New York, N. Y.

MILE-OHM.—This is such a weight of wire just one mile long whose resistance is one ohm. It is a means of stating the conductivity or resistance of a material. This term is used mostly in connection with telephone and telegraph line wire. The poorer the conductor the greater the weight of a mile-ohm.

MILES, FRANKLIN S.—205 Quarry St., Philadelphia, Pa. Manufacturer of screw machine products. Business established 1860.

MILK WARMERS.—See Warmers, milk (two types).

MILKING MACHINES, ELECTRIC.—These milking machines are used on farms having fair-sized herds of cows and in dairies where their use for the large number of cows to be milked results in a material saving in time and labor. The machines imitate mechanically the natural sucking action of a calf. The machine operates on the suction principle and employs a motor-driven pulsating suction pump which draws the milk through flexible tubing into a receptacle. These machines make a much more sanitary dairy than when the milking is done by hand.

Manufacturers:

Burrell & Co., Inc., D. H., Little Falls, N. Y. "B. L. K."
Hinman Milking Machine Co., Oneida, N. Y.
Perfection Mfg. Co., 2125 E. Hennepin Ave., Minneapolis, Minn. "Perfection."
Sharples Milker Co., West Chester, Pa.
Success Milking Machine Co., 1033 Winnebago St., Milwaukee, Wis. "Success."

MILLBOARD.—An asbestos insulating board used in electrical construction and in the manufacture of electrical equipment. It is made in thin to thick sheets ranging in thickness from 1/32 to ½ inch.

Manufacturers:

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Union Paper & Twine Co., 1°5 St. Clair Ave., N. W., Cleveland, Ohio.

MILLER.—Trade name for lighting fixtures and portable electric lamps manufactured by Edward Miller & Co., 99 Center St., Meriden, Conn.

MILLER.—Trade name for electrically heated sealing machine manufactured by the Miller Mfg. Co., 1008 S. West St., Kalamazoo, Mich.

MILLER & CO., EDWARD.—Meriden, Conn. Manufacturers of lighting fixtures and portable electric lamps. Business established 1844. President, Edward Miller; vice-president and general manager, I. B. Miller; secretary, L. E. Frost; treasurer, William Kinghorn; sales manager, Michael Schwarz. Main office and factory, 99 Center St., Meriden, Conn. Branch offices, 68-70 Park Pl., New York, N. Y.; 125 Pearl St., Boston, Mass.; San Francisco, Cal.

MILLER & CO., J. E.—136 W. Lake St., Chicago, Ill. Manufacturer of glass cutters. President, J. E. Miller; secretary and treasurer, G. H. Dell.

MILLER & JOHNSON AUTO ELECTRIC CO.—1406 W. Pico St., Los Angeles, Cal. Manufacturer of ignition coils. President, S. G. Miller; treasurer and general manager, O. M. Johnson.

MILLER & PARDEE, INC.—625 W. Jackson Blvd., Chicago, Ill. Manufacturer of switchboards, panels, generators, screw machine products. Business established 1918. President and general manager, Harvey S. Pardee; vice-president, secretary and treasurer, Charles A. Pardee.

MILLER ANCHOR CO.—20 Monroe St., Norwalk, Ohio. Manufacturer of guy anchors and pole augers. Business established 1903. President and general manager, G. H. Miller; vice-president and treasurer, B. D. Miller; secretary, L. W. Miller.

MILLER-ANDERSON.—Trade name for electric vulcanizers, grinders, air compressors and wire wrapping machines manufactured by Charles E. Miller, Anderson, Ind.

MILLER, CHARLES E.—Anderson, Ind. Manufacturer of electric vulcanizers, grinders, air compressors and wire wrapping machines.

MILLER CO., BERTRAND F.—High & Canal Sts., Trenton, N. J. Manufacturer of transformers. Business established 1914. President, treasurer and general manager, Bertrand F. Miller; vice-president, N. F. Hough; secretary, C. M. Miller. Exclusive distributor, Be ts & Betts Corp., 511 W. 42nd St., New York, N. Y.

MILLER HI-SPEED.—Trade name for ignition coils manufactured by the Miller & Johnson Auto Electric Co., 1406 W. Pico St., Los Angeles, Cal.

MILLER LUMBER CO., J. W.—512 Lumber Exchange, Minneapolis, Minn. Producer of cedar poles.

MILLER MFG. CO.—1008 S. West St., Kalamazoo, Mich. Manufacturer of electrically heated sealing machines. W. E. Miller, manager.

MILLER MFG. CO.—Meyersdale, Pa. Manufacturer of electric washing machines. President, William H. Habel; vice-president and manager, F. S. Crawford; secretary, J. N. Lint; treasurer, R. H. Philson.

MILLER SAW-TRIMMER CO.—Pittsburgh, Pa. Manufacturer of adjustable lighting fixtures. President, F. F. Nicola; vice-president, P. C. Dunlevy; 2nd vice-president, W. H. Smith. Main office and factory, Penn & Water Sts., Pittsburgh, Pa. Branch offices, 191 High St., Boston, Mass.; 60 Beekman St., New York, N. Y.; 65 Walton St., Atlanta, Ga.; 141-143 N. 12th St., Philadelphia, Pa.; 524 S. Clark St., Chicago, Ill.; 216 Browder St., Dallas, Tex.; 145 2nd St., San Francisco, Cal.

MILLERS' CODE—The electrical regulations of the Millers' Mutual Fire Insurance Companies apply to flour mills and grain elevators, and are issued by the Mutual Fire Prevention Bureau, Oxford, Mich. They are largely an independent set of rules, although a number of rules have been taken from the National Electrical Code. The rules are issued in loose-leaf form, with explanatory matter and illustrations, and are revised through the issue, at irregular periods, of supplementary sheets. The rules are divided into five sections. The first section covers wiring, fuses, switches, and switchboards; the second, lighting systems; the third, power systems; the fourth, bleaching apparatus; and the fifth, signaling systems. There are supplementary sheets on lightning-rod protection, definitions and formulas.

MILLERS FALLS CO.—Millers Falls, Mass. Manufacturer of electricians' tools. Business established 1843. President, Kingman Brewster; vice-presidents, Philip Rogers and John M. Smead; secretary and treasurer, George W. Nims; sales manager, George V. Hatch. Main office, Millers Falls, Mass. Factories, Millers Falls, Mass.;

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Brattleboro, Vt. Branch office and warehouse, 28 Warren St., New York, N. Y.

MILLI.—A prefix designating one-thousandth; as millivolt, meaning 0.001 volt; milliampere, millimeter, milligram, etc. Also used with electrical instruments as the millivoltmeter, which is a sensitive instrument actually indicating in thousandths of a volt; also milliameter, although this is often contracted to milammeter.

MILLILAMBERT.—A commonly used unit of surface brightness, equivalent to the brightness of a perfectly diffusing surface having a reflection coefficient of one and illuminated by one milliphot. It equals 0.001 lambert or 0.929 lumen emitted per square foot.

MILLIMETER.—One thousandth part of a meter, the unit of length in the metric system. Abbreviated mm.; 1 mm.=0.03937 inch.

MILLIPHOT.—A unit of illumination equal to one millilumen incident per square centimeter. It equals 0.001 phot or 0.929 foot-candle.

MILLIVOLTMETER. — See Voltmeters, milli.

MILLS & BROTHER, THOMAS.—1301-1311 N. 8th St., Philadelphia, Pa. Manufacturer of motor-driven ice cream freezers, orange and lemon reamers and other confectioners' machinery. President, George M. Mills; vice-president, G. Thomas Mills; secretary, H. C. Elliott; treasurer, C. W. Hallowell.

MILLS, COFFEE.—See Grinders, electric, coffee.

MILLS NOVELTY CO.—221 S. Green St., Chicago, Ill. Manufacturer of electrically operated violins and pianos. President and treasurer, H. S. Mills; secretary, C. Z. Mills.

MILO-BAR BELL CO., THE.—301 Diamond St., Philadelphia, Pa. Manufacturer of medical batteries. Business established 1903. Sales representative, H. C. Owens, 215 Main St., Pueblo, Colo.

MILVAY.—Trade name for ammeters and voltmeters manufactured by the Chicago Apparatus Co., 701 W. Washington Blvd., Chicago, Ill.

MILWAUKEE.—Trade name for ignition timers manufactured by the Milwaukee Auto Engine & Supply Co., Milwaukee, Wis.

MILWAUKEE.—Trade name for electric cranes and hoists manufactured by the Milwaukee Electric Crane & Mfg. Co., Milwaukkee, Wis.

MILWAUKEE AUTO ENGINE & SUPPLY CO.—Milwaukee, Wis. Manufacturer of ignition timers. President, B. D. Zimmerman; secretary and treasurer, F. C. Meinhardt.

MILWAUKEE AUTO SPECIALTY MFG. CO., INC.—711 Chestnut St., Milwaukee, Wis. Manufacturer of storage batteries, spark plugs and other automobile specialties. Business established 1917. President, William J. Schubert; vice-president, W. R. Fleischer; secretary, treasurer and sales manager, W. J. Raley.

MILWAUKEE BAG CO. — Milwaukee, Wis. Manufacturer of mailing bags. President, F. P. Mann; secretary, H. F. Hunter; treasurer, C. R. Decker. Main office, 216 S. Water St., Milwaukee, Wis. Branch offices, Chicago, Ill.; Toledo, Ohio; Minneapolis, Minn.

MILWAUKEE DIE CASTING CO.—297 4th St., Milwaukee, Wis. Manufacturer of die castings. Business established 1909. President and treasurer, Fred J. Schroeder; vice-president, Charles H. Ellis; secretary and general manager, Edward S. Moldenhauer.

MILWAUKEE ELECTRIC CRANE & MFG. CO.—Milwaukee, Wis. Manufacturer of electric cranes and hoists. President, S. H. Squier; secretary and treasurer, M. P. O'Brian; general manager, Arthur Fritsch. Main office and factory, Milwaukee, Wis. Branch offices, New York, N. Y.; Chicago, Ill.; Pittsburgh, Pa.; Detroit, Mich.; Seattle, Wash.; San Francisco, Cal.; St. Louis, Mo.; Birmingham, Ala.

When writing to manufacturers please mention the

E M F ELECTRICAL YEAR BOOK

MILWAUKEE MFG. CO.—1316 Fond du Lac Ave., Milwaukee, Wis. Manufacturer of electric immersion heaters. Business established 1919. President, treasurer and general manager, E. W. Strauss; vice-president, N. F. Strauss; secretary, L. Schneider; sales manager, A. J. Wort.

MIMEOGRAPH MACHINES, MOTOR-DRIVEN.—These machines are used for making a number of copies of drawings, letters, maps, etc., which are made from a stencil prepared on a typewriter or by hand in the case of diagrams, drawings and maps. The motor-driven machines generally are entirely automatic, being self feeding and operating, so that no skilled help is necessary to produce the copies. They are used in large business houses and industrial plants for the production of advertising matters, bulletins, shop directions, etc.; in schools and colleges for making up class notes, copies of lectures, examination question sheets, etc.; in hotels and restaurants for copying menu cards, etc., and for similar purposes in other establishments.

Manufacturer:

Dick Co., A. B., 736 W. Jackson Blvd., Chicago, Ill. "Edison-Dick."

MINCER.—Trade name for socket attachments manufactured by the Elbee Electric Sales Co., 180 N. Dearborn St., Chicago, Ill.

MINE & SMELTER SUPPLY CO., THE.—Denver, Colo. Manufacturer of electrically operated ore concentrators. President, J. H. Fennessy; vice-president, A. H. Seep; secretary, Eugene Delmar; treasurer, Clark Grove; general manager, W. L. Loveland. Main office, Denver, Colo. Branch offices, New York, N. Y.; Salt Lake City, Utah; El Paso, Tex.

MINE-A-PHONE.—Trade name for mine telephones manufactured by the Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

MINE FANS.—See Fans, mine and heavy-duty ventilating.

MINE HOISTS.—See Hoists, electric, mine.

MINE INSULATORS AND PINS.—See Insulators, mine; Pins, insulator, mine.

MINE PUMPS.—See Pumps, mine, electric.

MINE SIGNALING SYSTEMS.—See Signaling systems, mine.

MINE TELEPHONES.—See Telephones, mine.

MINERAL POINT ZINC CO.—140 S. Dearborn St., Chicago, Ill. Manufacturer of zinc slabs. President, Thomas D. Jones; general manager, A. D. Terrill.

MINERALLAC ELECTRIC CO. — 1045 Washington Blvd., Chicago, Ill. Manufacturer of high-tension insulating compounds, conduit fittings and time switches. Business established 1909. President, Louis A. Ferguson; vice-president, P. Junkersfeld; secretary, H. E. Wing; treasurer and general manager, A. L. Johnson. Sales representatives, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.; J. T. Pearson, 1220 Dime Savings Bank Bldg., Detroit, Mich.; A. D. Fishel Co., Illuminating Bldg., Cleveland, Ohio; White & Converse, Metropolitan Life Bldg, Minneapolis, Minn.; A. F. Douglas, Smith Bldg., Seattle, Wash.

MINERS' LAMPS.—See Lamps, miners' and miners' safety.

MINIATURE INCANDESCENT LAMP CORP.—Newark, N. J. Manufacturer of miniature incandescent lamps. Business established 1917. President and general manager, Harvey W. Harper; vice-president, L. Hofheimer; secretary, L. Rieben; treasurer, A. J. Liebmann. Main office, 95 8th Ave., Newark, N. J. Branch office, 275 Grand River Ave., Detroit, Mich.

MINIATURE LAMPS.—See Lamps, incandescent, candelabra and miniature.

MINIATURE RECEPTACLES AND SOCKETS.—See Receptacles, candelabra and miniature; Sockets, candelabra and miniature.

MINIER MFG. CO., INC.—Minier, Ill. Manufacturer of electric washing machines. Business established 1908. President, H. V. Schroeder; vice-president, Dan Otto; secretary, B. F. Quigg; treasurer, A. E. Ewing; general manager, C. W. Bird; sales manager, E. W. Wickert.

MINIMAX. — Trade name for motor-driven air compressors manufactured by the Pro-Mo-Tor Fabricating Corp., 182 Locust Ave., New York, N. Y.

MINIMAX ELECTRIC & MFG. CO., LTD., THE. — Maissonneuve, Montreal, Que., Can. Manufacturer of storage batteries.

MINING LOCOMOTIVES.—See Locomotives, electric, mining.

MINING MACHINES, COAL.—See Coal cutting and mining machines, electric.

MINING MACHINES, MISCELLANEOUS MOTOR-DRIVEN.—There are many applications of motors to mining machinery, some of which are described under pumps, coal-cutting machines, locomotives, fans, hoists, drills, etc. In addition to these uses there are other miscellaneous applications of motors, as they are gradually replacing steam and compressed air for nearly all mining and ore-treating operations. In cases where compressed air is still used, motor-driven compressors are applied to advantage. For operating tipples, breakers, crushers, screens, elevators, conveyors, washers, stamp mills, etc., motors in fairly large sizes are required. When direct current is available compound-wound totally enclosed motors are used. When alternating current only is available, three-phase motors, generally of the slip-ring type, are used. Occasionally squirrel-cage motors are used on belt conveyors and such machinery where the starting requirements are not severe.

Manufacturers:

Box Iron Works Co., William A., Blake & 33rd Sts., Denver, Colo.

GENERAL ELECTRIC CO., Schenectady, N. Y. Fort Wayne electric rock drills described under Drills, electric, rock. Also special mine type motors for operating tipple and breaker machinery, and other motors for driving mine pumps and other mine machinery, as well as suitable control equipment especially adapted for mine service. See page 1212 for general information on G-E service to coal mines. —Adv.

Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago, Ill. "Goodman."

Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

MINLARDO.—Trade name for lubricating oil manufactured by the American Oil Corp., 172 S. Water St., Jackson, Mich.

MINNEAPOLIS.—Trade name for heat regulator manufactured by the Minneapolis Heat Regulator Co., 2747 4th Ave., South, Minneapolis, Minn.

MINNEAPOLIS ELECTRIC & CONSTRUCTION CO.—112 S. 7th St., Minneapolis, Minn. Manufacturer of wire measuring reels.

MINNEAPOLIS HEAT REGULATOR CO.—Minneapolis, Minn. Manufacturer of heater regulators, thermostats and motors. Business established 1885. President and general manager, W. R. Sweatt; vice-president, H. W. Sweatt; secretary and sales manager, W. H. Wilson; treasurer, C. B. Sweatt. Main office and factory, 2747 4th Ave., South, Minneapolis, Minn. Branch office carrying stock, 231 Insurance Exchange Bldg., Minneapolis, Minn.

MINNESOTA CHANDELIER CO.—369-371 Jackson St., St. Paul, Minn. Manufacturer of chandeliers. Business established 1907. President and treasurer, W. A. Hall; vice-president, B. F. Pelton; secretary, M. G. Hall. Branch office, 1816 Lyndale Ave., Minneapolis, Minn.

MINNESOTA ELECTRIC CO.—309 2nd Ave., S., Minneapolis, Minn. Manufacturer of mine switches, lightning arresters, boring machines, cable lugs, terminals and connectors. Business established 1897. W. J. Chapman, owner.

MINNESOTA ELECTRICAL CONTRACTORS' ASSOCIATION.—Secretary, G. M. Jones, 112 S. 7th St., Minneapolis, Minn.

MINNESOTA INDEPENDENT TELEPHONE ASSOCIATION.—President, H. F. Lueders, Norwood, Minn. Secretary, E. C. Kast, Minneapolis, Minn.

MINNESOTA STORAGE BATTERY CO.—208-210 N. 4th St., Minneapolis, Minn. Manufacturer of storage batteries, battery charging sets and electrical indicating instruments. Business established 1918. President and sales manager, W. E. Lean; secretary, J. G. Schaefer; treasurer, James J. Dilley; general manager, C. E. Scanlan.

MIOWN.—Trade name for belt dressing manufactured by the Whitlock Mfg. Co., 1506 W. 112th St., Cleveland, Ohio.

MIRALUX.—Trade name for commercial lighting unit manufactured by the Wagner-Woodruff Co., 830 S. Olive St., Los Angeles, Cal.

MIRETE METAL CO. OF MASS., INC.—225 Main St., Springfield, Mass. Manufacturer of brass, bronze and aluminum sheets,

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rods, etc. Business established 1919. President, Thomas W. Burden; vice-president, treasurer and general manager, George C. Raymond, Jr.; secretary, Henry A. Bryant; sales manager, N. E. O'Connor. Branch office, O. C. O. Metal Co., 208 W. 56th St., New York, N. Y. Sales representative, Gerald Hulett Co., Dime Bank Bldg., Detroit, Mich.

MIRROR-PARK LITE CORP.—208 W. 17th St., New York, N. Y. Manufacturer of electric automobile signals. Business established 1919. President, Ernest W. Boyce; vice-president, Edward A. Jarvis; secretary and treasurer, Frank W. Xiques. Sales representative, Shultis Automotive Corp., 161 W. 61st St., New York, N. Y.

MIRRORS, SEARCHLIGHT.—Mirrors of various kinds are employed as reflectors behind searchlights, in which they give the concentrated beam essential to a searchlight. The mirrors are sometimes of glass and sometimes of polished metal, according to various requirements. The common forms are the parabolic and Mangin. Also see Searchlights.

Manufacturers:

Bausch & Lomb Optical Co., Rochester, N. Y.

ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.

Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" mirrors, with permanently brilliant silver reflecting surface. All X-Ray mirrors have a specially processed, high-temperature backing that will not crack, peel or blister. See Projectors, floodlight. Also adv. page 1405.—Adv.

Standard Plate Glass Co., 30 Sudbury St., Boston, Mass.

MIRRORS, SHAVING OR TOILET, ELECTRICALLY LIGHTED.—These devices consist of a small mirror mounted on a stand to which is attached an adjustable bracket holding the incandescent lamp. The lamp is thereby made adjustable to give light from the various angles desired for shaving. These mirors are used particularly where the bathroom lighting is unsatisfactory for shaving and in the bed room when a better light is desired for dressing the hair, etc. For the latter purpose boudoir lamps are now more commonly used.

Manufacturers:

Polly Mfg. Co., Milwaukee, Wis.

Shavelight Corp., 30 Church St., New York, N. Y.

White Steel Sanitary Furniture Co., Grand Rapids, Mich.

MIRROSCOPE CO., THE.—Cleveland, Ohio. Manufacturer of post card projectors. President, W. H. Kelly; secretary and treasurer, G. W. Furth. Main office and factory, Cleveland, Ohio. Branch offices, San Francisco, Cal.; Chicago, Ill.; New York, N. Y.

MISS SIMPLICITY.—Trade name for electric washing machines manufactured by W. A. Kribs Co., Ltd., Hespeler, Ont., Can.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES.—President, L. P. Andrews, Sedalia, Mo. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo.

MISSOURI ENGINE CO.—2806 N. 11th St., St. Louis, Mo. Manufacturer of oil engines. Business established 1913. President, A. S. Winkelmeyer; vice-president, H. H. Lippert; secretary, H. Bain.

MISSOURI STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Secretary, W. L. Hutchinson, Kansas City Electric Construction Co., Kansas City, Mo.

MISSOURI TELEPHONE ASSOCIATION.—President, Houck McHenry, Jefferson City, Mo. Secretary, C. D. Long, Jefferson City, Mo.

MR. PUNCH.—Trade name for automatic drills manufactured by the Goodell-Pratt Co., Greenfield, Mass.

MITCHELL.—Trade name for electric vibrating screens, manufactured by the Stimpson Equipment Co., Felt Bldg., Salt Lake City, Utah.

MITCHELL MOULDING CO.—15th St. and Circle Ave., Forest Park, Ill. Manufacturer of wood moulding. Business established 1898. President and treasurer, O. K. Mitchell; vice-president, E. G. Mitchell; secretary, M. E. Mitchell; general manager, A. W. Mitchell.

MITCHELL-RAND MFG. CO.—18 Vesey St., New York, N. Y. Manufacturer of insulating materials. Business established 1885. President, L. F. Rand; vice-president and general manager, W. E. G. Mitchell; secretary, C. L. Rand; treasurer, J. H. Lecour.

MITCHELL VANCE CO., INC.—503-511 W. 24th St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1854.

MITENIUS SIGN CO., E.—8 Steeple St., Providence, R. I. Manufacturer of special electric signs. E. Mitenius, proprietor.

MIXERS, CAKE AND DOUGH.—These cake mixers are motor-driven machines that mix by revolving a whip through the ingredients which are placed within a bowl on the machine. The whips are made of wire, in globe and flat mesh forms. Though called cake mixers, they are by no means limited to that function but may be used for mashing potatoes, beating eggs, whipping cream, sieving flour, and mixing ingredients for a great variety of foodstuffs.

Dough mixers are largely used to mix bread dough. These machines, of different form and larger than the cake mixers, have motor-driven eccentric arms which imitate the action of hand kneading of the dough. Both types of machines are especially designed for hotels, bakeries, pastry shops, restaurants, and similar establishments where they are extensively used.

Manufacturers:

American Oven & Machine Co., 111 W. Washington St., Chicago, Ill. "New Era."

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Hall Kitchen King Co., 909 Mutual Life Bldg., Philadelphia, Pa. "Kitchen King."

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

MIXERS, DRINK.—This type of electric device consists of a small stand on which is mounted a universal motor. Directly attached to the armature shaft is a vertical spindle which revolves within a cup containing the materials to be mixed. The motor requires very little power and operates at a very low cost. The rapid and sanitary action of these machines and the fact that the clerk at the fountain can continue to serve other refreshments while they are at work, saving much of his time which would be lost in hand mixing, has made them very popular. They are used at soda fountains in drug stores, ice-cream parlors, candy shops, hotels, restaurants, etc.

Manufacturers:

ARNOLD ELECTRIC CO., Racine, Wis. Manufacturer of "Arnold" sanitary drink mixers.—Adv.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Fulton-Bell Co., 451 Greenwich St., New York, N. Y. "Thermo."

Gibson Co., H. B., 38 Park Pl., New York, N. Y. "Twin-Mixer."

Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "Cyclone," "Whirlpool."

Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."

MM.—Abbreviation for millimeter, one-thousandth part of a meter or metric unit of length.

M. M. F.—Abbreviation for magneto-motive force.

MN.—The form Mn is the chemical symbol for the metallic element manganese.

MO.—The form Mo is the chemical symbol for the metallic element molybdenum.

MOEBIUS PROCESS.—A process for the parting of gold and silver, especially in the alloy resulting from the smelting of the slimes from electrolytic refining of copper or lead. Anodes of the alloy are suspended in groups of four or five to a common busbar in an electrolyte of silver and copper nitrate containing free nitric acid. The cathodes are of thin silver foil and are nearly equal in size to the cross-section of the tank; they are suspended alternately with the anode rows, connected in multiple. The tanks are of earthenware or tarred wood. The concentration of silver in the electrolyte is only about 1 gram per liter; the pure metal deposits in loose crystalline form and is scraped off the cathodes by a wooden scraper worked by an eccentric. The electrolyte builds up in copper, so that a portion must be removed continuously for purification.

MODEL AUTOMATIC.—Trade name for smokeless furnace manufactured by the Automatic Furnace Co., 1st & Harshman Sts., Dayton, Ohio.

MODEL CHICAGO.—Trade name for chain-grate stokers manufactured by the Automatic Furnace Co., 1st & Harshman Sts., Dayton, Ohio.

MODEL PRODUCTS CO.—9th & Venango Sts., Philadelphia, Pa. Manufacturer of ground clamps.

MODERN.—Trade name for armature and other dies manufactured by the Modern Tool, Die & Machine Co., Columbus, Ohio.

MODERN.—Trade name for radio apparatus manufactured by the Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J.

MODERN ENGINEERING CO.—St. Louis, Mo. Manufacturer of oxy-acetylene welding and cutting apparatus and supplies. Business established 1914. President and general manager, A. J. Fausek; vice-president and sales manager, I. F. Fausek; secretary and treasurer, John J. Keane. Main office, 23rd & Walnut Sts., St. Louis, Mo. Branch offices and warehouses, 1935 McGee St., Kansas City, Mo.; 1118 W. 16th St., Los Angeles, Cal.

MODERN LAMP & SHADE CO.—1104 S. Wabash Ave., Chicago, Ill. Manufacturer of silk shades and floor lamps.

MODERN LAUNDRY MACHINE CO.—1414-20 E. 19th St., Kansas City, Mo. Manufacturer of electric washing machines. Business established 1914. President and treasurer, Russell M. Smith; vice-president, F. C. Downey; secretary, Denis Downey; general manager, J. P. Ellison.

MODERN RADIO EQUIPMENT CO.—27 S. Broad St., Elizabeth, N. J. Manufacturer of radio equipment. Business established 1919. Louis P. Horning, Jr., owner.

MODERN TOOL, DIE & MACHINE CO.—214 N. 4th St., Columbus, Ohio. Manufacturer of armature and other dies. J. E. Cain, general manager.

MODERN WIRE SPECIALTY CO.—334 S. Wabash Ave., Chicago, Ill. Manufacturer of wire frames for lamp shades. President, Guy Dincognito; secretary and treasurer, A. Grussel.

MODULATION, RADIO.—This term is applied to radio telephone transmission referring to the superposition of voice frequencies upon the high-frequency carrier wave. The envelop of the high-frequency wave radiated by a radio-telephone set should correspond to the voice frequency. In electron-tube sets this is usually brought about in one of two ways, by varying the plate voltage of the oscillator tube, or by varying the grid voltage of the oscillator tube.

MOE-BRIDGES CO.—236 Broadway, Milwaukee, Wis. Manufacturer of lighting fixtures. Business established 1918. President and general manager, Henrik Moe; vice-president, C. A. Bridges; secretary and treasurer, T. L. Conrad; sales manager, O. E. Moe.

MOELLER, A. E.—261-3-5 Sumpter St., Brooklyn, N. Y. Manufacturer of electrical testing instruments. Business established 1898.

MOFFAT.—Trade name for electric ranges manufactured by Moffats, Ltd., Denison Ave., Weston, Ont., Can.

MOFFATS, LTD.—Denison Ave., Weston, Ont., Can. Manufacturer of electric ranges. Business established 1893. President, J. K. Moffat; secretary and treasurer, T. L. Moffat; general manager, F. W. Moffat; sales manager, T. L. Moffat.

MOGADORE INSULATOR CO., THE.—Mogadore, Ohio. Manufacturer of electrical porcelain. President and general manager, F. W. Butler; secretary and treasurer, F. A. Fenton.

MOGUL.—This term has been adopted in the electrical trade to designate the largest standard type of screw base lamp sockets and receptacles. When applied to incandescent lamps it is used for multiple lamps ranging from 300 to 1000 watts and for series lamps of practically all sizes. The nominal diameter of the screw shell in mogul sockets and receptacles is 1½ inch. This large diameter is intentionally used so as to prevent insertion of large lamps into sockets or receptacles intended for smaller ones. Aside from their use with large lamps, mogul sockets or receptacles are used for appliances taking over 660

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watts, in which case the circuit must be a special circuit, however, and wired with larger than No. 14 wire.

MOGUL.—Trade name for portable lamp guards manufactured by the McGill Mfg. Co., Valparaiso, Ind.

MOGUL.—Trade name for babbitt-lined bearings and babbitt metal manufactured by the Muzzy-Lyon Co., Detroit, Mich.

MOGUL CO.—41 W. 39th St., New York, N. Y. Manufacturer of waterproofing compounds. A. Grothwell, owner. Business established 1893.

MOHAWK.—Trade name for fire extinguishers manufactured by James M. Castle, Inc., 1210-12 Arch St., Philadelphia, Pa.

MOHAWK ELECTRIC MFG. CO.—15 Kirk Pl., Newark, N. J. Manufacturer of fire alarm and other signaling devices and specialties. Business established 1910. E. H. Rollinson, proprietor.

MOHEGAN TUBE CO., THE.—Scott Ave. & Meserole St., Brooklyn, N. Y. Manufacturer of seamless, butted steel tubing, etc.

MOHR & SONS, JOHN.—96th St. & Calumet River, S. Chicago, Ill. Manufacturers of boilers and other equipment for steel mills. President, Albert Mohr; vice-president, Edward Mohr; secretary, Charles E. Schramm; treasurer, William J. Mohr.

MOHRLITE.—Trade name for electric lighting fixtures manufactured by the Mohrlite Co. of America, 901 Harrison St., Nashville, Tenn.

MOHRLITE CO. OF AMERICA, THE.—901 Harrison St., Nashville, Tenn. Manufacturer of electric lighting fixtures. President, John Early; vice-president, L. G. Boxwell; secretary, C. W. Hanchette; treasurer, M. Flantt.

MOISE-KLINKNER CO.—369 Market St., San Francisco, Cal. Manufacturer of electric branding irons, dies and die sinking tools, time recorders, signs, signals, metal stampings, etc. Business established 1873. President and treasurer, L. H. Moise; vice-president, M. J. Silva; secretary and sales manager, S. Pels.

MOISTENERS.—See Humidifiers, air, electric; Humidifiers, cigar, electric.

MOLA.—Trade name for electric washing machines manufactured by the Modern Laundry Machine Co., 1414-20 E. 19th St., Kansas City, Mo.

MOLDED INSULATION.—See Insulation, molded, miscellaneous.

MOLDING.—This material was used largely in the early electrical days for wiring of lighting circuits as well as for other moderate capacity circuits. It consisted of a wooden molding patterned after a picture molding and made in two parts, the base containing two or three grooves for as many wires, and a separate top piece or capping which was fastened over the base and covered the grooves or raceways for the wires. This wood molding was used for a long time, but was found to have some objections for lighting circuits. It warped frequently when exposed to moisture or excessive heat and this caused the capping to spring off, leaving the wires in the base exposed. Unless carefully installed the wires were not very well protected. The outcome of this was that wood molding was not permitted for lighting circuits in a number of cities.

Later, metal molding was introduced which had also two parts, the base and capping, and is used for lighting or other circuits of moderate capacity, chiefly for extension circuits from outlets already installed. Certain modified types of such metal molding were introduced that were not strictly molding and for this reason the designation of this material was later changed to raceways. Raceways are now divided into the two main classes, wood raceways and metal raceways, and both types are used for surface wiring and in either case the raceway is run on the surface of the wall or ceiling and not within it. For further details and manufacturers see Raceways or moldings, metal, for surface wiring; Raceways or moldings, wood, for surface wiring.

MOLDING FITTINGS.—See Raceways or moldings, metal, fittings for; Raceways or moldings, wood, fittings for.

MOLDING MACHINES, INSULATION.—Molded insulation, such as Bakelite, Condensite and other similar products, is generally formed from a powder or plastic mass in a hot hydraulic press. The heat is applied to make the material more plastic. Pressures up to about 2000 lbs. per square inch and at a temperature of approximately 350° F. are required. This pressure and temperature are maintained for a few moments. The material itself is formed in steel dies which may or may not be arranged for holding metal inserts.

Manufacturers:

Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

MOLDS FOR ELECTRICAL INSULATION.—These molds are made up in special forms for the endless variety of molded insulating parts used in electrical equipment. These molded parts must be very accurately made. The molds are generally cut from metal by mold and die cutting machines and in intricate designs by highly skilled die sinkers or other specially trained hand workers.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J. (High production.)
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Kuhn & Jacob Machine & Tool Co., 28 Wood St., Trenton, N. J.
Parkin Mfg. Co., San Rafael, Cal.
WATERBURY BUTTON CO. 835 S. Main St., Waterbury, Conn. (See display advertisement on page 1328.)

MOLDS FOR LEAD STORAGE-BATTERY PARTS.—Most of the parts of lead storage batteries are of lead cast in special molds; such parts include grids, connecting straps, terminal posts, etc. Special steel molds which are very accurately made are used in casting the grids. The smaller parts are cast in molds forming a number of such parts at each pouring. Battery molds are used chiefly by storage-battery manufacturers and to a limited extent in battery service stations.

Manufacturers:

Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill., "Besco."
BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J.
Orum, S. R. M., North Philadelphia, Pa.

MOLECULAR CONCENTRATION.—The number of gram molecular weights of a compound present in a liter of solution. For instance, the molecular weight of sulphuric acid is 98. The molecular concentration of any solution of sulphuric acid is therefore expressed by the number of grams of acid present in a liter of the solution, divided by 98. Electrochemically, the number of gram equivalents of the substance present in a liter is more significant and useful in calculation.

MOLINE MALLEABLE IRON CO.—St. Charles, Ill. Manufacturer of malleable iron castings. President, T. S. Fauntleroy; secretary, R. R. Fauntleroy.

MOLONEY BELTING CO.—130 N. Franklin St., Chicago, Ill. Manufacturer of leather belting. President, B. F. Horsting; vice-president, E. R. Lewis; treasurer, Joseph Ennrich.

MOLONEY ELECTRIC CO.—St, Louis, Mo. Manufacturer of transformers. Business established 1897. President and treasurer, T. O. Moloney; vice-president and sales manager, J. J. Mullen; secretary, H. W. Wurdack. Main office and factory, 7th & Hickory Sts., St. Louis, Mo. Branch offices, New York, N. Y.; Chicago, Ill.; Minneapolis, Minn.; San Francisco, Cal.; Los Angeles, Cal.; Seattle, Wash.; Boston, Mass.; Salt Lake City, Utah; Pittsburgh, Pa.; Buffalo, N. Y.; Cleveland, Ohio; Philadelphia, Pa.; Detroit, Mich.; Charlotte, N. C.; Birmingham, Ala.

MOLONEY ELECTRIC CO. OF CANADA, LTD.—Windsor, Ont., Can. Manufacturer of transformers. Business established 1910. Main office and factory, Windsor, Ont., Can. Branch offices, Toronto, Ont.; Winnipeg, Man.; Montreal, Que.; Halifax, N. S., Can.

MOLTEN ELECTROLYTES.—Melted materials used as electrolytes, meaning materials that are solid at ordinary temperatures. Examples: fused caustic soda, melted lead chloride, etc. They usually conduct well, and are split up by electrolysis into two essential constituents—the metallic base at the cathode and the acid radical at the anode. They are often used as the basic materials from which metals are extracted, the heat necessary to maintain the electrolyte melted being frequently supplied by the electrolyzing current alone.

MOLTRUP STEEL PRODUCTS CO.—Beaver Falls, Pa. Manufacturer of shafting and other steel products. F. H. Guppy, secretary.

MOLYBDENUM, SHEET AND WIRE.—The uses of this material are on the whole recent developments. One of the most important uses is in hot cathode apparatus used in radio telephone and telegraph equipment. It is made into fine wire and in sheets as thin as 0.005 inch.

Manufacturers:

Fansteel Products Co., Inc., North Chicago, Ill.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display ad page 1251.)
Pick Mfg. Co., Richard, 224 N. Wells St., Chicago, Ill. (Wire.)

MOMENT.—Trade name for switches manufactured by the Esler Electric Mfg. Co., 416 Lincoln St., Marion, Ind.

MONARCH.—Trade name for gasoline and kerosene engines manufactured by the Grand Rapids Gas Engine Co., Grand Rapids, Mich.

MONARCH.—Trade name for wires manufactured by the Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill.

MONARCH.—Trade name for renewable fuses manufactured by the Monarch Refillable Fuse Co., Jamestown, N. Y.

MONARCH.—Trade name for soot blowers manufactured by the Monarch Soot Remover Co., Inc., Wollaston, Mass.

MONARCH.—Trade name for motor-driven bench grinders manufactured by the Winchester Optical Co., Horseheads, N. Y.

MONARCH.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

MONARCH ELECTRIC & WIRE CO.—624 W. Adams St., Chicago, Ill. Manufacturer of wires. Business established 1901. President, L. A. Schwab; vice-president, A. G. Schwab; secretary and treasurer, H. Schwab; sales manager, E. H. Frank.

MONARCH ELECTRIC CO., LTD.—St. Lawrence & Waterman Sts., St. Lambert, Que., Can. Manufacturer of switchboards, street lighting equipment, transformers, lightning arresters, wiring devices and other electrical specialties. Business established 1907. President, J. M. Robertson; general manager, G. M. Wight; sales manager, H. W. Fairlie.

MONARCH REFILLABLE FUSE CO.—Jamestown, N. Y. Manufacturer of renewable fuses. President, R. P. Stewart; vice-president, H. H. Roberts; secretary, treasurer and general manager, R. F. Fisher. Sales representatives, F. B. Smith & Co., 170 Summer St., Boston, Mass.; Watts & Barry, Inc., 50 Church St., New York, N. Y.; Louis Cassin, 414 Pennsylvania Bldg., Philadelphia, Pa.; Jefferies & Goodloe, Mutual Bldg., Richmond, Va.; Jefferies & Goodloe, Mutual Bldg., Atlanta, Ga.; W. A. McCombs Co., Union Arcade Bldg., Pittsburgh, Pa.; Buckeye Equipment Co., 26 W. 3rd St., Cincinnati, Ohio; A. R. McNally, 517 National City Bldg., Cleveland, Ohio; J. T. Pearson Co., 1220 Dime Savings Bank Bldg., Detroit, Mich.; I. A. Bennett Co., 122 W. Adams St., Chicago, Ill.; Wescoe Electric Supply Co., Denver, Colo.; O. L. Hoadley, 609 Seaboard Bldg., Seattle, Wash.; Electrical Specialty Co., 525 Market St., San Francisco, Cal., and Los Angeles, Cal.

MONARCH SOOT REMOVER CO., INC.—Wollaston, Mass. Manufacturer of soot blowers. President, Bradford L. Ames; treasurer, Leonard W. Newell. Main office, Wollaston, Mass. Sales office, 261 Franklin St., Boston, Mass.

MONARCH TELEPHONE MFG. CO.—Fort Dodge, Iowa. Manufacturer of telephones, switchboards and exchange equipment. Business established 1901. President, O. M. Oleson; vice-president, F. L. Loomis; secretary and general manager, L. Q. Trumbull; treasurer, J. M. Plaister; sales manager, Wm. F. Qualls.

MONAX.—Trade name for illuminating glassware manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

MONCE, INC., S. G.—Unionville, Conn. Manufacturer of glass cutters. President, S. G. Monce; secretary and treasurer, Orrin J. Moses.

MOND-LANGER CELL.—A gas cell in which the reacting gases are hydrogen and oxygen.

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MONDELL MFG. CO.—New Bedford, Mass. Manufacturer of brass cylinder connectors.

MONEYWEIGHT SCALE CO.—326 W. Madison St., Chicago, Ill. Manufacturer of electrically lighted computing and weighing scales. Subsidiary of Cumputing-Tabulating-Recording Co., 50 Broad St., New York, N. Y.

MONITOR.—A person in a manual central telephone office who (unobserved) listens in on the operator's telephone sets to see how the operators are doing their work.

MONITOR.—Trade name for mechanics' levels manufactured by C. L. Berger & Sons, Boston, Mass.

MONITOR.—Trade name for electric washing machines manufactured by the Huenergardt Co., 19th & Vine Sts., Lincoln, Neb.

MONITOR.—Trade name for bells for street cars, telephones, etc., manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

MONITOR.—Trade name for portable lamp guards manufactured by the McGill Mfg. Co., Valparaiso, Ind.

MONITOR.—Trade name for motor-driver. ice cream freezers manufactured by Thomas Mills & Brother, 1301 N. 8th St., Philadelphia, Pa.

MONITOR CONTROLLER CO.—500-16 E. Lombard St., Baltimore, Md. Manufacturer of motor-starting and control equipment. President, C. R. Durling; vice-president, William T. Holmes; secretary, Edward McIntyre; treasurer, J. E. Henderson.

MONO-CELL.—Trade name for flashlight batteries manufactured by the Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.

MONOCOIL.—Trade name for electric toy motor manufactured by the C. D. Wood Electric Co., 441 Broadway, New York, N. Y.

MONO CORP. OF AMERICA.—25 W. Broadway, New York, N. Y. Manufacturer of combustion recorders and flue gas analysis instruments. Business established 1901. President and treasurer, Gustav Lange, Jr.; vice-president and general manager, F. D. Harger; secretary, L. Burke; sales manager, E. D. Harger. Sales representatives, C. D. Davis, Pittsburgh, Pa.; Bryant Engineering Co., Detroit, Mich.; George B. Allan Co., Dallas, Tex.

MONOGRAM.—Trade name for red cedar poles produced by the Central Wisconsin Supply Co., Beaver Dam, Wis.

MONOLITE.—Trade name for adjustable lighting fixture made by the Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

MONOLITE.—Trade name for street-lighting standards manufactured by the King Mfg. Co., St. Joseph, Mo.

MONOPIVOT.—Trade name for pyrometer indicators manufactured by the Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

MONOX.—The technical name for silicon monoxide, produced by the partial reduction of silica by carbon in the electric furnace. It is a good refractory and heat-insulating material.

MONROE.—Trade name for ground clamps manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

MONTAN.—Trade name for insulating wax manufactured by the Strohmeyer & Arpe Co., 139-141 Franklin St., New York, N. Y.

MONTEREY.—Trade name for hydraulic packing made by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

MOODY.—Trade name for electric pumps manufactured by the William Cramp & Sons Ship & Engine Building Co., I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa.

MOON.—Trade name for oil and grease cups manufactured by the American Injector Co., 175 14th Ave., Detroit, Mich.

MOON CO., GEORGE C.—Garwood, N. J. Manufacturer of galvanized strand and wire rope.

MOON-GLOW.—Trade name for lighting fixtures manufactured by the Rogers Silver Plate Co., Danbury, Conn. (Exclusive distributor, Eclipse Light Co., 587 Broadway, New York, N. Y.)

MOONLIGHT SCHEDULE.—This is a schedule for lighting of street lamps which shows the time of lighting and extinguishing every night in the year on a schedule in which advantage is taken of those times when there is supposed to be moonlight, at which times the lamps are extinguished according to definite rules. For further details see Schedules for street lighting.

MOONSTONE.—Trade name for illuminating glassware manufactured by the Jefferson Glass Co., Follansbee, W. Va.

MOORE.—Trade name for elevator threshold illuminators manufactured by the Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.

MOORE.—Trade name for steam turbines manufactured by the Moore Steam Tubbine Corp., Wellsville, N. Y.

MOORE.—Trade name for electric furnaces manufactured by the Pittsburgh Electric Furnace Corp., 714 Union Bank Bldg., Pittsburgh, Pa.

MOORE & WHITE CO., THE.—Philadelphia, Pa. Manufacturer of friction clutches. President, J. Atwood White; vice-president, D. R. Taylor; secretary and treasurer, Shelton A. Hibbs.

MOORE BROS. LIGHTNING ROD CO.—Maryville, Mo. Manufacturer of lightning rods and lightning rod fittings. Business established 1900. President, D. C. Moore; vice-president, E. V. Moore; secretary-treasurer, G. J. Moore. Main office, Maryville, Mo. Branch office, Peoria, Ill.

MOORE CO., THE FRANKLIN.—Winsted, Conn. Manufacturer of electric hoists and traveling cranes. President, J. B. Adams; secretary and treasurer, J. H. Whiting. Branch offices, 50 Church St., New York, N. Y.; Stephen Girard Bldg., Philadelphia, Pa.; Peoples Bank Bldg., Pittsburgh, Pa.

MOORE ELECTRIC CORP.—202 S. State St., Chicago, Ill., Manufacturer of electric hair cutters, hair driers, vibrators and face drying fans. Business established 1916. President and treasurer, Dr. G. W. Moore; vice-president, Spencer Ward; secretary and general manager, W. E. Gray. Factory, Racine, Wis. Exclusive distributor, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.

MOORE OIL REFINING CO., THE.—Cincinnati, Ohio. Manufacturer of lubricating oils and greases. Business established 1883. President, B. G. Dawes; vice-president and general manager, John Edwards; secretary and treasurer, F. S. Heath; sales manager, Charles Rice. Main office and factory, York & McLean Sts., Cincinnati, Ohio. Branch offices and warehouses, Columbus, Ohio; Logansport, Ind.

MOORE STEAM TURBINE CORP.—Wellsville, N. Y. Manufacturer of steam turbines.

MORAN & HASTINGS MFG. CO.—16-18 W. Washington St., Chicago, Ill. Manufacturers of lighting fixtures. President, Franz Brzeczkowski; secretary and treasurer, P. S. Olson; general manager, H. C. King; sales manager, H. S. Ismon.

MORAN & MAC NAIR, INC.—72 W. Lake St., Chicago, Ill. Manufacturer of electric lighting fixtures and lamps. Business established 1908. President, Walter MacNair; vice-president, Albert T. Tilton; secretary and treasurer, R. Hughes.

MORAN BOLT & NUT MFG. CO.—Main & Florida Sts., St. Louis, Mo. Manufacturer of pole-line hardware, carriage and machine bolts. President, John Gorman; treasurer, L. Moran.

MORE-JONES BRASS & METAL CO.—3132-44 N. Broadway, St. Louis, Mo. Manufacturer of babbitt metals, solders, bronze and copper sheets, rods, etc. Business established 1876. President and general manager, John B. Strauch; vice-presidents, Thomas H. Wright, Samuel W. Crawford; secretary and sales manager, Raymond S. Herman; treasurer, Joseph A. Neuwirth.

MORGAN.—Trade name for electric hoists manufactured by the Brown Clutch Co., Sandusky, Ohio.

MORGAN & CO.—Brooklyn, N. Y. Manufacturers of illuminating glassware.

MORGAN ENGINEERING CO., THE.—Alliance, Ohio. Manufacturer of motor-driven furnace charging machines, cranes, hydraulic presses. Main office and factory, Alliance, Ohio. Branch offices, Equitable Bldg., New York, N. Y.; Birmingham, Ala.; Oliver Bldg.; Pittsburgh, Pa.; 122 S. Michigan Ave., Chicago, Ill.

MORGAN-GARDNER ELECTRIC CO.—2640 Shields Ave., Chicago, Ill. Manufacturer of electric coal mining machinery.

MORGAN MFG. CO., INC.—Keene, N. H. Manufacturer of spark plugs. President, B. Morgan; treasurer, F. P. Kendall.

MORGAN VISE CO.—35 S. Desplaines St., Chicago, Ill. Manufacturer of vises. President, George W. Morgan.

MORGANITE BRUSH CO., INC.—519 W. 38th St., New York, N. Y. Manufacturer of commutator brushes, flexible brush connectors, contacts, etc. Business established 1909.

MORKRUM CO.—1410 Wrightwood Ave., Chicago, Ill. Manufacturer of printing systems and other telegraphic instruments. Business established 1910. President, Sterling Morton; vice-president, C. L. Krum; secretary and treasurer, Daniel Peterkin; general manager, Howard Krum; sales manager, J. O. Carr.

MOR-LITE.—Trade name for incandescent lamps manufactured by the Howland Mfg. Co., 60 Franklin St., Malden, Mass.

MORREAU CO., THE.—1303-1307 Oregon Ave., N. E., Cleveland, Ohio. Manufacturer of lighting fixtures and portable electric lamps.

MORRIN-CLIMAX BOILER CO.—Jersey City, N. J. Manufacturer of water-tube boilers.

MORRIS CRANE & HOIST CO., LTD., THE HERBERT.—Niagara Falls, Can. Manufacturer of electric cranes and hoists. President, M. R. Meldrum; vice-president, R. Gillespie; secretary, D. E. Parrish. Main office and factory, Niagara Falls, Can. Branch offices, Montreal, Que.; Toronto, Ont.

MORRISON LUMBER CO., J. W.—927-28 Lumber Exchange, Minneapolis, Minn. Producer of cedar poles and ties. Business established 1900. Partnership, W. L. Colgrove and J. W. Morrison. Yard, Deer River, Minn.

MORRISON RICKER MFG. CO.—Grinnell, Iowa. Manufacturer of linemen's leather gloves. Business established 1856. President and general manager, B. J. Ricker; vice-president, Fred Morrison; secretary, L. C. Bennett; treasurer, A. L. Ricker; sales manager, J. M. Ford.

MORROW CO., THE.—Waukegan, Ill. Manufacturer of electric vacuum cleaners. Factory, North Chicago, Ill. R. H. Morrow, proprietor.

MORSE.—Trade name for lamp guards manufactured by the Hamblin & Russell Mfg. Co., Worcester, Mass.

MORSE CHAIN CO.—Ithaca, N. Y. Manufacturer of silent power transmission chains. President, F. L. Morse; vice-president, E. T. Turner; secretary, D. B. Terry; treasurer, F. L. Morse; general sales manager, V. D. Morse. Main office and factory, Ithaca, N. Y. Branch offices, 141 Milk St., Boston, Mass.; Merchants Loan & Trust Bldg., Chicago, Ill.; Engineers Bldg., Cleveland, Ohio; Detroit, Mich.; 50 Church St., New York, N. Y.; Westinghouse Bldg., Pittsburgh, Pa.; Monadnock Building, San Francisco, Cal.; Atlanta, Ga.; Greensboro, N. C. Sales representatives, Morse Engineering Co., Kansas City and St. Louis, Mo.; Strong-Scott Mfg. Co., Minneapolis, Minn.; Jones & Glassco, Montreal, Que., and Toronto, Ont., Can.

MORSE, FRANK W.—289 Congress St., Boston, Mass. Manufacturer of electric lighting specialties. Business established 1899. Frank W. Morse, owner. Sales representatives, Electrical Equipment Co., 9 S. Clinton St., Chicago, Ill.; Central States Sales Co., 211 High Ave., Cleveland, Ohio; Automotive Equipment Sales Co., 1104 Hartje Bldg., Pittsburgh, Pa.; Electric Sales Co., Kenyon Bldg., Louisville, Ky.; S. F. Wilbur, 955 Post St., San Francisco, Cal.; Arthur M. Newhouse, 5 S. Wabash Ave., Chicago, Ill.; A. W. Voorhis, 21 Park Row, New York, N. Y.

MORSE EUREKA.—Trade name for testing clips, terminals and nuts manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

MORSE, SAMUEL FINLEY BREESE.—An American inventor and artist (born at Charlestown, Mass., 1791, died in New York, 1872), who is famous for his invention of the electric telegraph. He graduated at Yale College in 1810 and began life as an artist. He made several trips to Europe to continue his studies in painting and received a professorship in art in New York City. Morse first conceived the idea of the telegraph while on board ship on his return from Europe to America in 1832, while discussing the then recent discovery in France of a method of increasing the power of a magnet by passing electric current through coils of insulated wire wound on a soft iron bar. In September, 1837, he made a public exhibition of his telegraph and in that year filed his caveat at Washington. In 1838 he asked Congress for funds to construct an experimental line from Washington to Baltimore. After almost despairing of this aid, he was pleas-

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antly surprised to learn that Congress, at the last moment of its session in March, 1843, had appropriated $30,000 for this line. In 1844 Morse succeeded in establishing a working telegraph line between the two cities and demonstrated to the world the practicability and utility of his system of electromagnetic telegraphy. The first message was sent on May 24, 1844. He had invented not only the telegraph instruments and line equipment, but also a practical code of telegraph signals which is in use to this day and generally known as the Morse code. The number and character of the honors subsequently bestowed upon Professor Morse on account of this invaluable invention has probably never been equalled in the case of any other American. Professor Morse set up the first daguerreotype apparatus and with John W. Draper was associated in taking the first daguerreotypes (crude photographs) in America. In October, 1842, he had laid the first submarine line across the harbor of New York and later gave valuable assistance to Peter Cooper and Cyrus W. Field in the successive efforts to lay the first Atlantic cable.

MORSE TWIST DRILL & MACHINE CO.—163 Pleasant St., New Bedford, Mass. Manufacturer of twist drills, dies, chucks, etc. Business established 1864. Treasurer and general manager, H. E. Cushman.

MORSE-WATCH.—Trade name for telegraph sounder manufactured by the Manufacturers' & Inventors' Electric Co., 29 Gold St., New York, N. Y.

MOSAIC SHADE CO.—589 E. Illinois St., Chicago, Ill. Manufacturer of electric table lamps. President, F. Vizirito; vice-president and general manager, L. Vizirito.

MOSHER.—Trade name for steam and oil separators made by the United Machine & Mfg. Co., Canton, Ohio.

MOSLER & CO., A. R.—Mt. Vernon, N. Y. Manufacturer of spark plugs. President and treasurer, Arthur R. Mosler; vice-president and secretary, E. L. Mosler.

MOSSBERG CO., FRANK.—Lamb St., Attleboro, Mass. Manufacturer of wrenches. Business established 1902. President, Walter I. Tuttle; vice-president, Silas Tuttle; secretary and general manager, Everett L. Ford; treasurer and sales manager, Frank T. Chase. Branch offices and warehouses, 180 N. Market St., Chicago, Ill.; 214 Maritime Bldg., Seattle, Wash.; 1129 N. Beckley Ave., Dallas, Tex.; Chamber of Commerce Bdlg., Atlanta, Ga. District offices, 503 Equitable Bldg., Los Angeles, Cal.; 626 Underwood Bldg., San Francisco, Cal.; 414 Drummond Bldg., Montreal, Que., Can.

MOSS-SCHURY MFG. CO., INC.—444-446 Woodbridge St., E., Detroit, Mich. Manufacturer of electric household refrigerators, fuses, and automobile locks. Business established 1919. President, James B. Webber; vice-president and general manager, Benjamin L. Moss; secretary and treasurer, George B. Graves. Sales representatives, Advance Sales Co., 74 W. Washington St., Chicago, Ill.; W. L. Collings & Co., 405 Redondo Ave., Long Beach, Cal.; F. E. Reinhardt & Co., 13 S. 4th St., St. Louis, Mo.

MOSS TIE CO., T. J.—Security Bldg., St. Louis, Mo. Manufacturer of railroad ties. President, J. W. Fristoe; vice-presidents, T. J. Moss and E. E. Pershall; secretary, F. C. Wand; treasurer, J. M. Rigby.

MOTIOGRAPH.—Trade name for motion-picture and motion-picture rewind machines manufactured by the Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill.

MOTION-PICTURE MACHINERY AND APPLIANCES. MISCELLANEOUS.—Under this classification are included various devices, attachments to standard equipment, which are designed for special uses in connection with such machines. Among these devices are automatic or self-rewinding attachments, control devices for automatically cutting out the motor or arc light and closing the shutter in case of accident to machine or breaking of the film, also signals for various purposes, etc.

Manufacturers:

Feaster Film Feed Co., New York, N. Y. "Feaster." (Film feed machines.)
Prizma, Inc., 71 W. 23rd St., New York, N. Y.
Ulmer Circuit Breaker, Inc., Louisville, Ky. (For motion-picture machines.)

MOTION-PICTURE MACHINES, MOTOR-DRIVEN, MINIATURE.—The miniature motion-picture machines are used extensively mor projection of commercial and educational films in conjunction with sales talks, safety and other lectures, school and private entertainments, etc. The outfits, although in essential parts the same as the larger standard machines, are smaller and usually portable, being mounted within a metal cabinet or carrying case. Some types are made so that the film may be readily stopped or even reversed, so as to combine the motion-picture and stereopticon features. The National Electrical Code requires that these machines must not consume more than 660 watts for the projecting lamp and that they be made for narrow width "safety" or "slow-burning" film only.

Manufacturers:

Ad-Photo-Scope Co., 308 N. Michigan Blvd., Chicago, Ill. "Ad-Photo-Scope."
American Foundry Co., Newark, N. J. "Automatic."
American Projecting Co., The, 6231-33 Broadway, Chicago, Ill. "American."
Cummings, A. B., 53-59 Falmouth St., Attleboro, Mass. "Ab-Cum-O-Graph."
De Vry Corp., 1250 Marianna St., Chicago, Ill. "De Vry."
Graphoscope Mfg. Co., 49 Mechanic St., Newark, N. J. "Graphoscope."
Pathescope Co. of America, Inc., Aeolian Hall, New York, N. Y. "Pathescope."
Underwood & Underwood, Inc., 417 5th Ave., New York, N. Y. "Touriscope."
United Theatre Equipment Corp., 25 W. 45th St., New York, N. Y. "U. T. E.—Proctor."
Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa. "Victor."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

MOTION-PICTURE MACHINES, MOTOR-DRIVEN, STANDARD.—The motor-driven machines used in regular motion-picture theaters are subject to the most rigid requirements by the National Electrical Code. The arc or incandescent lamp and the reel magazine must be housed in individual metal casings; no solder can be used in the construction of the magazines; the film must not be exposed to the light of the projecting lamp except when the film is running at regular operating speed, and the motor must be specially designed and approved. These requirements are met by the standard machines, which are very ruggedly built almost entirely of metal. The reel magazines, lamp and control mechanism are usually mounted on a metal frame with adjustable legs, and sometimes adjustable for tilting to any desired angle. The motor is generally mounted directly below the lower magazine with the winding mechanism directly connected to the armature shaft. A lamp rheostat is also a part of the equipment, but is usually external to the machine. The motor-driven machines are used extensively, especially where the best results are desired as motor drive gives uniform projecting speed which cannot be obtained by the hand method. The machines are usually provided with automatic shutters to cut off the light beam in case the film breaks so as to prevent its ignition.

Manufacturers:

Baird Motion Picture Machine Co., 24 E. 23rd St., New York, N. Y.
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill. "Standard Cinemachinery."
Cosmograph Motion Picture Machine Co., Inc., Film Bldg., Cincinnati, Ohio. "Cosmograph."
Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill. "Motiograph."
Graphoscope Mfg. Co., 49 Mechanic St., Newark, N. J. "Graphoscope."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Master Machine Tool Co., Inc., New York, N. Y. "Master."
McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill. "Edison."
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y. "Cameragraph."
Precision Machine Co., Inc., New York, N. Y. "Simplex."
Uniscope Co., 2156 Fulton St., Chicago, Ill. "Uniscope."
United Theatre Equipment Corp., 25 W. 45th St., New York, N. Y. "U. T. E.—Proctor."
Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa. "Victor Safety Cinema," "Animatograph," "Victor."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

MOTION-PICTURE PROJECTING LAMPS.—See Lamps, arc, projecting, stage and stereopticon; Lamps, incandescent, projecting.

MOTION-PICTURE REWIND MACHINES, MOTOR-DRIVEN.—These devices consist of a sheet metal enclosure containing two reels and suitable motor-driven mechanism for unwinding an exhibited film from one reel onto another for future use and at the same time permitting inspection of the film during rewinding. The National Electrical Code requires that the films be housed in the sheet-metal magazines and that there shall not be exposed more than two feet of the film in the booth. These requirements are met in the standard machines.

Manufacturers:

Ansonia Novelty Co., The, 285 Main St., Ansonia, Conn.
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill. "Standard Cinemachinery."
Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill. "Motiograph."
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y. "Cameragraph."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

MOTION-PICTURE WIRE.—See Wire, motion-picture.

MOTOR, A-C.—A motor converting power in the form of alternating current into mechanical power. There are two general classes, the synchronous and the asynchronous. The synchronous motor is a synchronous alternator with its function reversed. Its speed is fixed by the frequency of the supply and the number of poles, independent of the voltage or load. Asynchronous motors change their speed more or less with load. They may have approximately constant speed, as the induction motor, or a variable speed as the a-c. series, the repulsion and some other forms of a-c. commutator motors.

MOTOR, A-C. COMMUTATOR.—A motor whose rotor is provided with a winding and a commutator similar to the armature of a d-c. machine. In some motors, as the series and the repulsion types, the commutator is a necessary feature of the construction; in others, as the single-phase and polyphase induction motors with shunt characteristics, the commutator is an auxiliary device for speed control or power-factor correction.

MOTOR, A-C. SERIES.—A motor having a series winding, similar to that of a d-c. series motor, and operatinig on alternating current. The iron of the field structure, as well as that of the armature, is laminated to reduce eddy currents. The power-factor is below unity due to the self-induction of the windings, but in large motors used for traction work this feature is improved by building in a compensating winding, which largely neutralizes the inductive reactance of the armature, leaving only that of the field winding to lower the power-factor. The commutation in large motors may be accompanied by sparking unless special designs are followed. A common arrangement consists in making the commutator risers of greater resistance than in d-c. motors. The speed-torque characteristic is similar to that of d-c. series motors, giving a large torque at low speeds and smaller torques at higher speeds.

A-c. series motors are used in small sizes for driving fans, vacuum cleaners and such devices as give a constant load or one in which a large change in speed with change in load is not objectionable; also where operation either on direct current or on alternating current is desired, this being called the "universal" motor. In large sizes they are used for a-c., and combined d-c. and a-c. electric railways, and to a limited extent for cranes and hoists.

MOTOR BASES.—See Bases, belt tightening, motor and generator.

MOTOR BEARINGS.—See Bearings.

MOTOR BOOSTER.—See Boosters, motor-driven.

MOTOR BRAKES.—See Brakes, electric, motor, miscellaneous.

MOTOR CITY STAMPING CO.—771 Maxwell Ave., Detroit, Mich. Manufacturer of switch boxes.

MOTOR CONTROLLERS.—See Controllers; also Control systems.

MOTOR CONVERTER.—Also called cascade converter. See Converter, cascade.

MOTOR DICTOGRAPH.—Trade name for automobile telephones manufactured by the Dictograph Products Corp., 220 W. 42nd St., New York, N. Y.

MOTOR, D-C.—A machine changing electrical energy in the form of direct current into mechanical energy. There are three general classes, viz.: (1) shunt motors in which the field winding for producing the excitation is in shunt with the armature circuit; (2) series

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motors in which the field winding is in series with the armature; (3) compound motors which have both a shunt and a series field winding. Shunt motors run at approximately constant speed for all loads when supplied with power at constant voltage. Series motors under like conditions have a large decrease in speed with an increase of load; they may race to destruction if the load is too light. Compound motors may be differentially or cumulatively wound; in the first case, the speed may be nearly constant with change of load; in the second case, it will decrease as the load increases, but not as much as with a series motor.

MOTOR-DRIVEN APPLIANCES AND MACHINES.—These are of such a large number that it has been found best to list them under the name of the particular appliance or machine desired. Also see Machines, motor-driven, miscellaneous.

MOTOR, ELECTRIC.—A dynamoelectric machine used to convert electrical energy into mechanical energy by utilizing the principle of electromagnetic induction. Motors consist of two essential parts, a magnetic field and windings carrying currents through this field in a transverse direction. The force acting between the field and the conductors carrying the currents gives motion with the resultant conversion of electrical energy into mechanical. The construction of electric motors is almost identical with that of electric generators.

Motors may be classified according to the character of the electric current into direct-current motors and alternating-current motors. D-c. motors may be subdivided according to the arrangement of the field-exciting winding into shunt, series and compound. Shunt motors have an exciting winding in shunt with the armature or load current; series motors, one in series with the load, and compound motors, one in series and one in shunt with the load.

A-c. motors may be classified as synchronous and asynchronous, the former having a speed fixed by the frequency and the number of poles, while the latter have a more or less variable speed. Asynchronous motors include a number of types, such as induction motors, repulsion motors, series motors, repulsion-induction and commutator motors with shunt characteristics. A-c. motors may be either single-phase or polyphase.

Motors are also classified with reference to their speed characteristics as constant-speed, multispeed, adjustable-speed and varying-speed motors.

Constant-speed motors are those whose speed is either constant at all loads or does not vary materially. Motors of this class are synchronous motors, induction motors with small slip and ordinary d-c. shunt motors.

Multispeed motors, or change-speed motors as they are sometimes called, can be operated at any one of several distinct speeds, these speeds being practically independent of the load, but which cannot be operated at intermediate speeds. An example of this type is an induction motor with the stator so arranged that it is possible to regroup the coils and alter the number of poles and thus alter the synchronous speed of the motor. Also see Concatenate.

Adjustable-speed motors may have their speed varied gradually over a considerable range, but when once adjusted the speed remains practically unaffected by the load. The most common adjustable-speed motor is a specially designed d-c. shunt motor whose speed is adjusted by changing the field strength, either by changing the field current or the reluctance of the magnetic circuit. Polyphase induction motors of this class may have their speeds adjusted by a cascade connection to a second motor or to an auxiliary commutator motor or synchronous converter. A-c. commutator motors have their speeds adjusted either by shifting the brushes or by the introduction of auxiliary e. m. f.'s in the brush circuit.

In varying-speed motors, the speed naturally varies as the load changes, ordinarily decreasing when the load increases. In this class are included series motors for direct and alternating current, repulsion a-c. motors and cumulative-compound d-c. motors. Some varying-speed motors are also adjustable so that the speed may be varied over a considerable range at any given load, but when once adjusted varies with the load. D-c. motors with resistance inserted in series with the armature belong in this latter group, as do polyphase induction motors with wound rotors.

Motors are also classified as to the degree of enclosure provided in their frame construction into open, semienclosed, and enclosed motors; as to their general design into dripproof, splashproof, dustproof, dusttight, explosion proof, gas-tight, moisture-resisting, acid-resisting and submersible motors; as to size or rating into fractional-horsepower motors (those of less than 1 hp. continuous rating) and large power motors (those of 1 hp. or larger); as to general character of service into continuous-duty, intermittent and periodic-duty, and varying-duty motors; also as to specific kind of service into many types usually designated by the name of the machine or equipment driven, such as crane, hoist, elevator, railway, mill, sewing machine, phonograph, etc., motors.

MOTOR ENCLOSING AND VENTILATING EQUIPMENT.—Motors located in dusty places easily become clogged with dust and fail to ventilate properly, which may result in dangerous overheating. Such motors are sometimes equipped with a motor enclosure made of sheet metal, which shuts out the dust. The motor is then ventilated by forcing an air current through the enclosed housing, a complete pipe ventilating system being provided including a blower. Such equipments are sometimes used in textile mills, woodworking plants and other dusty shops or factories.

Manufacturers:

Motor Protection Co., 17 Illinois St., Central Falls, R. I.

MOTOR GEARS.—See Gears and pinions, motor speed reduction and transmission.

MOTOR-GENERATORS.—Motor-generator sets are electrical converting machines consisting of a motor mechanically coupled to one or more generators. The motor of the set is always the machine that receives the electric power to be converted; it converts it first into mechanical power that is used to drive the generator (or generators) of the set; the latter generates the electric power of the kind, frequency and voltage desired, acting just like a generator driven by any other prime mover. There is no electrical connection between the motor and generator elements, except that sometimes the fields of both machines are separately excited from the same source, as in the case of frequency converter sets. The motor and generator are nearly always mounted on the same base and directly connected by a mechanical coupling or clutch. Occasionally two generators are provided for greater flexibility or to permit connecting them in series in case of high-voltage d-c. generators; in such cases the motor is usually placed between the two generators.

Motor-generators are used to convert from alternating current to direct current or the reverse; alternating current from one frequency to another frequency (sometimes also with change of voltage); direct current at one voltage to another voltage; single-phase to polyphase alternating current, or the reverse. While some of these transformations may be accomplished more efficiently and at a smaller first cost with other types of machines, such as synchronous converters, cascade converters, transformers, etc., motor-generators provide greater flexibility and permit of adjusting the ratio of voltage and frequency transformation over a wider range. They also do not require as close attention as some other machines, and are therefore widely used where expert attendance is not available.

Motor-generator sets driven by synchronous motors are often used for transforming from alternating to direct current. They permit simpler and greater voltage regulation than synchronous converters and the generator may be provided with all the desirable features of a machine driven by a prime mover, such as wide voltage range and practically any compounding characteristics. It is usually preferable to use synchronous motor drive, but occasionally cases arise where the simplicity and lower cost of the squirrel-cage induction motor make its use desirable in spite of its lower power-factor.

The motors of motor-generator sets are commonly wired for the transmission voltage and they are often started by means of an autotransformer starter at fractional line voltage. Synchronous motor sets are either started in this way or by the torque supplied by squirrel-cage windings fitted in the pole shoes. Another method sometimes employed is to temporarily use the d-c. generator as a motor.

Some of the principal applications of motor-generators and their manufacturers are given below. Also see Converters, frequency; Converters, phase; Balancer sets.

MOTOR-GENERATORS FOR BATTERY CHARGING.—In motor-generators whose output is used to charge storage batteries, the motor is of the constant-speed type for direct or alternating current, depending on the source of supply, alternating current being the more common. The generator may be either shunt or compound wound. Motor-generators are quite widely used for this work in garages or wherever storage batteries are to be charged from a rugged set and with fairly high efficiency. They are usually more efficient than mercury arc or other rectifiers, and do not require as skilled an operator as do synchronous converters. The voltage regulation while charging may be accomplished much more economically and readily with a motor-generator than with any constant-potential charging outfit. The voltage of the generator is set at the desired value to start and as the charge proceeds and the counter voltage of the cells increases, the generator voltage may be increased the proper amount by adjusting its field strength, without waste of power. With other devices furnishing constant voltage the charging current is usually adjusted by means of resistors in the battery circuits with an attendant large power loss, amounting in some cases to over 25%. Battery-charging motor-generators are made in a wide range of sizes and voltages, depending on the capacity or size and number of batteries to be charged in parallel at one time and the number of cells charged in series. Most of the sets are horizontal, but where space is restricted vertical-shaft sets are available.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Dayton."
Acme Electric & Mfg. Co., The, 1444 Hamilton Ave., Cleveland, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Andrae & Sons Co., Julius, Broadway & Michigan Sts., Milwaukee, Wis. "Jasco."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-89 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Commercial Electrical Supply Co., Broadway & Spruce Sts., St. Louis, Mo.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electric Products Co., The, Cleveland, Ohio. "Wotton."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Individual vehicle battery charging sets in capacities for charging lead batteries of 44 cells or less or Edison batteries up to 60 cells. For service on single phase or polyphase circuits of various frequencies and standard voltages. (Bulletin Y-1532.) Starting and lighting battery charging sets of 250 to 750 watts for series charging. (Booklet B3432-A.) Series-multiple charging sets for charging, starting and lighting batteries, in sizes for 2 to 10 separate charging circuits. (Y-1369.) Note—Tungar Battery Charger recommended for small battery charging stations. (Y-1457.) Battery charging sets for simultaneously charging two or more batteries in multiple, for operation from standard a-c. circuits and special sets for other voltages or for operation on direct current. These sets, together with the multiple-circuit switchboards to control them, are described in Bulletin Y-1364-A. See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hertner Electric Co., The, 1905 W. 114th St., Cleveland, Ohio.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
HOLTZER-CABOT ELECTRIC CO., THE,, 125 Amory St., Boston, Mass.

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Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
Mayhew Co., 867 Meinecke Ave., Milwaukee, Wis.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
Radio Corp. of America, 233 Broadway, New York, N. Y.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., Driving Park Ave. & Argo Park, Rochester, N. Y.
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTOR-GENERATORS FOR EXCITATION.—In motor-generator sets whose output is used for the excitation (usually) of alternators, the motors are practically always polyphase induction motors and the generators of the d-c. type wound for 125 or 250 volts. Motor-driven exciters are used in very many power plants, usually not as the exclusive excitation equipment, but commonly in conjunction with units driven by prime movers. In some plants they are considered of prime importance, but generally they are an emergency auxiliary to the exciters directly connected to the alternators. Their principal advantages are relatively low first cost, flexibility, and cheap, efficient and reliable operation. For industrial plants, laboratories, etc., where separate excitation is necessary for synchronous machines or special generators, motor-generators are often advantageous as exciter sets.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Motor-generator sets for every service — exciters, frequency changers, booster and balancer sets, described fully in Bulletin 42552A. See adv. pages 1203-1223.—Adv.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. on pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
TERRY STEAM TURBINE CO., THE, Terry Sq., Hartford, Conn.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTOR-GENERATORS FOR MINE HOISTS.—The use of motor-generators for mine hoisting control systems is one of the special but important applications of this apparatus. In this system a d-c. motor operates the hoist, and is supplied with energy from the d-c. generator of the motor-generator set. The motor of the set may be either a d-c. or a-c. motor depending on the supply. In large hoists where high peak currents are obtained, the generator is usually driven by a polyphase slip-ring induction motor and the set is equipped with a flywheel. The load motor is connected directly across the generator terminals without switches or rheostats in the circuit, the control being effected entirely by varying the generator field. The motor-generator set operates continuously at a fairly uniform speed, but while the load motor is not in operation the generator field circuit is open. On starting the motor, the field circuit is closed through a resistance, thus supplying a reduced voltage to the motor which is increased by gradually cutting out this resistance. A reversing switch in the generator field circuit permits reversing the direction of rotation of the motor. This use of a motor-generator makes it possible to handle sharp variations in load at widely varying speeds without rheostatic losses in the main circuit and without imposing any violent load variations on the supply system. Similar motor-generator sets are used for large rolling-mill motors and similar heavy-duty reversing service.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. This Company has built some very large sets for this purpose, a notable example being the Crown Mines hoist, South Africa, consisting of a 5000 hp. induction motor driving two d-c. generators, supplying hoist motors of 4000 hp. continuous capacity. There are G-E motor-generator sets for every service. Send for Bulletin 42552-A. See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTOR-GENERATORS FOR MISCELLANEOUS USES.—Motor-generator sets have a wide application to various electrical processes and control and distribution systems. Their principal advantage is the flexibility of transformation that is possible. By using a motor-generator set the voltage may be controlled without rheostatic losses in the main circuit. Among the miscellaneous applications not elsewhere referred to some of the most important are for electrolytic work, electric railway power supply, steel-mill control systems, portable welding sets, telephone and other signaling service, etc. For electrolytic work motor-generator sets are often very essential. The voltage required is on the order of 2 to 20 volts, and the current is very large so that rheostatic control is very inefficient. The generators for this kind of work are of special construction because of the unusual relation of current value to voltage. Motor-generators for electric railway supply are now mostly restricted to high-voltage systems where from 1200 to 3000-volt d-c. trolley circuits are used. These voltages cannot be obtained satisfactorily with synchronous converters. Before the advent of 60-cycle synchronous converters, motor-generators were often used for 600-volt railway systems. For steel-mill control the motor-generator system is very similar to that for mine hoisting, which see. A separate motor-generator is required for each load motor. Welding outfits of the portable type for arc welding are often made up as motor-generators mounted on a truck; this makes a convenient and economical equipment that can be brought close to the work. Where considerable arc welding is done in a shop a stationary motor-generator set of larger rating may provide for simultaneous operation of several welding arcs. In telephone exchanges ringing and busy-test generators are usually made up as motor-generator sets. Telegraph, fire alarm, railway signaling, elevator and other signaling systems commonly employ motor-generators.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J.
Cosby Electric & Machine Co., R. R., 1705 E. Broad St., Richmond, Va.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eager Electric Co., The, Watertown, N. Y.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electric Blower Co., 352 Atlantic Ave., Boston, Mass.
Electric Products Co., The, Cleveland, Ohio. "Wotton."
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F.B."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Fulton Co., E. E., 3208 Carroll Ave., Chicago, Ill. "Fulco."
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Hallberg, J. H., 25 W. 45th St., New York, N. Y. "20th Century," "Featherweight."
Hanson & Van Winkle, Newark, N. J.
Hertner Electric Co., The, 1905 W. 114th St., Cleveland, Ohio. (motion picture set) "Transverter."
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.

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Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y. (Welding)
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radioland Co., 209 Alsop St., Jamaica, N. Y.
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.
ROBBINS & MYERS CO., THE, Lagonda Ave & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y. "Rochester."
ROTH BROTHERS & CO., Chicago, Ill. Motor-generator sets are furnished either of the construction where two machines are direct coupled and



Roth Motor-Generator Set

mounted on an iron bed plate, or of the type where the two armatures are mounted on the same shaft. They are made for all voltage combinations. —Adv.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Wesche Eectric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."
Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y. (welding sets) "Plastic-Arc."

MOTOR-GENERATORS FOR MOTION-PICTURE PROJECTION.—The d-c. arc lamp gives a steadier, more powerful and whiter beam for projecting purposes and is therefore preferred to the a-c. arc in large motion-picture theaters. If the supply is direct current at standard 110 to 120 volts there is much power lost in series resistance because the arc takes less than 60 volts. A d-c. motor-generator set is therefore used in many cases. If there is a-c. supply a motor-generator to change it to direct current is often preferred to a synchronous converter because of its greater simplicity of operation and wide voltage control. The generator voltage is usually 60 volts if the arcs are to be connected singly across the terminals, and 120 volts if two arcs are to be fed in series.

Manufacturers:

Electric Products Co., The, Cleveland, Ohio. "Rexolux."
GENERAL ELECTRIC CO., Schenectady, N. Y. "Compensarc." Two outfits, the generator of each being specially designed and built in four standard sizes, 35, 50, 75 and 100 amps. In the a-c. to d-c. set the motor is a standard G-E induction motor, which can be furnished for any commercial circuit, whether single, 2- or 3-phase. The d-c. to d-c. set, for use where direct current is available, automatically regulates the current so that a strong, steady arc is easily maintained. Described, together with the a-c. to a-c. transformer type "Compensarc," in Booklet 45113. See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTOR, INDUCTION.—"An alternating-current motor, either single-phase or polyphase, comprising independent primary and secondary windings, one of which, usually the secondary, is on a rotating member. The secondary winding receives power from the primary by electromagnetic induction."—(A. I. E. E. Standardization Rules.) A rotating magnetic field is produced in the motor by the currents in its primary windings and this field cuts across the conductors of the secondary. The induced secondary currents react with the rotating field to produce the torque of the motor.

A drop or a difference in speed (called "slip") between the rotating field and the secondary conductors is necessary in order for the field to cut these conductors and thereby induce the secondary currents. Slip increases with load. The power-factor of the induction motor, unless special compensating construction is used, is less than unity due to the relatively large magnetizing current required on account of the air gap in the magnetic circuit. The power-factor is quite low at light load and rises with the load.

Induction motors are designed to operate with single-phase and with polyphase currents. Single-phase motors are very common in fractional-horsepower and other small sizes; while polyphase motors, particularly three-phase, are common in larger sizes. The secondaries of induction motors may consist of a series of bars equally spaced in slots around the circumference of the core and short-circuited at each end by rings of conducting material called the end rings; this is known as the "squirrel-cage" type. Or, in polyphase motors, the secondary may have a polyphase winding similar to that of the primary; this is known as the "wound-rotor" type. Also the secondaries may have a d-c. winding with a commutator and brushes, though this so-called "commutator" type is not common.

The speed of the usual types of induction motors depends mainly on the frequency of the supply, the number of poles and the secondary resistance. Speed control is usually effected by: (1) changing the secondary resistance of the wound-rotor type; (2) changing the number of poles produced by one or two primary windings; (3) by connecting two motors in tandem or cascade. In the last case, the secondary of one motor is connected to the primary of a second motor which is commonly built on the same shaft; the speed is that of one motor having a number of poles equal to the sum of the number of poles of the two motors in tandem; this is called the "concatenated" motor.

Induction motors of the squirrel-cage type are very commonly used where an approximately constant speed is desired and starting is infrequent; they are rugged machines and require very little maintenance. The wound-rotor type is used where adjustable speed and frequent starting is necessary, especially where starting is under considerable load and must be with minimum starting current; they are also used in reversing service, such as in crane, hoist and for heavy steel-mill work. Pole-changing and concatenated motors are not much used.

MOTOR KING.—Trade name for spark plugs manufactured by the Motor Spark Plug Co., 93-107 Lafayette St., Newark, N. J.

MOTOR PLAYER CORP.—Chicago, Ill. Manufacturer of electric motors for piano players. Business established 1920. President, Julius Keller, Sr.; vice-president, Herbert R. Stratford; secretary, Justin W. Macklin; treasurer, Kennett Sturges; general manager, Roland L. Stratford; sales manager, R. S. Hibshman. Main office and factory, 536 Lakeshore Drive, Chicago, Ill. Branch office, 1028 Society for Savings Bldg., Cleveland, Ohio.

MOTOR, POLYPHASE.—An a-c. motor operated by polyphase currents. The number of phases is generally two or three, the latter being the more common. Polyphase motors may be synchronous motors, induction motors or commutator motors with shunt or series characteristics.

MOTOR PRODUCTS CORP.—Detroit, Mich. Manufacturer of soldering coppers. President and general manager, D. B. Lee; vice-presidents, H. H. Seeley, C. F. Jensen; treasurer, R. R. Seeley; secretary, M. L. Brown; sales manager, H. H. Seeley. Main office, Detroit, Mich. Factories, Detroit, Mich., Ann Arbor, Mich., Walkerville, Ont., Can. Branch offices and warehouses, Detroit Copper & Brass Rolling Mills, 111 N. Jefferson St., Chicago; Detroit Brass & Copper Co., 149 Church St., New York. Sales representatives, Robert Knighton, San Francisco, Cal.; Thomas L. Fowler Co., 42 Broadway, New York, N. Y.

MOTOR PROTECTION CO.—17 Illinois St., Central Falls, R. I. Manufacturer of motor enclosing and ventilating equipment. Business established 1917. President, Joseph A. Kennedy; vice-president, G. T. Handle; secretary, W. H. Thornley; treasurer, W. E. Sprackling; general manager, L. F. Arnold.

MOTOR PROTECTOR MFG. CO.—47 Kearney St., San Francisco, Cal. Manufacturer of motor-protective equipment. Business established 1914. President, H. S. Lavenson; vice-president, H. Hauschildt; secretary, L. C. Leet.

MOTOR, REPULSION.—A single-phase a-c. motor in which the torque may be considered as being produced by the repulsion of like magnetic poles. The rotor is like the armature of a d-c. motor. Brushes bearing on the commutator 180 electrical degrees apart are short-circuited and a current induced in the armature by the primary magnetizes the armature along an axis displaced several degrees from the line of magnetization of the primary. The magnetomotive forces of the primary and the secondary are oppositely directed in part, and the poles, which may be considered as being produced on the surfaces of the stator and the rotor adjacent to each other but displaced tangentially, are of like sign and therefore give a force of repulsion.

The power-factor of the simple repulsion motor is rather low except at high speeds. This feature is improved in the compensated repulsion motor in which a second set of brushes placed 90 electrical degrees from the short-circuited set leads the primary current through the armature. Such a motor will take a leading current at speeds above synchronism.

The speed-load characteristic of the repulsion motor is similar to that of the d-c. or a-c. series motor and can be modified by shifting the brushes. This characteristic makes it suitable for a-c. traction purposes where it has been used to a very limited extent.

The repulsion motor characteristic is used in combination with the single-phase induction motor, either for continuous running or for starting only. For manufacturers of this type see Motors, A-c., repulsion-induction.

MOTOR SPARK PLUG CO.—93-107 Lafayette St., Newark, N. J. Manufacturer of spark plugs. President, Frederick Wackenhuth; manager, Theo. F. Schaubacher.

MOTOR SPECIALTIES CO.—Waltham, Mass. Manufacturer of automobile switches, horn push buttons, inspection lamps and other electrial specialties. Business established 1910. President, Grant R. Beebe; treasurer and general manager, F. C. Hersee; sales manager, A. Fraser.

MOTOR STARTERS.—See Starters, motor; Rheostats, motor-starting; Auto-starters, motor.

MOTOR STARTING PANELS.—See Panels, motor starting.

MOTOR SWITCHES.—See Switches, motor; Switches, safety, motor.

MOTOR TENDERS' OILERS.—See Oilers, engineers', dynamo and motor tenders'.

MOTORA.—Trade name for motor for operating player-pianos manufactured by the Piano Motors Corp., 5 S. 3rd St., Camden, N. J.

MOTORBOAT LIGHTING OUTFITS.—See Lighting outfits, automobile and motorboat.

MOTORBOAT STARTING OUTFITS.—See Starting and lighting outfits, automobile and motorboat.

MOTORS.—The selection of the proper motor to employ under service conditions peculiar to any particular installation is determined by several conditions. The characteristics of the motor should be such

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that it is best adapted for the service required. The torque required at starting, the maximum torque, speed control and speed constancy, as well as the character of the energy available, are all important factors in the selection. In many instances, such as isolated power plants, the satisfactory operation of the motor load determines the nature of the energy to be supplied as there are some special services for which only alternating-current or only direct-current motors may be used.

Where a wide range of speed is required and where the speed at any one setting should remain practically constant from no load to full load, d-c. motors are used, as no satisfactory adjustable speed a-c. motor has as yet been marketed for this purpose. The characteristics and application of d-c. motors depend largely on the type of field windings used. Shunt motors used without a starting rheostat will take several times the full-load current at starting and will develop to three times full-load torque. Shunt motors above ½ hp. are usually supplied with starting rheostats which limit the starting current to about two times full-load value. The operating speed of shunt motors is practically constant at all loads. This very desirable characteristic makes them applicable to many conditions unless the starting or overload conditions are too severe.

Compound-wound d-c. motors will develop higher starting and maximum torques than will shunt-wound motors having the same current input, but the operating speed is subject to greater variation. They should be applied where high starting torque is desired and where moderate speed variations with change of load are not objectionable, or where starting is frequent. Series-wound d-c. motors develop higher starting and maximum torque than either the shunt or compound types, but while operating the speed varies considerably with the load, increasing as the load is decreased. Because of this fact they should be used only where they may be geared or directly connected to the load, as the speed becomes dangerously high at very light loads and the motor may race to destruction if entirely disconnected from its load.

Alternating-current motors are now of greater importance than direct-current motors because of the more general use of alternating current in distribution systems. Synchronous motors are strictly constant-speed motors at all loads up to the "pull-out" point or maximum load possible to carry. They operate in synchronism with the line frequency and have no speed change if the frequency remains constant. Ordinarily with motors of this type the starting torque will vary from 20 to 30 per cent of full-load torque. The "pull-in" torque, that is, the torque the motor will develop during the time it is passing from the speed at which it would operate as an induction motor to synchronous speed is about 10 to 15 per cent of full-load torque. Synchronous motors are therefore not adapted to applications where it is required to start and accelerate large loads. Their use is also limited by their requirement of direct-current field excitation.

Induction motors are very widely used for many conditions of service. They are generally classified according to their secondary windings as squirrel-cage or wound-rotor, or according to the number of phases as single-phase or polyphase. Single-phase motors are not generally made in large sizes but are very extensively used in fractional-horsepower sizes for various appliances. Repulsion-induction motors are also used largely for single-phase service where the starting torque required is high and the starting current should be low.

Polyphase induction motors in both the squirrel-cage and wound-rotor type are made in numerous standard sizes from fractions of a horsepower to several hundred horsepower. Both squirrel-cage and wound-rotor motors may be considered as either constant speed or varying speed according to the amount of resistance which is put into the secondary or rotor winding. The drop in speed of an induction motor from no load to full load is known as the "slip." It is proportional to the amount of resistance in the rotor winding. If a motor has a small slip, that is, a low-resistance rotor winding, it is considered a constant-speed motor. The speed and torque characteristics of such motors compare with those of a d-c. shunt motor. If the motor has a high resistance in the rotor winding its slip is comparatively high, and the motor is therefore suited to varying-speed work, such as would be obtained with a heavily compounded or series d-c. motor.

The choice between squirrel-cage and wound-rotor types depends upon the effect of starting conditions on the line or generator and also upon the speed control desired. A low-slip squirrel-cage motor should not be connected to a line where the motor capacity exceeds about 35 per cent of the capacity of the generator supplying power if the starting conditions are severe. This is because a motor of this type develops a lower torque with a higher current and at a lower power-factor than a wound-rotor motor. A wound-rotor motor will start any load not exceeding its maximum torque and will not draw from the line over 1¼ times full-load current, if the proper resistance is inserted between the slip rings. By varying this external resistance the operation of the motor may be governed as desired and the speed-torque characteristics varied by the control equipment.

Motors are not always classified according to the principles of operation or construction, but sometimes according to the special purposes they are to be used for. Accordingly, the motors described and listed below include these uses, such as railway, mill type, crane and hoist, sewing machine, etc.

The importance of motors from the manufacturing and merchandising standpoint is shown by the fact that over $120,000,000 worth of motors were manufactured in 1920, exclusive of fractional-horsepower motors which were made in large numbers but the number and value are difficult to determine because many appliance manufacturers make the motors and include them in the value of the separate appliances. The value of motors manufactured in 1920 in sizes from 1 hp. to 100 hp. is placed at nearly $100,000,000. Of this amount alternating-current motors represent the largest percentage. As early as 1914 the a-c. motors manufactured represented about 60 per cent of the total value of motors and this percentage has been steadily increasing. Recent years have seen many small d-c. generating stations closed down and the use of a-c. motors has increased rapidly. They are more simple to operate as a rule, the squirrel-cage induction motors, which are the most common, requiring only occasional oiling that can be done by almost any one. There are also many cases where the sparking at commutators or slip rings would cause explosion or other serious trouble in gaseous mines, powder mills, etc., and where d-c. or wound-rotor motors can therefore not be used.

MOTORS, A-C., BRUSH-SHIFTING.—These are a-c. commutator type motors with the brush rigging so arranged that the brushes may be shifted around the commutator within certain limits. By shifting the brushes the speed may be varied from 50 to 150 per cent of synchronous speed. The characteristics of this motor are similar to the d-c. series motor, as an increase in load will cause a decrease in speed and vice versa, and are also similar to the slip-ring induction polyphase motor with external resistance in the secondary. In general, brush-shifting a-c. motors are suitable for any application where the slip-ring varying-speed induction motor can be used.

The brush-shifting motor consists of a rotor with commutator and brushes, and a transformer connecting the rotor with the stator. The stator has a distributed winding similar to the ordinary induction motor. The rotor is practically like that of a d-c. motor or generator. The chief function of the rotor transformer is to reduce the voltage impressed on the commutator; it is simply a series transformer with the primary in series with the stator of the motor and the secondary connected to the rotor through the brushes and commutator. These motors are made single phase, two phase and three phase. The starting torque may be made anything within the range of the motor merely by having the brushes in different positions. As soon as the motor begins to rotate the speed can be adjusted to the desired value by shifting the brushes. Shifting the brushes in the direction of the rotation lowers the speed and against the rotation increases the speed.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. Type BTS, three phase, brush shifting motors give an infinite number of speeds and high efficiency at all of them. Developed for 60 cycles from 10 to 100 hp., inclusive. Slow speed, 25-cycle motors can be furnished for 100, 125 and 150 hp. Type BSS. single phase motors are furnished in sizes ¼ to 7½ hp., 60 cycles, for 110 or 220 volts. Suitable for constant torque, belt or chain drive (fans and blowers, printing presses, refrigerators and laundry machinery, etc.). Will permit 50 per cent speed reduction against full load or three-quarters load torque and will start and accelerate loads having two and one-half times full load torque. Suitable control apparatus can be furnished for any service. (Bulletin 61401.) See adv. pages 1203-1223.—Adv.

MOTORS, A-C. FRACTIONAL HORSEPOWER.—Fractional horsepower a-c. motors are those having a continuous rating of less than 1 hp. at a speed of 1700-1750 r.p.m. In many cases the term is taken to mean motors of ¼ or ½ hp. or less, as the larger sizes are often identical in general design with those exceeding 1 hp. The fractional-horsepower machines are usually single-phase induction motors but sometimes single-phase series motors and very rarely polyphase. They are usually provided with some special starting device, such as a commutator which is used with a centrifugal starting switch for starting only. Commutator motors are also made in which the commutator is also used for running, giving both constant and varying speeds. A split-phase auxiliary winding is also largely used for starting. Some of the larger sizes of this type are equipped with a small automatic clutch which permits starting before throwing on heavy loads. Fractional-horsepower motors are widely used for a large number of small household and industrial appliances, such as washing machines, dishwashers, vacuum cleaners, fans, pumps, food choppers, coffee grinders, air compressors, portable drills and grinders, etc.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Advance Electric Co., 6315 Maple Ave., St. Louis, Mo. "Advance."
Air-Way Electric Appliance Corp., Toledo, Ohio.
American Radio & Research Corp., 21 Park Row, New York. "Twin-R."
ARNOLD ELECTRIC CO., Racine, Wis. "Arnold."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bissell Co., The F., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill. Fractional horsepower motors for all purposes.—Adv.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkeley, Cal.
Calumet Motor Co., Calumet, Mich.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. "Crawford" A. C. motors of this type are furnished in capacities of ⅛, ¼ and ½ h. p. (and sizes up to 15 h. p.). The same qualities of construction and operation are maintained as in the type described under Motors, A. C., Induction, Polyphase, Squirrel Cage.—Adv.
Crocker-Wheeler Co., Ampere, N. J.
Dawson, James J., McKeesport, Pa. (for motion-picture machines).
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio, Factory with 150,000 sq. ft. of floor space devoted exclusively to manufacture of "Domestic" fractional horse power motors, sold principally to manufacturers of electrical appliances. They are designed and built especially for the appliances which they are to drive in split phase induction type, plain or compensated series wound motor parts, ranging in sizes up to ½-hp. Domestic sales' engineers are in intimate contact with the daily problems

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of small motor applications under all conditions and specialize in submitting plans to meet individual requirements. See advertisement on page 1310.—Adv.
East Jersey Pipe Co., Paterson, N. J.
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. This Company has studied extensively problems of electric motor application to many small tools and domestic appliances, etc. G-E fractional horsepower motors are available for both alternating and direct current and in sizes as small as 1/200 hp. All embody the quality features of the larger G-E motors. For further information see page 1220.—Adv.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Gillespie." (See display adv. page 1296.)
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.
H-G MFG. CO., 1215 Pine St., St. Louis, Mo., Manufacturer of the H-G split-phase motor. No live parts exposed. Splashproof housing. High starting



H-G Split-Phase Motor.

torque. Low starting current. High efficiency and power-factor. Phosphor-bronze bearings. Large capacity oil wells, wick-filled type. Sizes ¼-hp. and 1/6 hp. for 110-volt and 220-volt single-phase operation.—Adv.
HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices, motor-generators and dynamos; also of hospital, fire alarm, factory call, school, bank and other signaling systems. Type "AS" universal motor made in sizes 1/20 to 1/30 h.p. Type "QS" in sizes from 1/20 to 1/6 hp. The mechanical parts of this type are interchangeable with type "QD" d-c. motors. They are suitable for coin sorters and counters, letter sealers and openers, addressing machines, light calculating machines, etc. Type "HS" motors, mechanically interchangeable with type "HD" d-c. motors are made in sizes from ⅛ to ⅓ h.p. for use in blue-printing machines, bottling machines, floor surfacing machines, etc. Type "HRI" motors for use as an integral part of pumps, compressors, coffee grinders, meat choppers, packaging machinery, etc., are made in sizes from ⅛ to 1 h.p. Mechanically interchangeable with "HD" d-c. motors. Engineers of the Holtzer-Cabot Electric Co. are always ready to work hand in hand with the designer of a new device or any manufacturer who is changing or improving the design of his present product, to the end that a fractional horsepower motor to fit exactly the requirements may be built.—Adv.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y.
Kendrick & Davis Co., Lebanon, N. H. "K. & D."
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Co., Port Chester, N. Y.
Lincoln Electric Co., The, E. 38th St. & Kelley Ave., Cleveland, Ohio.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marathon Electric Mfg. Co., Wausau, Wis. "O. K."
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
OHIO ELECTRIC & CONTROLLER CO., Cleveland, Ohio. Ohio ball-bearing, splash-proof motors will run safely even after lubricant has disappeared. The fan is thirteen-bladed sirocco type and cooling is scientifically correct so they will carry heavy overload without excessive heating. Cut out switch has only nine simple strong parts. They are best for use where they will get little or no care or attention.—Adv.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., Quincy, Ill. Interchangeability of Persons a-c. and d-c. fractional horsepower motors, is a feature of great advantage, especially to washing machine manufacturers. These motors are made in two principal types having frames of similar dimensions. This feature of convertibility applies to the type G-I a-c. and the type G-D d-c. motors of the same speeds and ratings. It is possible to interchange these motors on any machine without altering the supporting base, pulley, belt, gears or other parts in any way, fitting them for operation on different circuits. The frame and bearing brackets are cast from best grade gray iron, which provide ample



Persons Motor

protection and exceptionally good ventilation. Enclosing plates can be furnished where motors are exposed to moisture and dirt. These plates are of various types, including the splash proof type for washing machines. A dual advantage is gained in the special design of the oiling arrangement. It permits the motors to be mounted in any position, floor, wall or ceiling, and eliminates special drilling for the oil cups. Persons motors are equipped with a universal terminal block, consisting of a fibre block with two binding posts. This block is mounted on the motor with the binding posts extending inside the frame when enclosed terminal is desired, or extending out when exposed type of terminal is required. High grade bronze sleeve bearings are usually furnished, but ball bearings can be supplied when required. The high efficiency of Persons motors makes them exceptionally economical in operation on lighting circuits. All motors are built with heavy insulating material. The windings are carried in cells formed from material which combines high insulating qualities with the least dead space. They are placed in slots and bound into place with tape which also holds the terminal connections. The windings are impregnated with an insulating compound and thoroughly baked. This treatment is repeated several times, making the winding impervious to moisture, giving high di-electric strength and eliminating any possible danger from shock. Persons motors are quiet and free from vibration due to dynamic balancing of the rotor. Ample provision for ventilation by numerous ducts through the motor and frame insures low operation temperature. These motors are put through a series of tests during the process of winding, baking and assembling, and are carefully inspected, to meet the tests of the American Institute of Electrical Engineers standards. The Type G-I 60 cycle, single phase motors range from 1/7 to ½ hp. with speeds of 1140 to 3450 r. p. m. The 50 cycle are of ⅛ to ½ hp. with 1430 and 2860 r. p. m. The 40 cycle, 1/7 to ⅛ hp. with speeds of 1140 and 2300 r. p. m.; 30 cycle ⅛ to ⅓ hp. at 1720 r. p. m.; and the 25 cycle, from 1/7 to ¼ hp. at 1430. Persons motors can be supplied either open, enclosed, or semi-enclosed as desired, and are regularly furnished with groove pulleys.—Adv.
Phonograph Motors Corp., 341 N. Crawford Ave., Chicago, Ill. "Johnson."
Premier Emergency Corp., 767 3rd Ave., New York, N. Y. "Premier."
Racine Electric Co., Bridge & Ontario St., Racine, Wis.
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Shedd Electric Co., Inc., Clay & Locust Aves., Roselle Park, N. J. (special).
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)
Sieffert Electric Co., 210 Main St., Evansville, Ind. "Sieco."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
SUNLIGHT ELECTRICAL MANUFACTURING CO., THE, Warren, Ohio. Specializes in fractional-hp., a-c. motors, primarily designed for use with washing machines, mangles, moving picture machines, iceless refrigerators, pumps, churns, and wherever a well-ventilated, waterproof motor is needed. All insulation used on them is carefully im-



"Sunlight" Fractional h. p. A-C. Motor

pregnated. (General details of construction are shown in above illustration.) "Sunlight" motors are characterized by their high starting torque and overload running capacity. They are made in various cycles and voltages to meet the requirements of purchasers. The company confines its entire attention to this one line, with consequent reductions in costs and improvement in the quality of its product. Sunlight motors are mechanically and electrically efficient, powerful, dependable.—Adv.
Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.

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Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Warner Electric Co., Kalamazoo, Mich. "Kazoo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."
WISCONSIN ELECTRIC CO., Racine, Wis. This company is the manufacturer of the widely advertised "Dumore" line of fractional hp. motors. Regular stock sizes range from 1/25 to 1/8 hp. The company maintains a large research and experimental department for co-operating with responsible manufacturers in solving special power problems. See entry under Motors, universal, a-c. and d-c. and display adv. page 1311.—Adv.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

MOTORS, A-C. INDUCTION, POLYPHASE. SQUIRREL-CAGE. — Squirrel-cage induction motors are those in which the secondary or rotor consists of a series of bars equally spaced in slots around the core and short-circuited at each end by rings of conducting material. (See Motor, induction.) Squirrel-cage motors are used much more than any other type of induction motor, nearly 90% of all induction motors made in this country being of this type. They are very extensively used in all branches of industry where a-c. energy is utilized, and where adjustable speed is not required. With such wide applications they are made in an exceedingly large range of sizes, ranging up to 10,000 hp.; ratings up to 200 hp. are standard and above that special. Some of the common usages are for nearly all forms of group or individual motor-driven machine tools, such as lathes, drills, boring machines, bulldozers, milling machines, grinders, planers, saws, shapers, etc.; where such machines require adjustable speed, cone or step pulleys, or change-speed gears are used. These motors are also used in steel mills, cement mills, mines, power plants, etc., wherever a-c. power is used.

The advantages that have made their application so extensive are: simple and very rugged construction giving a low first cost and long life, fairly constant speed at all loads, moderate starting torque, ease of starting without any starting equipment for small sizes and simple starting equipment even for quite large sizes. The absence of any brushes, commutator, slip rings or other exposed contacts makes these motors especially serviceable in places where inflammable materials might become ignited by sparking.

Small squirrel-cage motors may be switched directly on the line at starting without drawing an excessive current. In motors of 5 hp. or over the starting current becomes too large if started at full voltage and some means of starting is required. In such cases autostarters or compensators, which reduce the voltage during the starting period, are widely used or the star-delta method employed. By specially designing the motor to give the "deep slot" effect, larger motors may be started directly from the line with a more moderate rush of current. In obtaining this result, very deep rotor slots and bars are used; this construction gives a high apparent resistance and low reactance at starting and the reverse near synchronism.

Manufacturers:

Advance Electric Co., 6315 Maple Ave., St. Louis, Mo. "Advance."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Electric Motors, Inc., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W. Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., Louis, Mo. (Split-phase.) "Invincible"
Clark, Jr., Electric Co., Inc., James W. Main St., Louisville, Ky. "W"
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio. "C A. W."
Cleveland Electric Motor Co., 5213 Winsor Ave., Cleveland, Ohio. "Cleveland."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can. "King Edward."
CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. "Crawford" induction motors have certain operating features worthy of notice. They are guaranteed to carry their full rated load with a temperature rise not to exceed 40 degrees C above room temperature. Or they are capable of standing 25% overload for two hours or a momentary overload of 100%. All are subjected to rigid tests, such as breakdown tests of 1500 volts, temperature, efficiency and power-factor tests. The squirrel cage type here illustrated has a frame of the best gray iron, carefully machined and all parts interchangeable. The bearings are of "Non-Gran" bearing bronze, oiled by concentric rings from wells of ample capacity, protected by dust proof caps. The stator is made up of high grade laminae, compacted under pressure. Primary coils in semi-closed slots, held with one piece insulating wedge, insulated and protected with moisture and acid proof varnish. The rotor is of the squirrel cage type, the copper is forced directly through the iron without insulation, and end rings are cast-on, of high-conductivity bronze, fusing the copper bars into a unit electrically perfect. The shaft is of special axle steel. These motors are equipped with sliding base and pulley when so ordered.—Adv.



Crawford Motor, Squirrel Cage Type

Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Forbes & Myers, 172 Union St., Worcester, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type KT Motors with riveted or skeleton frames range in size ¼ to 750 hp., standard voltages. Adaptable for driving all machines requiring constant speed. (Bulletins 41302-A and 61505-B.) Type KT multi-speed induction motors for 60-cycle, 3-phase service only, on 220, 440 and 550 volts may be furnished up to 12 hp. at four constant speeds—1800, 1200, 900, 600 r. p. m. Constant horsepower motors are suitable for machine tools, etc., and constant torque motors for operating fans, blowers, printing presses, etc., Squirrel-cage type motors with closed box frame construction are specially adapted for centrifugal pump service where moisture is often present and in cases of mine service, where water often drips on the motor. Special moisture resisting insulation is used. (Bulletin 61301.) Special high-speed motors constructed with cast alloy rotors are made for operation as high as 25,000 r. p. m., taking power from special induction frequency changers. Successful application of these motors has been made to woodworking machines; as, shapers, saws, tenonors, and drills; all applications being direct. See adv. pages 1203-1223.—Adv.
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Gillespie." (See display adv. page 1296.)
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Hall Switch & Signal Co., Garwood, N. J.
Hobart Bros. Co., 113 Water St., Troy, Ohio.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
HOWELL ELECTRIC MOTORS CO., Howell, Mich. "Red Band."
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Imperial Electric Co., The, Akron, Ohio. "Imperial."
International Electric Co., Ltd., 97 Bleury St., Montreal, Que., Can.
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Lincoln Electric Co., The, E. 38th St. & Kelley Ave., Cleveland, Ohio.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marchand Electrical Works, Ltd., 55 Cote St., Montreal, Que., Can. "Gold Band."
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Norfolk Electric Mfg. Co., 215 Cumberland St., Norfolk, Va. "Norfolk."
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
OHIO ELECTRIC & CONTROLLER CO., THE, 5900 Maurice Ave., Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., 560 Jersey St., Quincy, Ill.
Phoenix Electric Co., Mansfield, Ohio. "Phoenix."
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
Sieffert Electric Co., 210 Main St., Evansville, Ind. "Sieco."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Star Dynamo Co., Jefferson City, Mo. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."
Woods Machine Co., S. A., 27 Damrell St., Boston, Mass.

MOTORS, A-C. INDUCTION, POLYPHASE WOUND-ROTOR OR SLIP-RING. —Wound-rotor induction motors are those in which the secondary or rotor part has a polyphase winding similar to that of the primary. See Motor, induction. Wound-rotor or slip-ring motors are used in places where speed variation is required. Speed variation may be obtained with squirrel-cage motors but the motor must be of very special design which makes it expensive, consequently such motors are practically always constant-speed. With a slip-ring motor the rotor phase windings are brought out to slip rings, and variable external resistances may be connected between these. By properly proportioning the rotor-circuit resistance, the starting torque and starting current may be adjusted to any required value, and by a proper selection of resistance steps any speed-torque curve may be approximated in normal operation.

Motors having wound rotors are used for many of the same purposes as squirrel-cage motors, but give the advantage of directly adjustable speed without mechanical belt or gear shifting. Their applica-

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tion to industry for driving machine tools is generally to larger and heavier machines, such as forging machines, bulldozers, hammers, punching machines, bending and straightening rolls, shears, large pumps, blowers, compressors, etc. They are also used very widely for elevators, hoists, cranes, etc., and to a large extent in steel, flour and paper mills.

Manufacturers:

Advance Electric Co., 6315 Maple Ave., St. Louis, Mo. "Advance."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St. W. Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Clark, Jr., Electric Co., Ine., James, 520 W. Main St., Louisville, Ky. "Willey."
Cleveland Electric Motor Co., 5213 Windsor Ave., Cleveland, Ohio. "Cleveland."
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type MT motors for general service requiring frequent starting under load or starting of loads with high inertia. They possess high starting torque, using a comparatively small amount of current from the line. Standard ratings up to 200 hp. for 25 and 60 cycles. Special ratings up to 6000 hp. Also high speed types in sizes from 75 to 350 hp. for direct connection. Suitable control equipment for any service can be supplied. See adv. pages 1203-1223.—Adv.
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Gillespie." (See display adv. page 1296.)
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
HOWELL ELECTRIC MOTORS CO., Howell, Mich. "Red Band."
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Imperial Electric Co., The, Akron, Ohio. "Imperial."
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marchand Electrical Works, Ltd., 55 Cote St., Montreal, Que., Can. "Gold Band."
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
NORTHWESTERN ELECTRIC CO., 408 S. Hoyne St., Chicago, Ill.
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Warner Electric Co., Kalamazoo, Mich. "Kazoo."
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, A-C. INDUCTION, SINGLE-PHASE.—Induction motors operating from a single-phase supply. Such motors usually have squirrel-cage rotors, though wound rotors are used to a limited extent. A rotating magnetic field is produced, under running conditions, in the single-phase induction motor by the combined action of one magnetizing current in the primary and another in the secondary which is approximately in time and space quadrature with that of the primary. This rotating field produces the torque of the motor as in the polyphase induction motor.

The starting torque of a single-phase induction motor is zero, for then there is no rotating magnetic field, unless the motor is supplied with a starting device. The most common method of starting is that called the split-phase, which makes use of a starting winding connected in parallel and on the same structure with the main primary winding but dispaced from it so as to give a magnetomotive force approximately in space quadrature with that of the primary. The difference in phase between the two currents gives sufficient starting torque for most uses. The starting winding is automatically disconnected as the speed approaches normal value. The repulsion-start method is employed in some motors, making use of the principles of a repulsion motor in which short-circuited brushes bear on a rotor wound like a d-c. armature. The brushes are lifted and the coils automatically short-circuited as the speed approaches normal.

Single-phase induction motors are very common in the fractional-horsepower and other small and medium sizes and are used to drive a large variety of machinery at approximately constant speed. Fractional-hp. motors are separately listed. The larger ratings of these motors are made in standard sizes of ¾ hp. to 50 hp. for 60 cycles and 1 to 20 hp. for 25 cycles. For ratings exceeding these it is preferable to use the polyphase induction motor. Central-station companies place a much lower limit on the maximum rating of these motors that may be connected to their lines, in order to prevent serious unbalancing of the phases.

Manufacturers:

Advance Electric Co., 6315 Maple Ave., St. Louis, Mo. "Advance."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Bushnell Mfg. Co., 2926 Telegraph Ave., Berkley, Cal.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Crocker-Wheeler Co., Ampere, N. J.
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. See entry under Motors, universal, a-c & d-c. Also see display advertisement on page 1310.—Adv.
East Jersey Pipe Co., Paterson, N. J.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type RI repulsion induction motors up to 15 hp. Also commutator type for brush-shift control up to 7½ hp. and others in fractional horsepower sizes. See adv. pages 1203-1223.—Adv.
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Gillespie." (See display adv. page 1296.)
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., THE., 125 Amory St., Boston, Mass.
International X-Ray Corp., 326 Broadway, New York, N. Y.
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Liberty Electric Corp., Port Chester, N. Y.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
NORTHWESTERN ELECTRIC CO., 408 S. Hoyne Ave., Chicago, Ill. The motor illustrated is designed for variable speed to operate printing press and other machines with constant torque load on single-phase a-c. lines. The



Single Phase Motor

push button feature is favorably spoken of as a time saver. Descriptive booklet will be sent on application to any prospective user.—Adv.
OHIO ELECTRIC & CONTROLLER CO., THE, 5900 Maurice Ave., Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill.
Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St. New York, N. Y. (See display adv. pages 1306-1307.)
Star Dynamo Co., Jefferson City, Mo. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
Tideman Electric Mfg. Co., Cairo, Ill., "Menominee."
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Warner Electric Co., Kalamazoo, Mich. "Kazoo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTORS, A-C. MISCELLANEOUS.—There are many types of a-c. motors manufactured that are not used quite as extensively as those specially listed herewith. The characteristics and principal features of some of these miscellaneous types are described under Motor, repulsion; Motor, a-c. series; Motor, a-c. commutator; etc. The principal features of the other motors included under this heading are the methods used for speed control. One type is the spinner motor which by a combination of electrical and mechanical features gives several speeds. It consists of a stator or fixed primary, a rotor, and between them a spinner rotating independently of the rotor and having a short-circuited winding, which is the secondary for the stator, and a slip-ring winding, which is the primary for the rotor. The spinner may be clutched to the rotor or to the stator or allowed to rotate freely. The Deri single-phase motor giving speed control by brush shifting is another motor of this type. Still another single-phase type secures speed adjustment by an external vibratory contact device that changes the average time per cycle that the voltage is impressed.

Induction motors with commutators are also used to a limited extent, as they may be arranged to have characteristics similar to the adjustable-speed d-c. shunt motor. This is accomplished in a single-phase induction motor by having a rotor similar to the armature of a d-c. machine, on which two short-circuited sets of brushes bear, that are displaced from each other by 90 electrical degrees. One set gives a magnetic axis through the rotor in line with that of the stator. The object of using the commutator rotor is to provide a means for controlling the power-factor or

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the speed by introducing e.m.f.'s into one or the other of the brush circuits. A polyphase motor may also be arranged in a similar manner so that its speed can be adjusted either by shifting brushes or introducing auxiliary voltages between the brushes. This kind of motor is designed to do from an a-c. source of supply, what the d-c. adjustable-speed motor does. It is more expensive and has a limited application.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. "Crawford" Motors of this type possess the same qualities of construction and operation as in the type described under Motors, A. C., Induction, Polyphase, Squirrel Cage.—Adv.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. There is a G-E motor for almost every class of service, however special. With experience in building electric motors from fractional horsepower to several thousand hp. sizes, the General Electric Company is in a position to co-operate in supplying motors for particular applications, either industrial or domestic. Examples of this service are portrayed on pages 1212 to 1217.—Adv.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
ROBBINS & MYERS CO., THE, Springfield, Ohio. Robbins & Myers single and polyphase motors are made for all services in sizes ranging from 1/30 to 50-hp. inclusive. In addition to the



R. & M. A-C. Motor

standard types for general power service, special frames and windings are made on quantity orders for direct application to motor equipped appliances and machines of all classes.—Adv.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. page 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston Mass.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, A-C. REPULSION-INDUCTION.—A single-phase a-c. motor combining the characteristics of the repulsion motor with those of the single-phase induction motor. The rotor is wound and provided with a commutator like that of a d-c. machine or a repulsion motor. Two sets of short-circuited brushes make contact on the commutator 90 electrical degrees from each other, one set giving a magnetic axis through the rotor displaced several degrees from the magnetic axis of the stator, as in the repulsion motor. The second set of short-circuited brushes combine with the first to form with the rotor winding the secondary of a single-phase induction motor. The repulsion-start principle is used with many induction single-phase motors, but since these are induction motors while running, they are listed under Motors, a-c. induction, single-phase.

The speed-load characteristic of the repulsion-induction motor is similar to that of a cumulative compound d-c. motor, showing the series characteristic of the repulsion motor combined with the shunt characteristic of the single-phase induction motor. It may be designed to have its speed adjusted by shifting the brushes. Repulsion-induction motors are used for a number of purposes, such as blowers, rotary compressors and pumps, etc.

Manufacturers:

Advance Electric Co., 6315 Maple Ave., St. Louis, Mo. "Advance."
Baldor Electric Co., 4351-55 Duncan Ave., St. Louis, Mo.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghonse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1287 Pine St., St. Louis, Mo. "Century."
Dilg Mfg. & Trading Co., The, 27 E. 125th St., New York, N. Y. "Acme."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type RI, a constant speed, single-phase motor in sizes ¼ to 15 hp., 25, 40 or 60 cycles, voltages interchangeable for 110 or 220-volt circuit. Particularly adapted for starting at full load and will start and accelerate loads having two and one-half times full load torque. Reversible type, made up to 5 hp., especially useful for elevators, small cranes and hoists, laundry machinery, etc. Standard RI non-reversing motors may be made reversible with reduced rating by simply adding 4 leads and re-setting brush yoke. (Bulletins 61200-A and 61508.) See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Jeannin Electric Co., The, 110 11th St., Toledo, Ohio. "Jeannin."
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Union Electric Motor & Mfg. Co., Randolph & Montgomery Ave., Philadelphia, Pa. "Union."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTORS, A-C. SYNCHRONOUS.—Synchronous motors consist of a field structure and an armature practically identical with those of a synchronous generator. Any synchronous generator may operate as a motor and, vice versa, any synchronous motor may operate as a generator. Machines designed to operate as synchronous motors usually have heavier damping windings and greater synchronous reactance than corresponding machines designed to operate as alternators. The average speed of synchronous motors is dependent only on the number of poles and the frequency of the supply. Momentary changes of speed occur with changes in load, in applied voltage, or in excitation; and pulsations of speed, or hunting, may follow these changes or the pulsations in the frequency of the supply, but amortisseur or damping windings usually effectively reduce hunting to a negligible value. In general the synchronous motor gives the greatest constancy of speed of any type of electric motor.

The starting torque of a synchronous motor, as such, is zero. It may be brought up to synchronous speed by mechanically driving it from some outside source, or, in the polyphase motor, starting it as an induction motor, the amortisseur or damping winding serving as the secondary of an induction motor.

The power-factor of the synchronous motor depends upon its excitation and the mechanical load. It usually takes a lagging current when the excitation is such that the counter e.m.f. is less than the applied voltage and a leading current when it is greater. Easy adjustment of the excitation permits securing unity or leading power-factor. The excitation is provided, like that of alternators, from some d-c. source. Often this is a small d-c. generator built on an extension of the shaft of the motor, or sometimes it is belted to the shaft.

Synchronous motors are naturally adapted to uses where very constant speed and high or adjustable power-factor are desired with infrequent starting at low or moderate starting torque. Such conditions exist with many motor-generator sets, of which frequency converters are a typical class, also with refrigerating machines, compressors, pumps, etc.

The ability of the synchronous motor to take leading or lagging current according to its excitation enables it to be used for power-factor correction and voltage control. It can perform this service either with or without carrying a mechanical load. If it carries no load, it is called a synchronous condenser. (See Condensers, synchronous.) The ability to raise the power-factor while carrying load makes these motors favored by central-station companies who in some cases give preferential rates to power users employing them.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Eelectric Works, 3055 Lincoln Ave., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E synchronous motors covering a wide range of speeds and capacities are in extensive use throughout many industries driving rolls, compressors, pumps, grinders, crushers, blowers, fans, conveyors, etc. While the synchronous motor may be applied to most any industrial service, its greatest value is obtained when used on circuits with a need for power factor correction. It is also particularly desirable where dirty operating conditions make a motor with a small air gap inadvisable. See adv. pages 1203-1223.)—Adv.
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Gillespie." (See display adv. page 1296.)
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

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Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
NORTHWESTERN ELECTRIC CO., 408 S. Hoyne St., Chicago, Ill.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. See display adv. pages 1395-1402.)

MOTORS, BATTERY AND TOY.—Fractional-horsepower motors usually of the series type, that may operate from a small battery or from the low-voltage secondary of a transformer. Besides being used as toys and for toys, such as miniature railways, they are applied to small revolving signs, window displays, fans, slot machines, etc. They generally operate on 4 to 6 volts.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Thermostat Co., 226 Jelliff Ave., Newark, N. J. "Marvel."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Kendrick & Davis Co., Lebanon, N. H. "K. & D."
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y. "Baby Grand," "Little Hustler."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Gem."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
Voltamp Electric Mfg. Co., 407-409 N. Paca St., Baltimore, Md. "Voltamp."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich. "Wilgo."

MOTORS, BUFFING, FAN, GRINDING.—See Buffers, Fans, Grinders.

MOTORS, CRANE AND HOIST.—Motors of the series or compound type when operating on direct current, and generally of the wound-rotor type of polyphase induction motors when operating on alternating current, though the a-c. series type is also used at times. Of these types the series wound d-c. motor is best adapted for crane and hoist service and is probably the most common. It has a tendency to slow down under heavy loads and with light loads the speed increases, which is usually desirable. Compound wound d-c. motors are sometimes used with hoists to simplify the control if dynamic braking is required. When direct current is not available and it is not feasible to install a converter or a motor-generator, a-c. wound-rotor motors designed for heavy momentary overload capacity are generally used. As low-speed induction motors are not satisfactory, the motors are usually connected to the drum through single-reduction gearing. D-c. machines in large sizes can be built for such low speeds as 60 to 75 r.p.m. and are sometimes directly connected to the drum. In general, however, it is desirable to use a moderate-speed motor and connect to the drum through helical reduction gearing.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Electric Motor Co., 5213 Windsor Ave., Cleveland, Ohio. "Cleveland."
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type CO 1800 d-c. motors, designed for intermittent service requiring a maximum torque motor of ample overload capacity. Suitable for floor, wall or ceiling mounting. Furnished with or without back gear. To facilitate inspection or repair, top half of frame can be lifted off without disturbing back gearing, and shaft can be removed without disturbing windings or commutator. Sizes range from 2 hp. to 100 hp., 115, 230, and 550 volts. Electric brakes of half or full torque capacity can be supplied to insure a quick, sure stop. (Bulletin 68100-A.) Suitable control apparatus can be furnished. Types ITC and MTC a-c. motors, made for quarter-phase and 3-phase, give high starting torque and have low flywheel effect, and are well suited, therefore, to crane and hoist work. For such service they range in capacities from 1 to 450 hp. With construction extremely simple, they readily withstand hard usage. Regularly furnished with open frames and taper shafts on each end for gear and solenoid brake. Suitable control can also be furnished. (Bulletin 48119-1.) See adv. pages 1203-1223.—Adv.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTORS, D-C. COMPOUND.—Direct-current motors having both shunt and series field windings. The series winding may be connected so as to oppose the shunt, giving the differential compound motor, in which case the speed may be more nearly constant than it is with a shunt motor; see Motors, d-c. constant-speed. More commonly the series winding acts in the same direction as the shunt around the magnetic circuit, giving cumulative compounding. Cumulative compound motors decrease in speed as the load increases and their torque increases somewhat more rapidly than the armature current, depending in part upon the degree of compounding. They combine the characteristics of series and shunt motors. Cumulative compound motors are used where a large starting torque is required, a variable speed is desired, or at least is not objectionable, and a safe light-load speed is necessary. Such motors are very largely used for elevators and heavy machinery drive of all kinds. They are used extensively for nearly all kinds of mining machinery in mines supplied with direct current and are also applied to some types of variable-speed fans and blowers. Compound motors are sometimes made in small sizes but, being used mostly for industrial work where the load is heavy, most of them are large machines. They have a large starting torque and the speed does not drop off as much as with a series motor when the load is increased. If the load is entirely thrown off the speed does not reach a dangerous value, as may be the case with a d-c. series motor.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Ace."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse, Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont. Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type RC. For description see "Motors, D-C., Constant Speed." See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J.
National Screw & Tack Co., The, A B Products Division, Cleveland, Ohio.
Olson-Boettger Electric Mfg. Co., 413 N. Franklin St., St. Paul, Minn.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
ROBBINS & MYERS CO., THE, Lagonda Ave., & Leah St., Springfield, Ohio. "R & M."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Type R T form D, ¼ to 5 H. P. is popular within its range. Full line of Compound wound motors. Sprague products, see display adv., pages 1306-7.—Adv.
Star Dynamo Co., Jefferson City, Mo. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo Ill. "Menominee."
Triumph Electric Co., 3058 South St., Cincinnati, Ohio. "Triumph."
Wald Electric Mfg. Corp., 248-56 N. Tenth St., Brooklyn, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, D-C. CONSTANT-SPEED.—The d-c. shunt motor gives a nearly constant speed throughout its range of load. For most purposes a drop of 2% from no load to full load is permissible, so that the shunt motor serves adequately. In special cases, however, a greater constancy is required. Where the speed must be maintained within less than 1% a differentially compounded d-c. motor is used. By special design and careful selection of the degree of compounding the speed may be kept within a fraction of 1% regardless of load. Also see Motors, d-c. compound.

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Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. The Type RC motor may be classed as the universal d-c. motor. Furnished for constant speed, shunt wound for conditions requiring close speed regulation, compound wound for conditions demanding heavy starting torque or where violent power fluctuations occur, series wound where load either possesses fixed values or may be made subject to automatic or manual control. All these motors are shipped for floor installation but are readily arranged for wall or ceiling suspension. Other structural details are in general uniform throughout the range of sizes from ½ to 200 hp. Suitable control apparatus can be supplied for any service where the motor is applicable. (Bulletins 41013-A and 61014.) See adv. pages 1203-1223.—Adv.

MOTORS, D-C. FRACTIONAL-HORSEPOWER.—Fractional-horsepower motors are defined as those which have a continuous rating less than 1hp. at 1700 to 1750 r.p.m. Many manufacturers, however, are inclined to call ¼ or ⅓ hp. the upper limit for fractional-hp. motors, as motors over that size are often identical in design principles and general proportions to the larger motors. These small motors are generally wound for the standard voltages 32, 115 and 230. For ½ and ¾-hp. motors both shunt and compound windings are standard. Compound windings only are standard for ¼, ⅓ and ⅛ hp., while shunt windings are used for 1/12 and 1/20 hp. Fractional-hp. motors are used for driving a large variety of small appliances, such as portable drills and grinders, office appliances, fans, dental engines, washing machines, vacuum cleaners, etc.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St. U. B. Bldg., Dayton, Ohio. "Ace."
Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Air-Way Electric Appliance Corp., Toledo, Ohio.
AMERICAN ELECTRIC CUTTING MACHINE CO., 149-151 Lafayette St., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill. Fractional horsepower d-c. motors for all purposes.—Adv.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Armature Works, 417 S. Racine Ave., Chicago, Ill.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Crocker-Wheeler Co., Ampere, N. J.
Dawson, James J., McKeesport, Pa. (for motion-picture machines.)
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Dilg Mfg. & Trading Co., The, 27 E. 125th St., New York, N. Y. "Acme."
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. "Domestic" electric motors, ranging in size up to ½ hp., sold principally to manufacturers of electrical appliances. See entry under Motors, universal, a-c. & d-c. Also see display advertisement on page 1310.—Adv.
East Jersey Pipe Co., Paterson, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. This company has studied extensively problems of electric motor application to many small tools and domestic appliances, etc. G-E fractional-horsepower motors are available for both alternating and direct current in sizes as small as 1/200 hp. All embody the quality features of the larger G-E motors. For further information see page 1220.—Adv.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.
HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices, motor-generators and dynamos; also of hospital, fire alarm, factory call, school, bank and other signaling systems. Type "QD" motor is made in sizes from 1/20 to 1/6 h.p. These are mechanically interchangeable with type "QS" a-c. motors. They are suitable for addressing machines, coin sorters and counters, letter sealers, etc. Type "HD" motors are made in sizes from ⅛ to one h.p., mechanically interchangeable with types "HS" and "HRI" a-c. fractional h.p. motors. They are used on blue-printing machines, bottling machines, wire stickers, labeling machines, pumps, compressors, refrigerators, packaging machinery. See also advertisement under Motors, a-c. fractional horsepower.—Adv.
International X-Ray Corp., 326 Broadway, New York, N. Y.
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y.
Kendrick & Davis Co., Lebanon, N. H. "K. & D."
Kimble Electric Co., 634-46 N. Western Ave., Chicago, Ill. "Kimble."
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marathon Electric Mfg. Co., Wausau, Wis. "O. K."
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
Munning & Co., A. P., Church St., Matawan, N. J.
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
OHIO ELECTRIC & CONTROLLER CO., THE, 5900 Maurice Ave., Cleveland, Ohio.
Olson-Boettger Electric Mfg. Co., 413 N. Franklin St., St. Paul, Minn.
Osann Co., Frederick, 245 7th Ave., New York, N. Y.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., Quincy, Ill. Persons Type G-D. d-c. motors are interchangeable, and can be easily converted for a-c. use if desired, without altering the supporting base, pulley, belt, gears or other parts in any way. These motors are direct current compound wound. They can be furnished in the following sizes: ⅛ to ⅓ hp., 3450 r. p. m.; ⅛ to ⅓ hp., 1720 r. p. m.; and 1/12 to ¼ hp., 1150 r. p. m.; for 32, 110 or 220-v. service. See also this company's entry under Motors, A-C., fractional horsepower.—Adv.
Premier Emergency Corp., 767 3rd Ave., New York, N. Y. "Premier."
Racine Electric Co., Bridge & Ontario St., Racine, Wis.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Shedd Electric Co., Inc., Clay & Locust Aves., Roselle Park, N. J. (special)
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague small power D. C. motors are furnished in sizes from 1/50 H. P. up. They are furnished with any type of winding. The Type RT or round type shown in the first illustration is a favorite for many kinds of work. The one shown, while of 2 H. P. capacity is furnished in fractional sizes. Another, the R. T. form D, shown in the second illustration, is back geared, shunt or compound wound. This is of simple design and rugged construction, arranged for ceiling or side wall suspension. Standard gear ratios 6-1, 5-1, and 4-1. Motor is enclosed, with doors allowing access to commutator. Sizes ¼ to 5 H. P., 115-230 volts. Sprague products, see display adv. pages 1306-7.—Adv.



Type RT



Sprague Motor, Type R. T., Form D

Star Electric Motor Co., Miller St. & N. J. R. R. Ave., Newark, N. J. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass
Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."
Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
Wald Electric Mfg. Corp., 248-56 N. 10th St., Brooklyn, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WISCONSIN ELECTRIC CO., Racine, Wis. This company is the manufacturer of the widely advertised "Dumore" line of fractional hp. motors. Regular stock sizes range from 1/25 to 1/8 hp. The company maintains a large research and experimental department for co-operating with responsible manufacturers in solving special power problems. See entry under Motors, universal, a-c. and d-c. and display adv. page 1311.—Adv.

MOTORS, D-C. SERIES.—Direct-current motors in which the field winding and the armature winding are electrically in series. The field current and the armature current being the same, the field is strong at heavy loads and weak at light loads with corresponding slow and high speeds. The speed is usually controlled by adjusting resistance in series with the motor. The speed-load characteristic with a very large starting torque makes this type of motor especially suitable for traction work where it is very extensively used for both light and heavy cars and locomotives. It is also used for cranes, hoists, freight elevators, rolling mills, cement mills, mining machinery, propeller type fans and blowers and many other similar applications. A series motor may race to destruction if entirely disconnected from a load, and for this reason is generally geared or rigidly connected to its load. If a belt drive were used the belt might break or come off and the motor would race.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

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Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. "Domestic" electric motors. See entry under Motors, universal, a-c. & d-c. Also see display advertisement on page 1310.—Adv.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hall Switch & Signal Co., Garwood, N. J.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Kurz & Root, Appleton, Wis.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill. "Peco."
Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill. "Racine."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y. "Rochester."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Complete line of Series motors. Sprague products, see display adv., pages 1306-7.—Adv.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
Triumph Electric Co., 3058 South St., Cincinnati, Ohio. "Triumph."
Wald Electric Mfg. Corp., 248-56 N. 10th St., Brooklyn, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, D-C. SHUNT.—Direct-current motors in which the field winding is in shunt with the armature circuit. With constant applied voltage, the speed of a shunt motor is nearly constant for all loads. The torque is approximately proportional to the armature current. Shunt motors are often designed and built for adjustable-speed operation. The speed is most commonly adjusted by changing the field current by means of the field rheostat, the speed increasing as the field current is decreased. Shunt motors have a very extensive application where d-c. power is available for driving a large variety of machines at constant or adjusted speeds, as may be desired. They are used widely in machine shops and industrial plants in general for driving nearly all kinds of machine tools, except such as require very large starting torque and are frequently started and stopped. They are also used for ventilating systems with either centrifugal, propeller or positive blowers and fans.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Ace."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell Electric Motor Co., Garwood, N. J.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Clark, Jr., Electric Co., James, 520 W. Main St., Louisville, Ky. "Willey."
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
Electromotor Co., 32-40 S. Clinton St., Chicago, Ill.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type RC. For description see "Motors, D-C., Constant Speed." See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Kurz & Root, Appleton, Wis.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
Munning & Co., A. P., Church St., Matawan, N. J.
Northwestern Mfg. Co., The, Milwaukee, Wis. "Northwestern."
Olson-Boettger Electric Mfg. Co., 413 N. Franklin St., St. Paul, Minn.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill.
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Road, Cleveland, Ohio. Type T heavy-duty Reliance motors are designed for all general service purposes. An unusual combination of engineering knowledge backed by years of practical experience was placed at the disposal of this company when designing Type T motors. Thirty-five prominent electrical engineers who have watched motors operating under the worst conditions and have seen them in their repair shops showed where extra strength and quality were needed. Their ideas were built into Type T motors. Actual results have proved the wisdom of getting more of the user's experience into motor design. Motors can be furnished shunt, compound, or series wound; open, semi-enclosed or fully enclosed; for constant and adjustable-speed service.—Adv.



Reliance Type T

ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y. "Rochester."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Complete line of Shunt motors. Sprague products, see display adv., pages 1306-7.—Adv.
Star Dynamo Co., Jefferson City, Mo. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
Wald Electrtic Mfg. Corp., 248-56 N. 10th St., Brooklyn, N. Y.
Wesche Electric Co., B. A., 1622-28 Vine St., Cincinnati, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, D-C. SHUNT AND COMMUTATING - POLE. — Commutating-pole motors, or interpole motors as they are sometimes called, are d-c. motors which have commutating poles between the main field poles. Such a construction is almost necessary in adjustable-speed shunt motors having a wide range in order to secure sparkless commutation at all loads and all speeds. The commutating poles are series wound and provide a commutating field increasing with the load, a condition desired for good commutation. They are used for many of the same purposes as shunt motors, but principally for industrial machine drive involving wide adjustment of speed. Car-dumping equipment is an example of drive where the adjustable speed with frequent starting, stopping and reversing requires the use of commutating poles.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bissell Co., The F., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Colonial Fan & Motor Co., The, Warren, Ohio. "Colonial."
Crocker-Wheeler Co. Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Eck Dynamo & Motor Co. Mill & Main Sts., Belleville, N. J. "High-Grade."
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type RF Adjustable Speed Commutating Pole Motors, designed for machine tool drive and similar service where wide variation and adjustment of speed independent of load is required. These motors are highly efficient, free from commutation troubles and electrically stable, and they give close speed regulation and permit rapid acceleration and deceleration. Especially adaptable to dynamic braking.

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Sizes from 2 to 50 hp. described in Bulletins 41021-A and 48029. Suitable control apparatus can also be supplied.—See adv. pages 1203-1223.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio. "Ideal."
Imperial Electric Co., The, Akron, Ohio. "Imperial."
Jantz & Leist Electric Co., Western Ave. & York St., Cincinnati, Ohio.
Jones & Moore Electric Co., Ltd., 296 Adelaide St., West, Toronto, Ont., Can.
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
Marble-Card Electric Co., Gladstone, Mich.
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Rd., Cleveland, Ohio. "Reliance."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y. "Rochester."
ROTH BROTHERS & CO., Chicago, Ill., have been established for over 25 years during which time the company has concentrated its efforts on the manufacture of electric motors and generators. The d-c. Roth motors are of the Interpole type. Frames are of



Rothmotor

steel, poles laminated, bearing brackets of type that can be set for floor, ceiling or wall support. The a-c. motors are of the very latest and up-to-date design, having features that make them particularly desirable for elevator service which the company has long been known as covering with a fine line of d-c. motors.—Adv.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Type L. C. motor shown in the illustration, 115 or 230 volt range in sizes from 25 to 50 H. P. Steel frame, massive construction, carefully finished. Equipped with steel pulley, split pulley end bearing, extra heavy shaft, wide base, protected field coils, spring oil well covers, pig tail brushes individually adjustable, single adjusting screw for belt tightening, wide range of speed control by field. Shunt wound. Another Type L. C., shunt or compound wound is made in smaller sizes, 5 to 25 H. P. Type C motors, pedestal bearing, 115-230-550-volt range in size from 75 H. P. to 500 H. P. Type C motors of lower rating, 115-230-500 volt, sliding base range from 40 to 200 H. P. Still another commutating pole type, with stabilizing winding is the L. C. 5, with wide range of speed by field weakening. These range in capacity from 3½ to 7½ H. P., 115 and 230 volts. Sprague products, see display adv. pages 1306-7.—Adv.



Type L. C.

Star Electric Motor Co., Miller St. & N. J. R. R. Ave., Newark, N. J. "Star."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Triumph Electric Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, D-C. SPECIAL ADJUSTABLE-SPEED.—Adjustable speed can be obtained in several types of d-c. shunt motors; see Motors, d-c. shunt; also Motors, d-c. shunt and commutating pole. These two types permit speed change by adjustment of the shunt-field resistance, the commutating-pole construction giving a very wide range of speeds. Another method consists in changing the reluctance of the magnetic circuit of the motor without changing the field current. One way in which this may be done is by mechanically moving the armature axially along or with the shaft. The armature core is slightly tapered so that the effect is to change the length and area of the air gap, thus affecting the magnetic field strength and the speed. This method permits a very gradual change of speed over a wide range and is especially adapted to drives where close speed setting is desirable and where the motor is accessible for the necessary adjustment.

Manufacturer:

RELIANCE ELECTRIC & ENGINEERING CO., 1054 Ivanhoe Road, Cleveland, Ohio. Type AS Reliance adjustable speed motors offer a simple and convenient method of speed control, giving unlimited running speeds over ranges as great as one to ten. Speed changes are made by simply shifting the motor armature. No electric con-



Reliance Type AS

troller is needed. The characteristics of Type AS motors make them particularly suitable for machine tool drive. They develop a constant horsepower output and will carry heavy overloads at all speeds. The motors are reversible and maintain a set speed steadily under changing loads. This company also furnishes adjustable speed motors of the field-resistance control type for speed ranges up to one to four.—Adv.

MOTORS, MILL TYPE.—Motors distinguished by specially rugged construction. They may be of any of the various types of a-c. or d-c. motors, and are used where severe operating conditions are experienced, such as in steel mills, cement mills, ore-treating and smelting plants, mines, etc. In installations where there are special speed and reversing requirements d-c. motors are used, but polyphase induction motors are more common when these special requirements are not met with. There are certain types of drives, such as reversing blooming mills in a steel plant, which cannot be driven advantageously by a-c. motors. These are either driven directly by d-c. motors, or in case of very large machines a special motor-generator set is used to control the speed and reversal of a d-c. load motor. Motors for use in steel mills are made in sizes from 5 to 10,000 hp. In cement, textile, flour and pulp mills, refrigerating plants, etc., mill type polyphase induction motors are widely used; where the speed is required to be adjustable the wound-rotor or slipring type induction motor is used.

Manufacturers:

Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CRAWFORD MFG. CO., 13-21 Park Row, New York, N. Y. "Crawford" motors of this type possess the same qualities of construction and operation as the type described under Motors, A. C. Induction, Polyphase, Squirrel Cage.—Adv.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
Fairbanks, Morse & Co, 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type MI for alternating current and Type MD for direct current, extensively used for cranes and reversing auxiliary machinery in steel plants; ore and coal bridges and unloaders; charging machines of all types; electric shovels, dipper dredges, capstans, canal gates, draw and lift bridges, cranes and small heavy duty hoists. Furnished totally enclosed in sizes from 3 to 150 hp. Open-type motors furnished up to 200 hp. Suitable control apparatus can be furnished for any service. (Bulletin 48121.1.) Large-capacity G-E motors and motor-generator sets for steel mill main roll drive are also available, as well as speed regulating sets, described elsewhere. See page 1214 for general information.—Adv.
Lancashire Dynamo Motor Co., of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. on pages 1306-1307.)
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTORS, MINE SERVICE.—The mine type of motor was designed to fill the demand for a motor of more rugged mechanical construction than the standard line of motors. The frame is of cast iron of exceptionally heavy section, and is of the box type without openings. An eyebolt is provided on the top of the frame to facilitate handling the machine. Both end shields are split horizontally and held together by large bolts which are placed so as to be as accessible as possible. The shields are enclosed with the exception of a hole for ventilation in each lower half. The windings are all supplied with moisture-resisting insulation and open-slot construction with form-wound coils. The rotor is especially designed to be as rigid as possible to resist the shocks and vibrations of gearing. The rotor spider has an extra long bearing surface on the shaft.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. Type HI Induction Motors of either the squirrel cage or wound rotor type, especially designed for this service, having unusually strong construction, high starting effort and large capacity for overload, which makes them especially suitable for operating breaker and tipple machinery. Enclosed self-ventilating fan permits cooling of motor with clean air from outside. Built in standard sizes from 5 to 75 hp. and furnished with or without back gearing. Suitable control equipment can also be supplied.—See adv. pages 1203-1223.—Adv.

MOTORS, PHONOGRAPH.—Small motors used to drive a phonograph directly or to wind the spring motor which in turn drives the turntable or cylinder carrying the record. These motors are usually of the series type so as to be universal in application to a-c. or d-c. circuits. They may have a governor or the governor of the spring motor may control the speed. The motor is either built right into the phonograph or may be separately attached. In all cases quietness of running is essential so as not to disturb the sound reproduction. An unusual type of electric motor is also used which does not have any rotating parts, but has an electromagnet that operates with a vibrating motion to move a belt over a pulley on the record spindle; the belt pulls on the pulley only

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while it moves in one direction, thus giving a continuous rotation.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Air-Way Electric Appliance Corp., Toledo, Ohio.
ARNOLD ELECTRIC CO., Racine, Wis. Manufacturer of "Arnold" electric phonograph motor.—Adv.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Electric Phonograph Corp., 4132 Park Ave., New York, N. Y. "Peerless."
Electro Dynamic Co., Ave. A. & North St., Bayonne, N. J. "Edco."
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of fractional-horsepower motors, both a-c. and d-c., which have been successfully applied to motor-driven applications in the home. For further information see page 1220.—Adv.
Ideal Electric & Mfg. Co., 153 E. 5th St., Mansfield, Ohio. "Ideal."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y. "Motrola."
Lakeside Supply Co., 416 S. Dearborn St., Chicago, Ill.
Phonograph Motors Corp., 341 N. Crawford Ave., Chicago, Ill. "Johnson."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Simplicity."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wireless Specialty Apparatus Co., C & Fergo Sts., Boston, Mass.

MOTORS, RAILWAY.—Motors used for propelling electric cars or locomotives on a railway. Such a motor may be either a d-c. or an a-c. machine. If d-c. it is almost invariably of the series type; if a-c., it may be of the series, the repulsion, or the polyphase induction type. D-c. motors wound for 500 to 1500 volts are the standard railway motors, 500 to 600 volts being used in large cities and 1200 to 1500 volts for interurban and heavy railway service. They are usually four-pole motors.

Railway motors are characterized by compact, sturdy design and are enclosed so as to protect the windings and other working parts from mechanical injury, dust, mud and water. The torque or pull of the armature or rotor is transmitted to the car wheels through a pinion on the armature shaft meshing with a gear on the car axle, or the armature may be mounted directly on the axle, as in some designs of large locomotives. Railway motors were formerly constructed in one general design, known as the split-frame type, in which the main enclosing frame or housing was split, usually in a horizontal plane along the central portion. The top and bottom halves of the frame were hinged and bolted together. Thus access was had to the armature and bearings while part of the motor remained in place on the car truck. Modern practice calls for the solid or box-frame type of motor in which the enclosing shell of cast steel is in one piece with large bored openings at the ends in which are pressed the circular housings containing the armature bearings, and through which the armature may be removed and replaced. The almost universal use of the solid or box-frame type of motor instead of the split frame is due to its superior mechanical design which results in low maintenance costs.

D-c. railway motors are further classified as between straight series type, interpole type and the interpole ventilated type. Until the development of the interpole motor, the limiting feature in the output was commutation. Heavier cars, more severe operating schedules, and the necessity of maintaining uniform full line voltage if fast schedules were to be met brought out very clearly the limitations of the straight series type of railway motor. The use of interpoles in railway motors removed the commutation handicap and the limit as to output was fixed only by allowable rise in temperature. To further increase the capacity of such motors, the ventilated type was brought out. In this latest design a fan is made a part of the revolving armature and by circulation of outside air through the armature and between the field coils carries away the heat so that greater output is obtained with safe temperature rise.

Motors for a-c. railway service have been developed along several lines, with single-phase series-wound compensated motors being the most common. This differs from the d-c. series motor in that it has two fields, the series and compensating fields. The latter neutralizes or compensates for the inductance of the armature produced by the alternating currents. They can be used interchangeably on a-c. and d-c. sections of lines. Repulsion motors are also sometimes used, having characteristics very similar to the series compensated motors. They have the advantage that the field circuit is distinct from the armature circuit and may be wound for potentials of 3000 volts or over, if desired. Polyphase induction motors have been used to a limited extent in locomotive service. Speed variation is obtained either by changing the number of poles, or by impressing variable voltages on the motors; the former gives only two or three speeds and is therefore of very limited application; the latter requires a transformer on the locomotive which may be used with a phase converter changing from single-phase trolley supply to polyphase supply for the motors.

Manufacturers:

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
GENERAL ELECTRIC CO., Schenectady, N. Y. The line of transportation motors built by this company is so comprehensive that a complete description is impracticable here. It includes all types and sizes from the large railway motors for 280-ton locomotives operating at 3000 volts, to the automotive motor for operation from the storage batteries of an electric vehicle. The railway motors include all types necessary to equip properly street cars and electric locomotives for every class of service. G-E electric locomotives equipped with these motors, as explained elsewhere on these pages, are built in various sizes for main line passenger and freight haulage, switching, interurban and terminal service, and for mine and other industrial work. G-E railway motors for city service have been applied successfully to subway and other trains with multiple-unit control as well as to one-man safety cars. Descriptive bulletins covering several different types of G-E railway motors are available. These or other information will be furnished on application stating kind of service. See page 1206 for further information on G-E service to electric railways.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

MOTORS, RATING OF.—See Rating of electrical machinery.

MOTORS, SEWING-MACHINE.—Motors used for driving sewing machines. They may be of the series or universal type or, when alternating current only is to be used, of the single-phase induction type; when direct current only is to be used they are either shunt or compound motors. They are sometimes mounted directly on the machine as an integral part of it, or they may be attached by means of a bracket or clamp. Other sewing-machine motors are mounted on a small stand and may also be used for cream whippers, fans, small grinders, etc., when not in use for the sewing machine. Resistance control by a pedal-operated rheostat is usually provided for household machine motors. For tailor shops or other factory sewing machines the motors are either d-c. shunt or single-phase or polyphase squirrel-cage induction motors, depending on the character of the supply. Group drive at constant speed is most common, the motor being often mounted at the end of a power table serving 3 to 8 or more machines.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio "Ace."
AMERICAN ELECTRIC CUTTING MACHINE CO., 149-151 Lafayette St., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. "Domestic" electric motors. See entry under Motors, universal, a-c. & d-c. Also see display advertisement on page 1310.—Adv.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa. "Eclipse."
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of fractional-horsepower motors, both a-c. and d-c., which have been successfully applied to motor-driven applications in the home. For further information see page 1220.—Adv.
Globe Electric Co., 6340 Stony Island Ave., Chicago, Ill.
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "Sew-E-Z."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
National Sewing Machine Co., Belvidere, Ill.
Osann Co., Frederick, 245 7th Ave., New York, N. Y.
PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill. "Peco."
Racine Electric Co., Bridge & Ontario St., Racine, Wis. "Little Gem."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Wald Electric Mfg. Corp., 248-56 N. 10th St., Brooklyn, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sew-Motor." (See display adv. pages 1395-1402.)

MOTORS, SPECIAL AND MISCELLANEOUS.—Some two dozen classes of motors are listed herewith together with their manufactures; the basis of classification is chiefly according to the construction of the motor and partly as to important specialized services, which have considerable effect in modifying essential design and construction features. A classification by service alone would give hundreds of classes, since the kinds of machines driven by motors are almost countless. There are numerous machine drives, however, that impose other important changes on the construction, such as special housing or frame construction, exceptionally low or very high speeds, extraordinary sizes and ratings, etc. For instance, motors for vacuum cleaners are usually built right into the casing of the cleaner; explosion proof motors and submergible motors require special frames, as do backgeared and many other kinds of motors. Unusually low and extremely high speeds may be desired sometimes without gearing or other speed-changing devices; these require special design. As to size there are such extremes as the miniature dental motor that may be held in the dentist's hand and weighs but a few ounces, and the powerful reversing rolling-mill motor with a momentary rating exceeding 15,000 hp. Practically all large rolling-mill motors as well as other high-rating motors are special. In this classification, therefore, are included all special motors and miscellaneous but distinctive types as are not covered by the other score or more classifications of motors.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Ace."
Ansonia Novelty Co., The, 285 Main St., Ansonia, Conn.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont. Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill. "Demonstration."
Chandeysson Electric Co., 4092 Bingham Ave., St. Louis, Mo.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Cline Electric Mfg. Co., Fisher Bldg., Chicago, Ill. "Cline-Westinghouse." (For printing machinery.)
Cushman Electric Co., 43 S. Main St., Concord, N. H. ("Cushman" offset linotype motors.)
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.

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Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "Fairbanks-Morse."
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. There is a standard G-E motor for almost every class of service. However, special machines can be developed when required. With experience in building electric motors from fractional horsepower to several thousand hp. sizes, the General Electric Company is in a position to co-operate in supplying motors for particular applications, either industrial or domestic. Examples of this service are portrayed on pages 1212 to 1217.—Adv.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Ideal Electric & Mfg. Co., The, 153 E. 5th St., Mansfield, Ohio.
International X-Ray Corp., 326 Broadway, New York, N. Y.
JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill.
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.
Kurz & Root, Appleton, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Marble-Card Electric Co., Gladstone, Mich.
MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."
MECHANICAL APPLIANCE CO., THE, Milwaukee, Wis. "Watson."
Munning & Co., A. P., Church St., Matawan, N. J.
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
ROBBINS & MYERS CO., THE, Springfield, Ohio. Robbins & Myers d-c. motors are made in sizes ranging from 1/40 to 15 hp. inclusive; series, shunt



R. & M. D-C. Motor

and compound wound for all services. In addition to the standard types for general power service, special designs are furnished on quantity orders for direct application to motor-equipped appliances and machines. Low voltage types for service on farm lighting plants are made in fractional horsepower and larger sizes.—Adv.
Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y. "Rochester."
ROTH BROS. & CO., 1400 W. Adams St., Chicago, Ill. "Rothmotors."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y. (special d-c. multi-speed).
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
U. S. Electrical Mfg. Co., 3rd St. & Central Ave., Los Angeles, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."

MOTORS, UNIVERSAL, A-C. AND D-C.—Series wound motors, generally in fractional-horsepower sizes, that will operate on either direct or alternating current. Such motors are commonly applied to small fans, portable vacuum cleaners, vibrators and other appliances that may be used interchangeably on d-c. or a-c. circuits. On account of this interchangeability they are called "universal" motors and are in considerable favor by manufacturers of many appliances who are thereby relieved of carrying two stock lines, one with d-c. motors and the other with a-c. motors. On larger sizes of universal motors a compensated series winding is used to improve commutation when in use on a-c. circuits. Properly designed universal motors give approximately the same speed and output when operating on d-c. or a-c. circuits of equal voltage and when the a-c. frequency is not above 60 cycles per second.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Ace."
Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
American Thermostat Co., 226 Jelliff Ave., Newark, N. J. "Marvel."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Birtman Electric Co., Lake & Desplaines Sts., Chicago, Ill. "Be-Co."
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill. The success of this company's interchangeable motors, generally supplied in sizes ranging from 1/6 to ¼-hp., is attributed to correct principle in design, careful selection of material, high grade workmanship and rigid inspection. Sample motors are sent to any responsible electric dealer, central station or manufacturer of small machines for thorough trial. All types are guaranteed to be free from mechanical or electrical defects.—Adv.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. Has factory of 150,000 sq. ft. of floor space devoted exclusively to manufacture of "Domestic" fractional horse power motors, sold principally to manufacturers of electrical appliances. They are designed and built especially for the appliances which they are to drive in split phase induction type, plain or compensated series wound motor parts, ranging in sizes up to ½-hp. The split phase type can be furnished for either a-c. or d-c., with voltages of 110 and 220, and cycles of 60, 50, 40 and 25. The d-c. type is built for voltages up to 250. The series wound motor parts are of the universal type, and can be used on either a-c. or d-c. current, but are particularly adapted to alternating current. Domestic sales' engineers are in intimate contact with daily problems of small motor applications under all conditions and specialize in submitting plans to meet individual requirements. See display advertisement on page 1310.—Adv.
Electric Blower Co., 352 Atlantic Ave., Boston, Mass.
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of fractional-horsepower motors, alternating direct current and universal. All universal motors have series characteristics. For further information see page 1220.—Adv.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Green Electric Co., The W., 81 Nassau St., New York, N. Y.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.
PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)
Phonograph Motors Corp., 341 N. Crawford Ave., Chicago, Ill. "Johnson."
Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill. "Racine."
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."
Shedd Electric Co., Inc., Clay & Locust Aves., Roselle Park, N. J. (special).
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Willey-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio. "Superior."
WISCONSIN ELECTRIC CO., Racine, Wis. "Dumore" motors, fractional hp. types, are light, compact, dependable power units in extensive use among many of the largest manufacturers of electrical appliances that require small motor drives. Special attention is given to such important parts as armatures, fields, bearings, etc. Each shaft is ground true, and all armatures are dynamically balanced, insuring a free-running, durable motor. The company maintains a large research and experimental department for co-operating with responsible manufacturers, and offering suggestions and recommendations where special power problems are



Dumore Universal Motor Type D

under consideration. Type D motor, shown above, is of 1/8 hp., built to meet the demand for a compact power unit. Finished in black enamel. Equipped with eight feet of cord and attachment plug. Cutler-Hammer 3-speed rheostat is mounted in the base. Speeds of 2,000, 6,000 and 8,000 r.p.m. are available. Universal motor operates on either a-c. or d-c. circuits. Net weight 11 lbs. Other "Dumore" standard types are 1/16 and 1/25 hp. See display adv. page 1311.—Adv.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

MOTORS, WASHING-MACHINE.—Shunt or compound motors where direct current is used and single-phase induction motors where alternating current is available. The series motor is not adaptable since a constant-speed drive is desired. These are fractional-horsepower motors usually rated at 1/6 to 1/4 hp. Because of the location below the machine they are often totally enclosed so as to be splashproof. The single-phase induction motor type is the most widely used and both the split-phase and repulsion methods of starting are employed. Washing-machine motors have been used in large quantities during the last few years because of the rapid increase in popularity of these labor-saving household appliances.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Ace."
American Radio & Research Corp., 21 Park Row, New York, N. Y. "Twin-R."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago, Ill. See entry under Motors, universal, a-c. & d-c.—Adv.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electric Co., 1827 Pine St., St. Louis, Mo. "Century."
Crocker-Wheeler Co., Ampere, N. J.
Dayton Fan & Motor Co., Monument & Meigs Sts., Dayton, Ohio. "Dayton."
Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
DOMESTIC ELECTRIC CO., THE, 7223 St. Clair Ave., N. E., Cleveland, Ohio. "Domestic" motors. See entry under Motors, universal, a-c. & d-c. Also see display advertisement on page 1310.—Adv.
Eck Dynamo & Motor Co., Mill & Main Sts., Belleville, N. J. "High-Grade."
EMERSON ELECTRIC MFG. CO., THE, 2012-2032 Washington Ave., St. Louis, Mo.
Fidelity Electric Co., 331 N. Arch St., Lancaster, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Protected type a-c. and d-c. motors 1/10 to ¼ hp. with waste packed bearings. Enclosed frame protects motor from splashing water. Furnished with or without feet, thus

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adapting it to any method of mounting. An ingenious method of ventilation is provided by a protected opening around the bearing housing. (Bulletin 61513.) See adv. pages 1203-1223. —Adv.

GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Eden." (See display adv. page 1296.)

International X-Ray Corp., 326 Broadway, New York, N. Y.

Liberty Electric Corp., Port Chester, N. Y.

Louisville Electric Mfg. Co., Inc., 31st & Magazine Sts., Louisville, Ky.

Munning & Co., A. P., Church St., Matawan, N. J.

MASTER ELECTRIC CO., THE, 460 Bacon St., Dayton, Ohio. "Master."

National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.

PEERLESS ELECTRIC CO., Warren, Ohio. "Peerless." (See display adv. page 1308.)

PERSONS ELECTRIC CO., 506 Jersey St., Quincy, Ill. "Peco."

Princess Wash Machine Mfg. Co., The, 433 E. Pearl St., Cincinnati, Ohio. "Princess."

Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."

ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio. "R & M."

SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)

Sturtevant Co., B. F., Damon St., Hyde Park, Baston, Mass.

Temco Electric Motor Co., The, 504 Sugar St., Leipsic, Ohio. "Temco."

Tideman Electric Mfg. Co., Cairo, Ill. "Menominee."

Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

Wald Electric Mfg. Corp., 248-56 N. 10th St., Brooklyn, N. Y.

Warner Electric Co., Kalamazoo, Mich. "Kazoo."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

MOTROLA.—Trade name for electric phonograph motors manufactured by Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y.

MOTT IRON WORKS, THE J. L.—118 5th Ave., New York, N. Y. Manufacturer of ornamental lamp posts, brackets and decorative lighting specialties. Business established 1828. President, Jordon L. Mott; vice-president and general manager, R. K. Bowman; secretary, Max Goebel.

MOULDED MICA.—Trade name for molded insulation manufactured by the Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

MOUND VALLEY GLASS MFG. CO.—Mound Valley, Kans. Manufacturer of illuminating glassware.

MOUNTAIN LUMBER & SUPPLY CO.—Mount Union, Pa. Producer of insulator pins, wood brackets, rollers, handles, poles, etc. Business established 1917. President, W. H. Crowell; vice-president, J. E. Peterson; secretary and general manager, C. R. Crowell; treasurer, F. B. Yourison.

MOUTHPIECES AND MUFFLERS, TELEPHONE.—The mouthpiece of a telephone instrument is part of the transmitter. It serves to collect the sound and direct it to the diaphragm and to eliminate outside noises. Special forms of mouthpieces so designed as to effectively eliminate certain external noises are used. These are sometimes called mufflers. An example of this is a mouthpiece used on radio telephone apparatus in an airplane, which is so designed as to eliminate the engine noise.

Special mouthpieces are often called sanitary mouthpieces. These are merely designed to prevent the carrying of disease from one user to the next. The intention is to provide something which will kill disease germs. Much more reliance is to be placed on periodic cleaning of the mouthpiece with an effective germicide. Attachments are very likely to cut down the transmission of the voice, and are opposed by telephone companies.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Burns."

Colytt Laboratories, 565 W. Washington St., Chicago, Ill. "Whispering Mouthpiece."

Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."

Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Theraphone."

Flint Sanitary Mouthpiece Co., 132 Pleasant St., Newton Centre, Mass.

General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

PARKER & SON, INC., J. H., Parkersburg, W. Va.

Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."

Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.

Standard Appliance Co. of America, 380 Lafayette St., New York, N. Y. "Privaphone."

Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.

WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

Watkins, Frederick A., 565 W. Washington St., Chicago, Ill. "Whispering."

Weeks Mfg. Co., F. A., 93 John St., New York, N. Y. "Maxum."

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

MOV-A-LITE.—Trade name for electric signs manufactured by the Chase Electric Co., 105 S. Dearborn St., Chicago, Ill.

MOVEMENTS FOR INSTRUMENTS, TIME SWITCHES, ETC.—See Clock movements for recording instruments, time switches, etc.

MOVING PICTURE MACHINES.—See Motion-picture machines.

M-R CO., THE.—122 N. 14th St., Lincoln, Neb. Manufacturer of ignition timers and other automobile accessories. Business established 1919. General manager, Kenneth L. Long.

M. S. W. CO., INC.—1527-1529 Niagara St., Buffalo, N. Y. Manufacturer of fixture studs, hickeys, etc. President, Arthur A. Schwartz; secretary, A. H. Blessing; treasurer, Alex. McNiven.

MUELLER & CO., V.—1779 Ogden Ave., Chicago, Ill. Manufacturers of electrical surgical engines, electromagnets and ether apparatus. President and treasurer, V. Mueller; secretary and general manager, G. W. Wallerich.

MUELLER & CO., WM.—115 S. Dearborn St., Chicago, Ill. Manufacturers of cedar poles. President, E. B. Brande; sales manager, William Mueller. Yards, Minneapolis, Minn.; Spokane, Wash.

MUELLER ELECTRIC CO.—2135-43 Fairmount Rd., Cleveland, Ohio. Manufacturer of attachment plugs, battery and test clips. Business established 1908. President, Ralph S. Mueller; vice-president and sales manager, Charles S. Ripley; secretary and treasurer, John Dromgould; general manager, J. E. Black. Sales representatives, Albert Fries, 8 W. 19th St., New York, N. Y.; Stackhouse & Allen, 560 W. Monroe St., Chicago, Ill.; Globe Commercial Co., 618 Mission St., San Francisco, Cal.; Ajax Electrical Specialty Co., 1011 Market St., St. Louis, Mo.

MUELLER MFG. CO., H.—Decatur, Ill. Manufacturer of water, plumbing and gas brass goods. Business established 1857. President and treasurer, Adolph Mueller; vice-president, F. B. Mueller; secretary, Robert Mueller. Main office and factory, Decatur, Ill. Branch offices, San Francisco, Cal.; 145-49 W. 30th St., New York, N. Y.

MUELLER MFG. CO., RUD.—4310 N. California Ave., Chicago, Ill. Manufacturer of electric carbonators. President, Rudolph Mueller; treasurer, O. L. Mueller.

MUELLER MFG. CO., LTD., W. H.—Sarnia, Ont., Can. Manufacturer of brass goods and aluminum and nickel silver castings. Business established 1912. President, B. Mueller; vice-president, C. G. Helby; secretary and treasurer, F. L. Riggin; sales manager, William Twaits.

MUFFLES FOR ELECTRIC FURNACES.—A muffle is usually defined as a compartment or oven in which articles are heated without being exposed to the direct action of a flame. With electric furnaces of the resistance and induction types there is, of course, no flame, but very often what corresponds to a thin muffle is placed inside of the heating element so that the element is not exposed and cannot be accidentally short-circuited. In order that the heat be as uniform as possible within the chamber, the heating element is well distributed and not imbedded within the muffle deep enough to interfere with the free radiation of heat. Usually an outer covering or muffle of a highly refractory composition is placed around the inner one and the whole thing is then enclosed in a steel jacket. These muffles have extensive use where accurate heating and heat control are required and especially where the articles heated are delicate, as in fusing dental porcelain. They are also used with furnaces for heat-treating high-grade tools and tool steel.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. This Company furnishes standard muffles for use in the G-E Electric Muffle Furnace, 4 kw. size. See adv. pages 1203-1223.—Adv.

White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. "S. S. White."

MUGNAI STATUARY CO.—1337 W. Grand Ave., Chicago, Ill. Manufacturer of portable electric lamps.

MUGS, SHAVING.—See Heaters, electric, shaving mug.

MULE-PULL.—Trade name for friction clutches manufactured by the Brown Engineering Co., 123-127 N. 3rd St., Reading, Pa.

MULLAN.—Trade name for electric vacuum pumps manufactured by the C. H. Wheeler Mfg. Co., Lehigh & Sedgley Aves., Philadelphia, Pa.

MULLER.—Trade name for strain insulators manufactured by J. H. Parker & Son, Parkersburg, W. Va.

MULTI ELECTRICAL MFG. CO.—703 Fulton St., Chicago, Ill. Manufacturer of conduit fittings. Business established 1917. President, Clarence T. McDonald; treasurer, William Carey. Sales representative, King Cramer Co., 1133 Broadway, New York, N. Y.

MULTI-VAPO-GAP.—Trade name for lightning arresters manufactured by the Shaw Insulator Co., 5-7 Kirk Pl., Newark, N. J.

MULTIFLEX.—Trade name for photographic lamps manufactured by the Simplex Photo Products Co., Richmond Hill, N. Y.

MULTIFORM.—Trade name for electric signs manufactured by the Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill.

MULTIFORM CORP.—1926 S. Wabash Ave., Chicago, Ill. Manufacturer of electric signs. Business established 1914. President and general manager, J. M. Schilling; vice-president, C. R. Wood; secretary and treasurer, N. Schilling.

MULTIFREX.—Trade name for high-frequency generators made by the Bleadon-Dun Co., 326 W. Madison St., Chicago, Ill.

MULTIGAP LIGHTNING ARRESTER.—A protective device used on high-voltage circuits in which a number of metallic cylinders are closely spaced in series between the line and ground, causing the flash across it to be broken up into a number of short arcs in jumping over the intervening gaps. See Arresters, lightning, multigap.

MULTIGRAPH.—Trade name for motor-driven printing and multigraph machines manufactured by the American Multigraph Sales Co., E. 40th St. & Kelly Ave., Cleveland, Ohio.

MULTIGRAPH PRINTING MACHINES, MOTOR-DRIVEN.—The multigraph machine is a special printing press for quickly making a considerable number of copies of form letters, circulars, leaflets, etc. It is used extensively by large business houses, schools and colleges. The printing is done by type set up on the surface of a cylinder, which is driven through suitable gearing by an electric motor. These machines may be self or automatic feeding to take advantage of the high rate of output of which the machine is capable. They permit very close copying of circular letters, the name of the addressee being inserted by a typewriter so that the entire letter looks much like one specially written.

Manufacturer:

American Multigraph Sales Co., The, E. 40th & Kelly Ave., Cleveland, Ohio. "Multigraph."

MULTIPHASE.—A term meaning two or more phases, as applied to alternating-current circuits or equipment. More commonly called polyphase. The great majority of these circuits are now three-phase circuits.

MULTIPHONE.—Trade name for interior phones manufactured by the S. H.

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Couch Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

MULTIPLE. — Connected in parallel branches of a circuit so that the combined circuit current is the sum of the currents in the branches. "Parallel" and "shunt" are other adjectives commonly used for multiple circuits. Multiple is also used to designate apparatus designed for connection to a multiple circuit (to distinguish it from similar apparatus designed for series circuits), as multiple lamps. Multiple is also used in the sense of numerous or plurality, as multiple-conductor cable in which the conductors are usually not in multiple or parallel electrically. It is also used in telephony, as multiple switchboard, which is a board arranged with sections in multiple so that each operator can complete connections to all lines on it.

MULTIPLE.—Trade name for storage batteries manufactured by the Multiple Storage Battery Co., Van Wyck Ave. & L. I. R. R., Jamaica, L. I., N. Y.

MULTIPLE-CONDUCTOR CABLE.—See Cable.

MULTIPLE ELECTRIC PRODUCTS CO., INC.—New York, N. Y. Manufacturer of renewable cartridge and plug type fuses. Business established 1918. President, S. M. Swenson; vice-president and treasurer, A. C. Swenson; secretary, Harold Payson; sales manager, A. T. Holbrook. Main office, 450 4th Ave., New York, N. Y. Factory, Newark, N. J. Branch offices, Boston, Mass.; Philadelphia, Pa.; Buffalo, N. Y.; Detroit, Mich.; Chicago, Ill.; Pittsburgh, Pa.; St. Louis, Mo.; Atlanta, Ga.; Columbia, S. C.; Jacksonville, Fla.; Toronto, Ont., Can. Sales representatives, Clapp & Lawrence, San Francisco Bldg., Los Angeles, Cal.

MULTIPLE STORAGE BATTERY CO.—Jamaica, L. I., N. Y. Manufacturer of storage batteries. Business established 1911. President and treasurer, N. D. Sturges; vice-president and secretary, Jasper Bayne; sales manager, C. A. Stanley. Main office and factory, Van Wyck Ave. & L. I. R. R., Jamaica, L. I., N. Y. Branch office, 104 W. 52nd St., New York, N. Y. Sales representative, Mechanical Service Co., Baltimore, Md.

MULTIPLE SYSTEM IN ELECTROLYTIC PROCESSES.—The placing of the plates in a metal-refining vat or tank in parallel, that is, all the cathodes forming one large cathode by being connected to the same negative busbar, and all the anodes forming one large anode by being connected to the same positive busbar. Electrically, there is therefore only one cathode and one anode in one tank, and the current makes only one jump through the electrolyte per tank. The subsequent arrangement of numbers of such tanks in parallel or in series with each other is immaterial; the term multiple system applies only to the parallel arrangement of electrodes in the individual tank. This plan is also used in all multiple storage cells.

MULTIPLE UNIT.—Trade name for electric furnaces, hot plates and flask heaters manufactured by the Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J.

MULTIPLE-UNIT CONTROL.—In electric railway equipment, a system by which one or more motor cars or electric locomotives are operated from a single master controller. This controller does not make nor break the main motor circuits directly, but controls them through an auxiliary system of wiring, the main switches or contractors being operated by electromagnets, or compressed air. See under Control systems.

MULTIPLE WINDING.—See Lap winding.

MULTIPLE WINDING CO.—77 Summer St., Boston, Mass. Manufacturer of cotton insulating yarn. J. B. Jamieson, treasurer. Factory, Malden, Mass.

MULTIPLEX.—Trade name for ratchet wrenches manufactured by the Lowell Wrench Co., 54 Commercial St., Worcester, Mass.

MULTIPLIERS, VOLTMETER AND WATTMETER.—A voltmeter multiplier is a resistor specially designed to be connected in series with a d-c. voltmeter to permit its use on a circuit whose voltage is higher than that indicated by a full scale deflection. The resistor is usually maintained in a box or suitable container which is provided with binding posts. The resistance of the multiplier is such that when in use the instrument scale divisions will represent some multiple, usually ten, of the original value. Multipliers should have negligible temperature coefficient of resistance; for this reason they are usually made of manganin wire. Identically the same kind of multiplier is used for the potential circuit of d-c. wattmeters; it permits a 75-volt wattmeter, for instance, to be used on circuits up to 750 volts.

Manufacturers:

Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

MULTIPLUS.—Trade name for lubricators manufactured by Greene, Tweed & Co., 109 Duane St., New York, N. Y.

MULTIPO.—Trade name for sockets manufactured by the H. T. Paiste Co., Philadelphia, Pa. Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

MULTIPOLAR.—Having more than two poles, but always an even number, as four, six, etc.; a term used to distinguish generators and motors having four or more poles from those having only two.

MULTIPOLAR MACHINE.—An electrical machine having four or more poles as distinguished from the old style bipolar machine.

MULTIVOLT. — Trade name for toy transformers manufactured by the Lionel Corp., 48-52 E. 21st St., New York, N. Y.

MULTO. — Trade name for ratchet wrenches manufactured by the Lowell Wrench Co., 54 Commercial St., Worcester, Mass.

MUMMERT-DIXON CO. — Philadelphia & Gay Sts., Hanover, Pa. Manufacturer of portable electric grinders. President and general manager, E. S. Mummert; vice-president, S. M. Bare; secretary, J. O. Dixon; treasurer, H. B. Baer.

MUNDY HOISTING ENGINE CO., J. S.—Newark, N. J. Manufacturer of electric hoists and derricks. President, C. L. Mundy, Jr.; secretary, L. E. Muller; treasurer, Mr. Strickland. Main office, 722 Frelinghuysen Ave., Newark, N. J. Branch offices, 39 Cortlandt St., N. Y; Market & Randolph Sts., Chicago, Ill.; Philadelphia, Pa.; Pittsburgh, Pa.; Norfolk, Va.; St. Louis, Mo.; Cincinnati, Ohio; Seattle, Wash.; Halifax, N. S.; Charleston, S. C.; Richmond, Va.; Houston, Tex.; Boston, Mass.; Cleveland, Ohio; Mobile, Ala.; Montreal, Que., Can.; Spokane, Wash.; St. Paul, Minn. Sales representative, H. Channon Co., 139 N. Market St., Chicago, Ill.

MUNICIPAL ELECTRICAL RULES.—Many of the large cities of the United States have their own municipal codes. Among them may be mentioned New York, Chicago, Detroit, Cleveland, St. Louis, Boston, Pittsburgh, Minneapolis. This practice also extends to cities of medium and even small size. On the other hand, some of the larger cities are without codes. Examples are Philadelphia, Buffalo, Cincinnati and New Orleans. A number of cities have adopted the National Electrical Code verbatim, but most cities have adopted its rules with additions and sometimes also omissions. The changes are invariably in the direction of added restrictions, such as the prohibition of knob-and-tube work and of wood molding or raceways. Porcelain sockets are required in certain locations, such as bathrooms and basements, in Milwaukee, Newark, Kansas City, Grand Rapids and many others. Enclosed or safety switches for motors are required in Chicago, Detroit, Newark, Portland (Ore.), St. Paul, Atlanta, Grand Rapids, etc. Part 2 of the National Electrical Safety Code is applied in Williamsport, Pa., and Part 3 in Tampa, Fla. New rules are now being drafted in Baltimore, Scranton and Mobile.

MUNN SIGN & ADVERTISING CO.—Atlanta, Ga. Manufacturer of electric signs.

MUNNING & CO., A. P.—Matawan, N. J. Manufacturers of electroplating and buffing apparatus and supplies. Business established 1863. President, A. P. Munning; vice-president, H. L. Zucker; secretary, F. A. Zucker; treasurer, P. P. Munning; general manager, F. T. Taylor. Main office, Church St., Matawan, N. J. Factories, Newark, N. J.; Matawan, N. J.; Chicago, Ill. Branch offices, 50 Church St., New York, N. Y.; 447 The Bourse, Philadelphia, Pa.; 2920 Carroll Ave., Chicago, Ill.; 709 Marion Bldg., Cleveland, Ohio; 604 Free Press Bldg., Detroit, Mich.; 43 Ft. Pleasant Ave., Springfield, Mass.; 415 Ridgeway Ave., Rochester, N. Y.

MUNSELL & CO., EUGENE.—New York, N. Y. Manufacturers of mica and mica products. Business established 1840. President, Lewis W. Kingsley; vice-presidents, H. S. Munsell and E. C. Wood; secretary and sales manager, E. G. Heald; treasurer and general manager, George S. Leary. Main office, 68 Church St., New York, N. Y. Branch office and warehouse, 542 S. Dearborn St., Chicago, Ill. Sales representatives, G. A. Morrell, 410 Belmont Bldg., Cleveland, Ohio; Monroe Brass & Wire Co., 804 Traction Bldg., Cincinnati, Ohio; Electrical Specialty Co., 525 Market St., San Francisco, Cal.

MURDOCK.—Trade name for cable insulators manufactured by J. H. Parker & Son, Parkersburg, W. Va.

MURDOCK CO., WILLIAM J.—Everett Ave. & Carter St., Chelsea, Mass. Manufacturer of radio equipment and telephone receivers. Business established 1896. General manager, William J. Murdock; sales manager, D. R. W. Murdock.

MURPHY.—Trade name for automatic furnaces manufactured by the Sanford Riley Stoker Co., 9 Neponset St., Worcester, Mass.

MURPHY VARNISH CO.—Newark, N. J. Manufacturer of protective paints and varnishes, enamels, etc. Business established 1865. President, John J. Nicholson; sales manager, C. J. Roh. Branch office, 50 W. 22nd St., Chicago, Ill. Sales representative, Dougall Varnish Co., Ltd., Montreal, Que., Can.

MURPHY.—Trade name for automatic cian's lamp manufactured by the Frank S. Betz Co., Hoffman St., Hammond, Ind.

MURRAY.—Trade name for protective devices manufactured by the Metropolitan Electrical Products Co., 1250 Atlantic Ave., Brooklyn, N. Y.

MURRAY IRON WORKS CO.—Burlington, Iowa. Manufacturer of boilers, engines and other steam power plant equipment. Business established 1870. President, George D. Higbee; vice-president and treasurer, F. A. Millard; secretary, C. H. Schroder.

MURRAY, W. B.—N. Winchester & Wabansia Ave., Chicago, Ill. Manufacturer of motor-driven artificial flower making machinery. Proprietor, W. B. Murray.

MUSICAL INSTRUMENTS, MISCELLANEOUS, ELECTRICALLY OPERATED.—There are several of these instruments of somewhat limited use up to the present which have not been separately listed. Among these are musical bells used chiefly to attract attention to advertising signs employed on wagons, or in carnivals, amusement parks, etc. They consist of a set of bells of differing tone to give a musical scale, together with electromagnetically operated hammers for striking the bells. The bells are controlled from a keyboard or by a roll or other device which governs the contact makers in a predetermined order. Another device is a very ingeniously operated electric violin. This device replaces the human hand and bow by small rotating wheels which are brought into contact with the strings in the proper manner to actuate them. Among the more recent devices of this class is an automatic electrically operated phonograph. This machine has two racks of records, one on either side of the machine. The rotating table, needle and diaphragm is placed between the two racks. By an electrically driven mechanism the machine will take the record for which it has been set, place it on the table, first taking off the record previously played and placing it in its rack, then put the needle in position and play the record, stopping automatically at the proper point. Music boxes and organs are also among the miscellaneous devices of this character. Perhaps the most interesting of all such electrical instruments is the telharmonium, a purely electrical instrument. One of the largest and finest of these instruments was installed in New York. This system produced from a set of 144 alternators, geared together and driven by a constant-speed motor, frequencies of from 40 to 4,000 cycles per second. These currents of various frequencies were combined, through a set of transformers, at the control of the operator. By means of a telephone receiver the electrical frequencies were translated into corresponding vibratory frequencies of the diaphragm. Impedances and rheostats in the transformer circuits controlled the volume of the tone and enabled the musician to give fine expression to the music. See also Actions, pipe organ, electric; Chimes, electric; Orchestrions, electrically operated; Phonographs, motor-driven; Pianos, electrically operated; Pianos, motor drive equipment for.

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Manufacturers:

Aeolian Co., The, 29 W. 42nd St., New York, N. Y.
Deagan, Inc., J. C., 1770 Berteau Ave., Chicago, Ill. "Una-Fon." (Electrically operated musical bells.)
Kimball Co., W. W., 308 S. Wabash Ave., Chicago, Ill. "Kimball." (Organs.)
Mills Novelty Co., 221 S. Green St., Chicago, Ill. (Piano and violin.) "Violana-Virtuoso."
Operators Piano Co., 16 S. Peoria St., Chicago, Ill. (Organs.) "Reproduco."
Regina Co., The, 47 W. 34th St., New York, N. Y.
Seeburg Piano Co., J. P., 419 W. Erie St., Chicago, Ill. (Organs.)

MUSKEGON.—Trade name for electric washing machines manufactured by the Michigan Washing Machine Co., Muskegon, Mich.

MUTTON'S.—Trade name for meter-reading recorders manufactured by the Economy Appliance Co., 517 Marsh-Place Bldg., Waterloo, Iowa.

MUTUAL ELECTRIC & MACHINE CO.—858 W. Fort St., Detroit, Mich. Manufacturer of switches, switchboards, panels, panelboards and equipment therefor. Business established 1902. President and general manager, H. J. L. Frank; vice-president, I. Blum; secretary and sales manager, Leon H. Frank; treasurer, F. M. Ferguson. Sales representatives, S. Robert Schwartz & Brother, 729 Broadway, New York, N. Y.; J. S. Jacobson Co., 627 W. Jackson Blvd., Chicago, Ill.; Keeler-White Co., 509 Mission St., San Francisco, Cal.

MUTUAL INDUCTANCE.—The magnetic property of adjoining circuits by virtue of which a change in the current in one circuit induces an e.m.f. in the adjacent circuit. See Inductance; also compare with Self-inductance.

Mutual inductance may also be defined as the ratio of the magnetic flux threading through a circuit to the current in an adjacent circuit producing it. Its symbol is M and its unit is the henry.

MUTUAL INDUCTION.—See Mutual inductance.

MUTUAL METAL MFG. CO.—1948 N. Kedvale Ave., Chicago, Ill. Manufacturer of lighting fixtures, fixture fittings and parts, metal spinnings and stampings, etc. Business established 1918. Copartnership, W. J. Tanney, William Christensen, Henry Goodfriend.

MYERS-WHALEY CO.—Knoxville, Tenn. Manufacturer of ore loaders and mining machinery.

N

N.—A symbol used in electrical formulas to represent the number of turns or number of conductors. It is also used on permanent magnets to designate the north-seeking end. N is also the chemical symbol for the element nitrogen. The form n is sometimes used as a symbol for the speed of rotation, expressed in revolutions per second (r.p.s.), also for the number of lines of magnetic force. The Greek letter n (eta) is used as a symbol for efficiency.

NA.—The form Na is the chemical symbol for the metallic element sodium, whose Latin name is natrium.

NA-ALD.—Trade name for molded insulation products made by the Alden-Napier Co., 54 Willow St., Springfield, Mass.

NACHOD SIGNAL CO., INC.—4771-4777 Louisville Ave., Louisville, Ky. Manufacturer of automatic signals for electric railways, highway crossing bells, headway recorders. President, Carl P. Nachod; vice-president, J. A. Stewart; secretary and treasurer, J. D. Augustus.

NAGEL ELECTRIC CO., THE W. G.—Toledo, Ohio. Manufacturer of automobile ammeters, Bakelite products and oil gages. Business established 1900. President and general manager, W. G. Nagel; vice-president and treasurer, H. E. Adams; secretary, R. N. Evans. Main office, 28-32 St. Clair St., Toledo, Ohio. Branch office, 2 Rector St., New York, N. Y. Sales representative, L. D. Rockwell Co., 853 Book Bldg., Detroit, Mich., and Union Commerce National Bank Bldg., Cleveland, Ohio.

NAGLE ENGINE & BOILER WORKS.—Erie, Pa. Manufacturer of steam engines and boilers. Business established 1879.

NAIAD.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

NAIL LEATHERHEADS.—See Leatherheads for nails.

NAIL-IT.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Parkersburg, W. Va.

NAIL-IT-PUNCH.—Trade name for portable punch manufactured by the Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.

NAILS, INSULATED.—One type of these nails is fitted with an insulator which separates them electrically from the wires which they hold in position; the insulator is a small spool, the wires fitting in the spool and the nail being driven through the center. It is especially adapted to fastening flexible cord, bell wire, etc., to ceilings, moldings and walls. Another type is a small nail the head of which is covered with an insulating cap.

Manufacturers:

Eureka Supply Co., Sewell, N. J.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

NALCO.—Trade name for carbon lamps manufactured by the North American Electric Lamp Co., 930 N. 22nd St., St. Louis, Mo.

NAME PLATES, FOR MACHINERY, APPLIANCES, ETC.—Name plates usually give not only the name of the manufacturer but state as well the necessary data regarding the rating of the machine or appliance. The rating data given should be the data prescribed by the A. I. E. E. Standardization Rules for the particular machine, transformer, etc. For machines or appliances not covered by the Standardization Rules the data generally given are: the kind of current (a-c. or d-c.); if a-c. also the frequency (cycles) and number of phases (unless evidently single-phase); the wattage or current, and voltage. Name plates are generally made of brass or bronze, either cast or stamped from sheets, and fastened to an accessible point on the machine. They are made in considerable quantities by manufacturers of metal stampings for the makers of appliances, etc.

Manufacturers:

Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Crowe Name Plate & Engraving Co., 1749 Grace St., Chicago, Ill. "Crowe."
Electro-Chemical Engraving Co., The, 440-458 19th St., Brooklyn, N. Y.
Ferry Mfg. Co., 2118 S. 4th St., St. Louis, Mo.
Flour City Ornamental Iron Co., 27th St. & 28th Ave., S., Minneapolis, Minn.
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Mayer Co., George J ., 4020 Guilford Ave., Indianapolis, Ind.
Metallograph Corp., The, 1100 Brook Ave., New York, N. Y.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Premier Metal Etching Co., 14th St. & Van Alst Ave., Long Island City, N. Y. "Premier."
Spencer Mfg. Co., S. M., Washington & Cornhill Sts., Boston, Mass.
Stanley Mfg. Co., The, 50 Cannon St., Dayton, Ohio.
Steere, George, 434 S. Dearborn St., Chicago, Ill.
TURNER BRASS WORKS, THE, Sycamore, Ill. (See display adv. page 1326.)
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 286 Grand St., Waterbury, Conn.

N. A. O.—Trade name for electric house pumps manufactured by the Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

NAPIER SAW WORKS, INC.—Springfield, Mass. Manufacturer of motor-driven and hand hacksaws. President, Frank Baldwin; treasurer, W. E. Cross; general manager, W. F. Pollock; sales manager, A. C. Whitefield. Main office, Roland St., Springfield, Mass. Branch office and warehouse, 549 W. Washington Blvd., Chicago, Ill. Sales representatives, Chas. A. Dowd Sales Co., 320 Market St., San Francisco, Cal.; Johnson Sales Co., Union Bank Bldg., Pittsburgh, Pa.

NARCO.—Trade name for safety panelboards manufactured by the Metropolitan Electric Mfg. Co., East Ave. & 14th St., Long Island City, N. Y.

NARCO CO., THE.—Wapakoneta, Ohio. Manufacturer of motor-driven refrigerators and refrigerating machinery.

NARO.—Trade name for safety panels manufactured by the Metropolitan Electric Mfg. Co., East Ave. & 14th St., Long Island City, N. Y.

NAROWETZ HEATING & VENTILATING CO.—1711 Park Ave., Chicago, Ill. Manufacturer of air washers. President, Louis Narowetz, Sr.; secretary, Louis Narowetz, Jr.; treasurer, Hattie Narowetz.

NATCO.—Trade name for clay underground conduit manufactured by the National Fire Proofing Co., Pittsburgh, Pa.

NATHUSIUS FURNACE.—An electric furnace of the combined arc-resistance type. In addition to the ordinary electrodes in the furnace, another set of metal electrodes is built into the hearth of the furnace, buried entirely in the hearth material, which, when heated up, conducts sufficiently to contribute materially to the heating of the furnace.

NATIONAL.—Trade name for wet batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

NATIONAL.—Trade name for renewable cartridge fuses manufactured by the Federal Electric Co., 8700 S. State St., Chicago, Ill.

NATIONAL.—Trade name for radio receivers manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

NATIONAL.—Trade name for electric air compressors manufactured by the Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill.

NATIONAL.—Trade name for portable lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

NATIONAL.—Trade name for oil burners for power plants manufactured by the National Airoil Burner Co., 9th & Thompson Sts., Philadelphia, Pa.

NATIONAL.—Trade name for air brakes and motor-driven air compressors manufactured by the National Brake & Electric Co., Belleview Pl., Milwaukee, Wis.

NATIONAL.—Trade name for furnace electrodes manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

NATIONAL.—Trade name for electrically operated cash registers manufactured by the National Cash Register Co., Main & K Sts., Dayton, Ohio.

NATIONAL.—Trade name for switchboards, rail bonds, trolley wheels and brass castings manufactured by the National Electric Co., 302 Kanawha National Bank Bldg., Charleston, W. Va.

NATIONAL.—Trade name for electric controlling devices manufactured by the National Electric Controller Co., 154 Whiting St., Chicago, Ill.

NATIONAL.—Trade name for electric cooking and heating devices manufactured by the National Electric Heating Co., Ltd., 544 Queen St., Toronto, Ont., Can.

NATIONAL.—Trade name for power transmission machinery and boiler grates manufactured by the National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa.

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NATIONAL.—Trade name for motor-driven electroplating barrel manufactured by the National Galvanizing & Plating Equipment Corp., 52 Broadway, New York, N. Y.

NATIONAL.—Trade name for weather-proof wire manufactured by the National India Rubber Co., Bristol, R. I.

NATIONAL.—Trade name for incandescent lamps manufactured by divisions of the National Lamp Works of General Electric Co., Cleveland, Ohio.

NATIONAL.—Trade name for conduit, outlet, switch boxes, covers, locknuts and other conduit fittings manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

NATIONAL.—Trade name for electric pianos manufactured by the National Piano Mfg. Co., Grand Rapids, Mich.

NATIONAL.—Trade name for feed-water heaters, purifiers, steam and oil separators and other power plant specialties manufactured by the National Pipe Bending Co., River & Lloyd Sts., New Haven, Conn.

NATIONAL.—Trade name for lubricating oils and greases manufactured by the National Refining Co., Cleveland, Ohio.

NATIONAL.—Trade name for regulators manufactured by the National Regulator Co., 208-12 S. Jefferson St., Chicago, Ill.

NATIONAL.—Trade name for code calling systems manufactured by the National Scale Co., Chicopee Falls, Mass.

NATIONAL.—Trade name for steam specialties manufactured by the National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill.

NATIONAL.—Trade name for electro-pneumatic water pumping systems manufactured by the National Utilities Corp., Belleview Pl., Milwaukee, Wis.

NATIONAL.—Trade name for railroad trolley guards manufactured by the Ohio Brass Co., Mansfield, Ohio.

NATIONAL.—Trade name for ozone air and water purifiers manufactured by the Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.

NATIONAL.—Trade name for electroplating equipment manufactured by the U. S. Electro Galvanizing Co., 28-34 Stockton St., Brooklyn, N. Y.

NATIONAL.—Trade name for electric washing machines manufactured by the Vacuum Washer Co., Ripon, Wis.

NATIONAL A.—Trade name for lighting fixtures manufactured by the National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill.

NATIONAL ACME CO., THE.—Cleveland, Ohio. Manufacturer of automatic screw machines and their products. Business established 1901. President and treasurer, A. W. Henn; vice-president and general manager, E. C. Henn; secretary, N. S. Rathburn; sales manager (product), A. W. Hopkins; sales manager (machinery), E. C. Woolgar. Main office, E. 131st St. & Colt Rd., Cleveland, Ohio. Factories, Cleveland, Ohio; Windsor, Vt.; Montreal, P. Q., Can. Branch offices and warehouses, 77 White St., New York, N. Y.; 23 S. Jefferson St., Chicago, Ill. District offices, 141 Milk St., Boston 9, Mass.; Majestic Bldg., Detroit, Mich.; 988 Ellicott Square Bldg., Buffalo, N. Y. Sales representatives, Hughson & Merton, Inc., 9 Main St., San Francisco, Cal.; V. A. Moore & Co., Healey Bldg., Atlanta, Ga.

NATIONAL ACME CO., THE.—278 De Courcelles, St. Henri, Montreal, Que., Can. Manufacturer of automatic screw machines and their products.

NATIONAL AIROIL BURNER CO.—9th & Thompson Sts., Philadelphia, Pa. Manufacturer of oil burners for power plants.

NATIONAL ASBESTOS MFG. CO.—163-193 Henderson St., Jersey City, N. J. Manufacturer of asbestos for electrical purposes. Business established 1907. President, J. A. Scharwath; vice-president, E. T. Connell; secretary, G. C. Hale; treasurer, H. J. Kennedy.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Organized at Buffalo, N. Y., 1901. An association of corporations, firms and individuals engaged in the installing of electrical materials, the repair of electrical apparatus and the retail sale of electrical appliances and supplies. It now has a membership of about 2200, located in 470 different cities of the United States and Canada. The Association is divided into four divisions known as the Atlantic, Central, Pacific and Canadian Divisions; the various state organizations are subsidiaries of these divisions, and the various district and local organizations form the state associations.

The objects of the National Association of Electrical Contractors and Dealers and its subsidiaries are: To promote the welfare of the industry; to distribute among the members data in regard to the business of electrical contracting and electrical retailing; to bring about more friendly relations throughout the trade; to elevate the standard of electrical installations and the quality of materials used, and to cooperate with the other national organizations in the industry in order that the public may be more efficiently and more economically served. Special effort is given to the collection and dissemination of data in reference to the cost of installations and general cost of doing business. As a result of this work, a standard cost accounting system for the retail electrical trade has been developed and adopted by the Association and has received the approval of all branches of the industry. A standard system of cost accounting for electrical installation work is being developed. Complete data are being compiled on the "overhead" costs of doing business.

Officers for 1921 are: National chairman, James R. Strong, New York, N. Y.; secretary-treasurer, W. H. Morton, 110 W. 40th St.; New York, N. Y.; special representative, Laurence W. Davis, 110 W. 40th St., New York, N. Y. The Executive Committee consists of Jas. R. Strong, New York; B. H. Bendheim, Chicago; T. M. Temphton, Detroit, as committeemen at large, and six members each from the Atlantic and Central Divisions, and two members each from the Pacific and Canadian Divisions. A national convention is held annually either in the summer or early fall, the sessions of which are open to the public.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS.—An association of electrical inspectors connected with various insurance organizations and municipalities. The Association has several sections, chiefly in the eastern part of the United States, and has usually held an annual convention in the East. Since 1917 it has not been as active as formerly. The secretary is Prof. Wm. Lincoln Smith, Northeastern College, Boston, Mass.

NATIONAL BOLT & NUT CO.—Pittsburgh, Pa. Manufacturer of bolts and nuts. President, John W. Hubbard; vice-president, S. A. Rankin; secretary and treasurer, E. W. Zinsmaster. Main office, Pittsburgh, Pa. Branch offices, New York, N. Y., and Chicago, Ill.

NATIONAL BRAKE & ELECTRIC CO.—Bellevue Pl., Milwaukee, Wis. Manufacturer of motor-driven air compressors and air brakes. President, R. P. Tell; secretary and treasurer, W. K. Boyle; general manager, P. H. Donovan.

NATIONAL BRAKE CO., INC.—888 Ellicott Sq., Buffalo, N. Y. Manufacturer of brakes for electric railway cars. President and general manager, Frank D. Miller; vice-president, J. L. Peacock; secretary, William D. Brewster; treasurer, H. D. Mills. Sales representatives, Eccles & Smith, Los Angeles, Cal.

NATIONAL BRONZE & ALUMINUM FOUNDRY CO., THE.—Cleveland, Ohio. Manufacturer of bronze and aluminum castings.

NATIONAL BRONZE & CHEMICAL WORKS.—220 W. 42nd St., New York, N. Y. Manufacturers of bronze powders, etc. Factory, Closter, N. J.

NATIONAL BUNDLE TYER CO.—Blissfield, Mich. Manufacturer of motor-driven tying machines. President, J. T. Carpenter; vice-president, J. J. Bachmayer; secretary, F. S. Saxton; treasurer, A. H. Saxton.

NATIONAL CAR COUPLER CO.—Attica, Ind. Manufacturer of car couplers and steel castings. President, J. W. Harrison; vice-president, R. J. Harrison; secretary and treasurer, G. W. Harrison. Main office, Attica, Ind. Branch office, 332 S. Michigan Ave., Chicago, Ill.

NATIONAL CARBON CO., INC.—1707 Madison Ave., Cleveland, Ohio. Manufacturer of ammeters, voltmeters, batteries, flashlights, commutator brushes and other carbon products. Business established 1882 as the Boulton Carbon Co. President, E. F. Price; vice-presidents, B. O'Shea, P. A. Rose, W. J. Knapp, F. A. Wilson-Lawrenson, H. E. Hackenberg; secretary, H. E. Hackenberg; treasurer, W. M. Beard; general manager, W. J. Knapp; sales manager, N. C. Cotabish. Factories, Cleveland, Fremont, Fostoria, Ohio; East St. Louis, Ill.; San Francisco, Cal.; Clarksburg, W. Va.; Niagara Falls, N. Y.; Long Island City, N. Y.; Jersey City, N. J.

NATIONAL CASH REGISTER CO., THE.—Main & K Sts., Dayton, Ohio. Manufacturer of electrically operated cash registers. Business established 1884. President and general manager, John H. Patterson; vice-president and general manager, J. H. Barringer; secretary, F. B. Patterson; treasurer, H. G. Carnell; sales manager, C. E. Steffey. Factories, Dayton, Ohio; Toronto, Ont., Can.

NATIONAL CHAIN CO.—8th St. & 3rd Ave., College Point, N. Y. Manufacturer of chandelier chains and electric welders. Business established 1909. President, C. H. Low; vice-president and general manager, Paul H. Low; secretary, treasurer and sales manager, C. W. Smith.

NATIONAL CO.—Cambridge 39, Boston, Mass. Manufacturer of mill wiring devices, power plant hardware and blueprint racks. Business established 1914. President and general manager, R. L. Douglass; treasurer, W. B. Hopkins.

NATIONAL CONDUIT & CABLE CO., INC.—Hastings-on-Hudson, N. Y. Manufacturer of wire and cables. President, H. J. Pritchard; vice-president, W. S. Eckert; treasurer and secretary, George F. Bauer. Branch offices, 41 Park Row, New York, N. Y.; 209 S. LaSalle St., Chicago, Ill.; 200 Devonshire St., Boston, Mass.; 639 Mission St., San Francisco, Cal.; 417 E. 3rd St., Los Angeles, Cal.

NATIONAL CONDUIT CO., LTD.—Dufferin & Queen Sts., Toronto, Ont., Can. Manufacturer of flexible interior conduit. President and general manager, Ross Clarke; secretary and treasurer, A. E. Allen.

NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS.—Organized February, 1919. An organization of manufacturers of lighting fixtures, fixture parts, table lamps, portables, reflectors and lighting specialties, formed to promote the good of the industry as a whole and to cooperate with each other for the solving of their own collective problems. The Council is vitally stimulating cohesion among the integral elements of the industry. It is effectively discouraging the policy of piracy of competing members' designs which has hitherto been rampant among the trade. It is laying the foundations for standardization of fixture parts and fittings, and ultimately of fixtures themselves. It is stimulating interest in proper and accurate systems of cost accounting, so that manufacturers may be in a position to know exactly what lines are bringing in profit and which should be eliminated or revised. It is allocating the relation of the lighting fixture industry to allied electrical activities, and furnishing a means of articulation to assure it its rightful place among them. It assists members to obtain satisfactory treatment from their own sources of supply. It is endeavoring to create a demand among the public and the dealers for a higher artistic standard for lighting fixtures.

Annual conventions are held in the various cities of the country. In conjunction with the convention, a Fixture Market is held to enable the dealers to inspect the latest developments in the lighting fixture industry and to make their selections from the goods displayed for the coming season. Officers for 1921 are: President, F. R. Farmer, Chicago, Ill.; vice-president, Wm. Horn; secretary, Chas. H. Hofrichter, Gordon Square Bldg., Detroit Ave. & West 65th St., Cleveland, Ohio; treasurer, B. F. Klein, Cleveland, Ohio.

NATIONAL DIFFUSED LIGHT CO.—136 W. Lake St., Chicago, Ill. Manufacturer of lighting fixtures. Proprietor, E. H. Strauss.

NATIONAL DISTRICT HEATING ASSOCIATION.—Organized 1909. An association of electrical central-station companies and men who are engaged in district heating from central generating plants. Its membership aggregates 293 and is divided into the following classes: 151 Class A members—operating companies and those engaged actively in operating district heating plants; 76 Class B members—employees or officers of Class A members; 13 Class C members—heating engineers and contractors; and 53 Associate members—those engaged in the manufacture of heating appliances and supplies. The Association has done much to standardize and otherwise aid district heating practice. A rule for computing required radiation was developed by the Association several years ago and has been almost universally adopted. Annual conventions are held in the various cities of the United States. The association publishes its proceedings in bound volumes. The Bulletin of the National District Heating Association is issued quarterly and has accomplished much in pre-

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senting the solutions of problems met with in district heating.

Officers for 1920-1921 are: President, J. L. Hecht, Public Service Co. of Northern Illinois, Chicago, Ill.; vice-presidents, J. H. Walker, Detroit, Mich.; E. L. Wilder, Rochester, N. Y.; W. G. Carlton, New York, N. Y.; secretary-treasurer, D. L. Gaskill, Greenville, O. The work of the association is divided among the standing committees: Public Policy, Station Operation, Rates, Educational, Heating Research, Accounting, Underground Construction, Rules and Regulations, Meters and Accessories, Auxiliary Gas and Heating, Membership.

NATIONAL ELECTRIC.—Trade name for electric ironing machines manufactured by the National Laundry Machinery Co., 700 W. 22nd St., Chicago, Ill.

NATIONAL ELECTRIC CO.—302 Kanawha National Bank Bldg., Charleston, W. Va. Manufacturer of castings, rail bonds and trolley wheels. Business established 1919. President and general manager, O. W. Kallmerten; vice-president and sales manager, William Schaffer; secretary and treasurer, Harry Eastwood. Sales representative, Howard B. Payne, House Bldg., Pittsburgh, Pa.

NATIONAL ELECTRIC CONTROLLER CO.—154 Whiting St., Chicago, Ill. Manufacturer of electric controlling devices. Business established 1907. Vice-president, Thomas Rhodus, Jr.; secretary, William Rhodus.

NATIONAL ELECTRIC FIXTURE CO.—17 S. Clinton St., Chicago, Ill. Manufacturer of lighting fixtures. President, W. C. Duncan; vice-president, William F. Higgins; secretary and treasurer, Bernard M. Smith.

NATIONAL ELECTRIC HEATING CO., LTD., THE.—544 Queen St., Toronto, Ont., Can. Manufacturer of electric cooking and heating devices. President, Leo Frankel; vice-president, B. Enuskevsky; secretary, treasurer and general manager, A. Pritzker; sales manager, C. M. Frankel.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—A national organization, founded in 1885, for the advancement of the art and science of production, distribution and use of electrical energy for light, heat and power for public service. In the furtherance of this object its activities are largely educational. The first convention was held in Chicago when about 100 men gathered together at the Grand Pacific Hotel. Those in attendance at this convention were mostly manufacturers, particularly of electrical equipment such as arc lamps and arc-lamp carbons. As the Association grew its membership among the central-station companies increased until these became the predominant factor in the work of the Association. The conventions were held semi-annually until 1892 and annually thereafter.

The first few years of the central-station business were largely devoted to the development and utilization of inventions and to the overcoming of many operating difficulties which presented themselves. Gradually many of these difficulties were surmounted and the progressive central stations began to devote more attention to the commercial side of their business. As a result, about 1908 it was decided to organize sections of the Association which would devote themselves to some of the other activities as well as the technical branch of the industry. These sections as first organized were Technical and Hydro-electric, Commercial, Accounting, Geographic and local or company sections were also organized, especially the latter.

The membership of the Association now consists of the following nine classes: Central-Station Company Members (Class A); Central-Station Individual Members (Class B); Invited Members (Class C); Manufacturer Company Members (Class D); Manufacturer Individual Members (Class E); Associate Company Members (Class F); Associate Individual Members (Class G); Foreign Members and Honorary Members. The membership as of Nov. 17, 1920, totaled 10,526, as follows: Class A, 1,121; Class B, 7,451; Class C, 93; Class D, 360; Class E, 1,434; Class F, 10; Class G, 1; and Foreign, 56.

The National Executive Committee, which is the governing body of the Association, consists of the president, the retiring president, the four vice-presidents, the treasurer, the presiding officer or other accredited representatives of each of the Geographic Divisions, the chairman of each of the National Sections, and nine members at large, six of whom are chosen from Class A and B members and three from Class D and E members.

Officers for 1921-22 elected at the 44th convention in Chicago on June 3, 1921, are: President, Milan R. Bump, chief engineer, Henry L. Doherty & Co., New York, N. Y.; first vice-president, Frank W. Smith; second vice-president, Walter H. Johnson; third vice-president, Franklin T. Griffith; fourth vice-president, James E. Davidson; treasurer, Harry C. Abell; executive manager, M. H. Aylesworth.

A general survey of the electrical industry made in 1919, with a view to broadening the activities of the Association to meet the ever increasing duties and responsibilities which accompany the growth, influence and importance of the electrical industry, resulted in the reorganization of the national headquarters staff. The organization at headquarters, located in the Engineering Societies Building, 29 West 39th St., New York, N. Y., is divided into several departments.

The Company Service Department is in charge of the "Rate Book," issued yearly with quarterly supplements: also "Rate Research," a weekly publication containing digests of commission and court decisions of importance to public utility companies. This department co-operates with the accounting committees and is prepared to give advice to members in the matters of technical accounting, rates, valuation, production, service and other problems.

The Department of Publicity is in charge of the publication of the monthly "N. E. L. A. Bulletin," and distributes to the membership letters of information regarding activities of the Association and developments within or affecting the industry. This department, in co-operation with the Advertising and Publicity Service Bureau, Commercial Section, makes available, on a nonprofit basis, various publications for member companies to distribute locally.

The Department of Engineering gathers statistics and deals with practical engineering problems affecting the industry today, such as inductive interference, the National Electrical Safety Code and electrolysis.

The N. E. L. A. correspondence courses for the education of employees of member companies and allied industries are available through the Department of Education.

In addition to some of the enumerated work of the foregoing departments, the Association is conducting many other activities, some of which are: Co-operation with the National Committee on Gas and Electric Service at Washington, D. C., with particular reference to the coal situation; co-operation with the Investment Bankers Association and other similar agencies, in promoting more favorable financial conditions; close working relations with public service commissions and other regulatory bodies in all matters associated with their supervision of operation of public utility companies; development of standards, also their adoption in co-operation with the American Engineering Standards Committee; co-operation with the United States Department of the Interior in a superpower survey of electrical resources along the eastern seaboard for the purpose of ascertaining any and all interconnection possibilities; co-operation with the United States Government in the matter of water-power developments; a practical and prompt service on all insurance matters as related to the electrical industry; a service calculated to help solve engineering problems as rendered by the recently created Technical Advisory Board; co-operation with each and every representative element of the electrical industry to the end that the industry may go forward in unison; and service to member companies in promoting cordial and profitable relations with employees.

The technical and attendant scientific and educational work of the Association, in addition to the work of the headquarter's staff, is carried on through appropriate subdivisions of the National Association known as the Accounting Section with 9 committees; Commercial Section with one department, 5 bureaus, 27 divisions, 17 committees, and 5 subcommittees; Public Relations Section with 7 committees; Technical Section with 10 committees, 4 geographic districts, 27 subcommittees, 4 sub-subcommittees; 4 General National Committees with 11 subcommittees; and 12 National Committees. There is a total of 173 committees of all classes exclusive of Geographic Division committees and several joint committees with other associations.

An annual convention is held usually in May or June of each year occupying about five days. The technical papers, discussions and reports presented at the convention are published annually in one or more bound volumes. The "Electrical Salesman's Handbook" and the "Meterman's Handbook" are published by the Association.

The revised constitution of the Association provides for the division of the United States and Canada into 13 Geographic Divisions, each division made up of two or more adjacent states, as follows: Eastern—New Jersey, New York, Pennsylvania; East Central—Kentucky, Ohio, West Virginia; Great Lakes—Illinois, Indiana, Michigan, Wisconsin; Middle Atlantic—Delaware, District of Columbia, Maryland, Virginia; Middle West—Iowa, Kansas, Missouri, Nebraska; New England—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont; North Central—Minnesota, North Dakota, South Dakota; Northwest—Alaska, Idaho, Montana, Oregon, Utah, Washington; Pacific Coast—Arizona, California, Hawaii, Nevada, Philippine Islands; Rocky Mountain—Colorado, New Mexico, Wyoming; Southeastern—Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, Porto Rico; Southwest—Arkansas, Louisiana, Mississippi, Oklahoma, Texas; and the Canadian Electrical Association—Canada.

Provisions are made for Company Sections and similar local clubs in the communities as integral parts of respective State Associations. State Associations administer intimately and intensively to State problems. Geographic Divisions are integral units of the National Association, each division having its own complete organization designed to administer to the requirements of Association members residing or engaged in business within the boundaries of a Division, which members of all classes become automatically members of such Geographic Divisions.

Where a Geographic Division consists of a group of states, none of which have included therein State Sections or Associations, or central-station company branches of state public utility associations, the officers and members of the Executive Committee of such Geographic Division are elected at an annual convention by the members of the National Electric Light Association residing or engaged in business within the boundaries of such Geographic Divisions.

In the case where a Geographic Division is made up of a number of states, all of which have their own state organizations and which organizations may hold separate annual conventions, which conventions may make unnecessary the holding of an annual Geographic Division convention, an annual Geographic Division conference is held to the end that the activities of the respective states may be coordinated and provision made for the functioning of the states as a Geographic Division.

Where a Geographic Division includes a number of states, some of which have their own state organizations, while other related states are not so organized, each of the organized states may be represented at a Geographic Division conference by representatives. Each of the States not organized would be represented at a conference by an equal number of representatives selected by a committee in each state, which committee should be elected by the N. E. L. A. members located in such state.

The Association has demonstrated that centralization of effort and production, with the greatest possible volume of output, are essential for the furthest economy and efficiency and to provide the maximum expansion, the highest standards of service, and the lowest rates to the public. It has lent its support to the great movement for the conservation of energy and of natural resources. It has favored and promoted reasonable state regulation by commission rather than wasteful competition as a means of assuring reasonable rates for service. It holds that no instance exists where public utility competition has not finally been at the expense of the community served, and that a regulated monopoly is the essential condition for best service.

The following is a list of the presidents of the National Electric Light Association from its organization in 1885 to date: 1885-88, James F. Morrison; 1888-89, Samuel A. Duncan; 1889-90, Edwin R. Weeks, 1890-91, Marsden J. Perry; 1891-92, Charles R. Huntley; 1892-93, James I. Ayer; 1893-94, Edw. A. Armstrong; 1894-95, M. Judson Francisco; 1895-96, C. H. Wilmerding; 1896-97, Frederic Nichols; 1897-98, Samuel Insull; 1898-99, Alden M. Young; 1899-1900, Samuel T. Carnes; 1900-01, James Blake Cahoon; 1901-02, Henry L. Doherty; 1902-03, Louis A. Ferguson; 1903-04, Charles L. Edgar; 1904-05, Ernest H. Davis; 1905-06, William H. Blood, Jr.; 1906-07, Arthur Williams; 1907-08, Dudley Farrand; 1908-09, William C. L. Eglin; 1909-10, Frank W. Frueauff; 1910-11, W. W. Freeman; 1911-12, John F. Gilchrist; 1912-13, Frank M. Tait; 1913-14, Joseph B. McCall; 1914-15, Holton H. Scott; 1915-16, E. W. Lloyd; 1916-17, Hubert A.

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Wagner; 1917-18, John W. Lieb; 1918-19, Walter F. Wells; 1919-20, R. H. Ballard; 1920-21, Martin J. Insull; 1921-22, Milan R. Bump.

NATIONAL ELECTRIC PIANO CO.—St. Johnsville, N. Y. Manufacturer of electrically operated pianos.

NATIONAL ELECTRIC PORCELAIN CO., THE.—Carey, Ohio. Manufacturer of electrical porcelain. Business established 1911. President and general manager, W. S. Bish; vice-president, W. R. Kurtz; secretary, J. D. Ewing; treasurer, H. F. Graves. Sales representatives, Ohio Distributing Co., 222 Lomax Pl., Chicago, Ill.; Robertson Supply Co., Birmingham, Ala.; A. J. Bressan Co., 120 Liberty St., New York, N. Y.; J. T. Pearson Co., 1220 Dime Savings Bank Bldg., Detroit, Mich.

NATIONAL ELECTRIC SPECIALTY CO., THE.—Toledo, Ohio. Manufacturer of lightning arresters. President, S. O. Richardson, Jr.; vice-president, Chris F. Wall; secretary and treasurer, L. L. D. Chapman.

NATIONAL ELECTRIC WATER HEATER CORP.—42nd St. & Broadway, New York, N. Y. Manufacturer of electric water heaters. President, treasurer and general manager, J. C. Feldman; secretary, Horace Broham. Factory, Newark, N. J.

NATIONAL ELECTRICAL CODE.—The National Electrical Code is a set of rules relating to electrical installations which is intended to prevent fire hazards. It is prepared by the Electrical Committee of the National Fire Protection Association and issued by the National Board of Fire Underwriters, 76 William St., New York City. It is enforced not only by inspection departments of the fire underwriters, but also by many municipal inspection departments which have adopted it. Other municipalities enforce rules which are substantially those of the National Electrical Code supplemented by additional regulations to more fully cover certain local conditions.

The Code consists of six parts: Class A deals with equipment found in generating stations and substations; Class B with outdoor lines; Class C with inside work; Class D with materials, fittings and details of construction; Class E with signaling systems and miscellaneous items; Class F with marine work. The rules of Class C are the most complete and valuable part of the Code and set an accepted standard for this class of work. They are kept up-to-date by frequent and thorough revision. They are very important because they deal with the installations found in factories, stores, residences, offices and public buildings, where equipment is used by persons not especially skilled in electrical operations; also with theaters, garages, motion-picture booths and other conditions of especial hazard. They have been an important and beneficial influence in directing electrical development along safe and conservative channels. The rules of Class D were extensively revised and curtailed in 1918, and many construction specifications omitted. This field is covered by the standards of Underwriters' Laboratories for the construction and test of electrical appliances. The rules remaining in Class D form a guide to the classification and identification of types, sizes, etc., and give such general requirements as are of use to the inspector. The rules of Class B and Class F have not been developed with the same completeness as Class C. The rules of Class A are more particularly applicable to small power plants, such as found in factories, rather than to large central stations.

The National Electrical Code was first issued in 1897 as the result of a national conference of engineering and underwriters' organizations, and was revised every two years by the Electrical Committee of the National Underwriters' Electric Association. In 1911 this work was taken over by the National Fire Protection Association, whose Electrical Committee is made up of members of the inspection departments of various underwriters' associations, several municipalities, Underwriters' Laboratories, and representatives of the following organizations: American Electric Railway Association, American Institute of Electrical Engineers, Associated Factory Mutual Fire Insurance Companies, Associated Manufacturers of Electrical Supplies, Electric Power Club, National Association of Electrical Inspectors, National Association of Electrical Contractors and Dealers, National Board of Fire Underwriters, National Electric Light Association, Electrical Supply Jobbers' Association, U. S. Bureau of Standards.

The current edition of the Code was issued in 1920. Sponsorship for this Code by the N. F. P. A. has been recognized by the American Engineering Standards Committee and future revisions will be carried out according to the scheme and methods of the latter. The N. F. P. A. and the Bureau of Standards have accepted joint sponsorship for a Combined Electrical Fire and Safety Code.

Copies of the National Electrical Code can usually be obtained locally from the underwriters' inspection department and also from the National Board of Fire Underwriters. The Code should be used in conjunction with the "List of Inspected Electrical Appliances" issued by Underwriters' Laboratories.

NATIONAL ELECTRICAL CREDIT ASSOCIATION.—Incorporated, not for pecuniary profit, under the laws of Illinois in 1898. Its objects are to promote a more cordial feeling among its members, to protect their mutual interests, to secure uniformity and certainty in the customs and usages of electrical trade and commerce, to settle differences among its members, to collect trade information and distribute it among its members, and to save them from making unsatisfactory credits.

The membership consists of the following six local associations: New England Electrical Credit Association, 161 Devonshire St., Boston, Mass.; New York Electrical Credit Association, 52 Broadway, New York City; Electrical Credit Association of the Middle and Southern Atlantic States, Land Title Bldg., Philadelphia, Pa.; Electrical Credit Association of the Central Division, 1350 Marquette Bldg., Chicago, Ill.; Denver Electrical Credit Association, Denver, Colo.; Electrical Credit Association of the Pacific Coast, 501 Flatiron Bldg., San Francisco, Cal.

Service by the Association consists of the publication of the "National Monthly Bulletin" containing the names of about 10,000 customers of doubtful credit standing; also "The Viewpoint," a monthly publication filled with credit and collection data. The members of the six local associations, comprising the N. E. C. A., report their slow and no-pay customers to the local organizations which, in turn, report to the national, thus interchanging ledger facts and credit experiences for the co-operative credit protection of nearly 800 leading electrical manufacturers and jobbers employing the system throughout the United States.

Officers for 1921 are: President, Charles R. Oliver, Wetmore-Savage Co., Boston; vice-president, Robert Edwards, Jr., Edwards & Co., New York; secretary-treasurer, Frederic P. Vose, Marquette Bldg., Chicago, Ill. On the board of managers, in addition to Messrs. Oliver and Edwards, are Clarence Kaeber, of the Electric Storage Battery Co., Philadelphia; B. P. George, Beardslee Chandelier Mfg. Co., Chicago; S. B. Anderson, Pacific States Electric Co., San Francisco.

NATIONAL ELECTRICAL SAFETY CODE.—The National Electrical Safety Code has been developed by the United States Bureau of Standards, the third edition being published in 1921 as Bureau Handbook No. 3. This Code is intended primarily to obviate electrical accidents. It consists of four parts. Part 1 contains rules for generating stations and substations, Part 2 for supply and signal lines, Part 3 for utilization equipment, and Part 4 for the operation of equipment and lines. A supplementary section gives rules for the protective grounding of circuits and equipment. A discussion of the rules of this Code is published separately by the Bureau as Handbook No. 4. The Bureau has also published Circular No. 72 entitled "Scope and Application of the National Electrical Safety Code."

This Code has been developed with the co-operation and assistance of many state commissions, electrical inspectors, engineers of operating and manufacturing companies, insurance representatives and committees of engineering societies and of the electrical workers. The rules have been made to recognize differences in climate, in density of population, and in character of attendance, where these show a difference in degree of hazard, as is particularly the case with overhead lines. It is the most complete set of rules on this subject ever formulated. The first complete edition of this Code was issued in 1916 for trial and constructive criticism. As revised in 1920, the rules have the substantial agreement of the various interests concerned, with the exception of a few matters concerning overhead lines where the conflicting interests could not reach agreement.

The Code has been adopted in whole or in part by a number of states such as Montana, Pennsylvania, Oregon and Wisconsin and in a number of others has formed the basis for commission orders. (See State electrical rules; also see Bureau of Standards.)

Copies of this Code can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 40 cents a copy.

NATIONAL ELECTRICAL SUPPLY CO.—1328-30 New York Ave., Washington, D. C. Manufacturer of automobile generator and lighting outfits and heating devices.

NATIONAL ELECTRO PRODUCTS, LTD.—Toronto, Ont., Can. Manufacturer of hydrogen and oxygen generators. Business established 1919. President and general manager, William J. Cluff; vice-president, Archibald J. MacDougall; secretary, Arthur W. Holmsted; treasurer, William Skelly; sales manager, J. H. Carson. Main office, 87 Church St., Toronto, Ont., Can. Factories, Toronto, Ont., Can., Montreal, Que., Can. Branch office, 149 Moreau St., Montreal, Que., Can.

NATIONAL ENAMELING & MFG. CO.—Renshaw Blvd., Pittsburgh, Pa. Manufacturer of rigid metallic interior conduit. Business established 1915. President, treasurer and sales manager, U. S. Armstrong; vice-president and general manager, B. B. White; secretary, B. F. Bachman. Sales representatives, Baker-Joslyn Co., San Francisco, Cal.; B. F. Clarke & Co., Philadelphia, Pa.; S. Robert Schwartz & Bro., 306 W. 93rd St., New York, N. Y.; Ludlow Jordan, Atlanta, Ga.

NATIONAL FIBRE & INSULATION CO.—Yorklyn, Del. Manufacturer of fibre sheets, rods, tubes, washers and specialties. Business established 1902. President and general manager, J. Warren Marshall; vice-president, H. W. Marshall; secretary and treasurer, J. A. Marshall; sales manager, S. E. Francis. Main office and factory, Yorklyn, Del. Branch office and warehouse, 216 W. Austin Ave., Chicago, Ill. District offices, Boston, Mass.; Rochester, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Pittsburgh, Pa.; Cleveland, Ohio; St. Louis, Mo.; Birmingham, Ala.; San Francisco, Cal.; 50 Church St., New York, N. Y.

NATIONAL FIRE PROOFING CO.—Pittsburgh, Pa. Manufacturer of clay underground conduit and other clay products. President, H. M. Keasbey; vice-president, V. L. Yebsen; secretary, C. G. Jones; treasurer, J. B. Robins. Main office, Pittsburgh, Pa. Branch offices, Boston, Mass.; Broadway & 23rd St., New York, N. Y.; Philadelphia, Pa.; 2600 Shields Ave., Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION.—An association of fire insurance underwriters, fire protection engineers and others interested in the reduction of fire hazards and the development of fire-fighting equipment. It is of direct interest to the electrical industry on account of its Electrical Committee, which has charge of the preparation and revision of the National Electrical Code. See Electrical Committee, N. F. P. A.

NATIONAL FLUE CLEANER CO., INC.—Groveville, N. J. Manufacturer of soot blowers. President, John L. Kuser; vice-president, Edwin J. Morris; secretary, J. Harry Thompson; treasurer, William McK. Morris.

NATIONAL FOLDING BOX CO.—New Haven, Conn. Manufacturer of cartons. President, D. S. Walton; vice-presidents, T. L. Cornell, J. S. Nugent; secretary, G. W. Mabee; treasurer, D. S. Walton, Jr.

NATIONAL FOUNDRY MFG. & SUPPLY CO.—Hepburn & Canal Sts., Williamsport, Pa. Manufacturer of power transmission machinery and boiler grates. Business established 1904. President, William T. Ehur; secretary and treasurer, R. M. Gingrich.

NATIONAL GALVANIZING & PLATING EQUIPMENT CORP.—52 Broadway, New York, N. Y. Manufacturer of electroplating equipment. Factory, Brooklyn, N. Y.

NATIONAL GAUGE CO.—300 Pacific St., Brooklyn, N. Y. Manufacturer of pressure and vacuum gages, thermometers, pyrometers, tachometers, counters and engineering instruments. Business established 1906. President, George M. Cowenhoven; vice-president, H. G. Cowenhoven; secretary, J. V. N. Cowenhoven.

NATIONAL INDIA RUBBER CO.—Bristol, R. I. Manufacturer of electrical wires and cables. Branch offices, 547 W. Randolph St., Chicago, Ill.; Boston, Mass.; Providence, R. I.

NATIONAL LAUNDRY MACHINERY CO.—700 W. 22nd St., Chicago, Ill. Manufacturer of electric ironing machines for small laundries, hotels, hospitals, etc. President and general manager, H. C. Keel; secretary, M. A. Keel.

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NATIONAL LEAD CO.—New York, N. Y. Manufacturer of babbitt metal, sleeving, solder, die castings, etc. President, Edward J. Cornish; vice-presidents, George O. Carpenter, R. P. Rowe, N. B. Gregg; secretary, M. D. Cole; treasurer, F. R. Fortmeyer. Main office, 111 Broadway, New York, N. Y. Branch offices, Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.

NATIONAL LEATHER BELTING CO.—423 E. 56th St., New York, N. Y. Manufacturer of leather belting.

NATIONAL LIGHTING FIXTURE MFG. CO.—176-180 Grand St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1914. President, George M. Tepfer; secretary, Phillip B. Tepfer; treasurer and general manager, Albert E. Tepfer.

NATIONAL LOCK WASHER CO.—Newark, N. J. Manufacturer of lock nuts. Business established 1886. President, C. H. Loutrel; vice-president, R. D. Reynolds; secretary and treasurer, J. D. Cowan; sales manager, J. Howard Horn. Main office and factory, 40 Hermon St., Newark, N. J. Branch office and warehouse, 1503 Kresge Bldg., Detroit, Mich. District office, 1535 Lytton Bldg., Chicago, Ill.

NATIONAL LUMBER CO.—Plymouth Bldg., Minneapolis, Minn. Producer of white cedar poles and posts. E. M. Oleson, manager.

NATIONAL MFG. & PRINTING CO.—Olney, Ill. Manufacturer of long-distance call-measuring telephone meters. H. H. Knipe, general manager.

NATIONAL MARINE LAMP CO., THE.—Forestville, Conn. Manufacturer of metal specialties, lamps, lanterns, etc., for ships, motor boats and railroads. Business established 1912. President, F. N. Manross; vice-president and general manager, R. Stern; secretary, J. Kleinberger; treasurer, H. Gernidsen; sales manager, E. T. Lindsey. Main office and factory, Forestville, Conn. Branch office, 254 Pearl St., New York, N. Y. Sales representative, Wright & Lacy, 254 California St., San Francisco, Cal.

NATIONAL METAL MOLDING CO.—Pittsburgh, Pa. Manufacturer of metal molding, conduit, conduit fittings, and armored cables and cords. Business established 1906. President, W. C. Robinson; vice-president and general manager, C. E. Corrigan; secretary, O. F. Felix; treasurer, H. H. Robinson; sales manager, V. J. Corrigan. Main office, Fulton Bldg., Pittsburgh, Pa. Factory, Ambridge, Pa. Branch offices, Detroit, Mich.; Atlanta, Ga.; Pittsburgh, Pa. Sales representatives, Farr Electric Service Co., Salt Lake City, Utah; Garnett Young & Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., and Seattle, Wash.; Albert Mann, Boston, Mass.; I. A. Bennett Co., 112 W. Adams St., Chicago, Ill.; Electrical Products Co., Philadelphia, Pa., and 253 Broadway, New York, N. Y.

NATIONAL METAL SPINNING & STAMPING CO.—176-180 Grand St., New York, N. Y. Manufacturer of fixture fittings and parts and metal spinnings. Business established 1908. President, George M. Tepfer; secretary, Phillip B. Tepfer; treasurer and general manager, Albert E. Tepfer.

NATIONAL PIANO MFG. CO.—Grand Rapids, Mich. Manufacturer of electric pianos. President and general manager, W. Loor; vice-president, Joseph Renihan; secretary and treasurer, S. D. Thompson.

NATIONAL PIN & BRACKET CO.—North Vernon, Ind. Manufacturer of insulators, brackets, pole steps and insulator pins. Business established 1910. President, treasurer and general manager, H. L. McNaughton; vice-president, Anna W. McNaughton; secretary, Blanch M. Stephenson. Sales representatives, Joslyn Mfg. & Supply Co., Chamber of Commerce Bldg., Chicago, Ill.; Jobbers Supply Co., Woolworth Bldg., New York, N. Y.

NATIONAL PIPE & CABLE HANGER CO.—137 E. 43rd St., New York, N. Y. Manufacturer of pipe and cable hangers. Business established 1915. Partnership, John G. Kelly and J. B. Heiser. Factory, Williamsport, Pa.

NATIONAL PIPE BENDING CO., THE.—River & Lloyd Sts., New Haven, Conn. Manufacturer of feed water heaters, purifiers, steam and oil separators and other power plant specialties. President and general manager, Harold S. Brown; vice-president, Thomas Hooker, Jr.; secretary and treasurer, Arthur H. Day; sales manager, William B. Hoyt.

NATIONAL PLASTIC RELIEF CO.—330 Main St., Cincinnati, Ohio. Manufacturer of lighting fixtures and portable electric lamps. Business established 1918. President, S. Newman; vice-president and secretary, S. J. Newman; treasurer, E. C. Newman; general manager, Charles M. Knoche; sales manager, F. W. Jellison.

NATIONAL POLE CO.—Escanaba, Mich. Producer of cedar ties, poles, posts and piling. President and general manager, J. C. Kirkpatrick; vice-president, H. W. Reade; secretary and treasurer, F. B. Bement. Branch offices and yards, New York, N. Y.; San Francisco, Cal.; Chicago, Ill.; Toledo, Ohio; Spokane, Wash.; Everett, Wash.; Duluth, Minn.; St. Paul, Minn.; Blackduck, Minn.; Kelliher, Minn.; Gemmell, Minn.; Baudette, Minn.; Itasca, Wis.; Park Falls, Wis.; Whitney, Mich.; L'Anse, Mich.

NATIONAL PORCELAIN CO.—Trenton, N. J. Manufacturer of porcelain sockets and insulators. Business established 1906. President, Samuel L. Dunkle; secretary, treasurer and general manager, Bayard L. Dunkle.

NATIONAL QUALITY.—Trade name for tanks made by the National Tank & Pipe Co., 275 Oak St., Portland, Ore.

NATIONAL RAILROAD TROLLEY GUARD CO.—Olean, N. Y. Manufacturer of trolley wheel guards.

NATIONAL RAILWAY APPLIANCE CO.—New York, N. Y. Manufacturer of electric car heaters. President, B. A. Hegeman; vice-president, Charles C. Castle; vice-president and treasurer, H. A. Hegeman; secretary, Fred C. J. Dell; sales manager, W. C. Lincoln. Main office, 50 E. 42nd St., New York, N. Y. Branch offices, Munsey Bldg., Washington, D. C.; Little Bldg., Boston, Mass.; Hegeman-Castle Corp., 332 S. Michigan Ave., Chicago, Ill.

NATIONAL REFINING CO., THE.—Cleveland, Ohio. Manufacturer of lubricating oils and greases. Refineries, Coffeyville, Kans.; Findlay, Ohio; Marietta, Ohio; Cleveland, Ohio; Petrolia, Can.

NATIONAL REGULATOR CO., THE.—Chicago, Ill. Manufacturer of temperature regulators. President and treasurer, J. H. King; vice-president, J. B. Lord; secretary, J. M. Larson. Main office and factory, 208-12 S. Jefferson St., Chicago, Ill. Branch offices, New York, N. Y.; Boston, Mass.; Philadelphia, Pa; Washington, D. C.; Buffalo, N. Y.; Pittsburgh, Pa.; Winnipeg, Man., Can.; Des Moines, Iowa; Minneapolis, Minn.; Denver, Colo.; Milwaukee, Wis.; Los Angeles, Cal.; Seattle, Wash.; Montreal, Que., Can.; Cleveland, Ohio; Toledo, Ohio; Indianapolis, Ind.; St. Louis, Mo.; Kansas City, Mo.; Detroit, Mich.; Toronto, Ont., Can.

NATIONAL RETAILERS ADVERTISING CORP.—1846-48 Ogden St., Indianapolis, Ind. Manufacturer of electrical advertising specialties and electric signs. President, F. A. Gritt; vice-president, A. E. Gritt; secretary, C. W. Gritt.

NATIONAL SCALE CO.—Chicopee Falls, Mass. Manufacturer of code calling systems. President, F. D. Howard; treasurer, L. I. Howard.

NATIONAL SCREW & TACK CO., THE, AB PRODUCTS DIVISION.—Cleveland, Ohio. Manufacturer of motors, fans, arc lamps, reflectors and shades. President, W. D. B. Alexander; vice-president, J. E. Williams; sales manager (AB Products Division), W. G. Roland.

NATIONAL SEWING MACHINE CO.—Belvidere, Ill. Manufacturer of sewing machines, washing machines, screw machine products, etc. Business established 1879. President, David Patton; vice-president, John W. Eldredge; secretary, H. D. Pierce. Main office, Belvidere, Ill. Factories, Belvidere, Ill., and Chicago, Ill. Branch office and warehouse, 21 N. Wabash Ave., Chicago, Ill. District office, 290 Broadway, New York, N. Y. Exclusive distributor of electric sewing machines, Western Electric Co., Inc., 195 Broadway, New York, N. Y.

NATIONAL SPECIALTIES CO., INC.—54 W. La Fayette Blvd., Detroit, Mich. Manufacturer of incandescent lamps. Business established 1919. President, E. V. Fitzpatrick; vice-president and general manager, E. L. Fitzpatrick; secretary, O. L. Fitzpatrick; treasurer and sales manager, E. E. Fitzpatrick. Branch office, 501 Marion Bldg., Cleveland, Ohio.

NATIONAL SPOT LIGHT CO.—605 California Bldg., Los Angeles, Cal. Manufacturer of electric spotlights.

NATIONAL STAMPING & ELECTRIC WORKS.—410 S. Clinton St., Chicago, Ill. Manufacturers of electric water heaters. Business established 1891. President, F. L. Kohlhase; sales manager, Clyde E. Padden.

NATIONAL-STANDARD CO. — Niles, Mich. Manufacturer of automobile jacks and railroad track tools. President, W. F. Harrah; vice-president, C. K. Anderson; secretary and treasurer, W. H. Parkin. Main office, Niles, Mich. Branch offices, Atlanta, Ga.; New York, N. Y.; Providence, R. I.; Dallas, Tex.; Chicago, Ill.; Seattle, Wash.

NATIONAL STEAM SPECIALTY CO.—12-14 S. Clinton St., Chicago, Ill. Manufacturer of steam specialties. President and treasurer, R. W. Newton; vice-president, A. B. Chladek; secretary, H. R. Young.

NATIONAL STEEL CASTING CO.—Montpelier, Ind. Manufacturer of car couplings.

NATIONAL TANK & PIPE CO.—275 Oak St., Portland, Ore. Manufacturer of crossarms and tanks. Business established 1891. President, William E. Hampton; vice-president and general manager, F. M. Kirsch; secretary, J. W. Willis; sales manager, B. C. Teydel.

NATIONAL TELEGRAPHONE & SUPPLY CO.—317 Mills St., El Paso, Tex. Manufacturer of telephone and telegraph composite systems. Business established 1902. President and treasurer, W. B. Glardon; vice-president, Mrs. Etta Milligan; secretary, B. T. Glardon; sales manager, G. T. Glardon.

NATIONAL TRANSIT PUMP & MACHINE CO.—Oil City, Pa. Manufacturer of steam pumps and oil engines. President, F. D. Williams; vice-president and treasurer, D. R. MacKenzie; secretary, S. R. Ball. Main office and factory, Oil City, Pa. Branch offices, 30 Church St., New York, N. Y.; Reliance Bldg., Kansas City, Mo.; Park Bldg., Cleveland, Ohio; DeLong Bldg., Philadelphia, Pa.; Farmers Bank Bldg., Piftsburgh, Pa.; Foster Bldg., Denver, Colo.; Mason Bldg., Houston, Tex.

NATIONAL UTILITIES CORP.—Belleview Pl., Milwaukee, Wis. Manufacturer of electropneumatic water pumping systems. President, R. P. Tell; vice-president, A. C. Deverell; secretary and treasurer, W. K. Boyle.

NATIONAL VALVE & MFG. CO.—Pittsburgh, Pa. Manufacturer of power plant pipe, valves, etc. Henry E. Haller, president. Main office and factory, Arsenal Station, Pittsburgh, Pa. Branch offices, Chicago, Ill.; New York, N. Y.; Cleveland, Ohio; Atlanta, Ga.; Philadelphia, Pa.

NATIONAL WASTE CO.—Philadelphia, Pa. Manufacturer of cotton cleaning waste and packing. President and treasurer, Clayton C. Ingraham; vice-president, George H. Green; general manager, N. A. Katherman. Main office, Philadelphia, Pa. Branch office, 935 N. Halsted St., Chicago, Ill.

NATIONAL X-RAY REFLECTOR CO.—Chicago, Ill. Manufacturer of reflectors, lighting fixtures, portable lamps and other lighting equipment. Business established 1897. President, A. D. Curtis; vice-president, P. M. Hotchkin; secretary, E. L. Haines; treasurer, J. W. Marshall; sales manager, Norman B. Hickox. Main office, 235 W. Jackson Blvd., Chicago, Ill. Branch offices, 31 W. 46th St., New York, N. Y.; 742 S. Market St., San Francisco, Cal.

NATISCH GEAR WORKS.—451 Hudson Ave., Brooklyn, N. Y. Manufacturers of pinions. Business established 1918. President, William Natisch; vice-president, treasurer and general manager, George Scherr; secretary, T. Nermer.

NAUGLE POLE & TIE CO.—Chicago, Ill. Producer of posts, poles and ties. President and treasurer, A. T. Naugle; vice-president, C. E. Maxwell; secretary, E. M. Naugle; sales manager, W. G. Frostenson. Main office, 5 S. Wabash Ave., Chicago, Ill. Yards, Chicago, Ill.; Pinconning, Mich.; Green Bay, Wis.; Minneapolis, Minn. Branch offices, 615 Dwight Bldg., Kansas City, Mo.; 303 Interurban Bldg., Dallas, Tex.; 41 Park Row, New York, N. Y.; 21 S. High St., Columbus, Ohio; 618 S. 27th St., Omaha, Neb.; 546 Peyton Bldg, Spokane, Wash.

NAUTICAL INSTRUMENTS MFG. CO., INC.—558 Hendrix St., Brooklyn, N. Y. Manufacturer of navigation instruments. Business established 1918. President, T. Jullum; vice-president, E. B. Eriksen; secretary, LeRoy Jones; treasurer, J. E. Sharp; general manager, J. P. Cody.

NAUTICO.—Trade name for nautical instruments manufactured by the Nautical Instruments Mfg. Co., Inc., 558 Hendrix St., Brooklyn, N. Y.

NAVAL APPLICATIONS OF ELECTRICITY.—See Marine and naval applications of electricity.

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NAVALITE.—Trade name for rigid metallic conduit manufactured by the Mark Mfg. Co., 111 W. Washington St., Chicago, Ill.

NAVCO.—Trade name for power plant pipes, valves, etc., manufactured by the National Valve & Mfg. Co., Arsenal Station, Pittsburgh, Pa.

NAVY.—Trade name for radio receivers manufactured by C. Brandes, Inc., 32 Union Sq., New York, N. Y.

NAZEL ENGINEERING & MACHINE WORKS.—4041 N. 5th St., Philadelphia, Pa. Manufacturers of motor-driven hammers. Business established 1900. President, Ralph W. Nazel; vice-president, C. H. Wackernagel; secretary and treasurer, J. Milton Nazel. Sales representatives, Charles A. Strelinger Co., 43 E. Larned St., Detroit, Mich.; Frank B. Ward Co., 501 Park Bldg., Pittsburgh, Pa.; William K. Stamets, Hickox Bldg., Cleveland, Ohio; Blackman Hill McKee Machinery Co., 1513 N. Broadway, St. Louis, Mo.

NEBCO.—Trade name for lightning rods manufactured by the Nebraska Lightning Rod Co., Inc., 205 N. 17th St., Omaha, Neb.

NEBRASKA.—Trade name for insulator pins manufactured by the St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

NEBRASKA BRIDGE SUPPLY & LUMBER CO.—Peters Trust Bldg., Omaha, Neb. Producer of wood poles. Business established 1899. President, John W. Towle; vice-president and general manager, George Rasmussen; secretary and sales manager, G. H. Rheams; treasurer, A. T. Hansen.

NEBRASKA LIGHTNING ROD CO., INC.—205 N. 17th St., Omaha, Neb.

NEBRASKA SECTION, N. E. L. A.—Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co.. Beatrice, Neb.

NEBRASKA TELEPHONE ASSOCIATION.—President, Warren Pratt Kearney; secretary, L. E. Hurtz, Lincoln, Neb.

NEBULITE.—Trade name for illuminating glassware manufactured by Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.

N. E. C.—Abbreviation for National Electrical Code.

N. E. C.—Trade name for electrolytic copper produced by the Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.

NECO.—Trade name for loom fasteners manufactured by the E. & B. Mfg. Co., 965 Woodward Ave., Detroit, Mich.

N. E. C. S. OR N. E. C. STD.—Abbreviations for National Electrical Code Standard.

NEEMES BROS., INC.—41-49 Adams St., Troy, N. Y. Manufacturer of boiler furnace grates.

NEFCOLITE.—Trade name for lighting fixtures manufactured by the National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill.

NEGATIVE.—In electricity, having a potential or voltage opposed to the positive, or one less than that of the earth or "ground"; in mathematics, having a value less than zero. For further discussion and comparison see Positive and negative.

NEHRING ELECTRICAL WORKS.—De Kalb, Ill. Manufacturers of slow-burning and weatherproof wires. Business established 1916. President and general manager, Paul A. Nehring; vice-president, G. E. Clarke; secretary and treasurer, A. L. Clarke. Sales representative, J. P. Lane, 811 Holland Bldg., St. Louis, Mo.

NEIL & SMITH ELECTRIC TOOL CO., THE.—813-815 Broadway, Cincinnati, Ohio. Manufacturer of electric tools. Business established 1900. President, John N. Neil; secretary and treasurer, George P. Jung.

NEISCOLITE.—Trade name for lighting fixtures manufactured by the New England Incandescent Supply Co., 266 Bowery, New York, N. Y.

N. E. L. A.—Abbreviation for National Electric Light Association.

NELA SPECIALTIES DIVISION, NATIONAL LAMP WORKS OF G. E. CO.—Nela Park, Cleveland, Ohio. Manufacturer of artificial daylight units and illuminating specialties. Established 1915. General manager, C. W. Bender; assistant manager, W. L. Brandel. Branch office, 145 W. 45th St., New York, N. Y.

NELSON, SAMUEL.—1748 Grace St., Chicago, Ill. Manufacturer of brush holders. Proprietor, Samuel Nelson.

NELSON VALVE CO.—Philadelphia, Pa. Manufacturer of expansion joints and valves. President, S. F. Houston; general manager, J. Noll; sales manager, R. G. Ward. Main office, Chestnut Hill, Philadelphia, Pa. Branch offices, 1320 Healey Bldg., Atlanta, Ga.; 8 E. Lombard St., Baltimore, Md.; 131 State St., Boston, Mass.; 582 Ellicott Sq., Buffalo, N. Y.; 650 W. Lake St., Chicago, Ill.; 550 Kirby Bldg., Cleveland, Ohio; 242 Larned St., W., Detroit, Mich.; 90 West St., New York, N. Y.; 517 Liberty Ave., Pittsburgh, Pa.; 75 Fremont St., San Francisco, Cal.; 504 City Bank Bldg., Syracuse, N. Y.

NEMALITE.—Trade name for illuminating glassware manufactured by Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.

NEOTHERM CELL.—A type of primary cell using the combination copper-sodium hydroxide-zinc, with copper oxide as a depolarizer; a modification of the Lalande cell.

NEPAGE - McKENNEY CO. — Seattle, Wash. Manufacturer of switchboards, panelboards, steel cabinets, metal castings, etc. Main office and factory, Armour Bldg., Seattle, Wash. Branch offices, 388 Burnside St., Portland, Ore.; 589 Howard St., San Francisco, Cal.; 517 18th St., Oakland, Cal.; 1222 McGee St., Kansas City, Mo.

NEPTUNE.—Trade name for insulated wire and cable made by the Atlantic Insulated Wire & Cable Co., 52 Vanderbilt Ave., New York, N. Y.

NEPTUNE AND NEPTUNE DYNAMO.—Trade names for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

NEPTUNE METER CO.—New York, N. Y. Manufacturer of air, water and other meters. President and treasurer, J. H. Ballantine; secretary, J. Bayard Kirkpatrick. Main office, 50 E. 42nd St., New York, N. Y. Branch offices, 565-71 W. Washington Blvd., Chicago, Ill.; Cincinnati, Ohio; Los Angeles, Cal.; San Francisco, Cal.; Denver, Colo.; Portland, Ore.; Boston, Mass.

NEPTUNE SHIP SUPPLY CO., INC.—73 Front St., New York, N. Y. Manufacturer of feed water regulators. President, S. J. Bethauer; vice-president and treasurer, S. Kahn; secretary, E. W. Curtin.

NERFCO.—Trade name for lamp making machinery, electric water heaters, filing machines, etc., manufactured by the Newark Engineering & Tool Co., 476-482 18th Ave., Newark, N. J.

NERNST LAMP.—See Lamps, Nernst.

N. E. S. C.—Abbreviation for National Electrical Safety Code.

NESTED.—Trade name for letter boxes manufactured by the S. H. Couch Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

NETS AND GUARDS FOR BOWLS, CLUSTERS, GLOBES, ETC.—These are stiff wire nets, often in basket form, that are used to protect lighting units in gymnasiums, factories, baggage rooms, cargo spaces, etc., where there is likelihood of lamp clusters, bowls, globes or reflectors being broken. Where the cluster or other unit is mounted on or close to the ceiling, the net or guard often completely encloses it and may be attached to the ceiling by a hinge and hasp. In case of pendent units it is attached to the metal reflector, fixture stem or other suitable part. Where no metal reflector is used the net is sometimes made in two parts, the lower part being hinged to the upper or fixed part to give access to the reflector or bowl and lamps for cleaning and renewal. Sometimes the net or guard is locked to prevent tampering or theft. Where a lighting unit is mounted over machinery, tanks, vats, etc., it is often advisable to use a more closely woven net to prevent any part of the glassware or the lamps themselves from dropping in case of cracking or other breakage or loosening from vibration. Guards for individual incandescent lamps are made somewhat differently and are listed under Guards, lamp.

Manufacturers:

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Hamblin & Russell Mfg. Co., Worcester, Mass. "Meridian," "Webster."

NETWORKS, HIGH-TENSION.—The inter-connection of high-tension mains into a network similar to a low-tension network is not feasible, and the distributing mains of a 2200-volt system are not often interconnected. Automatic isolation of a faulty section of a high-tension line is secured by relays actuating oil switches or circuit breakers capable of interrupting several thousands of kilowatts. The expense of this equipment limits its use to lines serving large loads. High-tension interconnection is therefore found only in large industrial and metropolitan districts and is still undergoing development and improvement.

NETWORKS, LOW-TENSION.—In low-tension distributing systems the mains are tied together at junctions forming a network of conductors. The system may thus supply its load from two directions and at junction points from four. This makes it a stable source of supply if properly supported by feeders. In a 250-volt system a feeder is required for each 200 to 250 kw. of load. The feeders are of different lengths and must be supplied from buses having sufficient pressure to enable them to deliver full pressure at the network end. Two or three buses are necessary in stations supplying smaller areas and as many as five buses are used in large stations in some cases.

NEUBUS.—Trade name for standard lighting panels manufactured by the Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.

NEUTRAL WIRE.—In a three-wire system of electrical distribution, the middle wire or conductor, which is usually grounded, is known as the neutral. This system is usually employed in lighting service with a voltage of approximately 110 between the neutral and either outside wire, or 220 across the outside wires. If the load is properly balanced by placing the same number of equivalent lamps on either side of the neutral there will be little or no current flowing in this middle wire as the effect will be that of pairs of lamps, two in series, connected across the outside of 220-volt wires. This allows the neutral wire to be smaller in cross-section. The three-wire system with neutral is either direct current or single phase and should not be confused with the three-phase system of power and light distribution which uses three conductors. Also see Systems of Distribution, development of.

NEUTRALIZERS, STATIC ELECTRICITY.—The constant friction of nonconducting moving materials, such as paper in printing presses; wool, silk and cotton in textile mills; leather or rubber belts in various machines, etc., produces considerable static electricity which causes trouble with the charged material in the machine sticking to surfaces, etc., during very dry weather. There is also danger of fire and explosion caused by static discharges, especially in a dust-laden or other explosive atmosphere. To eliminate this danger the air in the room may be made humid to decrease the accumulation of static or the charge may be continuously conducted to the ground or neutralized. The collecting device used in conducting the electricity off the material, belt or other charged object, is sometimes called a neutralizer, although it is more properly designated a discharger. This device consists of grounded comb-like metal contact points set up near the moving belt or sheet. The real neutralizers apply a high-tension static discharge of opposite polarity to the one causing trouble, this discharge being adjustable to suit the conditions prevailing.

Manufacturers:

Chapman Electric Neutralizer Co., Portland, Me.
Portland Co., The, Portland, Me.

NEVER BREAK.—Trade name for lamp guard manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

NEVER CREEP.—Trade name for guy anchors manufactured by the Chance Co., Centralia, Mo.

NEVER-GIVE-UP.—Trade name for expansion shells and toggle bolts manufactured by the Paine Co., 1742 W. Van Buren St., Chicago, Ill.

NEVER-LEAK.—Trade name for cylinder-head gaskets manufactured by the Fitzgerald Mfg. Co., Torrington, Conn.

NEVER MISS.—Trade name for conduit mandrels manufactured by B. S. Barnard & Co., 31 Union Sq., New York, N. Y.

NEVEROUT.—Trade name for automobile heaters, spotlights, signals and other automobile electrical accessories manufactured by the Rose Mfg. Co., 910 Arch St., Philadelphia, Pa.

NEVERSLIP.—Trade name for side-cutting pliers manufactured by the Neverslip Works, Hamilton & Neilson Sts., New Brunswick, N. J.

NEVERSLIP.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

NEVERSLIP WORKS, THE. — New Brunswick, N. J. Manufacturer of pliers and wrenches. President, James W. Johnson; vice-president and secretary, Roy C. Nicholas; treasurer and general manager, George F. McCormick; Western sales manager, Fred M. Joiner; Eastern sales manager, B. J. Trumbull. Main office and fac-

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tory, Hamilton & Neilson Sts., New Brunswick, N. J. Branch office, Montreal, Que., Can.

NEW ADVANCE MACHINERY CO., THE.—Van Wert, Ohio. Manufacturer of electrically heated glue pots.

NEW BEDFORD VALVE MFG. CO.—New Bedford, Mass. Manufacturer of valves. Business established 1872.

NEW BRITAIN.—Trade name for electricians' benches, machinery guards and screw machine products manufactured by the New Britain Machine Co., New Britain, Conn.

NEW BRITAIN MACHINE CO.—New Britain, Conn. Manufacturer of electricians' benches, machinery guards and screw machine products. Business established 1887. President and treasurer, H. H. Pease; vice-presidents, A. Boul, S. T. Goss, C. R. Hare; secretary, R. S. Brown; sales manager, H. E. Erwin. Main office and factory, New Britain, Conn. Branch offices, 50 Church St., New York, N. Y.; Bourse Bldg., Philadelphia, Pa.; 1120 Otis Bldg., Chicago, Ill.; 46 Garfield Bldg., Detroit, Mich.; 812 Engineers Bldg., Cleveland, Ohio; 75 Fremont St., San Francisco, Cal.

NEW DEPARTURE MFG. CO.—Bristol, Conn. Manufacturer of ball bearings. President, DeWitt Page; vice-president, F. P. Furlong; secretary, A. C. Hitchcock; treasurer, W. E. Wightman. Main office and factory, Bristol, Conn. Branch offices, 2721 S. Michigan Ave., Chicago, Ill.; 3044 W. Grand Blvd., Detroit, Mich.

NEW ENGLAND. — Trade name for switches manufactured by J. I. Paulding, Inc., New Bedford, Mass.

NEW ENGLAND BRASS & FIXTURE CO.—77 Summer St., Boston, Mass. Manufacturer of lighting fixtures and portable electric lamps. President, Gabriel B. Levy. Sales representatives, Brandt Dent Co., Watertown, Wis.

NEW ENGLAND BUTT CO.—403 Pearl St., Providence, R. I. Manufacturer of wire polishing machines.

NEW ENGLAND CHAIN WORKS.—12 Pearl St., Boston, Mass. Manufacturers of power transmission chains. President, Russel Hobbs; secretary, H. M. Chamberlain; treasurer and general manager, Clinton E. Hobbs.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION.—President, Allan R. McDonald, Boston, Mass.; secretary, James A. Loring, 161 Devonshire St., Boston, Mass.

NEW ENGLAND ELECTRICAL WORKS.—Lisbon, N. H. Manufacturer of insulated wires and cables. Business established 1899. President and general manager, B. S. Webb; secretary and treasurer, W. E. Price. Sales representatives, James Goldmark Co., 83 Warren St., New York, N. Y.

NEW ENGLAND GEOGRAPHIC DIVISION, N. E. L. A.—President, Bowen Tufts, Boston, Mass.; secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW ENGLAND INCANDESCENT SUPPLY CO.—266 Bowery, New York, N. Y. Manufacturer of lighting fixtures.

NEW ENGLAND MICA CO.—Waltham 54, Mass. Manufacturer of mica and mica products. President, T. B. Plimpton; vice-president, William Cooper; secretary, Edward Cooper; treasurer and general manager, C. G. Plimpton. Main office and factory, Waltham, Mass. Branch office, 253 Broadway, New York, N. Y.

NEW ENGLAND ROLLER GRATE CO.—95 Liberty St., Springfield, Mass. Manufacturer of boiler grates. President, David Hale; secretary and treasurer, James Hale.

NEW ENGLAND VENTILATING & HEATING CO.—926 Manton Ave., Providence, R. I. Manufacturer of exhaust fans. Business established 1880. President and treasurer, W. S. Williams.

NEW ENGLAND WIRE MACHINERY CO.—Water Front St., New Haven, Conn. Manufacturer of wire machinery. President, G. F. Waterbury; vice-president, Josiah Judd; secretary, Charles M. Steele; treasurer and sales manager, H. W. Manson.

NEW ERA.—Trade name for cake and dough mixers manufactured by the American Oven & Machine Co., 111 W. Washington St., Chicago, Ill.

NEW ERA.—Trade name for commercial lighting unit manufactured by the Crescent Brass Products Co., 8410 Lake Ave., Cleveland, Ohio.

NEW ERA.—Trade name for babbitt metal manufactured by the New Era Mfg. Co., Inc., 730 Cobb Ave., Kalamazoo, Mich.

NEW ERA.—Trade name for motor-driven printing presses manufactured by the Regina Co., 47 W. 34th St., New York, N. Y.

NEW ERA MFG. CO., INC.—730 Cobb Ave., Kalamazoo, Mich. Manufacturer of babbitt metal and packing for pistons, valves, rods, etc. Business established 1901. Vice-president and sales manager, C. C. Hall; secretary, John C. Dreher; treasurer, Frank A. Nason; general manager, F. A. Nason. Sales representatives, Endura Mfg. Co., 63rd & Eastwick Sts., Philadelphia, Pa.; Charles F. Ames & Co., 90 West St., New York, N. Y.

NEW HAVEN.—Trade name for sandblast equipment manufactured by the New Haven Sand-Blast Co., 6 Church St., New Haven, Conn.

NEW HAVEN COPPER CO., THE.—Seymour, Conn. Manufacturer of sheet copper, copper anodes and auger bits. Business established 1849.

NEW HAVEN SAND-BLAST CO.—6 Church St., New Haven, Conn. Manufacturer of sandblast equipment. President, Alfred E. Hammer; secretary and treasurer, C. E. Billings.

NEW HAVEN SCREW CO.—New Haven, Conn. Manufacturer of screw machine products, pipe couplings, etc. President, P. B. Foster; treasurer and general manager, L. G. Richardson.

NEW HOME.—Trade name for electric sewing machine manufactured by the New Home Sewing Machine Co., Orange, Mass.

NEW HOME SEWING MACHINE CO.—Orange, Mass. Manufacturer of electric sewing machines. President, Charles R. Scarborough; vice-president and treasurer, H. S. Dawley; vice-president and sales manager, A. H. Chadbourne; secretary, W. L. Ranney. Main office and factory, Orange, Mass. Branch offices, 427 S. Wabash Ave., Chicago, Ill.; 204 Pacific Bldg., San Francisco, Cal.

NEW JERSEY ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Chairman, Chas. R. Newman, 414 Passaic Ave., Passaic, N. J.; secretary, Geo. E. Davis, 15 Central Ave., Newark, N. J.

NEW JERSEY CAR SPRING & RUBBER CO., INC.—Jersey City, N. J. Manufacturer of axle generator belting for car lighting equipments. Business established 1858. Sales manager, A. E. Vinton.

NEW JERSEY FOUNDRY & MACHINE CO.—90 West St., New York, N. Y. Manufacturer of electric traveling cranes. President, Henry B. Newhall, Jr.; vice-president, Lewis R. Conklin; vice-president and general manager, E. N. Hescock; treasurer, Clifford Willis. Factory, Garwood, N. J.

NEW JERSEY TUNGSTEN LAMP CO.—Hoboken, N. J. Manufacturer of tungsten incandescent lamps.

NEW JERSEY ZINC CO., THE.—New York, N. Y. Manufacturer of zinc and zinc products. Business established 1848. President, Edgar Palmer; vice-presidents, J. E. Hayes and A. P. Cobb; secretary, A. B. Schultz; treasurer, H. S. Wardner; general manager, W. L. Coursen; sales manager, E. V. Peters. Main office, 160 Front St., New York, N. Y. Factories, Palmerton, Pa.; Franklin, N. J.; Mineral Point, Wis.; Depue, Ill.; Canon City, Colo. Branch office, 1439 Oliver Bldg., Pittsburgh, Pa. Sales representative, Mineral Point Zinc Co., 1111 Marquette Bldg., Chicago, Ill.

NEW JUDSON.—Trade name for engine governors manufactured by the Judson Governor Co., Rochester, N. Y.

NEW KEYSTONE.—Trade name for lamp guards manufactured by the Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa.

NEW LIBERTY.—Trade name for electric washing machines manufactured by the Fosston-Carpenter Co., 473 Cleveland Ave., N., St. Paul, Minn.

NEW LIFE.—Trade name for electric vibrators manufactured by the Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

NEW MEXICO ELECTRICAL ASSOCIATION.—President, E. A. Roberts; secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW MODEL.—Trade name for electric peanut blanchers and stoners manufactured by the Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.

NEW PREMIER.—Trade name for electric vacuum cleaners manufactured by the Electric Vacuum Cleaner Co., Inc., Ivanhoe Rd., Cleveland, Ohio.

NEW PROCESS.—Trade name for wood separators for storage batteries manufactured by the Ermet Mfg. Co., 16th & Sherman Drive, Indianapolis, Ind.

NEW PROCESS.—Trade name for rawhide pinions manufactured by the Meachem Gear Corp., 411-415 Canal St., Syracuse, N. Y.

NEW PROCESS SPECIALTY CO.—230 Hanover St., Milwaukee, Wis. Manufacturer of conduit bushings and clamps. Business established 1913. President and general manager, C. M. Wheelock; vice-president, C. B. Borland; secretary and treasurer, K. V. Whelock; sales manager, E. C. Bruhy. Exclusive distributor, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill.

NEW SUCCESS.—Trade name for water turbines manufactured by the S. Morgan Smith Co., Lincoln & Hartley Sts., York, Pa.

NEW VELVET EDGER.—Trade name for electric safety razor blade sharpeners manufactured by the F. W. Cochrane Mfg. Co., 5829 S. Vermont Ave., Los Angeles, Cal.

NEW WAY.—Trade name for show cases and wall cases for electrical stores manufactured by the Grand Rapids Show Case Co., Grand Rapids, Mich.

NEW WRINKLE.—Trade name for wiring devices manufactured by the Bryant Electric Co., Bridgeport, Conn.

NEW YORK.—Trade name for ground clamps manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

NEW YORK.—Trade name for electric blasting machines and cable manufactured by the New York Blasting Supply Co., 11 Broadway, New York, N. Y.

NEW YORK.—Trade name for water filters manufactured by the New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.

NEW YORK & NEW JERSEY LUBRICANT CO.—New York, N. Y. Manufacturer of lubricating oils and greases. President, W. F. Kimball; vice-president and secretary, Joseph H. Bennis; treasurer, F. J. Barnes. Main office, 401 Broadway, New York, N. Y. Branch offices, Charlotte, N. C.; Atlanta, Ga.; New Orleans, La. Factory, Newark, N. J.

NEW YORK ART WORKS.—328-330 7th Ave., New York, N. Y. Manufacturer of lighting fixtures and candelabras. Business established 1886. A. O. and R. E. Luetke, owners.

NEW YORK BEARINGS CO., INC.—311 W. 59th St., New York, N. Y. Manufacturer of bearings. Business established 1915. President, Harold Gass; secretary and treasurer, Joseph Walzer. Sales manager, S. Ross.

NEW YORK BELTING & PACKING CO.—New York, N. Y. Manufacturer of belting, packing and soft rubber products. Business established 1846. Main office, 91 Chambers St., New York, N. Y. Factory, Passaic, N. J. Branch offices, 65 Pearl St., Boston, Mass.; 821 Arch St., Philadelphia, Pa.; 124 W. Lake St., Chicago, Ill.; 420 1st Ave., Pittsburgh, Pa.; 218-220 Chestnut St., St. Louis, Mo.; 519 Mission St., San Francisco, Cal.; 313 Felt Bldg., Salt Lake City, Utah.

NEW YORK BLASTING SUPPLY CO.—11 Broadway, New York, N. Y. Manufacturer of electric blasting apparatus. Business established 1907. Director, William W. Nicoll. Factories, Jersey City, N. J., New York, N. Y.

NEW YORK COIL CO. OF PENNA., INC.—Mont Clare, Pa. Manufacturer of ignition coils.

NEW YORK CONTINENTAL JEWELL FILTRATION CO.—Nutley, N. J. Manufacturer of water filters and water softening apparatus. Business established 1883. President, William B. Anderson; secretary and assistant treasurer, E. K. Sorenson; general manager, Arthur M. Crane. Main office and factory, E. Centre St., Nutley, N. J. Branch offices, Flatiron Bldg., New York, N. Y.; Harris Trust Bldg., Chicago, Ill.; New Birks Bldg., Montreal, Que., Can.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. — President, William R. Conklin, Elizabeth, N. J.; secretary, W. J. Krieger, 47 West 34th St., New York, N. Y.

NEW YORK ELECTRICAL SOCIETY.—Secretary, George H. Guy, 29 W. 39th St., New York, N. Y.

NEW YORK ENGRAVERS' SUPPLY.—230-234 W. 17th St., New York, N. Y. Manufacturer of arc lamps for process work, etc., and advertising specialties. H. D. Farquhar, proprietor.

NEW YORK GAS TUBING CO.—806-810 Greenwich St., New York, N. Y. Manufacturer of flexible speaking tube. President and treasurer, J. J. Vautier.

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NEW YORK INSULATED WIRE CO.—New York, N. Y. Manufacturer of insulated wire and electrical tapes. Business established 1884. President, C. H. Wilcox; vice-president, W. R. Evans; secretary, R. E. Gallaher; treasurer, R .F. Herrick; general manager, L. O. Brewster. Main office, 114 Liberty St., New York, N. Y. Factory, Wallingford, Conn. Branch office, 7 Otis St., Boston, Mass. Sales representatives, L. E. Sperry, 126 New Montgomery St., San Francisco, Cal.; Illinois Electric Co., 312 W. Madison St., Chicago, Ill.; B. K. Sweeney, 13th Ave. & Broadway, Denver, Colo.

NEW YORK LIGHTING FIXTURE MFG. CO.—67-69 Spring St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1900. President and treasurer, Frank Butensky; vice-president, Barnet Butensky; secretary, Sadie Butensky.

NEW YORK LUBRICATING OIL CO.—New York, N. Y. Manufacturer of lubricating oil. President, W. W. Dashiell; vice-president, H. J. Hall, Jr.; secretary, Philip Harrison; treasurer, W. B. Sheddan. Main office, 116 Broad St., New York, N. Y. Factory, Bayway, N. J. Branch offices, Boston, Mass.; Philadelphia, Pa.; Los Angeles, Cal.; Omaha, Neb.; Pendleton, Ore.; Portland, Ore.; San Francisco, Cal.; Seattle, Wash.; Spokane, Wash.

NEW YORK MICA & MFG. CO.—Auburn, N. Y. Manufacturer of spark plugs. Business established 1910. President, George Wright; vice-president, C. R. Burt; secretary and treasurer, James A. Wright; sales manager, George C. Fichter.

NEW YORK MICA PRODUCTS CO.—68 Murray St., New York, N. Y. Manufacturer of ground mica.

NEW YORK WIRE & SPRING CO.—Hoboken, N. J. Manufacturer of springs. Business established 1909. President, E. S. Page; vice-president, F. W. Throssell; secretary, F. E. Colson; treasurer, J. W. Campbell; general manager, F. W. Wernig; sales manager, R. L. Dickey. Sales representatives, Lewis Sales Co., 965 Woodward Ave., Detroit, Mich., Ringe-Meade Co., 16 California St., San Francisco, Cal.

NEWARC.—Trade name for welding electrode holders, welder's mask and welding electrodes manufactured by the Electric Arc Cutting & Welding Co., 152-8 Jelliff Ave., Newark, N. J.

NEWARK CORNICE & SKYLIGHT WORKS.—9-15 17th Ave., Newark, N. J. Manufacturers of electric ventilating and exhaust systems. Business established 1898. President, H. W. Egner, Jr.; vice-president, William R. Yunker; secretary and treasurer, G. Yunker.

NEWARK ENGINEERING & TOOL CO.—476-482 18th Ave., Newark, N. J. Manufacturer of lamp making machinery, electric water heaters, filing machines, etc. President and general manager, George J. Zisch.

NEWBOLD.—Trade name for generators and lighting systems for automobiles manufactured by the National Electrical Supply Co., 1328-30 New York Ave., Washington, D. C.

NEWBURY & SON, JAY H.—Goshen, N. Y. Manufacturers of pipe fittings. Business established 1885.

NEWELS, ORNAMENTAL LIGHTING.—Newel lights are used as a partial source of illumination for a staircase and to add to the appearance of the staircase. They have been used in residences where they are usually provided with a plain globe or a more ornamental metal and artglass enclosed shade mounted on the newel post. In large office buildings, hotels, banks, etc., the broad stairways leading from the entrance lobby are sometimes provided with ornamental newel lights of various designs, in keeping with the general design of the stairway and the lobby or foyer lighting fixtures. At the entrances to buildings, especially where these include a few steps from the sidewalk level, newel posts of ornamental pattern are frequently used; these are provided with weatherproof lamp housing and globe.

Manufacturers:

Bailey-Reynolds Chandelier Co., The, 913-915 Grand Ave., Kansas City, Mo.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Fremont Foundry & Machine Co., Fremont, Nebr.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Smyser-Royer Co., York, Pa.
Union Metal Mfg. Co., Canton, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

NEWGARD.—Trade name for lamp guards manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

NEWGARD.—Trade name for receptacles, boxes and cabinets for electrical purposes, switchboards, switchboard fittings, etc., manufactured by Henry Newgard & Co., 947-955 Washington Blvd., Chicago, Ill.

NEWGARD & CO., HENRY.—Chicago, Ill. Manufacturers of switchboards, switchboard fittings, framing, etc., receptacles, boxes and cabinets for electrical purposes. Business established 1882. President and treasurer, Henry Newgard; vice-president, Martin Newgard; secretary, C. E. Browne; general manager, Benjamin Olson; sales manager, Albert Uhl. Main office, 947-955 Washington Blvd., Chicago, Ill. Branch office, 276 W. Water St., Milwaukee, Wis.

NEWHALL CHAIN FORGE & IRON CO.—New York, N. Y. Manufacturer of poleline hardware, electric cranes, etc. Business established 1869. President, Henry B. Newhall; vice-president, Lewis R. Conklin; secretary and treasurer, Clifford Willis; general manager, Harry C. Brown. Main office, 90 West St., New York, N. Y. Factory, Garwood, N. J. Branch offices, 17 N. 6th St., Philadelphia, Pa.; 156 2nd St., San Francisco, Cal.

NEWMAN MFG. CO.—Cincinnati, Ohio. Manufacturer of electric lighting fixtures, portable lamps, signs and lighting specialties. Business established 1882. W. N. Mackey, sales manager. Main office and factory, 717 Sycamore St., Cincinnati, Ohio. Branch office, 68 W. Washington St., Chicago, Ill.

NEWPORT.—Trade name for fixture canopy manufactured by the Universal Metal Spinning & Stamping Co., 718-728 Atlantic Ave., Brooklyn, N. Y.

NEWPORT PIN MILLS.—Newport, Pa. Manufacturers of wood insulator pins. Business established 1901. Sole owner, B. F. Demaree.

NEWPORT ROLLING MILL CO.—Newport, Ky. Manufacturer of sheet iron and steel for electrical purposes.

NEWTON, CHARLES I.—305 W. 15th St., New York, N. Y. Manufacturer of stereopticons and stage lighting equipment. Business established 1890.

NEWTONE.—Trade name for electric automobile horns manufactured by the E. A. Laboratories, Inc., Myrtle Ave. & Spencer St., Brooklyn, N. Y.

N. F. P. A.—Abbreviation for National Fire Protection Association. Also see Electrical Committee, N. F. P. A.

Ni.—The form Ni is the chemical symbol for the metallic element nickel.

N. I.—Trade name for resistance wire manufactured by the General Electric Co., Schenectady, N. Y.

NIAGARA.—Trade name for electric dishwashers manufactured by G. S. Blakeslee & Co., Cicero, Ill.

NIAGARA.—Trade name for electric washing machines manufactured by the Niagara Appliance Co., 7 S. Dearborn St., Chicago, Ill.

NIAGARA.—Trade name for machines and tools for sheet metal work manufactured by the Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y.

NIAGARA.—Trade name for flashlights and batteries manufactured by the Niagara Searchlight Co., Inc., Ferry & 8th Sts., Niagara Falls, N. Y.

NIAGARA.—Trade name for bronze castings manufactured by Paul S. Reeves & Co., Inc., 1415-25 Catharine St., Philadelphia, Pa.

NIAGARA APPLIANCE CO.—7 S. Dearborn St., Chicago, Ill. Manufacturer of electric washing machines.

NIAGARA INSUL-BAKE SPECIALTY CO., INC.—483 Delaware Ave., Albany, N. Y. Manufacturer of molded insulation. President and treasurer, Ronald Kinnear; vice-president, V. B. Hubbell; secretary, A. R. Van Horne.

NIAGARA MACHINE & TOOL WORKS.—639-685 Northland Ave., Buffalo, N. Y. Manufacturer of motor-driven presses and other machines and tools for sheet metal work. Business established 1880. President, George R. Munschauer; secretary, William F. Schweigert; treasurer, Frederick E. Munschauer.

NIAGARA SEARCHLIGHT CO., INC.—Ferry & 8th Sts., Niagara Falls, N. Y. Manufacturer of flashlights and batteries. Business established 1911. President and general manager, R. Max Eaton; secretary, Robert H. Gittins; sales manager, P. C. Smalley. Warehouses, New York, N. Y.; Pittsburgh, Pa.; Niagara Falls, N. Y.; Chicago, Ill. General sales office, Niagara Sales Corp., 3-5 Waverly Pl., New York, N. Y.

NIAGRITE.—Trade name for fireproof insulation for electric cables manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

NICHOLAS POWER CO., INC.—90 Gold St., New York, N. Y. Manufacturer of motion picture machines and accessories. President, Edward Earl; vice-president, S. S. Cassard; secretary and treasurer, Alfred D. Bell; general manager, Will C. Smith. Sales representatives, United Theatre Equipment Corp., 1604 Broadway, New York, N. Y., 729 Seventh Ave., New York, N. Y., 514 S. Wabash Ave., Chicago, Ill., 28 Piedmont St., Boston, Mass., 57 E. Elizabeth St., Detroit, Mich., 509 Produce Exchange Bldg., Minneapolis, Minn., 320 N. Grand Ave., St. Louis, Mo., 13th & Harney Sts., Omaha, Neb., 524 Broadway, Cincinnati, Ohio, 714 Huron Road, Cleveland, Ohio, 1233 Vine St., Philadelphia, Pa., 1006 Forbes St., Pittsburgh, Pa., 116 S. Hudson St., Oklahoma City, Okla. Kansas City Machine & Supply Co., 813 Walnut St., Kansas City, Mo.; Southern Theatre Equipment Co., 9 Nassau St., Atlanta, Ga., 912 Gravier St., New Orleans, La., 1815 Main St., Dallas, Tex.; Denver Theatre Supply Co., 1436 Welton St., Denver, Colo.; Theatre Equipment Supply Co., 134 Golden Gate Ave., San Francisco, Cal.; Pacific Amusement Supply Co., 800 S. Olive St., Los Angeles, Cal.

NICHOLS & BROTHER, GEORGE P.—2139 Fulton St., Chicago, Ill. Manufacturers of electrically operated transfer tables. Business established 1894. Partnership, George P. Nichols and S. F. Nichols.

NICHOLS-LINTERN CO., THE.—8404 Lorain Ave., Cleveland, Ohio. Manufacturer of electric railway supplies. Business established 1901. President and general manager, William Lintern; vice-president, John B. Lintern; secretary and treasurer, Lewis B. Foote; sales manager, A. R. Lintern. Sales representatives, Iron & Steel Equipment Co., 711 Empire Bldg., Pittsburgh, Pa.; Linn O. Morrow, Franklin Trust Bldg., Philadelphia, Pa.; William McKee, 601 Commonwealth Trust Bldg., Philadelphia, Pa.; Williams-Beasley Co., 53 W. Jackson Blvd., Chicago, Ill.; Michigan Sales Agency, Empire Bldg., Detroit, Mich.; M. C. McElligott, Box 584, Preston, Ont., Can.

NICHOLSON & CO., W. H.—125 Oregon St., Wilkes-Barre, Pa. Manufacturers of steam traps and separators and shaft couplings.

NICHROME AND NICHROME II.—Trade names for resistance wire and resistance materials manufactured by the Driver-Harris Co., Harrison, N. J.

NICKEL.—A hard grayish-white metal. Its symbol is Ni; at. wt. 58.7.; sp. gr. 8.6.; m. p. 1450° C. It occurs principally as the sulphide or arsenide, and in nickel-bearing copper or iron ores. About 80% of the world's production comes from Canada and 15% from New Caledonia. The Canadian production in 1919 was 22,035 short tons. The ore is usually smelted to yield nickel matte, a mixture of sulphides of iron, copper and nickel. The metal is then recovered from the matte by the Orford process, the Mond process, or the electrolytic process. In the former the matte is smelted with sodium sulphate and carbon, forming a double sulphide of copper and sodium, which rises to the top, leaving a matte poorer in copper and richer in nickel; after sufficient repetition the rich nickel matte is roasted, leached to remove the remaining copper, and smelted to produce metallic nickel. In the Mond process the matte is roasted to remove sulphur, leached with sulphuric acid to remove most of the copper, and the residue treated with producer gas. The nickel is converted in towers to the volatile compound nickel carbonyl, $Ni(CO)_4$, which on proper regulation of the temperature decomposes, yielding metallic nickel which is deposited in towers on nickel shot. The electrolytic process in use is the Hybine process, which see. When used as anode, nickel shows very markedly the phenomenon of passivity.

NICKEL ANODES.—Plates, slabs or rods of nickel to be hung in a plating bath as anodes so as to supply to the bath metal equivalent to that plated out upon the cathodes (objects to be plated). They should not contain impurities which will dissolve in the bath; iron is particularly objectionable as an impurity, because it dissolves and is then deposited with the nickel plating, making it much inferior to a pure nickel plating. If very pure they dissolve slowly, and are apt not to restore the requisite amount of nickel to the bath

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unless their surface area is greatly increased by being cast into a special shape.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn. "Benedict."
Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill. (anodes)
Burns Supply Co., E. Reed, 21-27 Jackson St., Brooklyn, N. Y.
Chase Metal Works, 236 Grand St., Waterbury, Conn.
Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn. (anodes, ingots)
Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J.
Ely, C. Upham, 50 Vesey St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "Excelsior," "Silverite."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
International Nickel Co., 43 Exchange Pl., New York, N. Y. "Inco."
Midwest Brass & Copper Co., 480 Broome St., New York, N. Y.
Munning & Co., A. P., Church St., Matawan, N. J.
Seymour Mfg. Co., The, Seymour, Conn.
Supplee-Biddle Hardware Co., 507 Commerce St., Philadelphia, Pa.
Williams & Co., 901-37 Pennsylvania Ave., Pittsburgh, Pa.

NICKEL, ELECTROLYTIC.—Nickel which has been produced by electrolyzing a solution of nickel salt obtained from the Nickel ore, or by using an alloy of nickel and copper obtained from the ore as an anode, first extracting the copper and later the nickel, by electrolysis. Very pure nickel is thus obtained, in deposits 1 to 3 centimeters (0.4 to 1.2 inch) thick.

NICKEL-IRON CELL.—See Batteries, storage.

NICKEL PLATING.—One of the most commonly used finishes applied in electroplating. See Electroplating.

NICKEL SILVER.—An alloy of copper, nickel, zinc and, in some cases, very small parts of other metals; it was formerly called German silver. It is usually composed of about one-half copper and about equal parts nickel and zinc. It resembles silver in appearance, but resists corrosion and tarnishes slowly and is consequently widely used in hand instruments and similar devices. It has a comparatively high resistance and is also used to some extent as a resistance wire.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bridgeport Rolling Mills, Inc., The, Bruce & Stratford Ave., Bridgeport, Conn. (sheets)
Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn.
Eagle Smelting & Refining Works, Woolworth Bldg., New York, N. Y.
Gorham Co., 5th Ave. & 36th St., New York, N. Y.
Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.
Midwest Brass & Copper Co., 480 Broome St., New York, N. Y.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Seymour Mfg. Co., Seymour, Conn.
Stimpson Co., Edwin B., 70 Franklin St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

NICKELTYPING. — The electrotyping process of covering a wax sheet with a layer of nickel. The object is to produce an electrotype plate which is harder than the ordinary plate of copper and consequently wears longer. The process is the same as described under electrotyping.

NIEBLING & CO., F. W.—406 Elm St., Cincinnati, Ohio. Manufacturer of motor-driven refrigerating and ice making machinery and refrigerators. F. W. Niebling, owner.

NIEHOFF & CO., INC., PAUL G.—232-242 E. Ohio St., Chicago, Ill. Manufacturer of armature and automobile testers, magnetizers, ammeters, ignition coils, etc. Business established 1912. President and sales manager, Conrad Niehoff; secretary, treasurer and general manager, Paul G. Niehoff. Branch office, 365 Richmond St., London, Ont., Can. Sales representative, C. N. & F. W. Jones, 111 New Montgomery St., San Francisco, Cal.

NIGRUM.—Trade name for wood bushings manufactured by the Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

NIKOLAS & CO., G. J.—Chicago, Ill. Manufacturer of metal lacquers, enamels and paint spraying brushes. Business established 1892. President, G. J. Nikolas; secretary, F. E. Nikolas; treasurer, G. J. Nikolas, jr. Main office and factory, 1227-35 Van Buren St., Chicago, Ill. Branch office and warehouse, 77 Broadway, New York, N. Y. Sales representatives, S. G. Meddel, 1723 Fruitvale Ave., Oakland, Cal.; Mefford Chemical Co., 749 San Pedro St., Los Angeles, Cal.

NILCO.—Trade name for incandescent lamps made by the Novelty Incandescent Lamp Co., Emporium, Pa.

NILO.—Trade name for water meters made by the Union Water Meter Co., 33 Hermon St., Worcester, Mass.

NILSON MACHINE CO., THE A. H.—1525 Railroad Ave., Bridgeport, Conn. Manufacturer of wire forming and bending machines.

NILSON-MILLER CO.—Hoboken, N. J. Manufacturer of motor speed reduction gears and pinions. President, L. G. Nilson; vice-president, L. P. Prossen; secretary, R. G. Hartwig; treasurer, J. E. Miller.

9-0-3 SWIVEL.—Trade name for swivel attachment plug manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

1900 CATARACT.—Trade name for reciprocating type electric washing machine manufactured by the 1900 Washer Co., 215 Clinton St., Binghamton, N. Y.

1900 WASHER CO.—215 Clinton St., Binghamton, N. Y. Manufacturer of electric washing machines. Business established 1898. President, T. B. Crary; vice-president and general manager, H. L. Barker; secretary and treasurer, W. G. Trowbridge. Factories, Binghamton, N. Y., and Toronto, Ont., Can. Branch office, 357 Yonge St., Toronto, Ont., Can.

NIPPERS, END CUTTING.—A wire-cutting tool used by electricians and linemen. The cutting edges are located at the end of the tool. For cutting heavy wires these tools are constructed to give a compound leverage.

Manufacturers:

KLEIN & SONS, MATHIAS, Chicago, Ill. (See display adv. page 1257.)
Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.
Robinson Co., M. W., 296 Broadway, New York, N. Y. "Carew."
SMITH & HEMENWAY, INC., 266 Broadway, New York, N. Y.
Starrett Co., The L. S., Athol, Mass.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."

NIPPLES, CONDUIT. — See Conduit couplings, nipples and unions.

NIPPON.—Trade name for boudoir lamps manufactured by the Highlands Mfg. Co., Muncie, Ind.

NITELITE.—Trade name for flashlights manufactured by the Providence Electric Mfg. Co., 23 Broad St., Providence, R. I.

NITELITE.—Trade name for 2-cp. lamp manufactured by the Union Electric Corp., 103 Mott St., New York, N. Y.

NITRATES.—Nitrates of ammonia and lime are extensively produced from nitric acid by the various nitrogen fixation processes. In the Birkeland and Eyde process, which see, the acid is used mainly to dissolve limestone with the formation of calcium nitrate, Ca $(NO_3)_2$, which is used for fertilizer purposes. Ammonium nitrate, NH_4NO_3, may be obtained from combination with gas-works ammonia liquors; it is also produced by the combination of ammonia from cyanamide, or from the Haber process with the nitric acid made by the oxidation of more ammonia to nitric acid. See Nitric acid.

NITRIC ACID.—Formula, HNO_3. It is produced electrothermally by the oxidation of the nitrogen of the air by several different processes, some direct and some indirect. In the direct processes the nitrogen is oxidized to nitrous oxide by a high-tention arc discharge, as in the Birkeland and Eyde, Pauling, or Schoenherr-Hessberger processes, which see; in the indirect processes ammonia, obtained either from cyanamide or from the Haber process, which see, is oxidized by a combined electrothermal and catalytic process to nitric acid. Nitric acid is extensively used in various industries. It is a powerful solvent and oxidizing or adducing agent.

Manufacturers:

Central Chemical Co., 4200 S. Marshfield Ave., Chicago, Ill.
COOPER & CO., CHARLES, 194 Worth St., New York, N. Y.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
General Chemical Co., 25 Broad St., New York, N. Y.
Grasselli Chemical Co., The, Cleveland, Ohio.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Mallinckrodt Chemical Works, St. Louis, Mo.
Merrimac Chemical Co., Boston, Mass.
Riverside Acid Works, Warren, Pa.
Seldner & Enequist, Inc., 86-112 Hausman St., Brooklyn, N. Y.

NITRITES.—Sodium nitrite, $NaNO_2$, is made by absorbing the nitrous acid gases from the operation of the nitrogen fixation process (see Nitric acid) into a solution of sodium hydroxide, NaOH.

NITROGEN.—A colorless, tasteless and odorless gas forming about 77% of the weight of air, of which it is the principal constituent. Its symbol is N; at. wt. 14.01; sp. gr. (air=1) 0.971. It may be liquefied at low temperature and high pressure and the liquid solidifies at —203° C. Nitrogen does not burn, nor support combustion, being quite inert with respect to most other elements. Among its most important compounds are ammonia, NH_3; nitric acid, HNO_3; and the numerous nitrates. Of electrical interest is the use of nitrogen as a filling in large tungsten-filament lamps and in certain types of Moore tube lamps. For electrical fixation of atmospheric nitrogen see Nitric acid.

NITROGEN FIXATION.—Conversion of the nitrogen of the air into nitric acid or other useful nitrogen compounds by means of an electrothermal process. See Nitric acid; Birkeland and Eyde processes; Pauling process; Schoenherr-Hessberger process.

NITROGEN LAMPS.—See Lamps, incandescent, tungsten, gas-filled.

NITROGLASS.—Trade name for illuminating glassware manufactured by the Jefferson Glass Co., Follansbee, W. Va.

NITROGON ELECTRIC CO., INC.—Newark, N. J. Manufacturer of incandescent lamps. Business established 1914. President, treasurer and general manager, R. H. Amberg; vice-president, secretary and sales manager, E. A. Eppstein. Main office, 48 Spring St., Newark, N. J. Branch offices and warehouses, 403 Scollard Bldg., Dallas, Tex.; 304 Scarritt Arcade Bldg., Kansas City, Mo. District office, 180 N. Dearborn St., Chicago, Ill.

NITROGON SERVICE.—Trade name for incandescent lamps manufactured by the Nitrogon Electric Co., Inc., Newark, N. J.

NITROLITE.—Trade name for lighting fixtures and units for nitrogen filled lamps manufactured by the Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

N-L.—Trade name for street car signals, locomotive crane, pneumatic sanders for electric railway cars, etc., manufactured by the Nichols-Lintern Co., 8404 Lorain Ave., Cleveland, Ohio.

NO-LEAK-O PISTON RING CO.—824 W. North Ave., Baltimore, Md. Manufacturer of piston rings. Business established 1914. President and treasurer, J. E. Norwood; vice-president, C. L. Norwood; secretary, M. S. Weber; general manager, L. G. Matthews. Factory, Muskegon, Mich.

NO-LOAD CHARACTERISTIC.—A curve showing the relation between the field current or the field ampere-turns of a machine and the voltage generated under zero load. Also called no-load or open-circuit saturation curve, and magnetization curve.

NO-OX-ID.—Trade name for a compound that prevents rusting and corrosion of metal surfaces, manufactured by the Dearborn Chemical Co., 332 S. Michigan Ave., Chicago, Ill.

NO-SPARK.—Trade name for carbon brushes made by the Calebaugh Self-Lubricating Carbon Co., Inc., 1503 Columbia Ave., Philadelphia, Pa.

NO STEAL.—Trade name for lamp guard manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

NOARK.—Trade name for fuses manufactured by the Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

NOARK ALLSAFE.—Trade name for safety switches manufactured by Johns-Pratt Co., 555 Capitol Ave., Hartford, Conn.

NOBLE & CO., F. H.—59th & Wallace Sts., Chicago, Ill. Manufacturer of solder and welding wire. Business established 1878. President and treasurer, F. H. Noble; vice-president, R. E. Kehl; secretary and general manager, H. C. Van Pelt.

NOCK & GARSIDE ELEVATOR CO., THE.—1850 Wazee St., Denver, Colo. Manufacturer of electric passenger and freight

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elevators. President, Tom Nook; vice-president, Ben C. Garside.

NODULES, CATHODE.—Irregular forms, like knobs or cauliflower growths, forming on the edges and particularly the corners of cathodes which are run for a long time or at a high current density. They sometimes grow so fast as to bridge over from cathode to anode, and short-circuit the electrolytic cell. They form quickest where the solution is not rich in metallic salt. Some additional agents (such as glue, gelatin, oil of cloves, tincture of aloes, etc.) tend to hinder their formation and make a smoother deposit. In large refineries, particularly those using high current density, men must be constantly employed to go from tank to tank breaking off such nodules.

NOISE IN ELECTRICAL APPARATUS.—Electrical apparatus, both stationary and rotating, produces some noise when operating. Much of this is due to mechanical vibration. There are other noises of an electrical nature. One of these is called generation noise. It is that disturbance of electrical current which is due to the process of generation. A direct-current generator is supposed to produce smooth, steady, direct current. But if a telephone receiver be connected, much noise will be heard, due to inequalities of generation or to the commutation. Part of this is known as commutation noise. It is that part of the generation noise which is due to the commutator and brushes. It may be heard by connecting a telephone receiver into the circuit of the delivered current.

All noises that are heard over the telephone are the result of a stray current getting onto the line or an irregularity of some other current. Harmonics of various frequencies are sometimes present and these cause noise. The noise caused in generation or commutation might be considered as being due to this, although it is not strictly a harmonic current. Slight irregularities in the brush or in one or more commutator segments will produce irregular currents which recur at rather definite intervals. These irregularities cause vibration of the receiving diaphragm and produce the noise.

NOISELESS.—Trade name for electric hair driers manufactured by Herman J. Bosch, Hotel Biltmore, New York, N. Y.

NOKORODE.—Trade name for soldering salts manufactured by the M. W. Dunton Co., Providence, R. I.

NOKUT.—Trade name for pump valves manufactured by the Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.

NOLU OILLESS BEARING CO.—6 E. Johnson St., Germantown, Philadelphia, Pa. Manufacturer of oilless bearings. Business established 1910. President and general manager, H. G. Price; vice-president, O. H. Dilley; secretary and treasurer, W. F. Wagner.

NOMINAL RATING.—A special rating applied to motors and other apparatus employed in electric railway service. See Rating of electrical machines.

NON-BURN.—Trade name for asbestos linings manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

NON-FLUID.—Trade name for lubricating oils and greases manufactured by the New York & New Jersey Lubricant Co., 401 Broadway, New York, N. Y.

NON GRAN.—Trade name for bronze bearings for motors, generators, etc., manufactured by the American Bronze Corp., Berwyn, Pa.

NON-KOR.—Trade name for lighting fixture parts manufactured by the Phoenix Light Co., 525 Market St., Milwaukee, Wis.

NON-SLIP.—Trade name for ladder shoes used in shops and factories as a safety device, manufactured by the American Mason Safety Tread Co., 125 Perry St., Lowell, Mass.

NON-TWIST CANOPY RING, CANADA, LTD.—58 Temperance St., Toronto, Ont., Can. Manufacturer of lighting fixtures and brass stampings. Business established 1919. President and general manager, Frank D. Parmenter; vice-president, E. B. Merrill; secretary and treasurer, Frank Edgerton.

NONINDUCTIVE CIRCUIT.—A noninductive circuit is one in which the impressed e.m.f. and resulting current are in phase. Such a circuit may contain resistance only and no inductance, or its inductance may be counterbalanced by an equivalent capacitance. Such a circuit may also be called a nonreactive circuit.

NONINDUCTIVE LOAD.—A noninductive load is any load in which the current is in phase with the voltage across the load.

NONMETALLIC FLEXIBLE CONDUIT.—See Tubing, flexible fabric, or nonmetallic conduit.

NONPAREIL.—Trade name for vibrating bells and buzzers manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N .Y.

NONREACTIVE CIRCUIT.—A circuit in which the impressed e.m.f. and the resulting current are in phase is a nonreactive circuit. It either contains no reactance (that is, no inductance and no capacitance) or else its inductance exactly neutralizes its capacitance. In the latter case it is a resonant circuit.

NORDBERG MFG. CO.—Milwaukee, Wis. Manufacturer of electric and steam hoists, pumps, steam and oil engines. B. V. N. Nordberg, sales manager.

NORDYKE.—Trade name for cable hangers manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

NOREACOL.—Trade name for creosote oil manufactured by the Northeastern Co., 80 Beverly St., Boston, Mass.

NORFOLK CREOSOTING CO.—Norfolk, Va. Producer of creosoted poles and crossarms.

NORFOLK ELECTRIC MFG. CO.—215 Cumberland St., Norfolk, Va. Manufacturer of a-c. motors. President, Porter O. Sutton; secretary and treasurer, Fred W. Walter.

NORMA CO. OF AMERICA, THE.—Anable Ave., Long Island City, N. Y. Manufacturer of precision ball bearings, roller bearings and thrust bearings. Business established 1911. President and treasurer, W. M. Nones; vice-president, O. P. Wilson; secretary, Samuel Robert.

NORMAL ELECTRODE.—A metal placed in a closed vessel in contact with a saturated solution of one of its own salts, the solution also filling a siphon-like capillary tube projecting from the vessel. The whole can thus be put into communication with the electrolyte of a cell being investigated, and potentials measured from the metal of the normal electrode to the anode and the cathode of the cell under investigation. These are then called single potentials, and have considerable theoretical significance. Mercury in contact with a solution of calomel ($HgCl$) is known as the normal calomel electrode; see Calomel electrode.

NORMAL IN TELEPHONY.—The condition of telephone apparatus when it is not in use and it is ready to be used.

NORMALAIR CO.—Winston Salem, N. C. Manufacturer of electric air humidifiers.

NORMALITY.—The strength or concentration of a solution measured by the number of gram chemical equivalent weights of the substance dissolved in a liter of the solution. For instance, the chemical equivalent weight of sulphuric acid is 49. The normality of any solution of sulphuric acid is therefore expressed by the number of grams of acid in a liter of the solution, divided by 49. The normality is indicated in chemical nomenclature by putting the letter n after the normality; thus 0.1n., 1n., 2n., etc.

NORTH AMERICAN ELECTRIC LAMP CO.—930 N. 22nd St., St. Louis, Mo. Manufacturer of incandescent lamps. Business established 1917. President and treasurer, Isaac H. Cohn; vice-president and secretary, Charles M. Rice; general manager and sales manager, Arnold E. Glass. Sales representatives, H. E. Sorenson, Des Moines, Iowa; O. W. Holt, Watertown, S. D.; Charles L. Warrick, New York, N. Y.; C. L. V. Wolcott, Cleveland, Ohio; Folsom Co., Dallas, Tex.; Western Agencies Co., San Francisco, Cal.; Seattle, Wash.; Los Angeles, Cal.

NORTH AMERICAN ELECTRICAL PRODUCTS CORP.—Equitable Bldg., New York, N. Y. Manufacturer of rigid interior conduit and other specialties. President, E. G. Hatch. Factory, Brooklyn, N. Y.

NORTH AMERICAN MFG. CO., THE.—5902 Carnegie Ave., Cleveland, Ohio. Manufacturer of electric forge blowers and oil burners. Business established 1917. President, secretary and treasurer, George Reuben Brown; vice-president, Chas. J. Forbes; assistant manager, Z. D. Basset; sales manager, George F. Naab.

NORTH AMERICAN SMELTING CO.—9th & Thompson Sts., Philadelphia, Pa. Manufacturer of babbitt metal, solders, brass and bronze car bearings and castings.

NORTH AMERICAN STORAGE BATTERY CO.—40-44 W. North St., Indianapolis, Ind. Manufacturer of storage batteries. President, H. E. Von Grimmenstein; vice-president, M. O. Smith; secretary, W. E. Bushong; treasurer, C. E. H. Johnson.

NORTH BROS. MFG. CO.—Lehigh Ave. & American St., Philadelphia, Pa. Manufacturer of screw drivers, drills, vises, etc. Sales representatives, John H. Graham & Co., 113 Chambers St., New York, N. Y.; McMillan & Wagener, Peoples Gas Bldg., Chicago, Ill.

NORTH CENTRAL GEOGRAPHIC DIVISION, N. E. L. A.—President, T. D. Crocker, Northern States Power Co., Minneapolis, Minn.; secretary, H. E. Young, Minneapolis General Electric Co., Minneapolis, Minn.

NORTH DAKOTA TELEPHONE ASSOCIATION.—President, A. J. McInnes, Dazey, N. D.; secretary-treasurer, H. W. Wilson, New Rockford, N. D.

NORTH EAST.—Trade name for electrical equipment for automotive vehicles manufactured by the North East Electric Co., Rochester, N. Y.

NORTH EAST ELECTRIC CO.—Rochester, N. Y. Manufacturer of electrical equipment for automotive vehicles. President, W. A. Montgomery; vice-presidents, E. A. Halbleib, Joseph T. Alling; secretary, G. A. Hollister; treasurer, J. J. Stafford; general manager, E. A. Halbleib. Main office, Rochester, N. Y. Branch offices, 55 W. Peachtree St., Atlanta, Ga.; 2701 S. Wabash Ave., Chicago, Ill.; 815 Cass Ave., Detroit, Mich.; 1819 McGee St., Kansas City, Mo.; 355 W. 52nd St., New York, N. Y.; 941 Geary St., San Francisco, Cal.; 425 Pierre Ave., Windsor, Ont., Can.

NORTH ELECTRIC MFG. CO., THE.—Galion, Ohio. Manufacturer of telephone equipment. Business established 1918. President, C. H. North; vice-president, Frank R. McBerty; secretary and treasurer, George C. Steele; general manager, Kempster B. Miller; sales manager, George W. Dickerson.

NORTH STAR.—Trade name for dry batteries manufactured by the Canada Dry Cells, Ltd., Winnipeg, Man., Can.

NORTH TONAWANDA MUSICAL INSTRUMENT WORKS.—North Tonawanda, N. Y. Manufacturers of electrically operated pianos and orchestrions.

NORTH WALES MACHINE CO., INC.—Elm Ave. & Center St., North Wales, Pa. Manufacturer of grinding wheel dressers; hacksaws, etc. Business established 1902. President, F. M. King, Sr.; secretary, B. F. Baird; treasurer and general manager, J. W. King.

NORTH-WESTERN STAMPING CO.—Burlington, Iowa. Manufacturer of conduit and pipe straps. President, Samuel Senti; vice-president, A. L. Bilen; secretary and treasurer, Arthur J. Klein.

NORTHEASTERN CO., THE.—Boston, Mass. Manufacturer of wood preservatives. President, Charles H. Wastwick; secretary, Ralph E. Joslin; treasurer, John J. Monahan. Main office, 80 Beverly St., Boston, Mass. Branch office, 74 Wall St., New York, N. Y.

NORTHERN.—Trade name for electric cranes and hoists manufactured by the Northern Engineering Works, 10 Chene St., Detroit, Mich., and Northern Crane Works, Ltd., Walkerville, Ont., Can.

NORTHERN.—Trade name for electric fire pumps and extinguishers manufactured by the Northern Fire Apparatus Co., 2422 University Ave., S. E., Minneapolis, Minn.

NORTHERN CEDAR & TIMBER CO.—Menominee, Mich. Producer of cedar poles and ties. Business established 1919. President, J. C. Kirkpatrick; vice-president, H. S Gilkey; secretary and treasurer, W. S. Patch; general manager, Edward Barstow.

NORTHERN CRANE WORKS, LTD.—Walkerville, Ont., Can. Manufacturer of electric cranes and hoists. President, George A. True.

NORTHERN ELECTRIC CO.—542 St. Clair St., Chicago, Ill. Manufacturer of electric curling irons and wavers. Business established 1920. S. I. Russell, sole owner.

NORTHERN ENGINEERING WORKS.—10 Chene St., Detroit, Mich. Manufacturers of electric cranes and hoists. Business established 1899. President, George A. True; vice-presidents, E. S. Reid and W. V. Moore; secretary and treasurer, H. W. Stondart. Sales representatives, D. Hurley, 201 Devonshire St., Boston, Mass.; R. A. Byrns, 120 Liberty St., New York, N. Y.; W. J. Mulholland, Commercial Trust Bldg., Philadelphia, Pa.; E. E. Brosius, Benedum Trees Bldg., Pittsburgh, Pa.; J. B. Laird,

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788 Potomac Ave., Buffalo, N. Y.; J. G. Bricker, 504 Marshall Bldg., Cleveland, Ohio; Abell Howe Co., 332 S. Michigan Ave., Chicago, Ill.

NORTHERN EQUIPMENT CO.—110 W. 11th St., Erie, Pa. Manufacturer of feed water regulators. President and general manager, E. W. Nick; vice-president, V. V. Veenschoten; sales manager, C. E. Wolff, Jr.

NORTHERN FIRE APPARATUS CO.—2422 University Ave., S. E., Minneapolis, Minn. Manufacturer of electric fire pumps and fire extinguishers.

NORTHERN FLOOR SURFACER CO.—307 Bellin Bldg., Green Bay, Wis. Manufacturer of electric floor surfacing machines. President, H. J. Nelson; secretary and treasurer, Max H. Strehlow.

NORTHERN INDUSTRIAL CHEMICAL CO.—11 Elkins St., Boston, Mass. Manufacturer of heat-resisting molded insulation. Business established 1907. President, G. Victor Sammet; treasurer, Barthold E. Schlesinger.

NORTHERN LIGHT.—Trade name for photographic lamps manufactured by the Simplex Photo Products Co., Richmond Hill, N. Y.

NORTHERN POLE & LUMBER CO.—Duluth, Minn. Producer of poles, posts, ties and insulating lumber. Business established 1898 as Duluth Log Co. President and treasurer, E. L. Bradley; vice-president, secretary and general manager, T. P. Bradley. Main office, Palladio Bldg., Duluth, Minn. Yards, Big Falls, Minn. Branch offices, Big Falls, Minn.; Boy River, Minn.; Littlefork, Minn.; Tobique, Minn.; Remer, Minn.

NORTHERN WELDING CO.—2429 University Ave., Minneapolis, Minn. Manufacturer of oxyacetylene welding outfits.

NORTHLITE.—Trade name for farm lighting plants manufactured by the Northlite Mfg. Co., Chippewa Falls, Wis.

NORTHLITE MFG. CO.—Chippewa Falls, Wis. Manufacturer of farm lighting plants. R. Mohr, secretary.

NORTHRUP.—Trade name for potentiometers and pyrometers manufactured by the Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION (AFFILIATED WITH N. E. L. A.).—President, Franklin T. Griffith, Portland, Ore.; secretary, Stacy Hamilton, Portland, Ore.

NORTHWEST GEOGRAPHIC DIVISION, N. E. L. A.—See Northwest Electric Light and Power Association.

NORTHWESTERN.—Trade name for motors manufactured by the Northwestern Mfg. Co., Milwaukee, Wis.

NORTHWESTERN ART SHADE CO.—184 W. Lake St., Chicago, Ill. Manufacturer of electric lamps. Sole owner, J. M. Bassey.

NORTHWESTERN ELECTRIC CO.—408 S. Hoyne St., Chicago, Ill. Manufacturer of rotary converters and motors. Business established 1903. President and general manager, H. L. Martin; vice-president, E. T. James; secretary, M. J. Clark.

NORTHWESTERN MFG. CO.—Milwaukee, Wis. Manufacturer of motors. President and treasurer, William S. Smith; secretary, Frederick W. Ells.

NORTHWIND.—Trade name for electric desk and bracket fans manufactured by the Emerson Electric Mfg. Co., 2012-2032 Washington Ave., St. Louis, Mo.

NORTHWIND SPARK PLUG CORP.—42 W. 39th St., New York, N. Y. Manufacturer of spark plugs. Business established 1920. President, Leon Cammen; secretary, Walter P. Frank; treasurer, Ferdinand I. Haber.

NORTHWOOD CO., H.—36th & Wetzel Sts., Wheeling, W. Va. Manufacturer of illuminating glassware and ornamental lighting units. Business established 1906. President, George E. House; vice-president, treasurer and general manager, D. A. Taylor; secretary, K. Fitzimmons. Sales representatives, Kelly & Reasner, 17 N. Wabash Ave., Chicago, Ill.; Dela Croix & Wilcken, 19 Madison Ave., New York, N. Y.

NORTON CO.—Worcester, Mass. Manufacturer of electrically produced abrasives, grinding wheels and grinding machines. President, Charles L. Allen; treasurer, Aldus C. Higgins; secretary, George N. Jeppson. Main office and works, Worcester, Mass. Factories, Bauxite, Ark.; Niagara Falls, N. Y.; Chippewa, Ont., Can. Branch offices, New York, N. Y.; Chicago, Ill.; Detroit, Mich.; Philadelphia, Pa.; Pittsburgh, Pa.; Syracuse, N. Y.; Indianapolis, Ind.; Hartford, Conn.; Cleveland, Ohio.

NORTON ELECTRICAL INSTRUMENT CO., THE.—Manchester, Conn. Manufacturer of ammeters and voltmeters. Business established 1895. President and general manager, Charles E. Norton; secretary, treasurer and sales manager, Ralph P. Norton.

NORWALK IRON WORKS CO.—South Norwalk, Conn. Manufacturer of motor-driven air compressors. Sales manager, A. R. Betts.

NOSCRU.—Trade name for canopy switch manufactured by the Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J.

NOSHADOLITE.—Trade name for operating room lighting fixture manufactured by the Luminius Unit Co., Division of the St. Louis Brass Mfg. Co., 2615 Washington Ave., St. Louis, Mo.

NOSPLICE.—Trade name for solderless connectors manufactured by the Columbia Metal Box Co., 224-228 E. 144th St., New York, N. Y.

NOTCHING MACHINES.—See Armature disk notching machines.

NOTEAR.—Trade name for electric car curtains manufactured by the Railway Supply & Curtain Co., 614-618 S. Canal St., Chicago, Ill.

NOTORCH.—Trade name for solderless connector manufactured by the Columbia Metal Box Co., 226 E. 144th St., New York, N. Y.

NOVA.—Trade name for illuminating glassware manufactured by the Gill Glass Co., Inc., Amber & Venango Sts., Philadelphia, Pa.

NOVALUX.—Trade name for lighting units manufactured by the General Electric Co., Schenectady, N. Y.

NOVELTIES, ELECTRIC.—Such devices as illuminated lapel buttons and stickpins, illuminated toy dolls and animals, electrically operated airplanes for window display, other electrical display novelties and similar devices are included under this classification. Special devices, such as walking animals controlled by flashlight and selenium cell or by induction, may also be here included.

Manufacturers:

Adams Morgan Co., Sivin Place, Upper Montclair, N. J. "Paragon."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Brink, Inc., C. L., 24 Gold St., Boston, Mass.
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Elektra Toy & Novelty Co., Inc., 400 Lafayette St., New York, N. Y. "Electric-Eyed Boogy Bears."
Fine Arts Lamp & Shade Co., 2301 Wabansia Ave., Chicago, Ill.
Gudeman & Co., 30 Irving Pl., New York, N. Y.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y. "Electric Questioner," "Learnelectrico."
Morse, Frank W., 289 Congress St., Boston, Mass.
Novelty Statuary Co., 1363 W. Lake St., Chicago, Ill.
Parkin Mfg. Co., San Rafael, Cal.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Propp Co., M., 108 Bowery, New York, N. Y. ("Flaglite." lapel button.)
Providence Electric Mfg. Co., 23 Broad St., Providence, R. I.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
Rose Electric Mfg. Co., 160 N. Wells St., Chicago, Ill.
St. John, Thomas M., East Windham, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

NOVELTY INCANDESCENT LAMP CO.—Emporium, Pa. Manufacturer of incandescent lamps. Business established 1906. President and general manager, B. G. Erskine; vice-president and treasurer, H. H. Rice; secretary, T. S. Merrill. Main office, Emporium, Pa. Factories, St. Marys, Pa., and Emporium, Pa. Branch office and warehouse, 275 Grand River Ave., Detroit, Mich. Sales representatives, Baker Smith Co., Rialto Bldg., San Francisco, Cal., L. C. Smith Bldg., Seattle, Wash., Los Angeles, Cal.; W. A. Horlacher, 106 N. La Salle St., Chicago, Ill.; C. H. Wallis & Co., Syndicate Trust Bldg., St. Louis, Mo.; H. W. Evans Co., 88 Park Place, New York, N. Y.; A. Hopkins, Jr. Co., 905 Walnut St., Philadelphia, Pa.; American Consolidated Electric Co., Newark, N. J., Boston, Mass.; Ingersoll, Erskine & Healy, Inc., Rochester, N. Y.; Gershon Bros., Atlanta, Ga.; Groesbeck & Bodson, El Paso, Tex.

NOVELTY LAMP & SHADE CO.—2480 E. 22nd St., Cleveland, Ohio. Manufacturer of lighting fixtures and portable electric lamps. Business established 1906. George J. Klein, sole owner.

NOVELTY STATUARY CO.—1363 W. Lake St., Chicago, Ill. Manufacturer of electrical novelties.

NOVELTY TURNING CO.—34 Main St., Norway, Me. Manufacturer of lamp bases, handles and other wood specialties. Business established 1870. B. Brown, sole owner.

NOVO.—Trade name for flashlights, batteries, Christmas tree lighting outfits and other lighting specialties, manufactured by the Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y.

NOVO MFG. CO., INC.—424 W. 33rd St., New York, N. Y. Manufacturer of flashlights, batteries, Christmas tree lighting outfits and other lighting specialties. Branch office, 531 S. Dearborn St., Chicago, Ill.

NOXALL.—Trade name for piston packing manufactured by the Boston Belting Co., 80 Elmwood St., Boston, Mass.

NOZZLE.—A short tube, usually tapering, serving as the vent or orifice in a pipe or hose. In water-power plants nozzles are used with impulse turbines to carry the water to, and to direct it against, the buckets. Two types of such nozzles are generally used, deflecting and needle. The deflecting type accomplishes the regulation by changing the angle between the nozzle and the wheel and deflecting the jet away from the buckets. The regulation is effective, but is very wasteful of water. A needle nozzle has a sharp-pointed conical-ended rod inside of the opening and the flow of water is varied by changing the axial position of this needle. The needle must be moved slowly to prevent the shock of a sudden change in velocity of water in the pipes.

NU-ACMELITE.—Trade name for illuminating glassware manufactured by the Gill Bros. Co., 627 Franklin Ave., Steubenville, Ohio.

NU-BESTOS.—Trade name for packing manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

NU-SYSTEM VIBRATOR CO.—Lightner Bldg., Detroit, Mich. Manufacturer of electric vibrators.

NUART.—Trade name for illuminating glassware manufactured by the Imperial Glass Co., Bellaire, Ohio.

NUBIAN.—Trade name for cotton belting manufactured by the Empire Mfg. Co., Lockport, N. Y.

NUBIAN.—Trade name for packing manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

NUGENT & CO., INC., WILLIAM W.—146 W. Superior St., Chicago, Ill. Manufacturer of oil filters, oiling systems, tanks and oiling devices. Business established 1897. President and treasurer, William W. Nugent; vice-president and secretary, Corliss D. Nugent; 2nd vice-president and superintendent, Walter Hacker.

NUHRING & BRO., CHARLES.—1212 Walnut St., Cincinnati, Ohio. Manufacturers of water treating compounds, boiler-tube cleaners, etc.

NULOCK.—Trade name for automobile lock manufactured by the Nulock Mfg. Corp., 1639 Broadway, New York, N. Y.

NULOCK MFG. CORP.—1639 Broadway, New York, N. Y. Manufacturer of automobile locks. Business established 1918. Secretary and treasurer, S. D. Shwitzer; sales manager, Henry B. Cohn.

NUMBERS, HOUSE, ILLUMINATED.—Illuminated house numbers generally serve the dual purpose of lighting the porch and making the house number luminous at night. One type is a special fixture, a small box-like casting, in which is an electric lamp. The front face of the box has

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an opal glass window on which are painted the house numbers. The back face has a ribbed glass window to throw light upon the porch. Another type utilizes the ordinary porch lighting fixture. It is simply a stencil in which are cut the house numbers. The stencil is fastened to the fixture so that it faces the street; the light shining through brings out the numbers.

Manufacturers:

Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Whitlock Mfg. Co., The, 1506 W. 112th St., Cleveland, Ohio.

NUMERICAL AND NONNUMERICAL APPARATUS, AUTOMATIC TELEPHONE.—Numerical refers to anything or any relation which is directly or indirectly dependent upon the call number. A selector or a connector in most automatic exchanges is a numerical switch, because it is primarily controlled by the calling device. A lineswitch is nonnumerical because the trunk which it selects has no relation to the call number—one trunk will do as well as another. The selector also has a nonnumerical function, as when it is rotating its wipers to find an idle trunk.

NURSES' CALL SYSTEMS.—See Signaling systems, hospital, nurses' and doctors'.

NUT SPLITTER.—A hand-operated but powerful shear for cutting or splitting threaded nuts of bolts, studs, etc. It is a special form of bolt cutter. See Cutters, bolt, nut and rivet.

NUTS, BRASS.—Brass nuts are peculiarly adapted to electrical work. They have a high conductivity, resist corrosion, and can be given an attractive finish. The hexagonal or square forms may be tightened with a wrench; other forms are knurled or provided with a slot for a screw driver. They are made in a wide variety of sizes and standard and special forms for battery, instrument and appliance terminals, spark plugs, panelboards, switchboards and other apparatus.

Manufacturers:

Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Chicago Nut Co., 2513 W. 20th St., Chicago, Ill.
Corbin Screw Corp., New Britain, Conn.
Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
Reed & Prince Mfg. Co., Worcester, Mass.
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.
Universal Chain Co., The, Stroudsburg, Pa.

NUTS, COPPER, FOR SWITCHES AND SWITCHBOARDS.—Nuts used on switches and switchboards frequently are a part of the electrical circuit and must carry a heavy current. The low resistance of copper makes it particularly desirable for nuts used on such apparatus. These nuts are made in standard hexagonal, square, and acorn forms, and in numerous special shapes.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bayonne Bolt & Nut Co., Bayonne, N. J.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Stimpson Co., Edwin B., 70 Franklin St., New York, N. Y.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

NUTS, EYE, FOR DEAD-ENDING.—Dead-ending nuts are fittings for adapting an eye to the end of a pipe or rod. The fitting is simply a pipe cap and an eye in one piece.

Manufacturers:

Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
HUBBARD & CO., Pittsburgh, Pa. Hubbard drop forged eye nuts will develop the full strength of the bolt on which it is used. They are hot galvanized. See Hubbard's catalog.—Adv.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Milton Mfg. Co., Milton, Pa.

NUTS, INSULATED.—It is sometimes desirable to insulate the nut from the bolt, pipe or rod to which it is attached. This is done by using an insulated nut which is made up in two sections insulated from each other, or by covering the nut with an insulating cap.

Manufacturers:

American Equipment Co., Norristown, Pa.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

NUTS, LEAD-ENCASED.—This type of nut is much used for connecting the terminals of stationary lead storage batteries. All such connections must be of lead or lead-covered to resist the action of the acid. A lead nut is not practical because it is too soft to be threaded. Therefore, a brass nut is used with a brass stud; the nut is entirely encased in lead except for the small opening giving access to the threaded portion of the enclosed brass nut. Hexagonal nuts are mostly used although square nuts are sometimes required.

Manufacturers:

American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Bayonne Bolt & Nut Co., Bayonne, N. J.

NUTS, STEEL OR IRON.—Where mechanical strength is the chief requirement, iron or steel nuts are used. They are usually made hexagonal, square, or round, and in standard or special castellated forms. The castellated nut differs from the ordinary forms in that it has slots cut across the head to receive a cotter pin or key which goes through the bolt or bar and locks the nut in place. Steel and iron nuts are very extensively used in electrical machinery, installation of equipment, power plant and line construction, electric railway track and overhead construction, etc.

Manufacturers:

American Equipment Co., Norristown, Pa.
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Chicago Nut Co., 2513 W. 20th St., Chicago, Ill. (iron)
Corbin Screw Corp., New Britain, Conn.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Milton Mfg. Co., Milton, Pa.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
New Haven Screw Co. New Haven, Conn.
Pawtucket Mfg. Co., 327 Pine St., Pawtucket, R. I.
Stimpson Co., Edwin B., 70 Franklin St., New York, N. Y.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.
Supplee-Biddle Hardware Co., 507 Commerce St., Philadelphia, Pa.
Universal Chain Co., The, Stroudsburg, Pa.

NUTTALL CO., R. D.—Pittsburgh, Pa. Manufacturer of gears, flexible couplings, trolley bases and wheels, etc. President, F. A. Estep; vice-president, Milton Rupert; general sales manager, L. H. Kein. Main office, McCandless St. & Harrison Ave., Pittsburgh, Pa. Branch office, 111 W. Washington St., Chicago, Ill.

NUWAY.—Trade name for electric washing machine manufactured by the Haag Bros. Co., Peoria, Ill.

NUWAY BOILER CO.—810 Monadnock Block, Chicago, Ill. Manufacturer of boilers for power plants. General manager, P. G. Kaiser.

NUX.—Trade name for insulating fiber products manufactured by the Rogers Paper Mfg. Co., Inc., 219 Hartford Rd., South Manchester, Conn.

NUYORK.—Trade name for electric blasting caps manufactured by the New York Blasting Supply Co., 11 Broadway, New York, N. Y.

N. W. 2.—Trade name for electric hair wavers manufactured by the LeBijou Specialties, 186 N. LaSalle St., Chicago, Ill.

NYE TOOL & MACHINE WORKS, THE.—108-28 N. Jefferson St., Chicago, Ill. Manufacturers of die stocks, pipe cutters, pipe vises and other tools. Sole owner, H. G. Nye.

NYELEC SWITCHBOARD CO.—422 E. 53rd St., New York, N. Y. Manufacturer of switchboards, panelboards, etc.

NYGREN BROS. MFG. CO.—Lindsborg, Kans. Manufacturer of cord adjusters.

NYLCO.—Trade name for lighting fixtures manufactured by the New York Lighting Fixture Mfg. Co., 67-69 Spring St., New York, N. Y.

NYLO.—Trade name for lubricating oil manufactured by the New York Lubricating Oil Co., 116 Broad St., New York, N. Y.

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O

O.—The chemical symbol for the element oxygen. The Greek letter omega (ω) is used as a symbol for the ohm.

OAKES & DOW CO., THE.—311 Atlantic Ave., Boston, Mass. Manufacturer of spark plugs. Business established 1914.

OAKES CO., THE ROLAND T.—Holyoke, Mass. Manufacturer of electric iron extractors. Business established 1885. President and treasurer, Arthur J. Newell; vice-president and secretary, J. Otis Whitehouse.

OAKES ELECTRIC HEN.—Trade name for electric incubators manufactured by the Oakes Mfg. Co., Tipton, Ind.

OAKES MFG. CO.—Tipton, Ind. Manufacturer of electric poultry incubators. L. R. Oakes, president.

OAKWOOD.—Trade name for power transmission belting manufactured by the H. N. Cook Belting Co., Howard & Fremont Sts., San Francisco, Cal.

OAKWOOD.—Trade name for soldering paste made by the Weaver Specialty Co., 6344 Aurelia St., Pittsburgh, Pa.

OAMCO.—Trade name for reflectors for industrial, commercial, stage and other lighting purposes, manufactured by the Overbagh & Ayres Mfg. Co., 411 S. Clinton St., Chicago, Ill.

OASIS.—Trade name for electric ironing machine manufactured by the Oasis Mfg. Co., Peoria, Ill.

OASIS MFG. CO.—Peoria, Ill. Manufacturer of electric ironing machines.

O-B.—Trade name for trolley line equipment and electric railway, power transmission and distribution insulators, manufactured by the Ohio Brass Co., Mansfield, Ohio.

OBERMAYER CO., THE S.—Pittsburgh, Pa. Manufacturer of boiler furnace cement. President and treasurer, T. Kaufmann; vice-presidents, S. T. Johnston and E. D. Frohman; secretary, L. A. Gosiger. Main office, 2833 Smaliman St., Pittsburgh, Pa. Branch offices, Cincinnati, Ohio; 2563 W. 18th St., Chicago, Ill.; St. Louis, Mo.; Newark, N. J.; Springfield, Mass.; Dallas, Tex.

O'BRIEN BOILER WORKS CO., JOHN.—1601 N. 11th St., St. Louis, Mo. Manufacturer of boilers. Business established 1873. President, treasurer and general manager, James A. McKeown; vice-president, R. C. O'Brien; secretary, G. J. O'Brien; sales manager, W. T. Miller.

O'BRIEN VARNISH CO.—South Bend, Ind. Manufacturer of insulating and protective paints and varnishes. Business established 1878. President, W. D. O'Brien; secretary and treasurer, G. L. O'Brien; general manager, E. S. Dickens. Main office and factory, Washington & Johnson Sts., South Bend, Ind. Branch offices and warehouses, 315 4th Ave., New York, N. Y.; 175 W. Jackson Blvd., Chicago, Ill.; 31-33 Woodbridge St., W., Detroit, Mich.

OBSOLESCENCE.—Obsolescence is the state of becoming obsolete. It is a special form of depreciation that is very important in the electrical industry. It results from new inventions or radical improvements and changes in the methods employed or in the machinery manufactured, etc. It usually causes a setback or a passing-by of the older forms of machinery because of an increase in efficiency, or because of the creation of new demands which it is not possible to meet under the prevailing conditions with the sizes of equipment at hand. When a new or improved machine is compared with one of the obsolete type, but not yet worn out in the physical sense, to determine whether the new type should immediately supplant the old, the question is usually determined by the consideration whether the total annual charges resulting from the substitution will overbalance the remaining service value of the machine within a reasonable period, or much sooner than the expiration of the probable life period of the new machine. When a new process that permits a reduction in production costs is compared with an old process, the same consideration is given.

There are certain cases in which obsolescence is not a proper charge against depreciation. In these cases the savings in operation secured by discarding obsolete machinery or plant should be used to amortize the cost of the change. Obsolescence of this type where the improvement is one of efficiency or methods is much more common than those relatively infrequent conditions which make it almost imperative to discard the old for the new because of a sudden and radical advance in the art.

OCEAN CABLE.—See Cable, telephone and telegraph, submarine.

OCEAN CABLE TELEGRAPHY.—See Submarine cable telegraphy.

O C O.—Trade name for aluminum solder manufactured by the Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

ODOFOR.—Trade name for electric sewage pumps manufactured by the Barnes Mfg. Co., N. Main St., Mansfield, Ohio.

O. D. SYSTEM SIGNS, INC.—534 Edison St., Milwaukee, Wis. Manufacturer of electric signs. Business established 1908. President, William Allenberg; vice-president, E. Allenberg; secretary and treasurer, Otto C. Driebel; general manager, H. H. Graboske; sales manager, C. E. Gilman.

OEHRLE BROS. CO.—Philadelphia, Pa. Manufacturer of lamp shade fringes. Business established 1883. President and sales manager, A. C. Oehrle; vice-president, treasurer and general manager, F. W. Oehrle; secretary, C. O. Swalm. Main office and factory, 417-427 N. 3rd St., Philadelphia, Pa. Branch offices, 32 S. Wabash Ave., Chicago, Ill.; 41 Union Sq., New York, N. Y.; 361 N. Reno St., Los Angeles, Cal.

OERLIKON ELECTROLYZER.—See Schmidt electrolyzer.

OERSTED.—The oersted is the unit of reluctance or magnetic resistance. It is that reluctance which requires a magnetomotive force of one gilbert to produce a flux of one maxwell.

OERSTED, HANS CHRISTIAN.—A Danish physicist, born at Rudkjobing in 1777 and died at Copenhagen in 1851. He received the degree of Doctor of Philosophy in 1799 at the University of Copenhagen. He became an assistant to a professor of medicine in 1800, traveled in Europe 1801-1804 and again in 1812-1813, and in 1806 was appointed professor of physics at Copenhagen. In 1829 he became director of the new Polytechnic of Copenhagen and in 1850 a privy councillor. During his residence in Berlin he wrote his famous essay on the identity of magnetic and electrical forces, in which he first developed the ideas on which was based his discovery of the intimate connection existing between magnetism and electricity. Oersted's great discovery, made in 1819, was that a magnetic needle was deflected by a current in a wire passing over or below it. This was the earliest experiment combining electricity and magnetism and opened the way to many other brilliant experiments that finally led to the adaptation of electricity to industrial and other uses. In his honor the unit of magnetic reluctance was named the oersted.

OETTEL PROCESS.—A process for the electrolytic oxidation of potassium chloride (KCl) to potassium chlorate ($KClO_3$); now little used.

OFF NORMAL.—The condition of an automatic telephone switch when its switching member is away from its normal position.

OFFICE APPLIANCES, MISCELLANEOUS, ELECTRIC.—See Office machines and appliances, miscellaneous, electric.

OFFICE, CENTRAL, TELEPHONE.—This is the room, building, or place where a telephone switchboard is located. If the exchange is too large for the switchboard to be economically located at one place, the switchboard is subdivided. Each switchboard location is an office. Thus we have single-office exchanges and multi-office exchanges. Formerly one office was called main office and the others branch offices, but now all are practically equal and nearly all have direct connections to all others.

Sometimes in a manual system, there are a few subscribers so located that they could be economically served by a few trunks instead of running all their subscriber lines to the nearest office, yet so few in number that a complete manual office would not pay. In this case an automatic office is installed. Calls from this automatic office are trunked to the nearest manual office and answered by operators. Calls to the automatic office are dialed by operators in the manual office. To the subscribers the service is manual. This is also called an automatic district station.

An automatic office is one in which the switching is operated automatically by the calling subscriber, by dialing. An automatic exchange sometimes has suboffices also. These are used where an office is very small, so that it pays to have the selectors for it located in the nearest main office. The suboffice has only lineswitches, connectors, and sometimes a few selectors. It depends on the main office for its switching. Sometimes it is equipped with switching repeaters, so that calls between subscribers in the suboffice will not hold any trunks between it and the main office.

OFFICE LIGHTING FIXTURES.—See Fixtures, lighting, office and drafting room; also Lighting units, office, storg, etc.; Lamps, desk.

OFFICE MACHINES AND APPLIANCES, MISCELLANEOUS.—There are a number of other classifications covering the more common office machines and appliances; however, there are several machines of special character, such as high-speed motor-driven addressing machines, special recording machines, etc., which are not so listed. It is intended that such machines be included under this general classification. For other office machines listed in other portions of the book see the following: Billing, Blueprinting, Bookkeeping, Computing, Copying, Dictating, Letter folding, Letter opening, Mimeographing, Multigraphing and Tabulating machines, all of which are electrically operated; also see Annunciators, miscellaneous; Erasers, motor-driven; Fans, desk and bracket; Lamps, desk; Telephones, interior; Typewriters, electrically operated.

Manufacturers:

Rapid Addressing Machine Co., 46 W. 23rd St., New York, N. Y. ("Belknap System" addressing machine.)
Standard Envelope Sealer Mfg. Co., Everett, Mass. "Standard."

OFFICE WIRE.—See Wire, annunciator or office.

O'HARA WALTHAM DIAL CO., INC.—Waltham, Mass. Manufacturer of luminous attachments for switches, etc. Business established 1890.

OHIO.—Trade name for conduit fittings manufactured by the Frankel Light Co., Cleveland, Ohio.

OHIO.—Trade name for electric cranes manufactured by the Locomotive Crane Co., Bucyrus, Ohio.

OHIO.—Trade name for brushes for motors and generators and other carbon and graphite products made by the Ohio Carbon Co., 8219 Almira Ave., Cleveland, Ohio.

OHIO.—Trade name for splash proof induction motors manufactured by the Ohio Electric & Controller Co., 5900 Maurice Ave., Cleveland, Ohio.

OHIO.—Trade name for electric passenger and freight elevators manufactured by the Ohio Elevator & Machine Co., Curtis & Jefferson Aves., Columbus, Ohio.

OHIO. — Trade name for lubricating greases manufactured by the Ohio Grease Co., Loudonville, Ohio.

OHIO.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

OHIO BODY & BLOWER CO., SWARTWOUT SPECIALTY DIVISION.—Cleveland, Ohio. Manufacturer of feed water heaters.

OHIO BRASS CO., THE.—Mansfield, Ohio. Manufacturer of trolley line equipment and electric railway power transmission and distribution insulators. Business established 1888. President, F. B. Black; vice-presidents, C. K. King and H. S. Black; secretary and sales manager, E. F. Wickwire; treasurer, C. V. Marks; general manager, C. K. King. Main office, Mansfield, Ohio. Factories, Mansfield, Ohio; Barberton, Ohio. Branch offices, 50 Church St., New York, N. Y.; 343 S. Dearborn St., Chicago, Ill.; 710 Witherspoon Bldg., Philadelphia, Pa. Sales representatives, Burt Gellatly, 2205 Oliver Bldg., Pittsburgh, Pa.;

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Holabird Electrical Co., 525 Mission St., San Francisco, Cal.; Holabird Electrical Co., 451 E. 3rd St., Los Angeles, Cal.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Charleston Electrical Supply Co., Charleston, W. Va.; Sands Electric & Mfg. Co., Wheeling, W. Va.; Fairmont Mining Machinery Co., Fairmont, W. Va.; Shook & Fletcher Supply Co., Inc., Birmingham, Ala.; Jeffrey Mfg. Co., Columbus, Ohio; Columbus Mill & Mine Supply Co., Columbus, Ohio; Sterling Hardware Co., Hazard, Ky.; McComb Supply Co., Harland, Ky., and Jellico, Tenn.

OHIO BRONZE POWDER CO.—1120 E. 152nd St., Cleveland, Ohio. Manufacturer of bronze powders.

OHIO CARBON CO., THE.—8219 Almira Ave., Cleveland, Ohio. Manufacturer of brushes for motors and generators and other carbon and graphite products. Business established 1917. President, M. G. Tielke; vice-president, W. H. Shepard; secretary, treasurer and sales manager, J. E. Schunck; general manager, A. K. Moulton.

OHIO ELECTRIC.—Trade name for electric vacuum cleaners manufactured by the United Electric Co., Canton, Ohio.

OHIO ELECTRIC & CONTROLLER CO., THE.—5900 Maurice Ave., Cleveland, Ohio. Manufacturer of small motors and lifting magnets. President, F. W. Jessop.

OHIO ELECTRIC LIGHT ASSOCIATION.—President, Dudley J. Hard, Wooster, Ohio; secretary-treasurer, D. L. Gaskill, Greenville, Ohio.

OHIO ELECTRIC SPECIALTY MFG. CO., THE.—Troy, Ohio. Manufacturer of commutator brushes. Business established 1908. President and general manager, J. R. Simpson; secretary, W. H. Stillwell; treasurer, J. W. Means.

OHIO ELEVATOR & MACHINE CO.—Curtis & Jefferson Aves., Columbus, Ohio. Manufacturer of electric passenger and freight elevators. Business established 1906. President and general manager, J. H. DeVere; vice-president, L. F. Sater; secretary and treasurer, H. R. Burton. Sales representatives, Elevator Equipment & Repair Co., Pittsburgh, Pa.; Reliance Elevator Co., Philadelphia, Pa.; Blake Palm & Bro., Washington, D. C.; Klug Elevator Co., St. Louis, Mo.; William Walker Jones, Raleigh, N. C.; Kanawha Engineering Co., Charleston, W. Va.

OHIO GREASE CO., THE.—Loudonville, Ohio. Manufacturer of lubricating oils and greases. Business established 1905. President, C. A. Fisher; vice-president, W. A. Wander; secretary and general manager, E. W. Beardsley; treasurer, R. W. Beardsley.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. — President, Frank L. Beam, Mt. Vernon, Ohio; secretary, H. P. Folson, Circleville, Ohio.

OHIO QUARRIES CO., THE.—Citizens Bldg., Cleveland, Ohio. Manufacturer of barriers for bus and switching chambers.

OHIO-TUEC.—Trade name for electric vacuum cleaners manufactured by the United Electric Co., Canton, Ohio.

OHM.—The practical unit of resistance is the ohm, which is defined as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of constant cross-sectional area, and of a length of 106.300 centimeters. While the ohm is thus defined in terms of a concrete standard, the construction of such a standard is an extremely difficult process. The name international ohm is applied to this concrete standard. The ohm equals 10^9 absolute units of resistance. A length of 1000 ft. of No. 10 A. W. G. annealed copper wire at a temperature of 20° C. (68° F.) has a resistance of approximately one ohm.

OHM-CM.—Abbreviation for ohm per centimeter cube.

OHM, GEORG SIMON.—A German physicist and discoverer of the famous electrical law bearing his name. He was born at Erlangen in 1787, and died at Munich in 1854. He became professor of mathematics in the Jesuits' College at Cologne in 1817 and in the Polytechnic School at Nuremberg in 1833, and in 1852 professor of experimental physics in the University of Munich. His researches were chiefly concerned with galvanic currents; while investigating the relative conductivity of metals he finally discovered the relation now known as Ohm's law, which underlies all electrical calculations and measurements. In his honor the unit of electrical resistance has been named the ohm.

OHM-MILE.—A special unit of resistance represented by a wire one mile long and having a resistance of one ohm. See Mile-ohm.

OHM PER CENTIMETER CUBE.—The scientific unit of resistivity. When a cube of any material one centimeter on each side has a resistance of one ohm it possesses unit resistivity. Such a cube is called a centimeter cube and the unit is sometimes, for brevity, called the ohm-centimeter, abbreviated ohm-cm. Although a centimeter cube equals one cubic centimeter (1c.c.), the latter is merely a volume equivalent to that of a centimeter cube but may have any shape. The resistance, however, depends upon the shape and the latter must be specified, as it is by the centimeter cube.

OHMER.—Trade name for ignition instruments, magnetos, generators and small motors manufactured by the Recording & Computing Machines Co., 1 Essex Ave., Dayton, Ohio.

OHMLAC MFG. CO.—140 S. Dearborn St., Chicago, Ill. Manufacturer of insulating paints. President, treasurer and general manager, L. F. Lindley; vice-president, L. B. Cary; secretary, F. B. Lindley.

OHMMETERS.—Ohmmeters are direct-reading instruments for measuring resistance. They are of two forms; in one the principle of the slide-wire Wheatstone bridge is employed, and in the other the resistance is indicated by a pointer whose deflection is some function of the resistance measured. In the bridge type of instrument, which is suitable for comparatively low resistance only, the resistance of one arm of the bridge is fixed while the ratio of the other two is adjusted until balance is secured. This ratio is adjusted by sliding a contact along a long wire, the two segments of which form the ratio arms. Under this wire may be placed a scale which is graduated in terms of the resistance required in the fourth arm of the bridge to obtain balance.

Under constant voltage the deflection of any instrument actuated by a direct current will vary with the resistance connected in series with it. It is thus evident that any such instrument may be calibrated in ohms and thus become an ohmmeter. This is the general principle of the deflection type of ohmmeters, which are used mostly for high resistances and are called megohmmeters. See Megohmmeters.

Manufacturers:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Megger" testing sets, for testing insulation resistance of interior wiring, cables, generators, motors, etc. See "Megohmmeters" for detailed description.—Adv.

ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Wheatstone bridge and Kelvin bridge type portable ohmmeters. The Wheatstone bridge type measures resistance from approximiately ½ ohm to 1,000,000 ohms, with an accuracy of ½ per cent. The Kelvin bridge type measures resistances from .0001 to 11 ohms, with the same accuracy. The latter is especially suitable for testing armature windings, rail bonds, etc. The instruments weigh approximately 7 lbs. each.—Adv.

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

Roller-Smith Co., 233 Broadway, New York, N. Y.

THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. The Vawter indicating ohmmeter, originated and developed by Prof. Vawter in the research laboratory of the Thompson-Levering Co., is the result of years of careful thought and study to produce an instrument that, immediately upon pressing the key, indicates resistance with great accuracy, and that, in addition, is independent of voltage and magnetic variations. Among the important features incorporated in the Vawter indicating ohmmeter are: 1—Simplicity of operation. 2—Reliability at all times. 3.—Accuracy of indications. 4—Uniform scale. 5—Independent of variations in voltage. 6—Independent of variations in magnetic clux. 7—Self-contained. 8—No magnetic shunt to be adjusted. 9—No calibration to be made before using. 10—Correctly damped. 11—Rugged construction. 12—Range, practically unlimited. The operation of the instrument is extremely simple. The resistance to be measured is connected to the line posts, the contact button is pressed, and the needle swings to the value of resistance measured. Electrical and mechanical details are thoroughly perfected, both theoretically and practically. On standard types, all readings are accurate within 1 per cent, and to within 1-10 of 1 per cent on the special type instrument which is supplied when such accuracy is required. The instrument will withstand all the hard usage to which a moving coil instrument of any design or make should be put. It fills a very long felt need for an instrument that does all the work of measuring resistance accurately and quickly. Also see display adv. on page 1286.—Adv.

"Vawter." (See display adv. page 1286.) Weston Electrical Instrument Co., Waverly Park, Newark, N. J.



Vawter Indicating Ohmmeter

OHM'S LAW.—The numerical relation between the resistance of a circuit, the impressed e.m.f. and the resulting current is known as Ohm's law. For direct-current circuits this relation is: Amperes=volts/ohms or I=E/R. The same relation holds for alternating-current circuits provided all of the electromotive forces in the circuit are taken into consideration. Also see Ohm's law for a-c. circuits.

OHM'S LAW FOR A-C. CIRCUITS.—The value of an alternating current in a circuit is determined by the impressed voltage, and the resistance and reactance of the circuit. Since the resistance volts, inductive reactance volts and condensive reactance volts are out of phase with the current to which they are due, the impressed voltage must have components opposite to each of the above mentioned voltages. The component required to keep the current flowing in the resistance must be in phase with the resistance; the component to overcome the inductive reactance volts must be one-quarter of a period ahead of the current, and the component to counteract the condensive reactance volts must lag the current one-quarter of a period. On a vector diagram IX_o of the impressed e.m.f., is 90° ahead, IX_c is 90° behind and IR is in phase with the current. The vector sum of these three quantities is the impressed e.m.f. or

$$E=\sqrt{(IX_o-IX_c)^2+(IR)^2} \text{ and}$$
$$I=E/\sqrt{R^2+(X_o-X_c)^2}=E/Z$$

The current will lag if X_o is greater than X_c, and vice versa. When $X_o=X_c$, I=E/R, as for direct currents. Z, which equals $\sqrt{R^2+(X_o-X_c)^2}$, is called the impedance of the circuit.

OIL AND GREASE CUPS.—The lubricating of much electrical machinery is accomplished by means of oil and grease cups. While a very large percentage of the motors and generators are lubricated by oil rings running in oil wells, the smaller sizes and some makes in the larger sizes use grease or oil cups. Small motors or motors mounted in inaccessible places usually have grease cups or oil cups with a wick which is pressed against the shaft by a small spiral spring. These require filling only at long intervals. Where the motors may be examined occasionally the grease cups are so arranged that by screwing on the cap the pressure is increased. Oil cups are sometimes merely dependent on gravity feed while others have a small piston that may be given one or two strokes to create a pressure in the cup that will insure a steady flow of oil. Oil cups usually have a glass cylinder containing the oil so that the quantity in the cup may be readily observed. In the sight-feed type the oil drips through a section wherein the flow may be seen.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y. "Conus."

American Injector Co., 175 14th Ave., Detroit, Mich. "Climax," "Economy,"

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"Emergency," "Moon,' "Star," "Sun," "Surfeed."
American Stamping Co., Battle Creek, Mich. "American."
Bay State Stamping Co., 380 Chandler, St., Worcester, Mass.
Bowen Products Corp., Auburn, N. Y. "Empress."
Challenge Co., Batavia, Ill.
Corning Glass Works, Corning, N. Y.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Detroit Lubricator Co., Trumbull, Lincoln, Marquette & Viaduct Sts., Detroit, Mich. "Detroit."
Edelmann & Co., E., 2638-56 N. Crawford Ave., Chicago, Ill.
Fay & Egan Co., J. A., 705-755 W. Front St., Cincinnati, Ohio.
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.
Gits Bros. Mfg. Co., 1901 S. Kilbourne Ave., Chicago, Ill. (oil)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Lindholm Metal Stamping Co., Inc., 107-115 Erie St., Camden, N. J.
Lonergan Co., J. E., 211-215 Race St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio. "Acorn," "Champion," "Cardinal," "Crown," "Hawk," "Miami," "Pioneer," "Reserve," "Royal," oil cups; "Apollo," "Atlas," "Checklock," "Dextro," "Ferro," "Gem," "Grip," "Guard," "Ideal," "Jewel," "Lion," "Lock," "Majestic," "Marine," "Owl," "Positive," "Primo," "Securo," "Surety," "Teeferro." "Tiger," "Wingo."
Madison-Kipp Corp., Waubesa St., Madison, Wis.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Penberthy Injector Co., Ltd., Windsor, Ont., Can. "Penberthy."
Powell Co., William, Cincinnati, Ohio.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Niagara," "Sherwood," "Buffalo."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Wilkinson Co., William H., West Medway, Mass.
Williams Valve Co., The D. T., Cincinnati, Ohio. "Tacoma," "Tamarack," "Tandem," "Tarrant," "Temple." "Terrier," "Topaz," "Tremont," "Trophy" oil cups, "Dandy," "Duchess," "Diploma," "Domino," "Dragon," "Diamond," "Diana," "Derby," "Dakota," "Duke," "Dahlia," "Daisy," "Dixie," "Dwarf," grease cups.

OIL BURNERS, POWER PLANT.—These devices consist essentially of a nozzle burner for control of the flame and oil supply in power-plant boilers where oil is used as the fuel. It is necessary to convert the oil stream into a fine spray so that the particles or globules of oil may be thoroughly mixed with the air and give a flame of large area. In the types using steam or air two pipes lead to the nozzle, one for steam or air, the other for the oil. The steam or air and oil mix in the nozzle to form an atomized spray. A by-pass from steam to oil pipe is usually included to allow the cleaning of the oil pipe by blowing the high-pressure steam through it. Valves in the burner pipes control the air or steam and oil supply. The tips are shaped to obtain the particular spread of flame which may be desired.

Mechanical atomizers may also be advantageously employed instead of the steam or air atomizers. In these mechanical atomizers the oil enters under high pressure and operates a revolving device in the nozzle of the burner which causes the oil to be ejected in a very fine spray, or atomization may be produced by forcing the oil under high pressure through a small orifice of special shape.

Manufacturers:

Binks Spray Equipment Co., 3120 Carroll Ave., Chicago, Ill.
Denver Fire Clay Co., Denver, Colo. "DFC."
Hammel Oil Burning Equipment Co., Inc., 185 Devonshire St., Boston, Mass.
Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.
Macleod Co., The, 2232-38 Bogen St., Cincinnati, Ohio. "Doelcam."
National Airoil Burner Co., 9th & Thompson Sts., Philadelphia, Pa. "National."
North American Mfg. Co., The, 5902 Carnegie Ave., Cleveland, Ohio.
Powell Co., The William, Cincinnati, Ohio.
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Tate-Jones & Co., Inc., Pittsburgh, Pa.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

OIL-BURNING EQUIPMENT, POWER PLANT.—The equipment for burning fuel oil consists of a storage tank, a pump for delivering the oil from the storage tank to the burners, a heater for raising the oil temperature, and the burners for atomizing the oil.

The oil storage tank is placed for safety so that the oil must be pumped to the burners and cannot flow toward them by gravity. It should have capacity for at least two weeks' and better still one month's supply of oil. Two storage tanks are better than one on the score of reliability, safety, etc. Storage tanks are frequently placed below ground and may be of steel or concrete.

Oil may be atomized either by steam or compressed air or by a mechanical atomizer. For the former, oil is pumped to the burners at a pressure between 50 and 75 lbs. per sq. in. at a temperature of 110° to 140° F. Steam at boiler pressure is used; the pump is usually operated by steam, the exhaust of which is used for heating the oil in the heaters and storage tank. With the mechanical atomizer, oil is pumped to the burners at a pressure of about 200 lbs. per sq. in. at 200° to 275° F. temperature; atomization occurs by forcing the high-temperature oil through a small orifice under high pressure. Steam atomizers require from 1½ to 2% of the boiler output. Mechanical atomizers use no steam for atomizing but for operating the pump. The steam consumption is less than 1½%. The mechanical atomizer removes from the control of the fireman the steam for atomizing, thus preventing a possible loss of between 3 and 7% of the boiler output.

Even more important than the burner is the furnace where the air and burning oil should mix together freely for perfect combustion. Furnace volume is to oil fuel what grate surface is to solid fuel.

OIL CIRCUIT BREAKER.—A switch whose contacts are made and broken under oil and which is provided with means for automatically opening the circuit under one or more abnormal conditions. In other words, it is an oil switch designed with special automatic protective features so it may serve as a circuit breaker. Several manufacturers design and designate nearly all their oil switches in this manner. See Circuit breakers, oil.

OIL CITY BOILER WORKS.—Box 137, Oil City, Pa. Manufacturers of boilers, gas and steam engines. Business established 1890. President, Charles O'Day; vice-president, Frank O'Day; secretary, treasurer and general manager, C. P. Berry; sales manager, William H. Heagerty. Main office, Oil City, Pa. Branch offices, 501 5th Ave., New York, N. Y.; 1224 Marquette Bldg., Chicago, Ill. Sales representative, Federal Engineering Co., House Bldg., Pittsburgh, Pa.

OIL CITY OIL & GREASE CO.—Oil City, Pa. Manufacturer of lubricating oils and greases.

OIL CONSERVATORS.—A device attached to large or high voltage oil-immersed transformers to serve as an expansion tank for the oil and to prevent moisture condensation in the main tank, thus protecting the oil from deterioration. It consists essentially of an auxiliary tank mounted above the transformer and partly filled with oil, which keeps the main transformer tank completely filled. A breathing vent filled with hygroscopic material connects with the upper part of the auxiliary tank and introduces dry air into the space above the oil when the oil temperature falls and permits escape of air as the oil expands with increase of temperature. It eliminates breathing and moisture condensation in the main tank and also protects the oil from sludging, thus serving to retard the deterioration of organic material used in transformer construction.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. This company has perfected the conservator type of tank for power transformers as a standardized product with its value fully established in the field and a factory equipment allowing its economic application, particularly of transmissions involving oil-immersed units. (Bulletin 49706.) See adv. pages 1203-1223.—Adv.

OIL FILTERS, DEHYDRATORS AND PURIFIERS.—Oil filtering and purifying devices are used for both lubricating and insulating oils so that they may be used over and over many times. As the requirements for these oils are different, the purifying apparatus is also different. Plain filters are ordinarily used with lubricating and cutting oils, to remove any particles of dust, dirt or metal flakes, chips, or other foreign matter that is present. In one of the common forms the dirty oil is placed in a compartment at the top of the filter, and passes through a series of screens or a thick layer of cotton waste which removes the larger particles. The weight of the oil then forces it down through a pipe which terminates just below a set of filter plates which are completely surrounded with water. The pressure of the water causes the oil to spread out in a thin film and the foreign matter is thus washed out. This washing operation takes place on three plates over which the oil passes as it tends to rise to the top of the water. It goes through another layer of waste and into the oil storage tank from which it is drawn off for reuse.

In the purifying and dehydrating outfits that are required for transformer and switch oil the sediment and foreign matter and also the free water in the oil and moisture held in suspension is removed. The purifying thus differs from that for lubricating and cutting oils as small amounts of water in these will do no harm, whereas a very small percentage, about 0.002% by volume of water will make insulating oils unsuitable for use. The purifying and dehydrating outfits differ therefore from the filters used for lubricating oils. In them the oil to be purified is forced through several layers of specially prepared filter paper or a high-grade white blotting paper prepared from wood pulp. Any sediment or foreign matter is strained out by the first paper and the moisture is removed by the capillary action of the other papers. If the oil is very dirty or contains much moisture, it is necessary to change the filter papers quite frequently. Rotary gear positive-pressure pumps are used to force the oil through. A strainer removes all large particles before the oil gets to the pump. These outfits are often used in large power plants for a battery of transformers and switches, where the circulating system is arranged so that any unit may have its oil cleaned or dehydrated to improve its dielectric strength.

Manufacturers:

Anderson Co., The V. D., 1935 W. 96th St., Cleveland, Ohio.
Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind.
Burt Mfg. Co., The, Akron, Ohio. "American," "Burt," "Cross," "Warden."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott."
Entorf Filter Co., Amboy, Ill. (for gasoline and other light oils)
Famous Filter Co., 116 Pine St., St. Louis, Mo.
Flower Co., Walter L., 312-314 S. 8th St., St. Louis, Mo. "Acme."
GENERAL ELECTRIC CO., Schenectady, N. Y. The method developed by this Company for freeing insulating oil from moisture, slime and sediment is by forcing it under pressure through several layers of dry blotting paper in a specially designed filter press. The outfits are provided with pump, motor, piping, drip pan, and auxiliary devices. Also electric oven specially developed for drying the blotting paper. Used also for purification of crude petroleum, insulating varnish and japan, benzine and viscous insulating compound. (Bulletin 49701.) See adv. pages 1203-1223.—Adv.
Hunt Mfg. Co., Edward J., 207 Market St., Newark, N. J.
Johnson Co., John, 37th St. & 2nd Ave., Brooklyn, N. Y. "Johnson."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Nugent & Co., Inc., William W., 146 W. Superior St., Chicago, Ill.
Rexford Mfg. Co., Liberty, Mo.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.
Seehausen, Wehrs & Co., 179 N. Franklin St., Chicago, Ill. "S & W."
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

OIL FUSES.—See Fuses, oil-enclosed.

OIL-KIPPS.—Trade name for force feed lubricators made by the Madison-Kipp Corp., Waubesa St., Madison, Wis.

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OIL, LUBRICATING.—Wherever relative motion occurs between two solid bodies, especially in machinery, lubrication is needed to reduce the friction. The varying degrees of load, pressure, speed, temperature and materials used as bearing surfaces naturally call for a wide range of lubricating oils. When properly lubricated a film of oil is maintained between the two surfaces. For high speeds and light pressures, light oils are used; while for slow speeds and very heavy pressures very heavy oils or greases are used. In general it is most economical and best results are obtained by using the lightest-bodied oil that can possibly be employed satisfactorily for the work. Very minutely divided graphite, such as deflocculated graphite, is sometimes added to oils and in this way their lubricating qualities may be improved.

Manufacturers:

Acheson Oildag Co., Port Huron, Mich. "Oildag."
American Oil Corp., 172 S. Water St., Jackson, Mich. "Amoilco," "Miniardo," "Oleosity."
Clark Co., The Fred G., 1087 W. 11th St., Cleveland, Ohio. "Hyvis," "H. M. & L. M."
Cook & Swan Co., Inc., 148 Front St., New York, N. Y. "Swanoleine."
Cook's Sons, Adam, 708-710 Washington St., New York, N. Y. "Albany."
Crescent Oil Co., 602 W. Pratt St., Baltimore, Md. "Crescent."
Crew Levick Co., 111 N. Broad St., Philadelphia, Pa.
Dearborn Chemical Co., 332 S. Michigan Ave., Chicago, Ill.
Emlenton Refining Co., Emlenton, Pa.
Faul Co., William J., 133 Front St., New York, N. Y.
Fiske Bros. Refining Co., 24 State St., New York, N. Y. "Fiske's."
Franklin Oil Works, Franklin, Pa. "Alyear."
Fuller & Co., W. P., Mission & Beale Sts., San Francisco, Cal.
Harris Oil Co., A. W., 326 S. Water St., Providence, R. I. "Harris."
Henle, Inc., S., 23 Beaver St., New York, N. Y.
Independent Refining Co., Oil City, Pa.
Indian Refining Co., 244 Madison Ave., New York, N. Y. "Havoline."
Midland Refining Co., El Dorado, Kans.
Moore Oil Refining Co., The, York & McLean Sts., Cincinnati, Ohio.
National Refining Co., Cleveland, Ohio. "National."
New York & New Jersey Lubricating Co., 401 Broadway, New York, N. Y. "Non-Fluid."
New York Lubricating Oil Co., 116 Broad St., New York, N. Y. "Nylo."
Ohio Grease Co., The, Loudonville, Ohio. "Triangle."
Oil City Oil & Grease Co., Oil City, Pa.
Pennsylvania Oil Products Refining Co., Warren, Pa.
Pierce Oil Corp., 25 Broad St., New York, N. Y. "Pennant."
Pigot, Sayre Co., The, 17 Battery Pl., New York, N. Y. "Aurora."
Pure Oil Co., 1306 S. 1st St., Minneapolis, Minn. "Puritan."
Pure Oil Co., Columbus, Ohio.
RELIANCE OIL & GREASE CO., THE, 16 W. Goodale St., Columbus, Ohio. "Reliance."
Robinson & Son Co., William C., 32 South St., Baltimore, Md. "Robinson," "Pittroil."
Sinclair Refining Co., Conway Bldg., Chicago, Ill. "Sinclair."
Sloan & Zook, 101 Main St., Bradford, Pa.
Standard Oil Co. of California, 200 Bush St., San Francisco, Cal.
Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill. "Renown," "Superla."
Standard Oil-Co. of Kentucky, Louisville, Ky.
Standard Oil Co. of New York, 555 W. 25th St., New York, N. Y.
Standard Oil Co. of Ohio, E. Ohio Gas Bldg., Cleveland, Ohio.
Star Lubricating Oil Co., 8714 Broadway, Cleveland, Ohio.
Sullivan Oil Co., 413 N. Wells St., Chicago, Ill.
Sun Co., 1428 S. Penn Sq., Philadelphia, Pa. "Sun."
Swan & Finch Co., New York, N. Y.
TEXAS CO., THE, 17 Battery Pl., New York, N. Y. Texaco lubricants of all kinds for power plants, central stations, electric street railways, marine railroads, etc. There is "Texaco" lubricant for every purpose.—Adv.
Tidewater Oil Co., 11 Broadway, New York, N. Y.
Traction Lubricating Co., 69 W. Washington St., Chicago, Ill. "Traluco."
Transcontinental Oil Co., Benedum Trees Bldg., Pittsburgh, Pa.
Universal Lubricating Co., Schofield Bldg., Cleveland, Ohio. "Tulc."
Union Oil Co. of California, 215 W. 7th St., Los Angeles, Cal.
Vacuum Oil Co., 61 Broadway, New York, N. Y. "Gargoyle."

OIL, MISCELLANEOUS INSULATING.—Oil is used extensively as an insulating medium, aside from its use in transformers, oil switches, etc., which is separately described below. It is used to saturate fibrous materials for tapes and cable-insulating fabrics, for coating paper and cloths, and in mixing insulating varnishes and paints. Nearly all oils have high resistivity, varying from 10^{12} to 10^{15} ohm-cm., and high dielectric strengths, which vary from 4000 to 16,000 volts per mm. The presence of moisture or traces of acid or alkali in the oil reduces its dielectric strength considerably and at the same time corrodes and destroys the materials in contact with it. The flashpoint, which is the temperature at which the vapor resulting from heat ignites, should also be high. Oil is composed of hydrocarbons and has the general formula $C_n H_{2n}$ or $C_n H_{2n} + 2$.

Manufacturers:

Calman & Co., Emil, 100 William St., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J. "Halowax."
Crew Levick Co., 111 N. Broad St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. This Company has found that the best operating results can be obtained by using specially adapted oils in its various classes of apparatus. It is prepared to furnish guaranteed insulating oils having characteristics best adapted for service with each type of its apparatus. Further information may be obtained from any G-E sales office. See page 1223.—Adv.
Robinson & Son Co., William C., 32 South St., Baltimore, Md. "Robinson," "Pittroil."
Standard Asphalt & Refining Co., Bartlesville, Okla.
Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Sun Co., 1428 S. Penn Sq., Philadelphia, Pa. "Sun."
Texas Co., The, 17 Battery Pl., New York, N. Y., and Houston, Tex. "Texaco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

OIL RESERVOIRS AND TANKS.—Sheet-metal containers provided for storing the supply of lubricating, insulating or fuel oil. In their application to the electrical industry, these tanks are not made in the very large sizes, such as are found in oil fields. Steel drums in capacities up to 110 gals., and steel barrels containing about 55 gals. are very frequently used both for shipping and storage in the plant. Steel reservoirs are sometimes used, especially where a large plant has a circulating system supplying several machines and including a filtering or purifying outfit. Lubricating oil is generally kept in steel tanks with a small pump arranged for drawing out the supply as needed. Fuel oil tanks are often of large capacity and therefore special; they are frequently placed underground in the yard of the plant.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Bauer Machine Co., The, 113 W. 18th St., Kansas City, Mo. "Bauer, K. C."
Biggs Boiler Works Co., Akron, Ohio.
Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind.
Codd Co., E. J., 700-708 S. Caroline St., Baltimore, Md.
Downingtown Iron Works, Inc., Downingtown, Pa.
Hamler Boiler & Tank Co., 39th & Halsted Sts., Chicago, Ill.
International Engineering Works, Inc., Waverly St., Framingham, Mass.
Leader Iron Works, Decatur, Ill. "Leader."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
Pittsburgh-Des Moines Steel Co., 404 Ross St., Pittsburgh, Pa.
St. Louis Pump & Equipment Co., 722 Chestnut St., St. Louis, Mo.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

OIL SWITCH.—A switch whose circuit opening and closing contacts are immersed in oil. See Switches, oil. If an oil switch is provided with automatic means for breaking the circuit under one or more abnormal conditions and is designated to function as an automatic protective device, it is called an oil circuit breaker. See Circuit breakers, oil.

OIL TEMPERATURE.—The temperature of the oil surrounding any piece of electrical apparatus should not exceed 90° C. in any part, as registered by thermometer.

OIL TESTING CUPS AND DEVICES.—The insulating value of oil, upon which most oil insulated apparatus depends for its principal insulation, can be ascertained reliably only by measuring its dielectric strength by direct voltage test. In this test samples of the insulating oil are poured into special oil-testing cups, frequently called gaps, containing special electrodes across which high potential energy is applied from a high voltage transformer until the oil breaks down and a discharge occurs.

Oil testing cups or spark gaps are usually made of insulating material or composition. Through opposite sides of the cups are passed the electrodes. The electrodes vary in gaps of different manufacture. The most common cup which is being generally adopted has electrodes consisting of flat discs 1 inch in diameter and spaced 0.1 inch apart. Some cups are made with micrometer adjustments for setting the gaps between the electrodes while others to be accurately adjusted require a special feeler gauge. After adjustment the electrodes are locked in position.

The sample of oil to be tested is then poured into the cup, covering the electrodes by about 1 inch. After all bubbles have disappeared the voltage is gradually increased until breakdown occurs. Usually five or more readings are taken on gap fillings of the same specimen of oil and an average dielectric value determined. It is very essential to keep the insulating oil used up to its proper dielectric value so in addition to carefully checking up the oil at the time the oil insulated apparatus is installed it is customary to take samples from the apparatus and make routine tests at frequent intervals, particularly in the case of high voltage transformers, to determine whether moisture or foreign material has lowered the oil's dielectric strength sufficiently to warrant filtering or dehydrating or complete replacement.

Potential is supplied to the oil testing cups usually from a special transformer and control apparatus which permits applying the high-tension voltage by successively increasing steps. In one compact set that is made portable for field testing the oil cup is mounted on the high-voltage terminals of the step-up transformer. Control is secured for this set from an autotransformer with taps and controlled from a separate small panel.

Other large sets are also made which are suitable for laboratory work and insulation testing in addition to oil testing.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. Complete line of oil testing equipment including oil testing spark gaps for use with existing testing transformers; the G-E Portable for oil testing in the field and the 30,000-volt oil and insulation testing set. The G-E Portable Oil Tester is a small compact portable set of three principal pieces of apparatus; the main 25,000-volt testing transformer, auto transformer control box, and the oil spark gap. (Bulletin 69901.) The 30,000-Volt Oil and Insulation Testing Set includes the main high potential transformer, induction regulator control, circuit breaker, and trucks, all mounted as a unit. Voltmeter is supplied for use with the voltmeter coil of the main transformer as an extra. Equipment suitable for oil testing, insulation testing and laboratory work. (Bulletin 69707-A.) Both of the above equipments can be furnished for either 110 or 220 volts and 25 or 60 cycles. See adv. pages 1203-1223.—Adv.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

OIL TRANSFORMER.—A transformer in which the coils are immersed in oil as distinguished from the air-cooled or air-blast type. See Transformer.

OIL, TRANSFORMER AND SWITCH.—The ideal oil used as a cooling and insulating fluid for transformers should be a good insulator, have good thermal conduc-

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tivity, high specific heat, high coefficient of expansion, low viscosity and must be capable of withstanding high operating temperatures without carbonizing; it must also be free from acids or any other ingredients that will attack fibrous materials, iron, copper or varnish. The oil generally used is a pure mineral oil obtained from crude petroleum by fractional distillation. It has a dielectric strength of from 40,000 to 50,000 volts when tested between discs 0.5 inch in diameter set 0.2 in. apart. It is important that the oil contain little or no moisture, as its presence reduces the dielectric strength very rapidly. The viscosity of the oil is a very important property, as the more sluggish the oil the slower will be its circulation and consequently the transfer of heat will be correspondingly slow. While the flashpoint should be high, it is not such an important factor in transformer oil, because the maximum temperatures existing in transformers very rarely cause the vapor to ignite.

Switch oil is usually similar in many respects to transformer oil, being a pure mineral oil free from moisture, acids, alkalies, etc. It is used as the insulating medium for oil switches, oil circuit breakers, autostarters, etc., where heat is generated by flashes caused by the make and break of contacts. For this service the viscosity of the oil is not so important, but the high flash and firepoints are. These can be obtained by using a heavier oil. When used on outdoor equipment a special oil having a very low congealing point is used. This generally lowers the flashpoint also. The flashpoint should be from 180° to 200° C. (Also see Oil, miscellaneous, insulating.)

Manufacturers:

American Oil Corp., 172 S. Water St., Jackson, Mich. "American," "Amoil-co," "Amoco."
American Transformer Co., 178-182 Emmett St., Newark, N. J.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Crescent Oil Co., 602 W. Pratt St., Baltimore, Md. "Crescent."
Crew Levick Co., 111 N. Broad St., Philadelphia, Pa.
Emery Mfg. Co., Bradford, Pa. "Emery."
Emlenton Refining Co., Emlenton, Pa.
Fiske Bros. Refining Co., 24 State St., New York, N. Y. "Fiske's."
Franklin Oil Works, Franklin, Pa. "Alyear."
Harris Oil Co., A. W., 326 S. Water St., Providence, R. I. "Harris."
Henle, Inc., S., 23 Beaver St., New York, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
National Refining Co., Cleveland, Ohio. "En-ar-co."
Pennsylvania Oil Products Refining Co., Warren, Pa.
Pierce Oil Corp., 25 Broad St., New York, N. Y. "Pennant."
PITTSBURGH TRANSFORMER CO., Columbus & Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Pure Oil Co., Columbus, Ohio.
Robinson & Son Co., William C., 32 South St., Baltimore, Md. "Robinson," "Pitroll."
Sinclair Refining Co., Conway Bldg., Chicago, Ill. "Sinclair."
Standard Oil Co. of California, 200 Rush St., San Francisco, Cal.
Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill. "Superla."
Star Lubricating Oil Co., 8714 Broadway, Cleveland, Ohio.
Sun Co., 1428 S. Penn Sq., Philadelphia, Pa. "Sun."
Swan & Finch Co., 522 5th Ave., New York, N. Y. "Atlas."
TEXAS CO., THE, 17 Battery Pl., New York, N. Y. Texaco oils for transformers and switches are made by this company, also lubricants for all purposes.—Adv.
Transcontinental Oil Co., Benedum Trees Bldg., Pittsburgh, Pa.
Vacuum Oil Co., 61 Broadway, New York, N. Y. "Gargoyle."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Lectroseal." (See display adv. pages 1395-1402.)

OIL WELL SUPPLY CO.—Pittsburgh, Pa. Manufacturer of gas engines, valves, air and gas meters, die stocks, babbitt metal, oil pumps and other equipment for oil and gas wells. Business established 1862. Main office, 213-215 Water St., Pittsburgh, Pa. Branch offices, New York, N. Y.; San Francisco, Cal.; Los Angeles, Cal. Factories, Pittsburgh, Pa.; Oil City, Pa.; Oswego, N. Y.; Parkersburg, W. Va.; Los Angeles, Cal.; Poplar Bluff, Mo.

OILDAG.—Trade name for lubricating oil manufactured by the Acheson Graphite Co., Port Huron, Mich.

OILED FABRICS.—See Fabrics, oiled insulating.

OILED PAPER.—See Paper, oiled and paraffined.

OILERS, ENGINEERS', DYNAMO AND MOTOR TENDERS'.—Oilers (sometimes called oil cans) for use in engine rooms and for filling motor and dynamo oil wells and cups are generally made in sets varying in capacity and length of spout. They are usually made of brass, occasionally of tin, and in some cases are nickel-plated. The spouts vary in length from about 6 to 24 ins. so that rather inaccessible places may be reached. A valve operated by the thumb controls the flow of oil. Several shapes and sizes of oilers having the spouts either at the top or extending from the side at various angles are made and vary in capacity from about ½ pint to 2 quarts.

Manufacturers:

Ansonia Novelty Co., The, 285 Main St., Ansonia, Conn. "Richard."
Detroit Lubricator Co., Trumbull, Lincoln, Marquette and Viaduct, Detroit, Mich. "Detroit."
Deverall Perfection Mfg. Co., Caton Ave. & E. 8th St., Brooklyn, N. Y.
Eagle Mfg. Co., Wellsburg, W. Va. "Eagle."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Malleable Iron Fittings Co., Branford, Conn.
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Porter Co., The, 241 Water St., New York, N. Y.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.
Waterbury Mfg. Co., Waterbury, Conn. "Acme."

OILING DEVICES, MISCELLANEOUS.—In addition to the oil and grease cups and continuous oiling systems described elsewhere, many motors, generators, and other electrical machines depend for lubrication on other forms of oiling devices. The oil rings, which are so common on motors of medium size, are flat rings, one or two to a bearing, which dip into an oil well forming part of the lower bearing housing, and raise an ample supply of oil to the journal over which they loosely hang and with which they revolve. On smaller motors, such as fractional-horsepower motors, a small cylindrical oil well, containing a felt wick which is pressed against the journal by a spiral spring, is screwed into the lower side of the bearing. These give very satisfactory service and require but little attention. On many types of electrical machinery gears are used which run completely surrounded by oil or grease. The gear casings on such machines form an essential part of the lubricating system. In some cases the centrifugal action of the gears is used to obtain a continuous flow of oil through a short local system. An important adjunct to many of these oiling devices is an oil gage; for these see Gages, oil, motor and generator.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y.
Elliott Co., The, Frick Bldg., Pittsburgh, Pa.
Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio. "Hale."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio.
Madison-Kipp Corp., Waubesa St., Madison, Wis.
Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich. "Cyclone." "Rural," "Brownie," "Sprite," "Duke," "Meteor."
Nugent & Co., Inc., William W., 146 W. Superior St., Chicago, Ill.
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Buffalo."
Tucker, W. F. & C. F., 191 Franklin Ave., Hartford, Conn.
Wilkinson Co., William H., West Medway, Mass.

OILING SYSTEMS, CIRCULATING OR CONTINUOUS.—Systems in which oil is constantly supplied to the bearings in a large quantity and under pressure are employed in the lubrication of nearly all large machines in a power plant; they are also used in many manufacturing processes involving much machinery. Oil cups or oil rings are generally used to lubricate only small engines, turbines, motors, etc. In the continuous oiling systems the pressure is obtained either by gravity action or by means of a pump. All such systems include a filter or purifier; the waste oil and drippings from the engines or turbines are piped to the filter which may be located on the floor below. The purified oil is then pumped into a storage tank or reservoir, which in the case of gravity feed, is located above the machines. Steam turbines in large sizes always require a system that gives a copious supply at 15 to 25 lbs. pressure. The speed of rotation causes a dragging of oil under the journal, so that the journal never rides on the metal bearing. Thrust bearings in vertical turbines and water-wheel generators also require a large continuous supply of oil under pressure.

Manufacturers:

Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind.
Burt Mfg. Co., The, Akron, Ohio. "Burt."
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Lunkenheimer Co., The, Cincinnati, Ohio.
Nugent & Co., Inc., William W., 146 W. Superior St., Chicago, Ill.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

OILTITE.—Trade name for sheet packing manufactured by the Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.

O. K.—Trade name for die stocks, threading dies and screw plates manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.

O. K.—Trade name for motors manufactured by the Marathon Electric Mfg. Co., Wausau, Wis.

O-K.—Trade name for boiler compounds manufactured by Charles Nuhring & Bro., 1212 Walnut St., Cincinnati, Ohio.

O. K.—Trade name for electric hoisting machinery manufactured by the O. K. Clutch & Machinery Co., Columbia, Pa.

O. K.—Trade name for weatherproof wire and cable manufactured by the Phillips Wire Co., Pawtucket, R. I.

O. K.—Trade name for bolt and rivet cutters manufactured by H. K. Porter, 6 Ashland St., Everett, Mass.

O. K.—Trade name for guy anchors manufactured by the St. Louis Malleable Casting Co., St. Louis, Mo.

O. K. BENCH.—Trade name for electric washing machine manufactured by the H. F. Brammer Mfg. Co., Davenport, Iowa.

O. K. CLUTCH & MACHINERY CO.—Columbia, Pa. Manufacturer of electric hoisting machinery. Business established 1907. H. Druschel, sole owner. Sales representatives, Chris. D. Schramm & Sons, Philadelphia, Pa.; Knickerbocker Co., Jackson, Mich.; Fairbanks Co., New York, N. Y.; Fairbanks, Morse & Co., New York, N. Y.; George W. Ziegler Machinery Co., Pittsburgh, Pa.; Brandeis Machine & Supply Co., Louisville, Ky.

O. K. ELECTRIC.—Trade name for electric washing machine manufactured by the H. F. Brammer Mfg. Co., Davenport, Iowa.

OK-I-CUP.—Trade name for industrial goggles manufactured by Strauss & Buegeleisen, 16 Hanover Pl., Brooklyn, N. Y.

O. K. METAL BOX CO.—198 Greenwich St., New York, N. Y. Manufacturer of steel cutout and panel switch boxes. Business established 1909. Sole owner, H. Kraushar.

OKLAHOMA UTILITIES ASSOCIATION.—President, J. W. Shartel, vice-pres. and gen. mgr., Oklahoma Railway Co., Oklahoma City, Okla.; secretary, H. A. Lane, 1107 First National Bank Bldg., Oklahoma City, Okla.

OKO.—Trade name for leather belting manufactured by the F. Raniville Co., 241-247 Pearl St., Grand Rapids, Mich.

OKOLOOM.—Trade name for cotton braid covered wires and cables manufactured by the Okonite Co., Canal St., Passaic, N. J.

OKONITE CO., THE.—Passaic, N. J. Manufacturer of insulated wires and cables. Business established 1884. President, H. Durant Cheever; vice-president, George M. Brooks; secretary, W. H. Hodgins; treasurer, F. Cazenove Jones; general manager, Lewis G. Martin; sales manager, J. Delmar Underhill. Sales representatives, Central Electric Co., Chicago, Ill.; Pettingell-Andrews Co., Boston, Mass.; F. D. Lawrence Electric Co., Cincinnati, Ohio; Novelty Electric Co., Philadelphia, Pa.

OLAF.—Trade name for magnetic contactors and relays manufactured by the Takamine Commercial Corp., 120 Broadway, New York, N. Y.

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OLD DOMINION.—Trade name for sheet packing and gaskets manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

OLD ENGLISH SLATE QUARRIES.—Boston, Mass. Manufacturers of all colors of slate. Business established 1908. President and general manager, Henry H. Mathews; secretary, Paul L. Stueber; treasurer, Fred B. Richards. Main office, 10 Milk St., Boston, Mass. Factories, Fair Haven and Pultney, Vt. Branch office and warehouse, Glenns Falls, N. Y. District offices, 101 Park Ave., New York, N. Y.; Fair Haven, Vt.

OLD FILE CUTLERY CO.—Havana, Ill. Manufacturer of electricians' knives. Business established 1906. Partnership, E. A. Smith and L. F. Coppel.

OLD GENUINE.—Trade name for brass and bronze castings manufactured by the Lumen Bearing Co., Buffalo, N. Y.

OLD HICK.—Trade name for rope paper manufactured by C. B. Jewitt & Bros., 16-24 Ferry St., New York, N. Y.

OLD HICKORY.—Trade name for fibre sheets, rods, tubes, washers and specialties manufactured by the National Fibre & Insulation Co., Yorklyn, Del.

OLEOSITY.—Trade name for lubricating oil manufactured by the American Oil Corp., 172 S. Water St., Jackson, Mich.

OLIVE HILL REFRACTORIES CO., THE.—Ashland, Ky. Manufacturer of refractories for furnace linings, etc. President, John F. Hagar.

OLIVER ELECTRIC & MFG. CO.—St. Louis, Mo. Manufacturer of lighting fixtures, electrical wiring devices and boxes. President and general manager, G. W. Oliver; vice-president, E. R. Hoyt; secretary and sales manager, J. A. Amos; treasurer, J. B. Oliver. Main office and factory, 4221 Forest Park Blvd., St. Louis, Mo. Branch office, 540 McCormick Bldg., Chicago, Ill.

OLIVER INSTRUMENT CO.—Adrian, Mich. Manufacturer of motor-driven sawing, filing and lapping machines.

OLIVER IRON & STEEL CO.—Pittsburgh, Pa. Manufacturer of pole-line hardware. Main office and factory, 10th & Muriel Sts., Pittsburgh, Pa. Branch offices, 50 Church St., New York, N. Y.; Monadnock Bldg., San Francisco, Cal.

OLIVER MFG. CO.—326 S. Desplaines St., Chicago, Ill. Manufacturer of automobile jacks. Business established 1891. President and general manager, W. H. Oliver; secretary, W. P. Robbins; treasurer, R. J. Mackinnon.

OLIVER MFG. CO., THE W. W.—1483 Niagara St., Buffalo, N. Y. Manufacturer of electric buffers. Business established 1880. President, Frank G. Oliver; secretary, Walter T. Oliver.

OLIVER-SIMPSON.—Trade name for automobile jacks manufactured by the Oliver Mfg. Co., 326 S. Desplaines St., Chicago, Ill.

OLIVETTE.—Trade name for stage lighting lamp manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

OLNEY & WARRIN, INC.—297-301 Lafayette St., New York, N. Y. Manufacturer of power transmission appliances. President, Ernest Warrin; vice-presidents, Robert Zepp, Herman P. Lowe; secretary and treasurer, Charles M. Dubbs.

OLSEN TESTING MACHINE CO., TINIUS.—500 N. 12th St., Philadelphia, Pa. Manufacturer of armature balancing and testing machines. President, Tinius Olsen; vice-president and treasurer, Thorsten Y. Olsen.

OLSON-BOETTGER ELECTRIC MFG. CO.—413 N. Franklin St., St. Paul, Minn. Manufacturer of electric dumbwaiters, motors and air compressors. Business established 1906. President and treasurer, H. S. Olson; vice-president, J. Schudel; secretary, J. Otto Nelson.

ONE-FLUID THEORY.—A theory of the nature of electricity proposed by Benjamin Franklin in which it was held that electricity was a single fluid uniformly pervading all substances but capable of being drawn to or from a substance as by rubbing. The substance having more than the uniform amount was said to be positively charged, and that having less, to be negatively charged. The modern electronic theory, while not an outgrowth of the one-fluid theory, resembles it through its hypothesis of electrons as being the only kind of electric charges. See Electron theory.

ONE-4-ALL.—Trade name for heater plugs manufactured by the M. Propp Co., 108 Bowery, New York, N. Y.

ONE-HAND-Y.—Trade name for electric drills and grinders manufactured by the Knight Engineering & Sales Co., 447 E. 3rd St., Los Angeles, Cal.

ONE MINUTE.—Trade name for electric washing machine manufactured by the One Minute Mfg. Co., Newton, Iowa.

ONE MINUTE MFG. CO.—Newton, Iowa. Manufacturer of electric washing machines. President, W. C. Bergman; vice-president, F. H. Bergman; secretary and treasurer, A. H. Bergman; sales manager, J. T. Gibson.

ONEIDA.—Trade name for arc lamp chains manufactured by the American Chain Co., Bridgeport, Conn.

ONEIDA. — Trade name for electric trucks manufactured by the Oneida Motor Truck Co., Green Bay, Wis.

ONEIDA MOTOR TRUCK SO.—Green Bay, Wis. Manufacturer of electric trucks. Business established 1917. President and general manager, Lafayette Markle; secretary, Samuel H. Cady; treasurer, Mitchell Joannes; sales manager, H. J. Butler.

ONTARIO ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Chairman, K. A. McIntyre; secretary, J. A. McKay, Room 206, 110 Church St., Toronto, Ont.

ONWARD.—Trade name for electric air humidifiers manufactured by the Onward Mfg. Co., Menasha, Wis.

ONWARD MFG. CO.—Menasha, Wis. Manufacturer of electric air humidifiers. President, O. C. Little; vice-president, L. H. Julius; secretary and treasurer, F. O. Heckrodt.

OPAL AND OPALESCENT GLASS.—Opal glass is glass in which very fine white particles are mixed so that the glass is white in appearance, and all light transmitted through the glass is thoroughly diffused so that when used as a globe or reflector for illuminating glassware, the source of light cannot be seen through the glass, but a fairly even illumination appears all over the surface of the glass. Opalescent glass is that in which the fine diffusing particles are insufficient in number to prevent the glass from being partly transparent, so that objects or light sources can be partly seen through the glass.

OPAL SIGN WORKS, INC.—254 10th Ave., New York, N. Y. Manufacturer of electric signs. Business established 1883. President, Davis Gumanow; vice-president, secretary and treasurer, Herbert Gumanow.

OPALITE SIGN CO.—407 N. Wells St., Chicago, Ill. Manufacturer of glass sign letters.

OPALUX.—Trade name for reflectors for lighting purposes made by the Opalux Co., 200 Fifth Ave., New York, N. Y.

OPALUX CO., THE.—200 Fifth Ave., New York, N. Y. Manufacturer of reflectors for lighting purposes. President, M. W. Gleason, secretary and treasurer, C. H. Tiebout, Jr. Factory, Brooklyn, N. Y.

OPAQUE.—Not transparent nor translucent to ordinary light. Many substances that are opaque to such light allow ultraviolet light or X-rays to pass through them. Most lighting reflectors are opaque, but those for semi-indirect lighting are translucent.

OPEN ARC LAMP.—An arc lamp in which the arc is not enclosed to exclude oxygen, as is done in the enclosed arc. The open arc lamp has now been almost entirely abandoned for ordinary lighting on account of its rapid consumption of carbons, but is still used for projection and photographic purposes. See Lamps, arc, carbon, enclosed and open.

OPEN CIRCUIT.—Any electric circuit, which either intentionally or accidentally, is open at some point. A term commonly applied to an accidental open spot in the circuit, as, an "open circuit" in an armature: often contracted to "open."

OPEN-CIRCUIT ARMATURE.—One in which each armature coil is attached to two commutator bars, one at either end, and these bars are not connected to any other coil.

OPEN-CIRCUIT BATTERY. — One or more primary cells of a type especially suited to intermittent service, such as for door bell, flashlight or telephone work. Such a battery quickly becomes polarized under continuous load but regains its working effectiveness during rest periods. Also see Polarization.

OPEN-HEARTH PROCESS.—A method of making steel in which pig iron with either scrap wrought iron or scrap steel and iron scale is used in a furnace of the regenerative reverberatory type with an open hearth. Also called the Siemens-Martin process.

OPEN MACHINE.—See under Motor, electric.

OPEN WORK.—That type of exposed electrical wiring in a building or under roof in which the wires are supported on exposed insulators, knobs or cleats and not enclosed in conduit.

OPENERS, DOOR.—See Door openers and closers, garage; Door openers and closers, miscellaneous; Door openers, house, electromagnetic; Door operating devices, electric car.

OPENING MACHINES, LETTER.—See Letter opening machines, motor-driven.

OPERATING-ROOM LIGHTING FIXTURES.—See Fixtures, lighting, operating room and other hospital.

OPERATING ROOM, TELEPHONE OFFICE.—The room in which a manual switchboard is located and in which the operators make the connections from calling to called parties.

OPERATION INDICATORS.—See Indicators, operation.

OPERATOR, TELEPHONE.—A person, nearly always a woman, who makes connections on a manual switchboard. Operators in a large office are divided into groups depending upon the type of boards they work on or the service they render. The following are the principal classes of operators.

"A" Operator or Subscriber's Operator. The operator who answers subscribers directly. So called because she operates the "A" board.

"B" Operator or Switching Operator. The operator who handles trunk calls, usually receiving them from an "A" operator, and connecting them to the called telephone. So called because she operates a "B" board.

Chief Operator. A person, usually a woman, who has charge of all the operators in an operating room, sometimes of all in an office.

Local Operator. An operator who makes connections on a local switchboard, serving the people of one locality.

Recording Toll Operator. A clerk who makes out the toll ticket, recording the subscriber's desires, etc. She passes the toll ticket to the line operator. It is the recording operator whom the subscriber gets when he calls for "toll" or "long distance."

Relief Operator. An operator who fills the places of regular operators who are off duty for a short time.

Toll Operator. An operator who makes connections on a toll switchboard, connecting people of different cities, for which service toll fees are charged.

Toll-Line Operator. The operator who handles toll lines. She secures the connection to the distant point and connects the calling subscriber. It is she who is calling when the subscriber hears that he is wanted by "long distance."

OPERATOR'S SET.—This is the telephone apparatus of an operator for talking with subscribers and others. It has a transmitter, receiver, coil, etc., and is connected in the circuit by a plug and jack so that it may be carried from position to position.

OPERATORS PIANO CO.—16 S. Peoria St., Chicago, Ill. Manufacturer of electrically operated pianos and organs. President, L. M. Severson.

OPHTHALMOMETERS AND OPHTHALMOSCOPES, ELECTRICALLY ILLUMINATED.—An ophthalmometer is an instrument used for measuring the size of a reflected image on the convex surface of the cornea and lens of the eye by which their curvature may be measured. The image is thrown from a small illuminated stencil mounted on the side of the instrument. The stencil is backed by an opal glass plate behind which is mounted the small incandescent lamp used as the light source.

An ophthalmoscope is an instrument for viewing the interior of the eye, particularly the retina. It consists usually of a small circular plate having a hole in the center through which ophthalmologist (eye specialist) examines the eye with or without the aid of lenses. Light from a miniature electric lamp mounted in the instrument directly above the plate is thrown into the eye, reflected there and returns the opening to the eye of the observer.

Manufacturers:

Eastern Brass Works, 221-23 Thirteenth Ave., Newark, N. J.
McElliott & Dahl, 26 W. Lake St., Chicago, Ill.
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

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Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

OPLEX.—Trade name for electric sign manufactured by the Flexlume Sign Co., 74 Kail St., Buffalo, N. Y.

OPTICAL TEST CHARTS, ELECTRICALLY ILLUMINATED.—These charts are used in the standard vision tests. The electrically illuminated types usually have the chart laid out on a pane of opal glass or ground glass to give uniform illumination over the pane by using a light source placed behind it. The lamp and pane are usually made up in the form of a cabinet, which may be fitted with a roller curtain to screen the chart from view when not in use. In some cases the chart is in the form of a curtain with several interchangeable sets of test lines so as to make it difficult to commit the test letters to memory.

Manufacturers:

Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

OPTIMUS.—Trade name for electroplating apparatus and supplies manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

ORANGEBURG.—Trade name for underground fiber conduit manufactured by the Fibre Conduit Co., Orangeburg, N. Y.

ORCHESTRA LIGHTING FIXTURES.—See Fixtures, lighting, orchestra.

ORCHESTRIONS, ELECTRICALLY OPERATED.—These instruments, designed to imitate an orchestra, usually include a piano, base and snare drums, cymbals, flute and sometimes bells or xylophone and string instruments. Various mechanisms actuate the devices playing the instruments, either by mechanisms controlled by electromagnets or by air or a combination of both. The devices are started and stopped by control of the motor which drives the air pump and actuates the mechanically operated devices. They are used in restaurants, ice-cream parlors, dance halls, etc.

Manufacturers:

Deagan, Inc., J. C., 1770 Berteau Ave., Chicago, Ill.
National Electric Piano Co., St. Johnsville, N. Y.
North Tonawanda Musical Instrument Works, North Tonawanda, N. Y.
Regina Co., The, 47 W. 34th St., New York, N. Y. "Regina."
Wurlitzer Mfg. Co., The Rudolph, North Tonawanda, N. Y. "Wurlitzer."

ORE AND COAL BRIDGES, LOADERS AND UNLOADERS.—At coal and ore docks, it is desirable to handle the material at the maximum possible speed and with minimum labor, which is best obtained by electrically driven equipment. Special loaders and unloaders may be used for this or they may be combined with some form of bridge. They have been much used at large ore and coal docks, especially on the Great Lakes. There are two general types of bridges, the "mantrolley" and the "rope-trolley." The mantrolley type has all the hoisting and conveying motors together with a cab containing the control equipment and operator mounted on a carriage which runs the length of the bridge. In the rope-trolley type the motors are in a stationary motor house and power is transmitted to the hoisting drum and carriage by means of cables; in this case the operator is located in a stationary cab at the end of the bridge. The bridge itself in both types runs over parallel tracks which extend along the length of the yard or dock like a gantry crane. The bridge may be used for unloading the coal or ore or it may be used in connection with other types of unloaders for distributing it over the storage yard.

In dock-type coal unloaders the coal is picked up by buckets dropped into the ship hold and carried to the point where it is desired to drop it, onto a storage pile or into cars. A number of motors are used in this equipment, as high as 12 in the larger installations, for operating the various hoists, drums, bridge movement, etc. For ore unloaders the more common construction is to use the stiff-leg principle, which consists of a vertical hoisting leg raised, lowered and drawn in and out by a pantograph or parallel-motion structure supported on the bridge. A bucket on the leg bottom is rotatable and it as well as the entire machine is under the complete control of the operator who rides in a cab on the leg so that he can see every part of the operation. The bucket picks up its load from the ship hold and deposits it in a lorry traveling under the bridge from which it is dumped into cars or onto the storage pile.

For loading coal and ore vessels some types of loaders pick up an entire car and dump it directly into the hold. Others use buckets, especially when the coal or ore are picked up from storage piles. In many of these various types of equipments a weighing scale is included as part of the equipment. Many of these sets are motor-operated, as this permits remote control, eliminates danger of freezing in cold weather and makes a very economical arrangement. They save a great deal of labor and load and unload a vessel so rapidly that it is tied up at the dock for a minimum time. Some of the unloaders have exceeded a capacity of 500 tons of ore per hour.

Manufacturers:

Myers-Whaley Co., Knoxville, Tenn.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

ORE SEPARATORS.—See Separators, electrostatic; Separators, magnetic or iron.

OREGON ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—State Chairman, R. C. Kenney, 389 Burnside St., Portland, Ore.; secretary, F. R. Whittlesey, 212 Henry Bldg., Portland, Ore.

OREGON LOCAL TELEPHONE ASSOCIATION.—President Charles E. Wells, Hillsboro, Ore.; secretary-treasurer, E. E. Goff, Newberg, Ore.

ORGAN ACTIONS, BLOWERS AND GOVERNORS.—See Actions, pipe organ, electric; Blowers, organ, electric; Governors, electric organ.

ORGANIC CHEMISTRY.—That branch of chemistry, which deals with the numerous compounds known as hydrocarbons and their derivatives.

ORGOBLO.—Trade name for electric organ blowers manufactured by the Spencer Turbine Co., Hartford, Conn.

ORIGINAL VELVET GRINDER.—Trade name for electric grinder manufactured by the F. W. Cochrane Mfg. Co., 5829 S. Vermont Ave., Los Angeles, Cal.

ORIPHONE.—Trade name for hearing device for the deaf manufactured by the Harper Oriphone Co., 936 Old South Bldg., Boston, Mass.

ORLEANS.—Trade name for lamp coloring compound manufactured by C. E. Franche & Co., 440 Orleans St., Chicago, Ill.

ORME.—Trade name for safety valves manufactured by the Scott Valve Mfg. Co., Detroit, Mich.

ORMSBY CO., LTD., THE A. B.—48 Abell St., Toronto, Ont., Can. Manufacturer of transformer cases and tanks. Business established 1912. President, C. Dolph; vice-president, A. C. Cameron; general manager, J. A. Findlay.

ORNAMENTAL OUTDOOR LIGHTING EQUIPMENT.—See Brackets, outdoor ornamental lighting; Lighting units, ornamental street; Newels, ornamental lighting; Pedestals, ornamental lighting; Posts, ornamental and plain street lamp, concrete; Posts, ornamental and plain street lamp, iron and steel.

ORNAMENTAL WOOD TURNING CO.—3217 W. Harrison St., Chicago, Ill. Manufacturer of floor and table lamps. Partnership, William Garren and Mr. Borsk.

ORO.—Trade name for automobile accessories manufactured by the Au-to Compresssor Co., 233 Mulberry St., Wilmington, Ohio.

ORPENITE.—Trade name for flexible interior conduit manufactured by the National Conduit Co., Ltd., Dufferin & Queen Sts., Toronto, Ont., Can.

ORR & SEMBOWER, INC.—Reading, Pa. Manufacturer of fire-tube boilers, steam-engines and electric hoists. Business established 1885. President and general manager, W. Harry Orr; secretary, G. K. Sembower; treasurer and sales manager, Harry Stitele. Main office and factory, Reading, Pa. Branch office and warehouse, 208 N. Clinton St., Chicago, Ill. District offices, 50 Church St., New York, N. Y.; 1007 Commonwealth Bldg., Philadelphia, Pa.

ORTON & STEINBRENNER CO.—608 S. Dearborn St., Chicago, Ill. Manufacturer of coal and ash handling equipment, cranes, hoists, etc. Business established 1906. President, H. G. Steinbrenner; vice-president, E. B. Ayres; secretary and treasurer, P. A. Orton. Sales representatives, R. J. Thomas, Leader News Bldg., Cleveland, Ohio; Bousack Machinery Co., 1601 Boatman's Bank Bldg., St. Louis, Mo.; Buckmaster-Luck-Maloochee, Inc., New Orleans, La.; Canadian Fairbanks Morse Co., Vancouver, B. C., Can.; P. Kranefeld, 1707 Franklin St., Denver, Colo.; S. R. Vanderbeck, 20 S. 15th St., Philadelphia, Pa.; Wonham, Bates & Goode, Inc., 17 Battery Pl., New York, N. Y.; Wonham, Bates & Goode, Inc., 141 Milk St., Boston Mass., and 145 St. James St., Montreal, Que., Can.; Utah Machinery Co., Salt Lake City, Utah; E. E. Brosius, Pittsburgh, Pa.

ORUM, S. R. M.—North Philadelphia, Pa. Manufacturer of battery repair shop equipment.

O. S. DEPENDABLE.—Trade name for locomotive cranes manufactured by the Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill.

OSANN CO., FREDERICK.—New York, N. Y. Manufacturer of sewing machine power tables and motors. Business established 1906. President, treasurer and general manager, Frederick Osann; vice-president, Robert L. Lyons; secretary, Edward W. Osann; sales manager, Charles W. Bublitz. Main office, 245 7th Ave., New York, N. Y. Branch office and warehouse, 394 Atlantic Ave., Boston, Mass. Factories, Boston, Mass.; Brooklyn, N. Y.

OSCILLATE.—To vibrate or swing back and forth. In electrical work the current in a circuit may oscillate under certain conditions, the frequency and amplitude of the oscillations depending on the conditions prevailing in the circuit. The amplitude usually diminishes but under special conditions it may rise to the point of breakdown of the insulation.

OSCILLATING CURRENT.—A periodic alternating current whose frequency is determined by the constants of the circuit in which it flows.

OSCILLATING FANS.—Electric fans that periodically change the direction of their breeze; their oscillating mechanism is actuated by the fan motor, usually through gearing. They are contrasted with the nonoscillating type which blow their breeze in one direction steadily. See Fans, desk and bracket; Fans, car; Fans, column.

OSCILLATOR.—Trade name for electric washing machines manufactured by the American Gas Machine Co., Albert Lea, Minn.

OSCILLATOR, SHAFT.—A device to cause a periodic axial motion in the shaft of a synchronous converter to prevent commutator scoring. These oscillators are mechanical or magnetic. A common type of mechanical oscillator depends upon a steel ball traveling around a circular race against the end of the shaft. The race being higher at one side than the other, the shaft is alternately pushed away and permitted to return. In the magnetic type an electromagnet is periodically energized, pulling the shaft toward itself and then allowing it to recede.

OSCILLATORS, RADIO.—An oscillator is any device for producing an "oscillatory" current or any current of very high frequency. If the current decreases in amplitude continuously it is called a damped oscillatory current, while if the amplitude is constant it is called a sustained oscillatory current. There are several methods of producing both of these oscillations. If a charged condenser is suddenly discharged in a circuit containing inductance and resistance in series with the condenser a damped oscillation is produced. Such a device suitably proportioned forms a radio oscillator. If a current is produced in a similar circuit by induction, and the inducing e.m.f. is suddenly cut off, an oscillatory current is produced. This gives another type of oscillator.

Oscillators for the production of sustained oscillations both for the purposes of measurement and in the transmission of messages are very important. The principal types are the electron tube, the arc and the high-frequency alternator. For the use of the electron tube as such, see Electron tubes. Also see Generators, high-frequency, radio. The arc is also used as an oscillator. If an ordinary d-c. carbon arc in air is shunted by a circuit containing capacitance and inductance in series oscillations may be obtained in the shunt circuit. This is called a singing arc. If copper is used in place of the positive carbon electrode and the arc is surrounded by a hydrocarbon gas and a magnetic field used to blow out the arc, sustained oscillations suitable for use in testing or communicating circuits are produced. This is known as the Poulsen arc.

Manufacturers:

Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.

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Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.
General Radio Co., 11 Windsor St., Cambridge, Mass.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa. "Vreeland."
Liberty Electric Corp., Port Chester, N. Y.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Radioland Co., 209 Alsop St., Jamaica, N. Y.
Simon, Emil J., 217 Broadway, New York, N. Y.

OSCILLION.—Trade name for thermionic tubes manufactured by Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

OSCILLOGRAPHS.—The practical oscillographs in common usage are special forms of galvanometer whose movable elements have such small moments of inertia and periods that the deflection is at each instant proportional to the intensity of the actuating current. Their chief use is the determination of the wave form of alternating currents. They may be of the movable-coil, movable-needle, string or electrostatic types. In the United States the most common form consists of a strong electromagnet between the poles of which is stretched a bifilar suspension upon which is mounted a minute mirror. As the alternating current, whose wave form is to be determined, flows up one side of the suspension and down the other, one side advances while the other recedes, causing the mirror to oscillate. Since the natural frequency of the vibrator is many times that of the current, any variation in the deflecting force is instantaneously followed by a corresponding change in the deflection. The indicator is a beam of light from an arc lamp, or other strong source of light, reflected from the mirror. The reflected beam is projected upon a screen by a synchronously rotating mirror and thus the path of the beam is extended into a curve at right angles to the plane of vibration. This curve is a representation of the fluctuations of the current.

For permanent records, the screen is replaced by transparent paper or tracing cloth and the path is traced with a pencil, or the rotating mirror is dispensed with and the beam is reflected upon a sensitized plate or film and photographed. The film is moved at right angles to the beam at a speed which is adjusted to suit conditions. The highest practical frequency of oscillation for a bifilar oscillograph is about 10,000 complete oscillations per second. For investigations requiring engineering accuracy a much lower frequency, about 5000, is satisfactory. For demonstration purposes a still lower frequency is desirable.

Oscillographs are essential instruments for investigating wave forms and phase relations of alternating currents and electromotive forces, as well as many transient electric phenomena. Prof. D. C. Miller has used the oscillograph principle in investigating the forms of sound waves.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crane, Harold G., 322 Front St., Adrian, Mich. "Crane."
GENERAL ELECTRIC CO., Schenectady, N. Y. This Company's oscillograph is a compact form of the vibrating loop type, combining photographic and tracing features in one apparatus. Among the scientific requirements that have been met in this instrument are: short free periodic time compared to the periodicity of wave forms recorded; critical damping, that is, the free motion just ceases to be oscillatory; negligible self-induction and sufficient sensibility. From an engineering standpoint, the working parts of the instrument are accessible. They are also of sufficient size to be renewed and repaired by persons ordinarily skilled in the handling of testing instruments. (Bulletin 46111.) See adv, pages 1203-1223.—Adv.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.

OSCILLOGRAPHS, SPECIAL. — Several special types of oscillograph have been developed, but are not extensively used. The electrostatic type is essentially an electrometer with a low free period of vibration and critical damping. This type of oscillograph is best suited to high-voltage work. It consumes no energy and only an exceedingly small current for operation.

The Braun tube oscillograph is a vacuum tube especially designed for determining wave form. The principle used in this form of oscillograph is the deflection of cathode rays by magnetic forces. The tube consists of a comparatively long stem of 1 to 2 ins. in diameter, terminating in an enlarged cylindrical bulb. In the end of the stem is sealed an aluminum cathode, the anode being sealed into the side of the stem not less than 15 cm. distant. Just below the bulb, within the stem is a grounded brass target coated with zinc sulphide or calcium tungstate. When a contant voltage, from 10,000 to 20,000 volts, is connected to the anode and cathode, a discharge takes place giving rise to cathode rays which are projected straight up the tube. All of these are stopped by the brass target except a small pencil which passes through the small hole. This pencil falls upon the glass screen, producing a bluish fluorescent spot. Two coils are placed on opposite sides of the tube above the target and through these is passed the current whose wave form is to be determined. The magnetic force of the current deflects the pencil of the cathode rays through an angle that is strictly proportional to the current intensity. By means of a rotating mirror the path of the deflected pencil may be expanded, reproducing the fluctuations of the current. As the cathode rays are without inertia, the deflected pencil follows waves of highest frequency without error. It is a useful instrument for investigating periodic waves of high frequency. The chief limitations of the instrument are the inability to photograph the path of the pencil by a single traverse over sensitized plate and the width of the path as compared with the amplitude of the curve.

OSGOOD TOOL CO., J. L.—45 Pearl St., Buffalo, N. Y. Manufacturer of tool handles, etc. J. L. Osgood, proprietor.

OSHKOSH. — Trade name for line construction tools manufactured by the Oshkosh Mfg. Co., Oshkosh, Wis.

OSHKOSH MFG. CO.—Oshkosh, Wis. Manufacturer of electrical construction tools. Business established 1857. President and treasurer, E. C. Leach; secretary, F. W. Huelster. Main office and factory, Oshkosh, Wis. Branch office, Philadelphia, Pa.

OSMOTIC PRESSURE. — The pressure which a solution of a salt exerts against a membrane if a pure solvent is placed on the other side of the membrane or semi-permeable partition. It appears as if the water or other solvent traverses the partition, being dragged in by the affinity of the salt in solution to combine with more solvent, while the salt cannot pass the other way. Another view is to regard it as the equivalent gas pressure of the dissolved salt, whose molecules bombard one side of the partition and thus exert pressure on it which is not balanced by the pure solvent on the other side. It plays an important part in the passage of salts through membranes in the animal body; also a large part in the ionization theory which was primarily conceived in order to explain anomalies observed in osmotic pressure experiments.

OSTER MFG. CO., THE. — Cleveland, Ohio. Manufacturer of die stocks and pipe threading machines.

OSTERHOUT ELECTRIC CO.—Philadelphia, Pa. Manufacturer of nonrenewable plug fuses. Business established 1917. F. C. Osterhout, sole owner. Main offie, 1013 Race St., Philadelphia, Pa. Branch office and warehouse, 199 Fulton St., New York, N Y.

OSTRANDER & CO., W. R.—New York, N. Y. Manufacturer of fire alarm systems, bells, buzzers, annunciators, sockets, reflectors, speaking tube fittings, push buttons and other specialties. Established 1852. President, C. P. Lashelle; vice-president, W. H. Vogel. Main office, 371 Broadway, New York, N. Y. Factory, Brooklyn, N. Y. Branch offices, Seattle, Wash.; San Francisco, Cal.; Detroit, Mich.; St. Louis, Mo.; Philadelphia, Pa.; 22 Lamox Pl., Chicago, Ill.

OSTRANDER-SEYMOUR CO.—7 S. Dearborn St., Chicago, Ill. Manufacturer of electrotyping and engraving machines and equipment. President, J. G. Ostrander; vice-presidents, F. A. Ostrander and E. C. Williams; secretary, J. W. Ostrander; treasurer, C. W. Ostrander.

OTIS ELEVATOR CO. — 11th Ave. and 26th St., New York, N. Y. Manufacturers of electric passenger and freight elevators. Branch offices in all principal cities.

OTTAWA CAR MFG. CO., LTD.—Ottawa, Ont., Can. Manufacturer of crossarms, wood molding electric street sweepers, and car accessories. President, T. Ahearn; vice-president, Warren Y. Soper; general manager, W. H. McIntyre; secretary and treasurer, G. L. Snelling.

OTTER MFG. CO.—243-245 W. 17th St., New York, N. Y. Manufacturer of ignition parts and brushes for motors and generators.

OTTER-WATERPROOF. — Trade name for leather belting manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

OTTO ENGINE MFG. CO.—Philadelphia, Pa. Manufacturer of internal combustion engines and suction gas producers. Business established 1876. President, Daniel B. Frazier; treasurer, S. B. Dobbs. Main office and factory, 33rd and Walnut Sts., Philadelphia, Pa. Branch office and warehouse, 15-17 S. Clinton St., Chicago, Ill. Sales representatives, Akerlund & Semmes, Inc., 17 Battery Pl., New York, N. Y.; F. E. Whitney Co., 65 Sudbury St., Boston, Mass.

OTTO OZONIZER.—One of the leading forms of apparatus for the conversion of oxygen into ozone.

OTTOMAN. — Trade name for grinding wheels manufactured by H. A. Stiles & Co., 97 Oliver St., Boston, Mass.

OUTDOOR TRANSFORMER. — One designed for outdoor service, as on a pole or in an outdoor substation, especially the latter.

OUTHENIN-CHALANDRE CELL. — An electrolytic cell for the production of alkali and chlorine using Acheson graphite anodes, iron cathodes and unglazed porcelain diaphragms.

OUTLET.—In electrical construction work, any opening provided on the walls, ceilings or floors of a building or elsewhere in its wiring system where lighting fixtures, receptacles, switches or other electrical devices may be connected to the circuit. Some form of conduit box or plate is generally used at each outlet if the wiring is enclosed. The term "outlet" is also used by some central-station companies to designate any sockets, receptacles or wiring terminals to which lamps, motors, heaters or other appliances may be connected.

OUTLET-BOX COVERS. — See Covers, conduit outlet box.

OUTLET BOXES.—See Boxes, conduit, outlet; Boxes, conduit, for concrete construction; Boxes, marine, outlet and junction; Boxes, outlet or switch, for armored cable; Boxes, outlet or switch, for flexible tubing; Boxes, outlet, switch or junction, for exposed conduit.

OUTLET BUSHINGS. — See Bushings, conduit end outlet.

OUTLET HOODS.—See Hoods, outlet.

OUTLET PLATES. — See Plates, ceiling and wall outlet; Plates, floor outlet.

OUTLETS, FLOOR. — Floor outlets are small fittings placed in a floor during construction and connected by conduit to a pull box, generally to anticipate future requirements. They are usually merely a long-radius conduit elbow or tee and are installed so that the top is a little below the floor surface. Adjustable tops with waterproof caps which screw into the fitting are then installed so that the top is flush with the finished surface. When the outlet is to be used the wires are pulled in, and special floor receptacles are provided which replace the cap. For the regular floor outlet boxes see Boxes, floor.

Manufacturers:

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."

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Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. Y.

OUTLINE LIGHTING. — A method of lighting the exterior of a building or other structure by means of incandescent lamps closely placed along the cornice, windows, doorways and other conspicuous lines of the structure so that these rows of lamps serve to outline it quite effectively even though they do not illuminate the wall surfaces to any great extent. This was the first method of lighting of building exteriors much used and was employed largely for spectacular effect. During the last seven or eight years flood lighting of buildings, monuments, etc., is being used more frequently than outline lighting because it is cheaper to install and operate and serves to actually illuminate the surfaces instead of merely outlining them.

OUTPUT, AVAILABLE.—In an electrical machine, the load which it is capable of carrying for a specified time without exceeding the specified limitations imposed.

OUTPUT, RATED.—The output marked on the rating plate of a machine. See Rating of electrical machinery.

OUTSIDE WIRING. — Electrical wiring installed for any purpose outside of buildings, as overhead telegraph or telephone lines, lighting and power lines, trolley lines, etc., with their feeders and wiring run on the outside walls of buildings or other structures for lighting or decorative effects. In general, wiring exposed to the weather.

OVALDUCT. — Trade name for conduit fittings manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

OVALITE. — Trade name for boudoir lamp manufactured by the Ovalite Co., 313 E. 22nd St., New York, N. Y.

OVALITE CO., THE. — 313 E. 22nd St., New York, N. Y. Manufacturer of portable lamps. General manager, R. Felix.

OVEN EQUIPMENT & MFG. CO., THE. —New Haven, Conn. Manufacturer of industrial electric ovens. President, V. M. Tyler; vice-president and general manager, G. P. Simpson; vice-president and sales manager, J. T. Fiske; treasurer, Brower Hewitt.

OVENS, ELECTRIC, ANNEALING.—Annealing is a process that is applied to steel and other metals and also to glass and chinaware, porcelain, etc. Steel annealing, because of the high temperatures required, is generally done in a furnace; see Furnaces, electric, annealing. Glassware after having been blown into complex forms, such as chemical laboratory apparatus of all kinds, requires careful annealing to relieve any stresses that may have been set up in the process. Chinaware and glassware that is given colored decoration requires firing or heating to a definite temperature in order that the coloring be permanent by fusing into the body of the article. Electric ovens are superior to any other method of heating for both of these processes, as they provide a uniform temperature in all parts of the heating chamber and accurate control of the temperature. Once the proper temperature required to give the desired results is obtained it can be exactly reproduced each time. The heating elements can be arranged in units or sections so that the heat may be gradually increased and again gradually reduced, which gives the best results in annealing delicate articles.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.
BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves Etchells."
Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021.A.) See adv. pages 1203-1223.—Adv.
Hoskins Mfg. Co., Lawton and Buchanan Sts., Detroit, Mich.
National Electric Heating Co., Ltd., The, 64 Queen St., Toronto, Ont., Can. "National."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

OVENS, ELECTRIC, ARMATURE, FIELD AND TRANSFORMER.—To insure varnish and other similar insulation being of dependable quality it is advisable that the fluid be dried rapidly at a definite temperature after it has been applied to the armature, field coil or transformer element before the same can absorb moisture from the air. For this purpose various types of electric ovens are used. They consist of a heat-insulated compartment, heating units, machinery for handling complete armatures, field windings or transformer windings in the oven, and for some purposes a ventilating system. The heat-insulated compartment may be of brick, but is more commonly constructed of layers of metal between which is packed heat-insulating material. The heating units are usually of the grid type. Racks, hangers, or trucks ordinarily furnish the means of handling the material; however, it is sometimes handled by conveying machines which feed the work through the oven continuously. The speed of baking depends largely upon the amount of fresh air that passes over the work, and the power consumed upon the manner in which this air is circulated through the oven. The ventilating system is therefore an important part of ovens baking railway armatures or other large work.

Manufacturers:

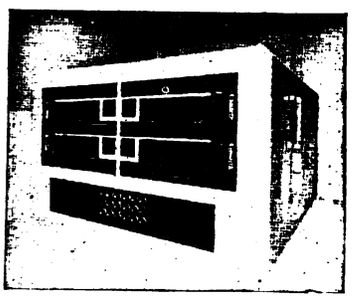
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Despatch Mfg. Co., 166-122 1st Ave., N., Minneapolis, Minn.
Eaton Electric Furnace Co., The, Taunton, Mass. "Eaton."
GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021.A.) See adv. pages 1203-1223.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Young Bros. Co., 6500 Mack Ave., Detroit, Mich.

OVENS, ELECTRIC, BACTERIOLOGICAL AND OTHER LABORATORY.—For laboratory purposes a number of types of ovens are manufactured. Generally they are of the box type fitted with racks, trays, etc., for holding the samples or other material in the oven; also with pilot lamps, pyrometers, and switches for heat control. For drying, several varieties are made which have a vacuum device for exhausting the oven. The latter type differs from the others in that it is very rugged and usually cylindrical in shape to withstand considerable pressure.

OVENS, ELECTRIC, BAKE, HOTEL, RESTAURANT, ETC.—This type of oven has several advantages over the fuel-fired ovens which are bringing it into use in many hotels, clubs, restaurants, bakeries, institutions, battleships, etc. They have a very accurate control over the oven temperature, thus insuring uniform results. They have the further advantages of cleanliness and freedom from objectionable odors. They are usually built in somewhat the same form as the fuel-fired ovens but are slightly more compact due to the reduction in space allowed by the smaller electric heating units. They are always built in batteries, where more than one oven is used, as this saves the construction of one wall for each oven added; the sections may be superposed, side by side, or both. The heating elements are commonly placed on the walls and top of each section to give a uniform distribution of heat. Elements are generally of unit construction so that any one element may be removed without interfering with the others.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Edison Appliance Co., Ltd. Downie St., Stratford, Ont., Can. "Hughes."
Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. This stationary brick-type oven has a capacity of 600 1-lb. or 720 ¾-lb. loaves—or 60 standard 19x27 in. roll pans, 15 to the small and 30 to the large compartment.



Electric Bake Oven

It has six heating elements—one under each deck and one at top of the upper compartment. Each element operated by a separate three-heat switch. It is 87 ins. high, 161 ins. deep and 141 ins. wide. The compartments are 11 ins. high, 134 ins. deep and 114 ins. wide. Another type brick oven, No. 315, has two compartments, and is similar to No. 415, the oven illustrated. See display adv. pages 1292-3.—Adv.
Electrik Maid Bake Shops, 209 Dakota Bldg., St. Paul, Minn. "Electrik Maid."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.
Weeks Mfg. Co., H. G., Hamilton, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

OVENS, ELECTRIC, BAKING AND ROASTING, PORTABLE.—When lack of space or other conditions make the complete electric range impracticable the portable electric oven has been found to be very useful in the small home or kitchenette apartment. The capacities of these ovens are about the same as those of the ordinary household range. In form they are simply a heat-insulated box, commonly of sheet metal, and mounted on a stand or legs. The heating units are usually placed in the bottom of the oven, though in some types they are placed in both bottom and top to give more uniform heat distribution. Heat control is not ordinarily automatic but obtained by a three-heat switch. Some types include the oven with a one- or two-burner electric stove.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Edison and Hughes electric appliances. The bake oven shown, No. 215, has a capacity of 80 1-lb. and 96 3-lb. loaves or 8 standard 19x27 in. roll pans, two to a compartment. Baking surface 28 sq. ft.

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Equipped with fine heating elements, one under each deck and one at the top of the upper compartment. Each element operated by a separate three heat switch. In addition, other bake ovens are made by this company—some larger, others smaller. Prices or more



Portable Bake Oven

detailed information furnished upon request. See display adv. pages 1292-3. —Adv.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

Electrik Maid Bake Shops, 209 Dakota Bldg., St. Paul, Minn. "Electrik Maid."

Faraday Co., The, 746 Chapel St., New Haven, Conn. "Kookerette."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Standard Electric Stove Co., The, 1718-1720 N. 12th St., Toledo, Ohio. "Standard."

Steroiectric Co., 117 W. Howard St., Muncie, Ind. "Steroclave."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

OVENS, ELECTRIC, CONDITIONING.—These ovens are so arranged that air conditioning may be effected within the oven itself. That is, the temperature and humidity of the air and even its composition may be controlled by suitable means. Certain gases may be admitted into the air to obtain whatever proportions are desired, such as chlorine gas or sulphur dioxide for bleaching purposes. In general principle they are the same as the other ordinary electric ovens. The control of the temperature and humidity is usually automatic unless special tests are being made under direct observation. Absolute control of the conditioning permits processes to be carried out under definite known conditions that are readily reproducible.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

Emerson Apparatus Co., Boston, Mass.

GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021-A,) See adv. pages 1203-1223.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

OVENS, ELECTRIC, DRYING AND IMPREGNATING.—To insure a good insulation of coils, cables, insulating pins and other similar electrical materials they must first be thoroughly dried, then impregnated with an insulating compound. The types of ovens or systems used vary largely with the insulation requirements. In some cases the work is simply dried in an oven of the kind used for drying and baking armatures, fields and transformer elements; then it is dipped into an impregnating compound. For more exacting requirements more complex methods are necessary. Some ovens are built so that the work may be dried in a partial vacuum and then the hot insulating fluid is admitted. The vacuum is let down and then pressure is applied sometimes to the extent of 50 lbs. per sq. in. This process insures that the liquid will be forced into every pore of the dried material. Also see Impregnating apparatus.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

Devine Co., J. P., 1372 Clinton St., Buffalo, N. Y.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021-A.) See adv. pages 1203-1223.—Adv.

Oven Equipment & Mfg. Co., The, New Haven, Conn. "Crawford."

Thermo Electric Instrument Co., The, 8 Johnson St., Newark, N. J. "Freas," "Thelco."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

Young Bros. Co., 6500 Mack Ave., Detroit, Mich.

OVENS, ELECTRIC, ENAMELING AND JAPANNING.—These ovens are used extensively in the automobile industry. The machinery for handling that class of work is generally of the conveying type, either continuous or semicontinuous. Typewriter, adding machine and other similar parts are handled in a like manner, frequently in ovens of special design. The standard types are used largely for enameling and japanning small metal parts, most of the work being handled on trays or trucks. The tray method of handling parts is inefficient for all except low-temperature baking. Each time a tray is removed the temperature must be reduced to approximately room temperature and upon recharge raised once more to baking temperature, thus causing considerable heat loss. This loss is somewhat reduced by the use of trucks and semicontinuous conveyors; but the most efficient type is the continuous conveyor. With the latter type the doors are kept open, but they are so constructed as to obtain an air seal at the openings or by use of exhaust fans maintain an air balance within the oven, thereby preventing the escape of heated air.

The heaters are generally placed along the walls of the oven or, in exceptionally wide ovens, are supplemented by a row in the middle. They are generally made up in rugged units that may be piled one on top of another to give the desired number in the room. The heating element consists of a ribbon wound on a fireclay bushing. Several of these are clamped to two tie rods that make up the frame and form the terminals for the heating elements and the unit itself.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York. N. Y.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

Eaton Electric Furnace Co., The, Taunton, Mass. "Eaton."

Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. "Greaves-Etchells."

Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021-A.) See adv. pages 1203-1223.—Adv.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Oven Equipment & Mfg. Co., The, New Haven, Conn. "Crawford."

SEPCO ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Young Bros. Co., 6500 Mack Ave., Detroit, Mich.

OVENS, ELECTRIC, FLOUR MILL.—These ovens are used in the laboratories maintained by most progressive flour mills. In such mills various grades of wheat are presented for milling and several grades of flour are usually made. In order to determine the actual value of the flour for baking purposes, it has been found convenient to have small electric bake ovens for testing samples from time to time. In this way minor details of the process can be regulated so as to maintain the quality of product desired regardless of the character of the wheat that is used.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

OVENS, ELECTRIC, MISCELLANEOUS.—Many ovens that are not listed under the above headings are designed for special and specific purposes, having a special form or giving a definite temperature required in some process. There are quite a few applications of this kind in the electrical industry and in laboratory work. Heat-treating processes of all kinds give better results with electrical ovens because of their constancy. A few of the ovens of this type are used in temper drawing; enameling jewelry, watch and clock dials; ash determinations, fusions, and special experimental work. Another type of oven which is used in storage-battery service stations consists of a box containing heating elements and open at the bottom which is placed over the batteries and heats them to the proper temperature for softning the sealing compound so that the plates may be removed.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts. Hamilton, Ont., Can. "Westinghouse."

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hughes." (See display adv., pages 1292-1293.)

Electric Furnace Construction Co., 908 Chestnut St., Philadelphia, Pa. (Core baking.) "Greaves-Etchells."

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

Electrik Maid Bake Shops, 209 Dakota Bldg., St. Paul, Minn. "Electrik Maid."

GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021-A.) See adv. pages 1203-1223.—Adv.

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Service Station Supply Co., 30-32 Larned St., Detroit, Mich. ("Battery oven.) "Hyrate."

Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md. (Laboratory Vacuum Type.)

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

OVENS, ELECTRIC, SHERARDIZING.—The process of sherardizing requires an oven of special construction. Electric ovens are now being used successfully for this purpose. They consist of a large rectangular metal-lined tank, the walls and ends of which contain heating elements and are constructed of heat-insulating material protected by a sheet-metal casing. The whole tank rotates on a central shaft, which is bolted to the ends and special current-collecting rings are provided to connect to

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the heating elements. After the material to be sherardized is placed in the oven and covered with zinc dust, the cover is bolted down and the heating circuit closed. A small motor is used to rotate the oven which turns at a slow speed.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. With G-E electric sherardizing machines a certain correlation between dust composition and sherardizing temperature can be maintained. Temperatures can be maintained with absolute certainty and results are superior to the ordinary coating in resisting corroding influences. Articles electrically sherardized may be deformed at ordinary room temperatures without injury to the coating. Bulletin 48926 gives other information regarding G-E electric machines for this process. See adv. pages 1203-1223.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

OVENS, ELECTRIC, TESTING. — The electric oven for general or special testing has the advantage that the temperature control is not only very accurate, but may be made automatic as well. Some types may be exhausted so that the material may be tested in a vacuum or at any desired low pressure. The ovens are usually equipped with indicating or recording pyrometers. The heating elements are generally arranged in separate units which are placed around the oven walls. Each unit may be removed or repaired independently of the others.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.

Despatch Mfg. Co., 116-122 1st Ave., N., Minneapolis, Minn.

GENERAL ELECTRIC CO., Schenectady, N. Y. This company, in cooperation with oven manufacturers, makes electric heating and control equipment for operation on direct or alternating current. (Bulletin 48021-A.) See adv. pages 1203-1223.—Adv.

Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

OVENS, ELECTRIC, VULCANIZING.— The process of vulcanizing consists of heating rubber and sulphur to a temperature above the melting point of sulphur, when the two combine and form vulcanized rubber. The degree of vulcanization depends upon the proportion of sulphur, the temperature and duration of heating. Electric ovens have the same advantage in this process that they have in general, i.e., more accurate cotnrol and greater constancy of the temperature. They also give a more uniform heat throughout the oven.

Manufacturers:

AUTOMATIC ELECTRIC HEATER CO., Warren, Pa.

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

OVERBAGH & AYRES MFG. CO.—411 S. Clinton St., Chicago, Ill. Manufacturer of reflectors for commercial, industrial, theatrical, street and other lighting purposes. Business established 1902. President and general manager, Franklin Overbagh; vice-president, I. H. Brent; secretary and sales manager, W. F. Overbagh; treasurer, L. W. Kittman.

OVERBAGH CO., CAMERON.—211 W. Randolph St., Chicago, Ill. Manufacturer of conduit fittings. Business established 1915. President, D. S. Overbagh.

OVERCOMPOUNDING. — A compound-wound, direct-current generator may be provided with a heavy series winding so as to cause the voltage at the brushes to increase as the load increases, thus keeping the voltage constant at a distant point on the circuits supplied. By using the proper amount of overcompounding, any desired regulation of the voltage may be secured.

OVERHAUL.—To rehabilitate; to carefully inspect and repair any used apparatus, appliance, machinery, or other equipment, cleaning and replacing worn-out parts and otherwise restoring it as nearly as possible to original condition short of replacing the entire equipment. Overhauling is intermediate between ordinary maintenance and complete replacement.

OVERHEAD.—A term applied to electrical line conductors, especially in electric railway service, when suspended above the car or locomotive. Also applied to other power, light and communication lines carried on poles or towers in the air. See Overhead line construction of electric railways; Distribution lines for power and lighting.

In cost accounting, the term "overhead" is very generally used to cover those items of general expense which cannot readily and accurately be assigned to the cost of any one product. Material and labor applied directly to a product or installation is usually classed as direct material and direct labor; but there is a large portion of the general expense, such as interest on loans; rent, insurance and upkeep of buildings and plant; cost of power and light; salaries of superintendents and foremen; executive and office expenses; advertising and selling costs, and many other general items, all of which appear as indirect but real charges against the business as a whole. These must be properly proportioned to each class of product, and are usually added to the cost as a certain percentage, varying with the article. This is called the percentage of overhead. It is sometimes referred to as "burden" and is variously handled by different accountants.

OVERHEAD, ELECTRIC RAILWAY.— Where an overhead trolley wire is used on any electric railway system, this is usually referred to, for brevity, as the "overhead." This term effectively distinguishes it from the track return and also from other contact systems, such as the third-rail system and the underground trolley system. For types of "overhead," see Overhead line construction of electric railways.

OVERHEAD LINE CONSTRUCTION OF ELECTRIC RAILWAYS. — Overhead line construction is divided into classes depending on the nature of the installation. These groups are as follows: (1) Electric railways—(a) city railways, (b) suburban and interurban railways, (c) electrified steam railroads; (2) mine haulage systems. The salient features of these various types are described below.

City Railways. In city railways the voltage is usually 500 and seldom exceeds 750 volts. "Direct" suspension is generally used, the trolley wire being supported directly from the cross-span wire or pole bracket. The supporting poles are usually spaced 100 ft. apart and in the cross-span construction poles are placed on each side of the street or roadway and the cross-span wire is installed between each pair of poles. An insulated trolley hanger is mounted on this span wire from which the trolley wire is supported by means of a trolley ear. Secondary insulation is usually provided in the span wire in addition to the insulation of the trolley hanger by means of strain insulators, particularly if steel trolley poles are used.

In bracket construction only one pole is required, the trolley wire being supported from a trolley bracket mounted on the side of the pole. In "centerpole" construction, the pole line is run between the tracks of double-track roads, a bracket being installed on each side of the pole.

Suburban and Interurban Railways. Suburban and interurban railways may employ direct suspension similar to city construction, or, owing to the high speeds and more rigid requirements, may find catenary constructed either necessary or more suitable.

In catenary construction the trolley wire is kept almost horizontal (i. e.,, without sag), by spacing the support points close together. This is accomplished by means of a supporting messenger wire over the trolley wire from which the trolley is supported by hangers of proper length to compensate for the sag in the messenger wire. The supporting points for the messenger wire are made farther apart than in direct suspension, usually 150 ft. for wood-pole construction and as high as 300 ft. or more when bridge supports are used. The catenary type of construction offers greater ease of insulation for the higher voltages which are often employed in this class of service.

Electrified Steam Railroads. In steam railroad electrification the heaviest form of bridge catenary construction is usually employed.

Mine Haulage Systems. In mine haulage systems the trolley wire is usually supported directly from the roof or the mine timbers by means of insulated hangers and trolley clamps. In the former case, expansion bolts, to which the insulated hangers are attached, are installed in the mine roof. In the latter case the hangers are secured to the mine timbers with lag bolts. Owing to the limited headroom usually encountered, the trolley is kept as close to the roof as possible and the hangers are spaced close together. This form of construction is more rigid than that used in the direct suspension of city railway work and is apt to cause more pounding, arcing and wear on the trolley wire and wheels, but is necessary under mine conditions and works out very well because of the comparatively slower speeds of this class service.

For detailed description and listing of overhead trolley equipment see Brackets, trolley suspension; Catenary hangers; Catenary fittings, miscellaneous; Clamps, trolley; Crossings, trolley; Frogs, trolley; Hangers, trolley wire; Insulators, strain, trolley; Poles, iron and steel; Poles, wood; Sleeves, trolley wire; Splicers, trolley wire; Suspensions, trolley wire; Switches, trolley; Wire, trolley.

OVERHEAD POWER AND LIGHTING LINES.—See Distribution lines for power and lighting.

OVERLOAD.—In general, a greater power load on a generator, motor, transformer, cable or other piece of electrical equipment than it is designed, or permitted by good practice, to carry. Overloading produces excessive heat and, even if it does not immediately interrupt the service, tends to injure the equipment by weakening the insulation, soldered connections, etc., by this overheating. In the case of electrical equipment designed for constant potential, overload means excessive current; with equipment designed for constant current, it means excessive voltage and is quite commonly called overvoltage.

OVERLOAD ATTACHMENTS FOR OIL SWITCHES AND BREAKERS.—See Attachments, overhead, for oil switches and breakers.

OVERLOAD CAPACITY.—Most manufacturers of electrical equipment will guarantee it under a certain percentage of overload for a limited time. This overload capacity, however, varies with the class of apparatus, and sometimes with the maker though the principal manufacturers have now standardized on most items. See Rating of electrical machines.

OVERLOAD CIRCUIT BREAKERS.—A circuit breaker designed to open the circuit it protects when there is an overload. See Circuit breaker; also Circuit breakers, air, overload; Circuit breakers, oil, overload.

OVERLOAD RELEASE.—This is an attachment furnished with many motor starters which on overload open-circuits or short-circuits the coil holding the starting arm in the running position so that the spring on this arm returns it to starting position.

OVERSPEED.—Rotating machines should be designed to safely withstand an overspeed of 25%, except steam turbines, which should be limited to 20%.

OVERTON.—Trade name for electric washing machines manufactured by the R. M. Overton Mfg. Co., Waterloo, Iowa.

OVERTON MFG. CO., R. M.—Waterloo, Iowa. Manufacturer of electric washing machines.

OVERVOLTAGE.—A voltage higher than normal or exceeding the highest voltage for which a circuit or piece of equipment was designed. In constant-current circuits it means a power overload; in constant-potential circuits it means excessive voltage with or without a power overload. In either case it represents a dangerous condition that is likely to result in severe stress on the insulation and its probable breakdown if long continued or if the excess voltage is very high. In the case of incandescent lamps it shortens the lamp life materially; in motors it causes excessive speed. The term overvoltage is often applied to protective devices designed to guard against it, such as overvoltage-circuit breakers and relays.

OVERVOLTAGE, ELECTROLYTIC. — When liberating gases by electrolysis upon metallic electrodes, it is found that different metals seem to interpose different electromotive forces for the same electrochemical reaction. Taking a platinized platinum electrode as standard (platinum electrode covered with platinum black), because it requires the least excess of voltage, other metals are referred to it and the excess of voltage required to liberate gases upon them is called overvoltage. It varies with the solution and whether used as anode or cathode. Used as cathodes, mercury shows 0.44, lead 0.36, aluminum 0.17, copper 0.19, nickel 0.14, silver 0.07, gold 0.05, iron 0.03 volt. Palladium shows a deficit of 0.26 volt, that is, it helps the current passing by that amount.

OWEN.—Trade name for farm lighting and power plants manufactured by R. M.

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Owen & Co., 1825 S. Michigan Ave., Chicago, Ill.

OWEN & CO., R. M.—1825 S. Michigan Ave., Chicago, Ill. Manufacturers of farm lighting and power plants. President, R. M. Owen; vice-president and general manager, H. M. Ballard.

OWEN, J. D., & E. G.—Janesville, Wis. Manufacturers of lightning rods.

OWL.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

OWL.—Trade name for Christmas tree lighting outfits and lamps manufactured by the Owl Flashlight Co., Inc., 102 Franklin St., New York, N. Y.

OWL FLASHLIGHT CO., INC.—102 Franklin St., New York, N. Y. Manufacturer of Christmas tree lighting outfits and lamps. M. J. Freiman, president.

OXIDATION.—Combination with oxygen or raising the valence of the chemical affected. The opposite of reduction and now chemically designated as adduction. See Adduction.

OXIDATION, ELECTROLYTIC.—The reaction produced by using the substance as an anode at which oxygen is electrolytically liberated, or by using it in an electrolyte in contact with an anode at which oxygen is being liberated. In either case it is subjected to the action of nascent oxygen and to strong oxidation. Particularly useful for oxidizing organic compounds, which are usually mixed into an acid, basic or neutral anolyte and thus brought into contact with the anode only. The term is sometimes generalized by chemists to mean subjecting the substance to any form of attack at or in contact with an anode, which results in the opposite of reduction, that is, in increasing the valence of the base and forming a higher compound; a better term for this kind of action is adduction, which see.

OXIDIZING AGENTS.—Chemical regents which tend to give off oxygen easily, and thus to oxidize other materials. Such are ozone, hydrogen peroxide, potassium chlorate, potassium permanganate, etc.

OXWELD ACETYLENE CO.—30 E. 42nd St., New York, N. Y. Manufacturer of oxyacetylene welding outfits.

OXY-ACETYLENE WELDING AND CUTTING OUTFITS.—Welding of metal parts may be done by the electric welder or by use of a high-temperature gas flame or oxy-acetylene outfit. These outfits are used in machine shops, garages, manufacturing plants and other places, especially where electric power is not available. Where machines must be kept in continuous operation they are especially useful for making quick repairs. The gas flame outfit is self-contained and can be used where no other power source is available. An intense gas flame is produced by igniting the mixed gases in a special jet. The gases are stored in two separate tanks, one for the oxygen, the other for the acetylene, the gases being conducted to the jet by separate tubes. The outfit is sometimes mounted on a small two-wheeled truck and is fitted with gages, valves, etc., for control of the gases. Various burner tips are used for different kinds of cutting or welding.

Manufacturers:

Admiral Welding Machine Co., The, 413-415 E. 15th St., Kansas City, Mo. "Admiral."
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Burdett Mfg. Co., 309 St. Johns Ct., Chicago, Ill.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Carbic Mfg. Co., Duluth, Minn.
Davis-Bournonville Co., Jersey City, N. J. "Duograph," "Weldograph," "Radiagraph," "Oxygraph," "Holograph," "Camograph," "Pyrograph," "Magentograph."
Dockendorff & Co., Inc., J. E., 20 Broad St., New York, N. Y.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Electro-Weld Co., 70 Munroe St., Lynn, Mass.
General Welding Co., 355-57 14th St., Hoboken, N. J.
Henderson-Willis Welding & Cutting Co., 2305-15 N. 11th St., St. Louis, Mo.
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
K-G Welding & Cutting Co., Inc., 556 W. 34th St., New York, N. Y.
Liquid Carbonic Co., 31st St. & Kedzie Ave., Chicago, Ill.
Macleod Co., The, 2232 Bogen St., Cincinnati, Ohio. "Doelcam."
Milburn Co., The Alexander, 1420-28 W. Baltimore St., Baltimore, Md. "Cut-Weld."
Modern Engineering Co., 23rd & Walnut Sts., St. Louis, Mo. "Meco."
Northern Welding Co., 2429 University Ave., Minneapolis, Minn.
Oxweld Acetylene Co., 30 E. 42nd St., New York, N. Y.
Prest-O-Lite Co., 533 N. Capitol St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Standard Gas Products Co., 216 Ivy St., Atlanta, Ga.
Superior Oxyacetylene Machine Co., Hamilton, Ohio.
TURNER BRASS WORKS, THE, Sycamore, Ill. (See display adv. page 1326.)
West Point Boiler & Tank Works, 23rd & Smallman Sts., Pittsburgh, Pa.

OXYGEN.—An odorless, colorless, non-poisonous gas, noncombustible, but an active supporter of combustion. Symbol O; at. wt. 16; sp. gr. (air = 1) 1.1056. It may be liquefied at —140° C. and a pressure of 50 atmospheres. Electrolytically it is produced along with hydrogen by decomposition of water, using sulphuric acid or caustic alkali in the electrolyte to carry the current. This process is generally economical only when both hydrogen and oxygen are desired. Oxygen is produced more cheaply by fractional distillation of liquid air. A condensed modification of oxygen containing three atoms to the molecule instead of two is called ozone, which see.

OXYGEN AND HYDROGEN GENERATORS, ELECTROLYTIC.—The best commercial method of generating oxygen and hydrogen is by electrolysis of water which has been made conducting. A strong caustic or acid solution, such as caustic soda or sulphuric acid, is used as the electrolyte through which direct current is passed. The electrolysis takes place in cells containing two compartments, one holding the anode on which the oxygen forms, the other the cathode on which the hydrogen forms. A number of such cells are connected together in series. Aside from the cells, such a plant contains apparatus for the control and distribution of the current, apparatus for the collection and accumulation of the gases as they are generated, equipment for compressing these gases where higher than generating pressures are required, cylinders for storing and shipping the gases under high pressures, and (where direct current is not available), a means of rectifying the alternating-current supply. These plants operate most economically when both the hydrogen and oxygen are collected and sold. Twice the volume of hydrogen is formed compared with the oxygen. In some cases this has yielded an excessive amount of one or the other gas, depending on the market available, so that much gas has been wasted. There are numerous used for both gases, so that a market should be found for all the gas produced.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Carbo-Hydrogen Co. of America, Benedum-Trees Bldg., Pittsburgh, Pa.
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Electrozone Water Sterilizer Co., 431 S. Dearborn St., Chicago, Ill.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
National Electro Products, Ltd., 87 Church St., Toronto, Ont., Can.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis. "Oxyoline."

OXY-HYDROGEN BURNING OUTFITS.—One of the first commercial uses of the oxy-hydrogen flame was in the calcium or lime light which has now been generally replaced by the more modern electric arc or incandescent projecting lamps. The outfit usually consists of a special blowpipe arranged to burn the hydrogen gas in a zone of oxygen gas, thus producing an extremely intense flame of the highest attainable combustion temperature. A valve in each gas tube permits adjustment of each gas. The gases are usually supplied from steel cylinders under pressure. At the present time the oxy-hydrogen blowpipe is employed in assay and other special laboratories and in certain lead-burning outfits used for joining lead sheet, pipe, and bars, where soldering cannot be used. For a full description of the latter outfits see Lead-burning outfits and tools.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Burdett Mfg. Co., 309 St. Johns Ct., Chicago, Ill.
Carbo-Hydrogen Co. of America, Benedum-Trees Bldg., Pittsburgh, Pa.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
Davis-Bournonville Co., Jersey City, N. J.
Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."
Electrolabs Co., The, 2635 Penn Ave., Pittsburgh, Pa.
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Milburn Co., The Alexander, 1420-28 W. Baltimore St., Baltimore, Md. "Cut-Weld."
Standard Gas Products Co., 216 Ivy St., Atlanta, Ga.

OXYGRAPH.—Trade name for oxyacetylene cutting and welding outfits manufactured by the Davis-Bournonville Co., Jersey City, N. J.

OXYOLINE.—Trade name for oxygen-vapor generators manufactured by the Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.

O-Z.—Trade name for hand tachometers manufactured by O. Zernickow, 15 Park Row, New York, N. Y.

O-Z TACHOSCOPES.—Trade name for revolution or speed counters manufactured by O. Zernickow, 15 Park Row, New York, N. Y.

OZITE.—Trade name for insulating compound, manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

OZOKERITE.—Trade name for insulating wax manufactured by the Strohmeyer & Arpe Co., 139-141 Franklin St., New York, N. Y.

OZONATORS.—See Ozonizers.

OZONE.—An allotropic form of oxygen; chemical formula O_3; produced by the action of a high-tension electric discharge through air. It is a powerful oxidizing agent.

OZONE CO. OF AMERICA.—416-418 4th St., Milwaukee, Wis. Manufacturer of ozone air and water purifiers, oxygen generators, electric sterilizers and electro-therapeutic apparatus. Business established 1918. President and general manager, William J. Eberle; vice-president, E. A. Sauer; secretary and treasurer, Otto L. Lundgren; sales manager, W. P. Stroesser.

OZONE PURE AIRIFIER CO.—1401-1405 W. Jackson Blvd., Chicago, Ill. Manufacturer of ozone machines.

OZONIZER.—An apparatus for the conversion of ordinary oxygen (O_2), into ozone (O_3), by the action of a high-tension discharge at voltages varying from 4,000 to 50,000 volts, depending on the type of apparatus used.

OZONIZERS, INDUSTRIAL AND COMMERCIAL.—This equipment consists of a transformer connected to any standard lighting or power circuit and developing a high-tension discharge in the secondary. The air to be ozonized passes through tubes or between plates so that the electrical discharge converts part of the oxygen into ozone. Regulation of the transformer secondary voltage is provided to give the best results for different conditions. Such ozonizers are made in different sizes and types depending on the work to be done. In some cases connection air currents are depended on to pass the air between the electrodes, while in others a small fan or blower produces a forced air current or blast. The ozonized air is used for many purposes, as for antiseptic use instead of fumigation, for freshening the inlet ventilating air in theaters, large offices, factories, etc., for removing disagreeable odors, for preventing the growth of mold, for accelerating the aging of certain liquors and chemical compounds and for clarifying and purifying water to make it potable. Among places where they are installed are the following: Cold storage rooms, tanneries and leather-goods factories, meat-packing plants, glue works, municipal water

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treating plants, etc. The water purification plants have been extensively used in some European cities where the entire municipal water supply is continually purified by electrically produced ozone. Portable outfits have also been used by armies for the purification of suspicious water supplies. Small outfits have also been made for use in the household, these being fastened to the wall, and connected to the water faucet so as to be automatically controlled by turning the water on and off.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis. "National."
Ozone Pure Airifier Co., 1401-1405 W. Jackson Blvd., Chicago, Ill.

OZONIZERS, THERAPEUTIC. — These are electrical appliances for the generation of ozone used for therapeutic purposes. The ozone generated is mixed with more or less air and often also with the vapors of soothing oils. It is discharged into the air of the patient's room or the patient may breathe directly from the machine outlet. This ozone treatment is claimed to have a marked healing effect on various diseases of the respiratory organs, such as tuberculosis, bronchitis, laryngitis, rhinitis, etc. The apparatus is usually especially designed for home use and is then generally mounted within a wooden cabinet finished like a piece of furniture and entirely concealing the mechanism.

Manufacturers:

Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Goldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis. "National."
Ozone Pure Airifier Co., 1401-1405 W. Jackson Blvd., Chicago, Ill.
RENULIFE ELECTRIC CO., Marquette Bldg., Detroit, Mich.
Virazone Co., the, 1111 Absopure Bldg., Detroit, Mich.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

P

P.—The letter P is the chemical symbol for the element phosphorus. It is also the symbol for power, of which the unit is the watt. It is used in some equations as an abbreviation or symbol for pressure.

P. & B.—Trade name for insulating varnishes, paints, tapes and compounds made by the Ruberoid Co., 95 Madison Ave., New York, N. Y.

P & C.—Trade name for electrically operated gate valves manufactured by the Pratt & Cady Co., Inc., Hartford, Conn.

P & G.—Trade name for wire skinners manufactured by Paul W. Herbst, 180 N. Dearborn St., Chicago, Ill.

P & H.—Trade name for electric cranes, hoists and excavators manufactured by the Pawling & Harnischfeger Co., 38th & National Aves., Milwaukee, Wis.

P. & M. CO.—80 E. Jackson Blvd., Chicago, Ill. Manufacturer of rail bond wire protectors. President, F. A. Poor; vice-presidents, F. A. Preston, P. W. Moore.

P. & S.—Trade name for electric wiring devices manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

PAASCHE AIR BRUSH CO.—Chicago, Ill. Manufacturer of portable painting outfits, air brushes, air compressor outfits and industrial finishing equipment. Business established 1906. President and treasurer, Jens A. Paasche; vice-president, R. Paasche; secretary, H. Norman; sales manager, Howard G. Bartling. Main office, 1219 W. Washington Blvd., Chicago, Ill. Branch offices, Seattle, Wash.; Los Angeles, Cal.; Commodore Hotel, New York, N. Y.

PACIFIC.—Trade name for leather belting manufactured by the Schwartz Belting Co., 74-76 Murray St., New York, N. Y.

PACIFIC CLAY PRODUCTS CO.—American Bank Bldg., Los Angeles, Cal. Manufacturer of refractories for furnace linings, etc. President, E. M. Durant; secretary, Archibald Douglass.

PACIFIC COAST GEOGRAPHIC DIVISION, N. E. L. A.—Secretary, S. H. Taylor, 821 Market St., San Francisco, Cal.

PACIFIC COAST LUMBER CO.—Lumber Exchange Bldg., Seattle, Wash. Producer of cedar poles. A. H. Ruelee, president.

PACIFIC COAST POLE CO.—Spokane, Wash. Producer of cedar poles, ties and piling.

PACIFIC ELECTRIC MFG. CO.—827-833 Folsom St., San Francisco Cal. Manufacturer of high-tension switches, fuses and circuit breakers. Business established 1910. President, secretary and treasurer, James A. Thompson; general manager, Edward F. Sextus; sales manager, Condon B. Kirkwood.

PACIFIC ELECTRIC WELDER & MFG. CO.—Renton, Wash. Manufacturer of electric spot welders. Business established 1915. President, O. E. Northquist; secretary and treasurer, A. F. Bradish. Sales representatives, Eccles & Smith, Portland, Ore.; Brunhoff & Co., Cincinnati, Ohio; Bogne & Co., Salt Lake City, Utah.

PACIFIC METAL WORKS.—San Francisco, Cal. Manufacturer of castings, bearings, trolley ears, lead sheet, soldering coppers and other metal products. Business established 1854. President and general manager, John W. Heidt; vice-president, C. Forderer; secretary, A. C. Wagner; treasurer, George S. Forderer; sales manager, T. E. Wales. Main office, 153-59 1st St., San Francisco, Cal. Factories, San Francisco and Los Angeles, Cal. Branch office and warehouse, Los Angeles, Cal.

PACKAGE MACHINERY CO.—Springfield, Mass. Manufacturer of electric wrapping machines. President, W. L. Putnam; vice-president and general manager, T. L. Jefferson, Jr.; secretary and treasurer, G. W. Kyburg. Main office, Medford St. & Bernie Ave., Springfield, Mass. Branch offices, 30 Church St., New York, N. Y.; 111 W. Washington St., Chicago, Ill.

PACKARD.—Trade name for electric washing machines manufactured by the Dexter Co., Fairfield, Iowa.

PACKARD.—Trade name for electric vacuum pumps manufactured by Norman Hubbard's Sons, 265-267 Water St., Brooklyn, N. Y.

PACKARD.—Trade name for transformers, wire and cable manufactured by the Packard Electric Co., Warren, Ohio.

PACKARD.—Trade name for incandescent lamps manufactured by the Packard Lamp Division, National Lamp Works of General Electric Co., Warren, Ohio.

PACKARD ELECTRIC CO.—Warren, Ohio. Manufacturer of transformers, current regulators, wire and cable. Business established 1890. President, treasurer and general manager, N. A. Wolcott; vice-president, Charles Filius; secretary, R. Snyder; sales manager, W. Parker. Main office and factory, Warren, Ohio. Branch offices, 141 W. 36th St., New York, N. Y.; 1207 Fisher Bldg., Chicago, Ill.; 347 Ellicott Sq., Buffalo, N. Y.; David Whitney Bldg., Detroit, Mich.

PACKARD LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Warren, Ohio. Manufacturer of incandescent lamps. R. E. Gorton, general manager.

PACKING AND SHIPPING HARDWARE.—Various small hardware utilities, such as joint fasteners, clasps, dogs, etc., are used for reinforcing boxed goods which are to be shipped some distance, especially for export. Twisted wire and flat strip box strapping are also used, especially on heavy boxes containing small metal parts, such as electric fans, flatirons, pole-line hardware, bolts, etc. The rough handling to which goods are subjected in being shipped makes box reinforcement necessary. Lack of attention to proper packing and boxing results in receipt of damaged goods or with parts missing, which gives a bad reputation to the manufacturer, or his forwarding agents.

PACKING, CYLINDER, PISTON, TURBINE, VALVE, ETC.—Various materials are used for packing, the materials used being determined by the conditions of service to which the packing is put Some of the materials are particularly adapted to high pressures, low pressures, acid resistance, heat resistance, etc. The packing is made up in sheet, helical tube or strip, rope or cord forms. The more common materials are asbestos, combined with wire reinforcement, in sheets or woven or twisted into cords or strips, rubber, rubber and duck interwoven or in alternate layers, hemp and jute. The rope or strips are generally impregnated with lubricating graphite. Carbon packing rings are used in certain steam turbines.

Manufacturers:

Advance Packing & Supply Co., 64 E. Lake St., Chicago, Ill.
American Asbestos Co., Norristown, Pa. (Asbestos.)
American Huhn Metallic Packing Co., Woolworth Bldg., New York, N. Y. "Float Cage."
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa. "Ankorite."
Asbestos Fibre Spinning Co., North Wales, Pa. (Asbestos.)
Atlantic Asbestos Co., Butler & Sepvira Sts., Philadelphia, Pa.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
Boston Belting Co., 80 Elmwood St., Boston, Mass. "Noxall," "Imperial," "Roxbro."
Boston Woven Hose & Rubber Co., Box 577, Boston, Mass.
Brandt, Randolph, 70 Cortlandt St., New York, N. Y. "Enterprise," "Hickory," "Magneto," "Selden," "Zena."
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can. (Leather.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Crandall Packing Co., Palmyra, N. Y. "Helios."
Crane Co., 836 S. Michigan Ave., Chicago, Ill. "CC," " Cranite."
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can. "CC," "Cranite."
Diamond Rubber Co., The, Akron, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y. "Rodtite," "Darcoid," "Griptite." "Flangetite," "Old Dominion," "Earl," "Sovereign," "Regent," "White, Seal."
Empire Rubber & Tire Corp., N. Clinton Ave. & Mulberry St., Trenton, N. J.
Eureka Packing Co., 78 Murray St., New York, N. Y. "Eureka," "Heet Sheet." "Ambest."
Franklin Mfg. Co., The, Franklin, Pa. (Journal box.)
Gasket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa. "Gasco."
General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C. "Petrobestos," "Garcobestos," "Calibestos," "Pyroid," "Dixie," "Fibro-Metallic," "Semibronze," "Sumter," "Valbestine," "Helicoid," "Gilt Edge," "Chicora," "Commercial."

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Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J. "Rex."
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio. "Goodyearite," "Red Wing," "Wyoga," "Monterey."
Greene, Tweed & Co., 109 Duane St New York, N. Y. "Palmetto."
Imperial Packing Corp., 191 Greenwich St., New York, N. Y. "Herrington," "Hydropak," "Sta-Tite."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa. (Cylinder.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y. "Kearsarge," "Seigelite," "Vulcabeston."
Merrill & Co., William B., 3368 Washington St., Boston, Mass. "Tripp."
Metallo Gasket Co., New Brunswick, N. J. (Asbestos.) "Stanite."
Mikesell Bros. Co., 156 N. La Salle St., Chicago, Ill. "Mibroco."
MORGANITE BRUSH CO., INC., 519-523 W. 38th St., New York, N. Y. "Morganite" packing rings for steam turbine glands are self-lubricating, mechanical-



Morganite Packing Rings

ly strong, and will not disintegrate under superheated steam. Suitable for shaft surface speeds up to 7500 ft. per min. Can be made in all sizes to suit varying shaft diameters. Segments are interchangeable, resulting in considerable economy in replacements.—Adv.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Waste Co., Philadelphia, Pa.
New Era Mfg. Co., Inc., 730 Cobb Ave., Kalamazoo, Mich. "Durametallic."
New York Belting & Packing Co., 91 Chambers St., New York, N. Y.
New York Insulated Wire Co., 114 Liberty St., New York, N. Y.
Nuhring & Bro., Charles, 1212 Walnut St., Cincinnati, Ohio.
Philadelphia Belting Co., 601-03 Spring Garden St., Philadelphia, Pa.
Pilley Packing & Flue Brush Mfg. Co., 606-10 S. 3rd St., St. Louis, Mo. "Pilley."
Q & C Co., The, 90 West St., New York, N. Y. "Q & C."
Quaker City Rubber Co., 629 Market St., Philadelphia, Pa. "Daniel's P. P. P. Rod," "Ebonite," "Kaloric," "Hercules," "Atlantic."
Robertson & Sons, James L., 78-80 Murray St., New York, N. Y. "Ambest."
Simplex Mfg. Co., Auburn, N. Y. "Simco." (Leather.)
Standard Asbestos Co., 69 Beekman St., New York, N. Y.
Steel Mill Packing Co., 238-42 W. Jefferson Ave., Detroit, Mich. "Safety."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J. "Voorbestite," "Nu-Bestos," "Nubian," "Double Service."
Vulcan Asbestos Mfg. Co., 95 Broad St., New York, N. Y.
Walker & Co., Ltd., James, 46 West St., New York, N. Y. "Lion."
Watson Co., H. F., Erie, Pa.

PACKING OF TELEPHONE TRANSMITTER.—Sometimes a telephone transmitter which has been used by a weak speaker will act as it were dead; it will not transmit as loudly as other transmitters. This may be due to the settling of the granular carbon particles, so that they are not free to respond to vibrations. Good transmitter design reduces this tendency. A packed transmitter can usually be revived by speaking to it loudly, or by shaking it.

PACKINGHOUSE CORD. — See Cord, flexible, packinghouse.

PADS FOR LINEMEN'S CLIMBERS — A small pad worn with linemen's pole climbers to protect the legs from the wearing and pressure of the metal parts of the climbers. The pads are plain leather or have a sheepskin or felt lining.

Manufacturer:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

PADS, HEATING AND WARMING.—See Heating pads, electric.

PADS, TELEPHONE.—A pad of paper held by a clamp on or near a telephone instrument so as to be convenient for making notes, while using the telephone instrument. On desk telephones the pad is usually attached to the upright stand just above the base.

The cushions placed on receivers to relieve ear pressure and exclude noise are often called telephone pads. (Also see Cushions, ear, telephone.)

On the bottom of desk stands there is usually a felt or other soft pad to prevent marring desk or table tops.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Colytt Laboratories, 565 W. Washington Blvd., Chicago, Ill. "Clariphone."
Davol Rubber Co., 69 Point St., Providence, R. I.
Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Therapphone."
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill. (Felt for desk stands.)
Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."

PADUCAH POLE & TIMBER CO.—City National Bank Bldg., Paducah, Ky. Producer of chestnut poles and posts. Yards, Metropolis, Ill.; Bonnieville, Ky., and Munfordsville, Ky.

PAGE & HILL CO.—Minneapolis, Minn. Producer of cedar poles. President, L. A. Page, Jr.; vice-president, L. L. Hill. Main office, 814 Plymouth Bldg., Minneapolis, Minn. Branch offices, 19 S. La Salle St., Chicago, Ill.; Times Bldg., New York, N. Y.; 717 Bryant Bldg., Kansas City, Mo.; 111 Carter Bldg., Houston, Tex.; 311 Sumpter Bldg., Dallas, Tex. Sales representative, T. B. Wilkinson, 1416 Stafks Bldg., Louisville, Ky.

PAGE BELTING CO.—Concord, N. H. Manufacturer of belting. Main office and factory, E. Penacook St., Concord, N. H. Branch offices, Boston, Mass.; Washington Blvd. & Desplaines St., Chicago, Ill.; 258 Broadway, New York, N. Y.; 52 N. 5th St., Philadelphia, Pa.; 18 Ellicott St., Buffalo, N. Y.; 61-67 4th St., Portland, Ore.; 587 Market St., San Francisco, Cal.; 1104-1112 Market St., Chattanooga, Tenn.; 565 S. Clinton St., Syracuse, N. Y.

PAGE BOILER CO.—815-819 Larrabee St., Chicago, Ill. Manufacturer of watertube boilers and valve specialties. Business established 1893. President and general manager, M. E. Page, Jr.; vice-president, John T. Johanson; secretary, Adolph T. Johanson; sales manager, Henry J. Gebhardt. Sales representatives, Karsten Engineering Sales Co., 5 Jefferson Ave., Detroit, Mich.; Vick Engineering Equipment Co., 241 Medford Bldg., Akron, Ohio; Atlas Machinery & Supply Co., 1532 Olive St., St. Louis, Mo.

PAGE STEEL & WIRE CO.—New York, N. Y. Manufacturer of wire and wire products. Business established 1883. President, Arthur A. Clement. Main office, 30 Church St., New York, N. Y. Branch offices, 29 S. La Salle St., Chicago, Ill.; Book Bldg., Detroit, Mich. Factories, Adrian, Mich.; New York, N. Y.; Monessen, Pa. Sales representatives, American Rolling Mill Co., San Francisco, Cal.; Taylor & Arnold, Ltd., Montreal, Que., Can., and Winnipeg, Man., Can.

PAGRIP.—Trade name for metal molding and fittings manufactured by the Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

PAIGE & CO., FRANK E.—68 Essex St., Boston, Mass. Manufacturers of felt products. Partnership, Frank E. Paige and Francis W. Paige, Mills, Camden, Me.; Byfield, Mass.

PAINE.—Trade name for toggle bolts, expansion shells and fixture hangers manufactured by the Paine Co., 1742 W. Van Buren St., Chicago, Ill.

PAINE CO., THE.—1742 W. Van Buren St., Chicago, Ill. Manufacturer of expansion shells and toggle bolts. Business established 1912. President, M. H. Paine; vice-president, E. C. Paine; secretary and treasurer, E. C. Hall; sales manager, Robert W. Huck.

PAINT BRUSHES AND BRUSH HOLDERS.—See Brushes, for insulating compounds, paint and varnishes; Holders, brush, insulating paint and varnish.

PAINT SPRAYING MACHINES, PNEUMATIC.—The essential parts of these machines are an air compressor and the air brush or spray gun. The brush consists of a double-pipe nozzle, one pipe for the compressed air, the other for the painting material. The compressed air draws the material out and throws it as a spray upon the object to be painted. The work is done in a cabinet from which the air is exhausted continually by an electric exhaust fan. Where necessary the paint material is heated by a small electric heater mounted on the nozzle or gun. Though ordinarily used as a hand gun, these sets are sometimes set up in automatic machines for such work as coating insulating material and frosting incandescent lamps. They are extensively used for applying varnishes, enamels and paints to small motors, fans, meter cases, etc., and various household appliances, such as washing machines and ironers.

Manufacturers:

Antakwa Co., The, 212 N. Jefferson St., Chicago, Ill. "Antakwa."
Binks Spray Equipment Co., 3120 Carroll Ave., Chicago, Ill.
DeVilbiss Mfg. Co., The, 3750 Detroit Ave., Toledo, Ohio. "Aeron."
Dielectric Mfg. Co., St. Louis, Mo.
Eclipse Air Brush Co., 79 Orange St., Newark, N. J. "Eclipse."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Paasche Air Brush Co., 1219 W. Washington Blvd., Chicago, Ill.
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.

PAINTS, ACID-RESISTING.—There is a kind of asphalt paint which resists the action of dilute acid solutions and acid gases. It is used for painting storage-battery boxes, trays, supporting framework, and tanks containing acids or near acids. In electrochemical plants, storage-battery rooms, etc., acid gases or sprays are frequently given off which corrode the conduit, sockets and other metal fittings causing considerable trouble in the maintenance of such equipment. These acid-resisting paints have been used to protect this and similar equipment from these corrosive effects

Manufacturers:

Antakwa Co., The, 212 N. Jefferson St., Chicago, Ill. "Antakwa."
Barber Asphalt Paving Co., The, Land Title Bldg., Philadelphia, Pa. "Genasco."
Battery Equipment & Supply Co., 1400 S. Michigan Ave., Chicago, Ill. "Besco."
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo. "Lion."
Lehon Co., The, 4411 Oakley Ave., Chicago, Ill.
Patton Paint Co., Milwaukee, Wis.
Redmanol Chemical Products Co., 636-678 W. 22nd St., Chicago, Ill. "Redmanol."
Suydam Co., M. B., 61st & Butler Sts., Pittsburgh, Pa.
U. S. Gutta Percha Paint Co., 12 Dudley St., Providence, R. I.
Vitrifyx Co., The, 2526 W. Congress St., Chicago, Ill.

PAINTS, INSULATING.—Insulating paints are required to have a pigment that is impervious to moisture and acid fumes and also is an insulator. They are widely used on electrical products and construction jobs and for all kinds of electrical wiring. One form of this paint is a general purpose paint that can be used for treating tapes, fibers, fabrics, and insulation, and for conduit and cable connections, switchboard bases, battery rooms, etc. There are other forms of in-

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sulating paints made that are acid-resisting and flameproof and are used for meter boards, moldings, aerial and underground cables, service boxes, street-car trucks, motor frames and bases, etc.

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York, N. Y.
Antakwa Co., The, 212 N. Jefferson St., Chicago, Ill. "Antakwa."
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio. "Bilchaco."
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Micabond." (See display adv. page 1320.)
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Dielectric Mfg. Co., St. Louis, Mo. "Graphon," "W. D.," "Dielectrol."
Dockendorff & Co., Inc., J. E., 20 Broad St., New York, N. Y.
Dolph Co., John C., 168 Emmett St., Newark, N. J. "Universalak."
Elaterite Paint & Mfg. Co., W. 11th & Market Sts., Des Moines, Iowa. "Des Moines Elaterite."
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo." (See display adv. page 1318.)
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display adv. page 1320.)
Lehon Co., The, 4411 Oakley Ave., Chicago, Ill.
Mica Insulator Co., 68 Church St., New York, N. Y. "Linolac."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Ohmlac Mfg. Co., 140 S. Dearborn St., Chicago, Ill. "Ohmlac."
Paterson-Sargent Co., Cleveland, Ohio.
Patton Paint Co., Milwaukee, Wis.
Riesenman Mfg. Co., Ltd., Franklin, Pa.
Robertson Chemical Co., Cleveland, Ohio. "Enamelac," "Resistolac," "Armalac."
Ruberoid Co., 95 Madison Ave., New York, N. Y. "P & B."
Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio. "Ajax."
Standard Varnish Works, 90 West St., New York, N. Y.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Suydam Co., M. B., 61st & Butler Sts., Pittsburgh, Pa.
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.
Toch Bros., 320 5th Ave., New York, N. Y. "R. I. W. Insulectric."
Union Clay Products Co., New Brunswick, N. J.
U. S. Gutta Percha Paint Co., 12 Dudley St., Providence, R. I.
Voltax Co., Bridgeport, Conn.
Vulcan Fuel Economy Co., 829A Transportation Bldg., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAINTS, PROTECTIVE.—Protective finishes in some form are applied to nearly all articles manufactured. In many cases the finish is intended to improve the appearance of the article as well as to prevent or combat the corrosive action of the elements, acid fumes and electrolysis. Paint is one of the most widely used finishes for this purpose and has a large number of applications in the electrical utility and manufacturing industries. One of the most important uses is a paint that will prevent rusting of ironwork. This requires a paint with a pigment that of itself is inhibitive or has a tendency to resist corrosion, and is electrolytically positive to prevent electrolysis. The vehicle used should be sufficiently elastic to allow for the contraction and expansion of the metal, and must form an impervious film to exclude moisture and fumes. All outside ironwork requires a protective covering of this nature. In a power plant the boiler fronts, coal bunkers, smoke stacks, metal roofs, trusses, columns, miscellaneous piping, etc., require protection that is often given by paints containing creosote and asphalt. There are a great many parts of electric cars, car houses, substations, telephone exchanges, manufacturing plants, etc., that require special protective paints. Paints are of many kinds, depending on the nature of the material to be protected, whether that material is exposed to specially corrosive action, and on the various ingredients that have been found to meet similar requirements with reasonable satisfaction.

Manufacturers:

Antakwa Co., The, 212 N. Jefferson St., Chicago, Ill. "Antakwa."
Atlas Mineral Products Co., Mertztown, Pa. "Triple Label Prince's."
Barber Asphalt Paving Co., The, Land Title Bldg., Philadelphia, Pa. "Positive Seal."
Barrett Co., The, 17 Battery Pl., New York, N. Y.
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio. "U. S. N. Deck," "Rustnaught."
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa. "Salfire."
California Paint Co., 11th, 12th & Pine Sts., Oakland, Cal. "Calpaco."
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Diamond Oil Co., 1538 Land Title Bldg., Philadelphia, Pa.
Dielectric Mfg. Co., St. Louis, Mo.
Dolph Co., John C., 168 Emmett St., Newark, N. J.
Du Pont de Nemours & Co., E. I., Wilmington, Del. "Carpo."
Elaterite Paint & Mfg. Co., W. 11th & Market Sts., Des Moines, Iowa. "Des Moines Elaterite."
Excello Mfg. Co., The, Cleveland, Ohio.
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Products." (See display adv. page 1320.)
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
Murphy Varnish Co., Chestnut & McWhorter Sts., Newark, N. J.
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Ohmlac Mfg. Co., 140 S. Dearborn St., Chicago, Ill. "Ohmlac."
Patton Paint Co., Milwaukee, Wis.
Reeves Co., The, 3110 S. Carrollton Ave., New Orleans, La.
Riesenman Mfg. Co., Ltd., Franklin, Pa.
Ruberoid Co., 95 Madison Ave., New York, N. Y. "S-P-C."
Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio. "Ajax."
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."
Standard Varnish Works, 90 West St., New York, N. Y.
Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.
Toch Bros., 320 5th Ave., New York, N. Y. "R. I. W."
U. S. Gutta Percha Paint Co., 12 Dudley St., Providence, R. I.
Vulcan Fuel Economy Co., 829A Transportation Bldg., Chicago, Ill. "Lastite."

PAINTER CO., G. E.—324 N. Charles St., Baltimore, Md. Manufacturer of electric signals and clusters for electric railways, crossings, etc. Business established 1906. Sole owner, G. E. Painter.

PAINTER'S.—Trade name for electric signals and clusters for electric railways, crossings, etc., made by the G. E. Painter Co., 324 N. Charles St., Baltimore, Md.

PAIR, TWISTED.—Two small insulated conductors twisted together. Twisted pairs are largely used in telephone cables and inside telephone wiring. See Wire, telephone, inside.

PAIRPOINT CORP., THE.—New Bedford, Mass. Manufacturer of paper sleeves for insulating and electrical purposes. President, Andrew G. Pierce, Jr.; vice-president, Thomas A. Tripp; treasurer, William A. Clarke; general manager, Frederick R. Fish. Main office and factory, New Bedford, Mass. Branch offices, 43-47 W. 23rd St., New York, N. Y.; Coristine Bldg., Montreal, Que., Can.; 140 Geary St., San Francisco, Cal.; 402 Columbus Memorial Bldg., Chicago, Ill.

PAISTE.—Trade name for wiring devices manufactured by the H. T. Paiste Co., Philadelphia, Pa. Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

PAISTE CO., H. T.—Philadelphia, Pa. Manufacturer of wiring devices and conduit fittings. Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

PALM BROS CO., THE.—Norwood, Cincinnati, Ohio. Manufacturers of decalcomania transfers.

PALMER & CO., N.—Bridgeport, Conn. Manufacturers of power transmission belting. Business established 1859. Fayette C. Clark, general manager.

PALMER ELECTRIC & MFG. CO., THE.—Cambridge, Mass. Manufacturer of switches. Business established 1912. President and treasurer, G. E. Palmer. Main office, 175 5th St., Cambridge, Mass. Branch offices, New York, N. Y.; Philadelphia, Pa.; Chicago, Ill.

PALMERS EXTRA.—Trade name for belting manufactured by N. Palmer & Co., Bridgeport, Conn.

PALMETTO.—Trade name for packing manufactured by Greene, Tweed & Co., 109 Duane St., New York, N. Y.

PANAMA ELECTRIC LIGHT CO., INC., PHILIP.—1627 Melrose St., Chicago, Ill. Manufacturer of electric lighting fixtures. President, Philip Panama; vice-president and treasurer, William Wolf; secretary, Thelma Panama.

PANAMA LAMP & COMMERCIAL CO.—595 Mission St., San Francisco, Cal. Manufacturer of lighting fixtures. Partnership, Joseph Thieben and S. J. Blumenthal. Sales representatives, Leco Electric Lamp Co., 133 Mercer St., New York, N. Y.; Panama Electric Lamp Co., 183 N. Wabash Ave., Chicago, Ill.

PANAMA-LITE.—Trade name for lighting fixtures manufactured by the Panama Lamp & Commercial Co., 595 Mission St., San Francisco, Cal.

PANCAKE.—Trade name for receptacles manufactured by the Bryant Electric Co., Bridgeport, Conn.

PANCHRO.—Trade name for photoengraving lamps manufactured by the New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y.

PANEL SWITCHES.—See Switches, panel, panelboard or combination cutout.

PANELBOARD.—Under the general name of panelboards are included panels or boards used for local control of electric light, heat or power circuits, usually of moderate capacity, but including intermediate boards, distributing or junction panels at distribution centers. The term panelboard is not intended to apply to switchboards in central stations, substations, or isolated plants directly controlling energy derived from generators or transforming devices, or to special control equipments not ordinarily enclosed in standard cabinets, cutout boxes, or junction boxes, and not having switches, fuses or other parts interconnected by busbars and straps. The material commonly used for panelboards is slate or molded composition, though marble is sometimes used.

The National Electrical Code requires that a certain space be maintained between points of opposite polarity according to the various voltages of the circuits. To obtain the maximum number of circuits on a board the circuits are generally wired in rows in the order of two positive straps, then two negative, etc., so that the connectors of like polarity may be mounted close together, at the same time preserving the required space between connectors of opposite polarity. The current enters the board on two or three busbars. From these bars the various circuits are tapped off by connecting straps through fuses and switches to be distributed to the branch lighting circuits. A knife switch or fuses or both are generally included in the busbar or main circuit.

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Panelboards are quite commonly assembled by grouping the required number of porcelain or other branch blocks and connecting them to the buses; each branch block consists of a cutout base for either plug or cartridge fuses and usually a switch, which may be of the knife, rotary, push-button or toggle type. In some cases single branch blocks are used, but more commonly they are arranged for the two branch circuits, one on each side of the buses. The branch circuits are nearly always two-wire, although the buses may be two-wire or three-wire. Where the board is made up as a complete unit, the assembly of parts is made by the manufacturer.

Panelboards are subclassified both as to important construction features and as to their principal uses. The following classifications cover both of these principal bases of subdivision.

PANELBOARDS, CONVERTIBLE. — These panelboards are equipped with the usual switches, fuses, busbars and straps, but have the connections so arranged that they may be readily altered to adapt them to various types of wiring systems without disturbing the arrangement of switches or fuse connections. The most common use of these boards is in wiring systems where the power supply may be either two-wire or three-wire, as where power from a two-wire isolated plant is used interchangeably with the three-wire supply from a central station at certain hours of the day or at certain seasons. A double-throw main switch permits changing over from the two-wire to the three-wire supply or the reverse without requiring any change in the branch circuits.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "Standardized," "Ready-To-Ship," "Benjamin-Starrett." (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Large-Dail Mfg. Co., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo. (See complete descriptive information under "Panelboards, standard.")—Adv.

PANELBOARDS, MARINE.—Marine panelboards are used for distributing the various lighting and signal circuits found in ships. The boards are so constructed, by use of water-tight enclosures, that no live parts may be reached by moisture or water that would cause a ground or short-circuit. They are also used in very moist locations as well as on shipboard; for example, in packing houses, laundries, dye houses, tanneries, etc.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin-Starrett panelboards (see description under "Panelboards, standard") are built in a variety of designs especially for the unusual conditions met with in marine service.—Adv.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electrical Mfg. Co., 4149 E. 79th St., Cleveland, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Western Electric Works, 213 6th St., Portland, Ore.

PANELBOARDS, METERING. — These panelboards are arranged to distribute the power through variously grouped circuits, but first including a meter in the circuit. From the busbars run two circuits to the meters, one for the potential coils, which is a circuit common to all the meters, the other for the current coil of each meter connected individually in each circuit to be metered. The panelboards are usually mounted in three-compartment cabinets, the panelboard in a middle compartment, the meters in the side compartments. Each metered circuit includes a switch and necessary fuses. These metering boards are used principally in large office and loft buildings where the space rented to different tenants is likely to be changed from time to time. Such a board permits grouping the lighting circuits for any number of rooms on one meter and at any later time regrouping them when the tenants' requirements change.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "Major," "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Manufacturer of all types of live front and safety type Panel Boards for light and power. Sprague metering panels are of the McWilliams type. With this panel it is possible to connect a circuit, or combination of circuits, through any of a number of meters by simply changing the location of the transfer switches on the face of the panel and without changing any of the



Sprague Metering Panel

wiring. These panels can be furnished in the same general types as the standard lighting panels described above. Sprague products, see display adv. pages 1306-7.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WM., 21 S. 11th St., St. Louis, Mo. Metering panels (McWilliams Patent) can be furnished with any number of circuits and meter bars and also with any style of mains or branches. Panels are furnished with Code gage cabinets, either with or without space for mounting the meters. Metering panels are recommended for all office buildings, warehouses or apartments where the tenants change from time to time. With this type of panel it is necessary to furnish only one meter for each tenant. Changes or additions to tenant space can be provided for very quickly and at no expense as any number of branch circuits can be metered on any one meter by simply changing the location of the meter connectors on face of panel. Our latest catalog fully describes all our products. It will be sent on request.—Adv.

PANELBOARDS, RESIDENCE.—The residence panelboard is a small board combining the main service switch, meter loop and circuit fuses in a steel cabinet or box. Where several meters are included in the circuits, sealing arrangements may be provided which are inserted in the meter loop to prevent theft of current. These boards are ordinarily used only in houses and small apartment buildings. They are made up for either two or three-wire systems. Where the three-wire system is used the circuits are usually disposed in equal numbers on each side of the three-wire main bus.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin-Starrett residence panelboards with cabinets combine numerous individual safety features with



Benjamin-Starrett Residence Panelboard

an ease of manipulation, a finely finished appearance and a ruggedness of structure that have met with wide approval of engineers and contractors. In

the open-front types, 90% of the current-carrying parts are concealed in the base. In the dead-front types, all current carrying parts are entirely concealed by a metal shield.—Adv.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Flint Electric & Mfg. Co., 1402 Delgany St., Denver, Colo.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Large-Dail Mfg. Co., Inc. 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WESTERN ELECTRIC SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Western Electric Works, 213 6th St., Portland, Ore.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo. (See complete descriptive information under "Panelboards, standard.")—Adv.

PANELBOARDS, SAFETY OR DEAD FRONT.—This form of panel is especially adapted for use in large offices, stores, factories and mills and in other places where men and women who are not familiar with the proper handling of electrical control apparatus and its attendant hazards have access to the board. The usual panelboard includes switches, fuses and metal busbars and connecting straps. The board is mounted within a metal cabinet, sometimes provided with a wood front, and with a locking door. The safety feature is obtained by so constructing the panel that live parts are not exposed. The switches are either rotary snap or flush push-button type and the fuses where exposed are of the plug type. The busbars and straps are concealed behind a glass panel, behind a metal plate, or buried in or mounted on the back of a composition board. A main knife switch is sometimes mounted on the board, but to prevent any but responsible parties having access to this switch (and in some types the fuses as well) the main outer door of the cabinet is locked. Within the main door is a smaller door which opens to expose only the rotary or push-button branch-circuit switches so that any one may operate these switches with safety.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "Benjamin-Starrett." (See display adv. pages 1231-1234.)
Electric Panelboard Co., Rochester, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y. "Narco."
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv., page 1285.)
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Manufacturer of all types of live front and safety type Panel Boards for light and power. Any type of live front or safety type panels and cabinets can be furnished to meet special requirements. Branches of live front panels arranged for fuses only, or, with fuses and knife-blade switches. Safety type panels are furnished with brush contact switches in the branches and can be furnished with a separate door over the fuse compartment of each



Sprague Safety Type Panel

switch so arranged that access to the fuses can be had only with the switch in "off" position, thereby making it impossible to come in contact with any live parts while inspecting or renewing fuses. This type of panel is made with branches up to 600-amp., 250-volt d-c., 500-volt a-c. Sprague products, see display adv. pages 1306-7.—Adv.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv., pages 1279-1281.)
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. In an electrical distribution system, the panelboards together with steel cabinets and slate barriers, are considered complete units and are furnished accordingly. This company manufactures, both for power and lighting distribution, all types of panelboards and steel cabinets. Special units of any size and capacity, with switches as desired, are generally furnished in accordance with customer's specifications. A complete line of standard



Type PT



Type PP

panelboards, with cabinets, (many catalog numbers are carried in stock) is listed in this company's bulletins, Nos. 1, 2 and 3 of 1920, being classified either as Dead-front or Live-front panelboards. The increasing safety requirements of the Bureau of Standards, Underwriters' Laboratories, and Workmen's Compensation laws of the various states, demand a panelboard so constructed as to allow unrestricted use of the circuit switches without the possibility of the operator coming in contact with any live part of the panel. Two styles of Dead-front panelboards, fully meeting these requirements are made, those with 30 ampere Tumbler switches in the branch circuits, and those with 20 ampere push button switches in the branch circuits. Live-front panelboards are made with 30 ampere panel knife switches in the branch circuits, and with fuses only. Both of the above panelboard classes are furnished with either plug or cartridge fuses in the branch circuits. Branch circuits are double pole, and mains are either two-wire or three-wire, arranged for 125 volt spacing. See, also, this company's advertisement on pages 1282-3.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WM., 21 S. 11th St., St. Louis, Mo. These panelboards are furnished with any style of mains, same as live-face panels. Branch circuits are regularly equipped with 20-ampere double-pole push-button switches with fuse connections for Edison plug fuses or cartridge fuses. The push-button switches are covered with a protecting plate which is easily removable from the front of the panel. This plate has a card holder mounted above each



"Wurdack" Safety Panel

switch. All safety panels are inclosed in a Code gage cabinet with trim having two doors. One small door within the large door gives access to the push-button compartment only; this door is equipped with a catch only. The large door gives access to the entire panel and is furnished with a lock, so that it can be opened only by an authorized person when it is necessary to renew fuses. Our latest catalog fully describes all our products. It will be sent on request.—Adv.

PANELBOARDS, STANDARD.—For ordinary service the panelboards may be made up of standardized branch-circuit sections built up to the required size. The standard sections are rectangular panel bases, wired for two-wire branches from either two or three-wire main circuits and so arranged that connection from the branch panels to the buses may be easily made. These standard boards are equipped with fuses only, or fuses and switches, either snap, push-button, knife or toggle type.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Alberene Stone Co., 228 E. 23rd St., New York, N. Y. (Soapstone.)
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Barber Electric Mfg. Co., North Attleboro, Mass.

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BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin-Starrett standardized panelboards with cabinets are different. The bases are of molded composition, a light material of great mechanical and dielectric strength, and extremely durable. These boards are "built-up" from unit sections which are factory made, i. e., by modern machinery on a production basis and therefore, fitting accurately as well as having the neat, finished appearance characteristic of the machine made product. Dead Front and Open Front types, 4 to 30 circuits, 125-volts, 2-2 and 3-2 wire main lugs, fusible mains, fuseless and fusible main knife switches. The Dead Front panels are remarkably simple in construction, are easy to install and have a wonderfully fine appearance. They are completely safe for the uninitiated to operate. The Benjamin-Starrett line also comprises a high type of safety residence panels for use in the better class residences and apartments. Stock panels packed and ready for immediate shipment, and watertight panels for marine and similar construction work.—Adv.



Benjamin-Starrett Standardized Panelboard with Cabinet

C. & P. Electric Works, Inc., 92 Hayden St., Springfield, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Switchboard Mfg. Co., 426 S. Clinton St., Chicago, Ill.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Consolidated Electric Mfg. Co., Inc., 223-25 N. 13th St., Philadelphia, Pa. "Diamond C."
Cregier Electrical Mfg. Co., 220 W Ontario St., Chicago, Ill.
CROUSE-HINDS CO., Syracuse, N. Y. Crouse-Hinds standard line of panelboards includes types for cartridge or plug fuses only in branches and, also, for either type of fuses in connection with knife, rotary snap or push button switches; also dead front (safety first.. and residence panelboards. The base consists of a high-grade black Monson slate free from flaws and metallic veins. Each steel trim and box is formed from one piece of No. 10 gage sheet metal. All panels are built in accordance with requirements of the National Board of Fire Underwriters. Special panelboards are designed for uncommon conditions and this service is free to customers. Copy of catalog sent upon request.—Adv.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Apparatus Co., 127 S. Green St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
Electric Panelboard Co., Rochester, N. Y.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Empire Engineering & Supply Co., 1 Dominick St., New York, N. Y.
Flint Electric & Mfg. Co., 1402 Delgany St., Denver, Colo.
Hatfield Electric Co., 102 S. Meridian St., Indianapolis, Ind.
Hub Electric Co., 2225 W. Grand Ave., Chicago, Ill.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Neubus."
Liberty Electric Corp., Port Chester, N. Y.
Liberty Mfg. Co., Inc., 3201-41 Carrollton Ave., New Orleans, La.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.
Metropolitan Electric Co., South Seattle, Wash.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1310.)
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
Nyelec Switchboard Co., 422 E. 53rd St., New York, N. Y.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Post-Glover Electric Co., 308 W. 4th St., Cincinnati, Ohio.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "SafetyProducts."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Manufacturer of all types of live front and safety type Panel Boards for light and power. The standard line of lighting panels are designed for 2/2 wire, 3/2 wire or 3/3 wire distribution and for 125 or 250-volt service. Branch circuits are arranged for either National Electrical Code enclosed or Edison plug fuses only, or, in addition to the fuses, are equipped with 30 amp. knife-blade switches, 20 amp. push button or tumbler switches, or 30-amp. heavy duty tumbler switches. Live front panels are enclosed in steel



Sprague Panel Board

cabinets having a door equipped with a lock covering the entire panel. Safety panels are generally furnished with a steel cabinet having a door equipped with a lock covering the fuse



Sprague Safety Panel

compartment and other exposed current carrying parts, and a smaller door, which is hinged to the large door, equipped with a spring catch covering the switch operating handles only. This arrangement provides maximum safety to the operator. All panels are furnished with or without main fuses or main switches. Main switches are either of the open knife-blade or the safety brush contact type. Sprague products, see display adv. pages 1306-7. —Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Electrical Construction Co., San Francisco, Cal.
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Tanner & Co., William F., Baltimore, Md.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Manufactures ten types of standard panelboards, one of which is illustrated. Special panels are built to customer's specifications. All panelboards are



T. V. Panelboard

well made of high-grade materials and are carefully tested and labelled in accordance with the Underwriters' requirements. Line includes dead front panelboards with push-button type switches, 10, 20, 30 amp. capacity.—Adv.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Co.
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wisconsin Electrical & Mfg. Co., Milwaukee, Wis.
Worcester Electric Mfg. Co., Worcester, Mass.
WURDACK ELECTRIC MFG. CO., WM., 21 S. 11th St., St. Louis, Mo. Can be furnished with the following mains: lugs only, fuses only, nonfusible knife switch or fusible knife switch for two or three-wire service. Branch circuits are equipped with Edison plug or cartridge fuse connections. Where circuit switches are desired in addition to the fuses, either the knife or push-button



"Wurdack" Safety Panel

type can be supplied. The knife switches are standard 30-ampere double-pole 125-volt with blades molded into a composition spool handle. The push-button switches are 20-ampere double-pole with black composition covers. Panels are enclosed in Code gage steel cabinets having slate barriers with adjustable corner angles. Special attention is called to our corner angle which provides adjustment of panel in any direction, so that it can be set plumb and flush with finished wall, regardless of whether the cabinet is properly set or not. Standard fronts for all cabinets are made of No. 10 or 12 gage steel, one-piece construction, with hinges, lock and catch. Wood fronts, made of any kind of wood and having any finish, can be furnished when specifically ordered. Our latest catalog fully describes all our products. It will be sent on request.—Adv.

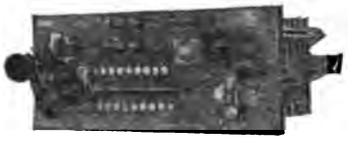
PANELS, BATTERY-CHARGING.—Isolated storage-battery-charging panels consist of a rheostat, ammeter, voltmeter and automatic reverse-current relay or circuit breaker, also sometimes a switch, all mounted on an insulating base (usually

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slate), which in turn is mounted on a supporting framework. Where a number of batteries are to be charged at the same time from the same constant-potential circuit, a number of individual panels (one for each battery) are mounted on the same framework. With this arrangement only one set of instruments is necessary; these are mounted on a main or instrument panel and arranged to be connected to any battery panel by means of switches or plugs on each panel. As the capacity of the garage or other battery-charging station is increased, additional panels can be added above each other or side by side; frequently 5, 6 or 7 are superposed.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "Benjamin-Starrett," "Standardized," "Ready-To-Ship." (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Battery Charging Panels are manufactured for use in connection with the charging of storage



C-H Unit Type Charging Section—Variable Resistance

batteries on all types of electric vehicles, industrial trucks, battery locomotives, etc. Battery charging racks are also supplied for miners' lamp batteries.



C-H Automatic Unit Type Charging Section

These battery charging panels include both the individual type and the unit type, the latter being made up of unit sections for mounting on standard floor type frames. The unit sections are assembled in frames in much the same way as the present-day sectional filing cabinets are assembled. Any number of sections can be installed at one time and additions readily made when desired. Each charging section is a complete unit so designed that the labor of installation is reduced to a minimum. Connections are so made that one duplex meter mounted on a swinging bracket serves all the sections. C-H Battery Charging Panels are supplied for both constant-current charging and modified constant-potential charging. For mine service the panels are suitably protected from mine moisture. See display adv. pages 1225-1230.—Adv.



C-H Mine Locomotive Charging Panel

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Il.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
GENERAL ELECTRIC CO., Schenectady, N. Y. Panels for charging individual batteries or groups of batteries and for control of charging circuits for starting and lighting sets. Switchboards of two, three and four circuits for controlling multiple battery charging motor-generator sets are described in Bulletin Y-1364-A. See adv. pages 1203-1223.—Adv.
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
Hatfield Electric Co., 102 S. Meridian St., Indianapolis, Ind.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Holt Farm Light Co., Toledo, Ohio. "Holt." (110-volt direct current.)
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Meier Electric & Machine Co., 136 S. Meridian St., Indianapolis, Ind.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Radio Corp of America., 233 Broadway, New York, N. Y.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-533 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

PANELS, CIRCUIT BREAKER.—With the rapid developments in the electrical industry there has arisen a demand for reliable switching mechanism and protective apparatus, which is very frequently met by some form of circuit breaker. It has been customary in small-capacity circuits to place the circuit breakers on the same switchboard panel with the instruments or control apparatus required for the circuit, but large installations frequently require separate panels for the breaker alone. The use of equipment that may be controlled from any required distance has demonstrated that circuit breakers do not need to be massed together on a single switchboard, but may be located in such a manner as will afford the most convenient and economical cable installation. This has led to the use of separate circuit-breaker panels with remote-control apparatus, located at different points in the plant close to the large motors or other apparatus controlled.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th & Wesley Aves., Columbus, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PANELS, CONTROLLER.—Controller panels are very widely used throughout the industries utilizing electric power. They contain all the control apparatus (automatic starting mechanisms, lockout controllers, reversing controllers, etc.) for such machines as motor-generators, hoists, fans, machine tools, etc. They are used extensively in mines where the controller panels for a pump, fan or automatic hoist are often placed on the surface, while the apparatus may be in the mine and some distance away. Many large machines, such as printing presses, may have several emergency or control push-button switches placed at convenient points, all of which work in conjunction with a controller panel located where space is available.

Controller panels are usually of slate, although marble, asbestos lumber and molded insulation are also used. Controller parts are sometimes also mounted on steel bases, in which case the live studs must be insulated with washers and bushings.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

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AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See display adv. pages 1225-1230.—Adv.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Kuhlman Engineering Co., The., 840 Champlain St., Toledo, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PANELS, DENTAL AND THERAPEUTIC CONTROL.—The modern dentist's office includes many electrical devices. For the convenience of the dentist these devices are all controlled from one panel usually placed near the chair. The panel may be a separate unit or it is sometimes mounted in a cabinet containing auxiliary devices, such as an air compressor. Besides electrical controls the panel usually has the air controls on the same board for the convenience of the operator, and also indicating instruments used in connection with the electrical or air equipment. Similar panels are used by physicians and surgeons employing electrotherapeutic apparatus.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind. "Massey."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.

PANELS, FIRE-ALARM CONTROL.—The various control appliances necessary for fire-alarm systems are generally mounted together on a panel enclosed in a metal or glass cabinet. Where batteries are used as the source of power a battery rack is sometimes included within the cabinet or a separate battery box is provided. The apparatus on the board generally includes relays, protectors, fuses, indicating meters, etc. The door to the cabinet is usually locked so that none but responsible parties may have access to the panel. A glass panel or small door is often mounted in the larger door to provide for viewing the indicating meters without opening the large door. For large systems, such as for a city or town or very large industrial plant, etc., a group of panels is arranged as in switchboard practice; for these see Switchboards, fire-alarm.

Manufacturers:

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess," "Circle H."
Stanley & Patterson, West & Hubert Sts., New York, N. Y.

PANELS, METERING OR METER LOOP.—Metering panels are used extensively in office, apartment and loft buildings, factories, stores, etc., or wherever it is desirable to connect a circuit, or combination of circuits, through any one of a number of meters by merely changing the location of or making additional meter connections on the face of the panel. The name meter loop, sometimes given to these panels, is an old trade term used by electricians, because of the fact that in running the service, they merely leave a loop of wire at the panel for the connections. Metering panels sometimes consist of a series of vertical bars in one plane, crossed by a series of horizontal bars connected to circuits to be metered, directly above them. Adjustable connections on the front of the panel permit placing any circuit on any meter desired, thus permitting regrouping of the rooms to suit the needs of the tenants without troublesome rewiring or meter reconnection.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO, 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo. (See complete descriptive information under "Panelboards, standard.")—Adv.

PANELS, MOTION-PICTURE CONTROL.—Control panels used in motion-picture theaters contain the starting switches and the voltage-regulating and control apparatus for the motor-generator set, converter or rectifier that is used to supply the arcs in the projecting machines. As these panels are usually mounted in a separate room from the operator's, it is necessary to have the feeders for the projecting machines terminate on the panel. Occasionally in small theaters the switches for controlling all the lights in the theater are on the same panel, but larger theaters require separate panels or control boards, and sometimes extensive equipment for producing varied colored lighting effects.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PANELS, MOTOR-STARTING.—When an automatic motor starter is used, the contactors, relays, resistors and other auxiliary equipment are often mounted on a panel not far from the motor so that the connecting leads from the starter to the motor need not be long. By mounting all the starting equipment on a panel it may be more readily protected from injury. Even where manual starters are used, they are sometimes mounted on a similar panel, especially when the motor is one of high rating so that the main switch, starter proper and resistors occupy considerable room, but logically should be grouped together. Smaller starters are often arranged with the main switch mounted above but on the same slate or other insulating base as the starter, thus constituting a small panel. Also see Panels, controller.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CUTLER-HAMMER MFG. CO., THE 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.

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METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO, 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-1281.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PANELS, PRESSURE GOVERNOR.—Pressure governors of the diaphragm type are usually self-contained devices with feet provided for mounting, and can be mounted separately or on a panel with the controller. Governors of the gage type are mostly used, either with a self-contained or separate relay. When used with a separate relay, the gage and relay are usually mounted on a small slate panel supported by a sheet metal frame. They may also be mounted on the controller panel with which the gage is used. Also see Governors, compressor or pressure pump; also Controllers, compressor and pump, automatic.

Manufacturers:

Automatic Switch Co., 154 Grand St., New York, N. Y.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Liberty Electric Corp., Port Chester, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

PANELS, RADIO.—Radio panels are made to provide a convenient mounting for variable condensers, inductances and resistances, as well as the control switches and apparatus for generators, transformers and the various receiving and transmitting circuits. Sometimes these panels are not very large and are mounted on a desk or table. In other cases, separate supporting frameworks are used. Slate is often used for the larger panels and some of the smaller ones are made of fiber and some of its various modifications.

Manufacturers:

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
KLAUS RADIO CO., Eureka, Ill.

PANELS, RHEOSTAT.—Separate panels for rheostat mounting are often placed near starting panels for motors where it is desirable to have adjustable though constant speed, as in machine tools, printing presses, etc. In these cases the resistors may be mounted directly on the back of the panel, or in the larger sizes they may be separately mounted and operated by a chain and sprocket or bevel gear mechanism. The use of remote-controlled rheostats for exciter or generator field control generally requires a separate rheostat panel placed close to the field resistors. These panels have the motor-operated rheostat mechanism as well as the rheostat faceplate mounted on them.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv., pages 1225-1230.)
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv., pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv., pages 1282-1283.)
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PANELS, SAFETY.—These panels are intended primarily as feeder or distributing panels for light and power; they are especially applicable in factories where inexperienced or unskilled employees have access to the switchboard and where the open type of knife switch is subject to accidental contact. The two main types of safety panels are the removable truck type and the stationary type. With the truck panels in place for operation all parts are completely enclosed and with the truck removed all its parts are absolutely dead electrically and very accessible, thus providing the maximum amount of safety for the operator. In addition to this by means of spare trucks any disabled unit can be quickly replaced. The stationary type also has no live contacts on the front of the panel, which frequently serves as the front of a cage which encloses the live parts. Some of the power-distributing panels are built like the safety type panelboard, but have much heavier switches and branch circuits. Each switch unit is usually either of the safety switch type or the special form known as the lever switch. The switches can usually be locked in the open position by means of a padlock. For application of these panels, see Switchboards, dead-front or safety first; Switchboards, truck panel type. Also see Switches, safety, miscellaneous; Switches, lever.

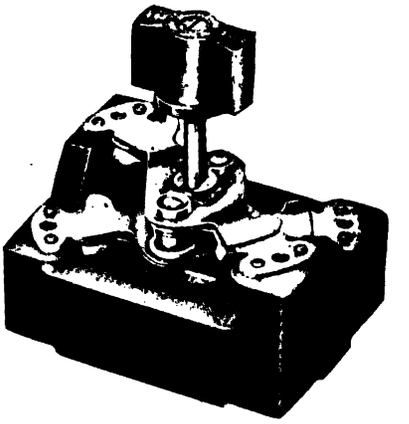
Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description of Benjamin-Starrett dead front panels under Panelboards, standard.—Adv.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W. & B. & O. R. R., Canton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y.



G-E Safety Panel

Both removable-truck and dead-front types, which see for description. Also an enclosed draw-out type panel which has a circuit breaker enclosed in a steel housing and so interlocked that the panel can be drawn out only when the breaker is in the "off" position, and cannot be replaced when the breaker is in the "on" position. When the panel is out, therefore, all apparatus mounted on it is dead and fully accessible. An oil circuit breaker mounted in a draw-out type panel, non-automatic or automatic, up to 300 amperes and 2500 volts and with or without an ammeter, provides an induction motor controlling and current indicating panel while dispensing with the usual panel and supports. (Bulletin 67105-A.) See adv. pages 1203-1223.—Adv.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp. Port Chester, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., Long Island City, N. Y. First illustration shows snap switch originated by



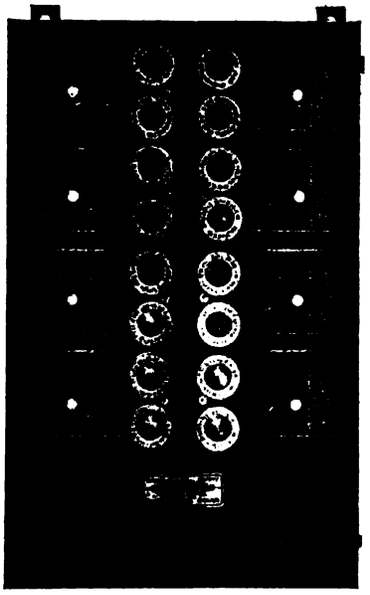
Metropolitan Snap Switch

this company. Safety panels are equipped with this snap switch made expressly for such work—rugged, large contact surfaces, positive in action and removable from face of panel. All live parts of panels are enclosed. They also manufacture all types and kinds of safety panelboards, switches, and switchboards. The second illustration shows the "NARO" panel This is type NPB only 10 ins. wide. NP is only 6 ins. wide. Simple and saves labor on installation work. Metropolitan

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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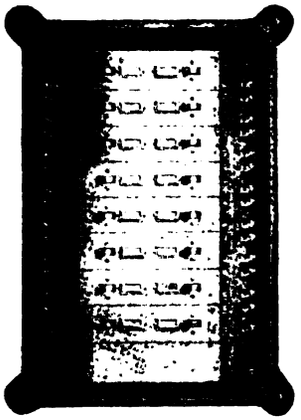
push button used. High grade throughout. Particularly adapted to work



The "Naro" Panel

where lightness, small dimensions, flexibility and safety against accident and panic are factors.—Adv.

MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., West, Detroit, Mich. A complete line of deadfront, safety-type lighting panels and cabinets, arranged for either plug or cartridge fuses, with branch push switches, or heavy 30-amp. toggle switches. The cabinets are so arranged that exposed live metal



Safety Type Lighting Panel

parts are not accessible to other than authorized persons, but access may be gained so as to permit operation of the switches without exposing the operator to dangerous live parts. For residential work, push switches are satisfactory. For public buildings and industrial plants, heavy 30-amp. toggle switches are recommended. Also see display adv. page 1285.—Adv.

PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."

PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.

Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.

Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.

Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo. (See complete descriptive information under "Panelboards, standard.")—Adv.

PANELS, TRANSFORMER. — Transformer panels are sometimes found in small substations or generating plants, especially in hydraulic power plants. They are really a modification of a line panel, except that they are used in conjunction with a small transformer, to supply the station lights or miscellaneous auxiliaries. The apparatus mounted on transformer panels is varied, depending on their use, and may contain nothing more than switches for the circuits supplied.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.

Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.

Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.

Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.

Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

Liberty Electric Corp., Port Chester, N. Y.

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.

SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv., pages 1306-1307.)

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

PANGBORN CORP.—Hagerstown, Md. Manufacturer of sand-blast equipment. President and general manager, Thomas W. Pangborn; vice-president, John C. Pangborn; secretary and treasurer, Charles L. Lane. Main office, Hagerstown, Md. Branch offices, Detroit, Mich.; Chicago, Ill.; Springfield, Mass.; Rochester, N. Y.; Philadelphia, Pa.; San Francisco, Cal.; Seattle, Wash.; Toronto, Ont., Can.

PANS, FIXTURE.—The drop lights or pendants of shower fixtures are commonly suspended from a stamped and embossed plate of brass or other fixture material frequently called a fixture pan on account of its shape. This pan may be fastened to the ceiling or suspended by chains from a canopy or plate mounted on the ceiling. Such pans are also known by the more general name of fixture plate. See Plates, fixture.

PANS, OIL DRIP, FOR MOTORS, GENERATORS, ETC.—Metal pans are frequently used to catch dripping oil and grease from motor and generator bearings. Oil dropping on floors makes them exceedingly slippery and makes walking particularly hazardous near electrical machinery; on wooden floors it also increases the fire hazard. Consequently sheet metal pans are usually placed beneath the bearings.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv., page 1257.)

Canadian Drill & Electric Box Co., 1402 Queen St., E. Toronto, Ont., Can. "C. D. & E. B."

Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.

Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PANTASOTE CO.—11 Broadway, New York, N. Y. Manufacturer of artificial leather for car curtains, etc. President, Clarence Whitman; vice-president, E. H. Outerbridge; secretary and treasurer, Raymond Harvey; sales manager, J. M. High.

PANTOGRAPHS, TROLLEY COLLECTOR.—A device utilizing the principle of the pantograph in adapting itself to variable heights of contact conductor and used as a means of collecting heavy currents at high speed and transmitting them to the moving car or locomotive. They are used in heavy and high-speed service and do not require reversal for change of direction of running. Spiral coil springs are used to maintain the pressure between the contact element of the pantograph and the overhead conductor. Lowering of the pantograph to its minimum height and raising it to operating position is accomplished by means of air pressure acting in suitable cylinders and mechanical connections. The outfit is characterized by light weight of all moving parts, so that minimum pressure is required between the current-collecting element of the pantograph and the overhead conductor to effect rapid changes in height, and maintain continuous contact at high speed. The limitations of the trolley wheel in regard to current-collecting capacity and in maintaining contact with the overhead under all conditions of speed brought about the development of the pantograph. The length of the current-collecting element, which is carried at right angles to and in direct contact with the conductor, is such that connection is maintained at all times under high-speed conditions and with maximum lateral motion of the top of the car or locomotive. These collecting elements are subject to considerable wear; they may be either of the roller or sliding type and are readily renewable.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAPER.—Paper is used extensively for electrical insulating purposes. It is made from wood pulp, plant fiber or rags, which are reduced to a thin pulp by the use of steam and chemicals combined with mechanical beaters or agitators. The pulp is then run onto a continuous fine-mesh sieve, and the fibers do not pass through but form a felt which when dried and finished is called paper. Very frequently loading matter, such as china clay or calcium sulphate, is used and a vegetable or mineral sizing solution is also applied to improve the surface. The fibers employed determine the quality and mechanical properties of the paper. Linen or manila fiber gives a tough strong paper, while wood pulp gives one that is easily torn. Insulating paper is usually treated to render it nonhygroscopic; when dry and untreated it has a dielectric strength of 4300 to 9000 volts per mm. Insulating papers are given various names, depending on the materials from which they are made and on their subsequent treatment.

PAPER, ASBESTOS.—A soft, hygroscopic material with very little mechanical strength, composed of an asbestos base and binding material, which will withstand temperatures of 250° C. without injury. It has a dielectric strength of about 4000 volts per mm. Frequently impregnating compounds are used and although they decrease the temperature range to around 100° C., the dielectric strength is increased to about 8000 volts per mm.

Manufacturers:

American Insulation Co., Roberts Ave. & Stokley St., Philadelphia, Pa.

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Franklin Mfg. Co., The, Franklin, Pa.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

Keasbey & Mattison Co., Ambler, Pa. "Ambler."

Kramig & Co., R. E., 8th St. & Eggleston Ave., Cincinnati, Ohio.

Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

Paterson Asbestos Mfg. Co., Paterson, N. J.

Robertson Co., H. H., 1st National Bank Bldg., Pittsburgh, Pa.

Standard Asbestos Co., 69 Beekman St., New York, N. Y

Union Paper & Twine Co., 125 St. Clair Ave., N. W., Cleveland, Ohio.

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Vulcan Asbestos Mfg. Co., 95 Broad St., New York, N. Y
Watson Co., H. F., Erie, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAPER, FISH AND ROPE.—Fish paper is a very tough, strong, flexible form of fiber, resembling hard fiber in appearance. It resists mechanical injury and moderate heat better than any other insulating paper known, and is used extensively for wrapping coils, etc. Fish paper is hygroscopic and is usually treated with paraffin or some similar compound. It will stand baking for a short time only and for this reason should not be used with impregnating compounds. Mica layers are frequently built up on either side to increase the dielectric strength and still give great mechanical strength. Rope paper is made from a good grade of hemp-rope stock, and because of its long fibers makes a very strong paper. It is bound together with cement or varnish and is frequently used to insulate transformer coil windings.

Manufacturers:

American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv., page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hewitt & Bros., C. B., 16-24 Ferry St., New York, N. Y. "Old Hick."
Manning Paper Co., John A., P. O. Drawer 87, Troy, N. Y. (Rope.)
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. ("Tuftex" and "Mica-Rite" rope), ("Fyberoid" and "Insulite" fish.)
National Fibre & Insulation Co., Yorklyn, Del. "Peerless."
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Rogers Paper Mfg. Co., Inc., The, 219 Hartford Rd., South Manchester, Conn.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

PAPER, FULLERBOARD AND PRESSBOARD.—Fullerboard and pressboard are made of paper clippings and cotton rags into a form similar to paper but thicker and less flexible. The product has good dielectric properties, if treated to make it nonhygroscopic, and is useful where mechanical strength is needed. The dielectric strength for dry untreated pressboard or fullerboard is about 7900 to 13,000 volts per mm., and its resistivity about 11×10^9 ohm-cm. Treating with varnish after baking improves the dielectric strength, but the best results are obtained by boiling in transformer oil, giving a strength of about 30,000 volts per mm. This makes these products valuable for use where they will be continually immersed in transformer oil. These materials are also much used for insulating the armature slots of low-voltage machines, but oil treatment is not then used.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv., page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H. 7 S. 17th St., Philadelphia, Pa.
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
GENERAL ELECTRIC CO. Schenectady, N. Y. (See adv. pages 1203-1223.)
Hewitt & Bros., C. B., 16-24 Ferry St., New York, N. Y. "Hipaco," "Adrian."
Manning Paper Co., John A., P. O. Drawer 87, Troy, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Mica-Rite."
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Rogers Paper Mfg. Co., Inc., The, 219 Hartford Rd., South Manchester, Conn.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAPER, MICA-COATED. — Various forms of insulating papers, such as fish and rope papers, pressboard, fullerboard, etc., are mica-coated by applying a cement, varnish or shellac and building up layers of thin mica scales. They are built up in a variety of ways, depending on their use and the flexibility desired. The products are heat-resisting and also have good dielectric strengths, ranging from 27,500 to 51,000 volts per mm.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Micabond." (See display adv., page 1320.)
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
English Mica Co., Spruce Pine, N. C.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.
Tar Heel Mica Co., Plumtree, N. C.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

PAPER, OILED AND PARAFFINED.—Paper, being hygroscopic, has its insulating properties considerably improved by treating it with oil or paraffin. The paper is usually heated until thoroughly dry and then boiled with oil or paraffin. The dielectric strength of oiled papers varies from 31,500 to 68,500 volts per mm.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Hewitt & Bros., C. B., 16-24 Ferry St., New York, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y. "Empire."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Standard Insulation Co., Rutherford, N. J. "Sico."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAPER SHADES.—See Shades, parchment, paper and celluloid.

PAPER SLEEVES.—See Sleeves, paper, for cable conductors.

PAPER, SPECIAL AND MISCELLANEOUS INSULATING.—Papers treated with various impregnating compounds, such as oxidized linseed oil and asphalt, or oil and gum-base varnish, etc., are made for special purposes. Cement papers are made by using a cementing varnish or binder. Others are made more flexible by using a rubber compound as a binder, and in conjunction with mica or asbestos.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Certain-Teed Products Corp., St. Louis, Mo.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F," "Glassine."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hard Fibre & Insulation Corp., 96-104 Spring St., New York, N. Y.
Hewitt & Bros., C. B., 16-24 Ferry St., New York, N. Y.
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. Irvington varnished paper is used extensively for coil windings, magnetos, etc., where high insulating qualities and limited space are the controlling factors. It is also used very largely for electrical condensers and in making punched condenser films. The product has been developed to take the place of mica in work of this character. The paper is specially made for the purpose, being of the finest quality obtainable, the entire output of certain mills being taken. This insures uniformity of the product. The amount of paper insulation now being used in electrical work of this character is indicated by the fact that a single magneto manufacturer consumes seven tons monthly. See display adv. page 1319 for all Irvington electrical products.—Adv.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Keystone Fibre Co., Yorklyn, Del.
Lehon Co., The, W. 44th St. & Oakley Ave., Chicago, Ill.
Manning Paper Co., John A., P. O. Drawer 87, Troy, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Rogers Paper Mfg. Co., Inc., The, 219 Hartford Rd., South Manchester, Conn.
Standard Insulation Co., Rutherford, N. J. "Sisco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PAPER TAPE.—Paper tapes are cut from many of the oiled, paraffined or otherwise treated and built-up papers, and are used extensively in the manufacture of paper-insulated cables for both power and telephone or telegraph service.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. See "Paper, Special and Miscellaneous Insulating." Also display adv. page 1319 for all Irvington electrical products.—Adv.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Standard Insulation Co., Rutherford, N. J. "Sisco."

PAPERS, ELECTRICAL WEEKLY AND MONTHLY.—See Periodicals, electrical for a complete list of American and Canadian electrical papers having a general circulation.

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PARA-STEEL.—Trade name for porcelain enameled reflector manufactured by the Wheeler Reflector Co., 156 Pearl St., Boston, Mass.

PARABOLIC REFLECTOR.—A form of reflector extensively used for headlights, spotlights and searchlights because, when the source of light is placed at a certain point on the axis, known as the focus, the reflected rays of light will be sent out in parallel lines. It derives its name from the fact that it corresponds in shape to the surface described by a parabola revolved on its axis. See Reflector.

PARAC.—Trade name for rubber-covered wire and cable manufactured by the Phillips Wire Co., Pawtucket, R. I.

PARACORE.—Trade name for rubber covered wire manufactured by the National India Rubber Co., Bristol, R. I.

PARADOX.—Trade name for reamers made by the Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio.

PARAFFIN.—Paraffin is obtained chiefly by the distillation of oil, but can also be produced by distillation of coal or wood. It consists of a mixture of hydrocarbons, and is a white or nearly colorless wax-like substance. It is not affected by most acids or alkalies. It melts at from 45 to 80° C. Paraffin is a good insulator, having a resistivity of 10^{15} to 10^{19} ohm-cm., and a dielectric strength of about 11,800 volts per mm. It is used for impregnating resistance coils of low current capacity to exclude moisture, sometimes also as a filling or sealing material, but more generally for impregnating and treating papers, fabrics and storage-battery boxes and trays to render them impervious to moisture and acids. It also forms an ingredient of many filling, sealing and impregnating compounds.

Manufacturers:

American Oil Corp. 172 S. Water St., Jackson, Mich. "American," "Amoil-co," "Amoco."
Emlenton Refining Co., Emlenton, Pa.
Emery Mfg. Co., Bradford, Pa. "Emery."
Pennsylvania Paraffine Works, Titusville, Pa.
Pierce Oil Corp., 25 Broad St., New York, N. Y.
Pure Oil Co., Columbus, Ohio.
Roebling's Sons Co., John A., Trenton, N. J.
Sinclair Refining Co., Conway Bldg., Chicago, Ill. "Sinclair."
Strohmeyer & Arpe Co., 139-141 Franklin St., New York, N. Y. "Montan," "Ozokerite," "Carnauba."
Tidewater Oil Co., 11 Broadway, New York, N. Y.

PARAFFIN, TO BOIL OUT IN.—To hold something in a bath of liquid paraffin until the water is all boiled out. The paraffin does not boil, but is hotter than 100° C. (212°F.). This treatment is often given to resistance coils for resistance boxes, other coils, condensers, wood parts, such as storage battery trays, etc. The paraffin fills all the pores and crevices and prevents the entry of moisture.

PARAFFINED PAPER.—See Paper, oiled and paraffined.

PARAGON.—Trade name for electrical toys, novelties, battery motors, etc., manufactured by the Adams-Morgan Co., Alvin Place, Upper Montclair, N. J.

PARAGON.—Trade name for lighting reflector manufactured by the American Reflector & Lighting Co., 100-104 S. Jefferson St., Chicago, Ill.

PARAGON.—Trade name for die stocks manufactured by the S. W. Card Mfg. Co., Mansfield, Mass.

PARAGON.—Trade name for radio receivers manufactured by the Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.

PARAGON.—Trade name for twist drills made by the Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio.

PARAGON.—Trade name for grounding devices, battery boxes, time switches and insulators manufactured by the Paragon Electric Co., Old Colony Bldg., Chicago, Ill.

PARAGON.—Trade name for soldering paste, fluid and salts manufactured by the Paragon Insulating Co., 5716 Euclid Ave., Cleveland, Ohio.

PARAGON.—Trade name for graphite and graphite products made by George F. Pettinos, Real Estate Trust Bldg., Philadelphia, Pa.

PARAGON ELECTRIC CO.—Chicago, Ill. Manufacturer of grounding devices, battery boxes, time switches and insulators. President, E. M. Platt; secretary, E. V. Platt. Main office, Old Colony Bldg., Chicago, Ill. Factory, Manitowoc, Wis. Branch offices, 911 Western Ave., Seattle, Wash.; 86 3rd St., San Francisco, Cal.; 253 Broadway, Los Angeles, Cal.

PARAGON INSULATING CO., THE.—5716 Euclid Ave., Cleveland, Ohio. Manufacturer of soldering fluid. Business established 1895. President, E. B. Meriam; general manager, Al Ascher.

PARALINE.—Trade name for attachment plug cap manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

PARALLEL.—Connected in branches of a circuit so that the combined circuit current is the sum of the currents in the branches. The branches are called parallel or multiple or shunt branches. Parallel connections are contrasted with series connections. In the former the total curren divides among the branches; in the latter all the current passes through all the parts of the circuit in succession.

PARALLEL-SERIES. — See Series-multiple or series-parallel.

PARALLEL WINDING.—A type of armature winding, also called lap winding, particularly suitable to large machines. See Armature winding. Also see Lap winding.

PARAMAGNETIC BODIES. — Those whose permeability is greater than unity (that of air) but less than that of iron. Cobalt and nickel are examples. Also see Permeability.

PARAMOUNT.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

PARANITE.—Trade name for wire and cables manufactured by the Indiana Rubber & Insulated Wire Co., Jonesboro, Ind.

PARAXEL.—Trade name for rubber-covered wires and cables manufactured by the Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y.

PARCH-O-LITE CO.—74 E. Roosevelt Rd., Chicago, Ill. Manufacturer of portable electric lamps and lamp shades. Business established 1919. President and general manager, Oscar Reinhold; secretary and treasurer, L. K. Rosenfeld.

PARDEL CORP.—Philadelphia, Pa. Manufacturer of water-tube boilers and superheaters. President, John Clinton Parker; vice-president, S. C. Delamater; treasurer, Bernard Dieckhaus; secretary, William C. Wells, Jr.; general manager, Edgar Cockroft; sales manager, E. C. Rolfe. Main office, Bailey Bldg., Philadelphia, Pa. Branch office, 1270 Broadway, New York, N. Y.

PARERS AND PEELERS, VEGETABLE AND FRUIT, MOTOR-DRIVEN.—These are machines which do not literally peel the vegetables or fruits, but accomplish the same result with much less waste by paring or abrasion. The vegetables are placed within a cylinder which is rotated by a motor driving through shaft and belting or gears, the abrasion process taking place by rolling within the roughened inner surface of the cylinder. Such vegetables as potatoes, carrots and turnips are effectively pared in these machines. Apples of certain kinds may also be treated in this manner so as to be as well prepared as by ordinary peeling.

Manufacturers:

American Machinery Co., Inc., 330 N. 12th St., Philadelphia, Pa. "American."
Anstice & Co., Inc., Josiah, Rochester, N. Y. "Sterling."
Blakeslee & Co., G. S., Cicero, Ill. "Blakeslee."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Maxim Mfg. Co., 700 W. 22nd St., Chicago, Ill. "Sinteelo."
Redmon, Edgar & Redmon, 218 S. 1st St., W., Cedar Rapids, Iowa. "EZ-Way."
Sprague Canning Machinery Co., 222 N. Wabash Ave., Chicago, Ill.
Stearnes Co., 133 W. Lake St., Chicago, Ill.

PARIAN.—Trade name for illuminating glassware manufactured by the Gill Bros. Co., 627 Franklin Ave., Steubenville, Ohio.

PARISIAN.—Trade name for electric heating appliances manufactured by the William E. Slaughter Co., 1716 S. Michigan Ave., Chicago, Ill.

PARISIENNE LAMP & SHADE CO.—1220 W. 6th St., Cleveland, Ohio. Manufacturer of portable electric lamps and lamp shades.

PARK AND SUBURBAN CABLE.—See Cable, park and suburban.

PARK FALLS LUMBER CO.—Park Falls, Wis. Producer of cedar poles, posts, railway ties and insulating lumber. Business established 1914. President, Edward Hines; vice-president, L. L. Barth; secretary, C. F. Wiehe; treasurer, E. H. Thomas; general manager, W. B. Clubine; sales manager, W. H. Bundy. Main office Park Falls, Wis. Branch offices, Hayward, Wis.; Rice Lake, Wis. Sales representative, H. S. Dewey, 1324 Otis Bldg., Chicago, Ill. (Exclusive distributor, Edward Hines Lumber Co., 2431 S. Lincoln St., Chicago, Ill.)

PARKER.—Trade name for water-tube boilers and superheaters manufactured by the Pardel Corp., Bailey Bldg., Philadelphia, Pa.

PARKER & SON, J. H.—Parkersburg, W. Va. Manufacturers of porcelain and other insulations. President, J. H. Parker; secretary and treasurer, W. M. Parker. Main office, Parkersburg, W. Va. Branch offices, Boston, Mass.; Chicago, Ill.; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; St. Louis, Mo.; New York, N. Y.

PARKER CO., THE CHARLES.—Meriden, Conn. Manufacturer of electric lighting fixtures, portable lamps, wood screws, etc. Business established 1832. President, D. W. Parker; vice-president, W. F. Parker; secretary, treasurer and general manager, W. H. Lyon; sales manager, C. L. Lyon. Main office and factory, 48 Elm St., Meriden, Conn. Branch office, 25 Murray St., New York, N. Y.

PARKER, C. W.—Leavenworth, Kans. Manufacturer of electrical amusement devices and decorative lighting specialties. Business established 1892.

PARKER PROCESS.—Trade name for rust preventives made by the Parker Rust-Proof Co., 623-45 Milwaukee Ave., Detroit, Mich.

PARKER RUST-PROOF CO.—623-645 Milwaukee Ave., Detroit, Mich. Manufacturer of rust preventives. Business established, 1915. President and general manager, George E. Lane; secretary and treasurer, W. M. Cornelius.

PARKER SUPPLY CO., INC.—781 E. 135th St., New York, N. Y. Manufacturer of screws.

PARKER WHITE METAL & MACHINE CO.—South Erie, Pa. Manufacturer of metal castings, magneto parts, etc.

PARKESBURG IRON CO.—Beale Bldg., Parkesburg, Pa. Manufacturer of boiler tubes.

PARKIN MFG. CO.—San Rafael, Cal. Manufacturer of molded insulation and dies therefor, instrument dials, radio instruments, etc. Business established 1919. General manager, John Parkin, Jr.

PARTRICK & WILKINS CO.—51 N. 7th St., Philadelphia, Pa. Manufacturer of annunciators, alarms, and electrical house goods. Business established 1867. President and general manager, E. Ward Wilkins; vice-president and treasurer, Frank G. Buckley; secretary and sales manager, Warren W. Wilkins.

PARTRIDGE LUMBER CO., T. M.—729-732 Lumber Exchange, Minneapolis, Minn. Producer of cedar poles, posts and railway ties. Business established 1901. President, T. M. Partridge; secretary and treasurer, H. F. Partridge; sales manager, W. M. Wattson.

PASS & SEYMOUR, INC.—Solvay Station, Syracuse, N. Y. Manufacturer of electrical wiring devices. Business established 1890. President, B. E. Salisbury; secretary and treasurer, J. W. Brooks; general sales manager, E. W. Kendall. Factory, Solvay, N. Y. Branch offices and warehouses, 6 Church St., New York, N. Y.; 700 W. Jackson Blvd., Chicago, Ill. District offices, Boston, Mass.; Philadelphia, Pa.

PASSING A TELEPHONE CALL.—The act of the "A" operator in telling the "B" operator the desired number, and of the "B" operator in assigning the trunk and taking charge of her end of the call. Calls

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are usually passed over an order wire. The term is also applied to the passing of calls between toll operators in which case it is usually done over the toll line itself, if a "ticket" wire is not available.

PASSIVITY.—A condition or state of a metal in which it becomes chemically nearly inactive. Ordinary iron, for instance, dissolves in cold nitric acid, precipitates copper from copper solutions, etc., but if first dipped into concentrated nitric acid or hydrogen peroxide, it loses this chemical activity and is inactive in those liquids. Scratching or rubbing the surface removes the passivity. Cobalt, nickel, chromium and bismuth also show passivity when suitably treated.

PASSMOUR.—Trade name for socket manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

PASTE, SOLDERING.—See Soldering compounds or flux.

PASTED PLATES.—The generally used type of lead storage-battery plates. Also called Faure plates; see Faure plates.

PASTEURIZERS, ELECTRIC, MILK.—Pasteurization is a process developed by the French bacteriologist, Pasteur, to check the fermentation of milk by exposing the fluid to a temperature of 55° to 70° C. The apparatus used in this process is essentially a large tank containing the milk, and a helical heating coil which is rotated through the milk, maintaining a uniform temperature throughout the tank during the process. The coil is connected to a hollow shaft which is rotated by an electric motor.

Manufacturers:

Burrell & Co., Inc., D. H., Little Falls, N. Y. "Simplex."
Cherry Co., J. G., Cedar Rapids, Iowa.
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Wizard."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.
Electropure Co., The, 53 W. Jackson Blvd., Chicago, Ill. "Electropurifier."

PATENTS, DESIGN.—Design patents in the United States are governmental grants, each awarding the originator of an ornamental design for an article of manufacture the exclusive right to manufacture such articles during a specified period. This period, at the option of the applicant, may be 3½, 7 or 14 years, but cannot be extended, nor can a design patent be renewed. Such patents relate only to the ornamental appearance and not to structural features, it being assumed that the latter would be protected by regular patents, sometimes referred to as structural or mechanical patents.

However, the general appearance of an object or of a part of the same may be quite distinctive even when its construction is not so novel as to warrant the patenting of the same and, if it is also ornamental, a design patent may be used to guard against imitations.

For this latter reason, the issuing of design patents on objects or parts of objects connected with the electrical industries has not been limited to those which were obviously designed for artistic effect. Thus, battery connectors, insulators, socket handles, switch bases, conduit fittings and telephone receiver parts have been subjects of design patents, although such patents are much more numerous as relating to lighting fixtures. Even with these, only some 7 or 8% of the issuing design patents relate to electrical devices.

PATENTS OR LETTERS PATENT.—The term "Letters Patent" means a governmental grant awarding the inventor (or his assignee or licensees) the exclusive right to manufacture, sell and use a new and useful invention. In the United States a patent runs for 17 years and cannot be renewed or extended, but serious omissions or errors, if promptly noticed, can be corrected by a reissue patent. Unauthorized reproduction or use of a patented invention (even if only for one's own use) can be enjoined through the Federal courts, who may also assess damages on the infringer.

Only one invention can be covered by a single patent unless the several inventions are so related to each other that they cannot be separated and employed independently of each other. Hence separate patents are usually required to protect a new composition of matter (such as the formula for a new high-resistance alloy), a new method of manufacture (such as the particular mixing temperatures and steps involved in the alloying), and a new apparatus for expediting such alloying or for drawing the resulting product into the form of a wire. Ordinary patents are not concerned with the shape or ornamental appearance of objects, the latter being protected by design patents, if sufficiently novel.

To guard against granting such a monopoly on features which are not novel, every patent application is examined in the United States Patent Office, which is conducted under civil service rules under the Department of the Interior. Its earnings from the statutory fees long ago made the Patent Office self-supporting, but approval of Congress is required for any increase in equipment, personnel or salaries, and the lack of such approval has been handicapping the Patent Office for years. Applications for patents are distributed according to their subject matter among 48 different divisions of the Patent Office, those relating to the electrical industries being mostly in 9 different divisions, four of which are devoted entirely to electrical patent applications. The issued patents (both United States and foreign) are classified under 20 general classes and over 14 subclasses to expedite the searching both for the examiners of the Patent Office and for attorneys seeking information for their business clients.

However, while providing for an examination of patent applications with such a degree of thoroughness as the co-operation of Congress will permit, the Patent Office does not guarantee the validity of any issued patent, but merely issues it in the belief that its "claims" recite strictly novel features. To be considered novel, the subject matter must not have been previously devised by some one else, nor have been in public use or on sale or disclosed in any publication more than two years before the filing of the application. To be valid, the patent must be in the name of the actual inventor (who may be male or female, adult or minor, citizen or foreign); or of the joint inventors, if two or more jointly thought out the presented invention. Unless hired to do inventing or otherwise bound by a contract, an employee usually owns the inventions made by him, but particular circumstances (such as his using the employer's time or material in making or testing the invention) may give the latter a so-called "shop right" which is a nonexclusive license to manufacture and sell the invention.

United States patents afford no protection to their holders in other countries, but the so-called "International Union" agreements give the American inventor priority over others for a year from his filing date in this country for filing corresponding patent applications in other countries.

No holder of a United States patent is required to manufacture or operate under the same, but he must mark the patent date (or number) on what is produced under his patent and must stop infringers, otherwise his monopoly lapses.

Since patents are virtually fences designed to bar piracy, their value depends on the earnings safeguarded by them and they may be listed definitely among the owner's assets, or included under the general head of "good will," and may have capital stock issued in payment for them. Formerly, the valuation of patent rights among the assets of electrical concerns varied greatly, some ignoring them entirely while others assigned high values. Thus in 1918, patents were entered on the books of the General Electric Co. for $66,548; of the Union Switch & Signal Co. for $1,000,000; Burke Electric Co., $506,636; Canadian General Electric Co., $1; Fairbanks Co., $2500; and the Telautograph Co., $1,520,083. Now definite rules have been issued by the Internal Revenue Bureau in connection with Income Tax calculations for valuing patents and for depreciating the same, and these may lead to more uniform accounting.

Of the 1,364,000 United States patents issued prior to 1921, about 85% were issued since 1877, so that real activity in the granting of patents has been contemporaneous with electrical progress. However, the proportion of electrical patents has not materially changed during the past 30 years, so that while from 5 to 10% of the approximately 700 patents issued every week may include electrical features, only about half that proportion relate directly to the electrical industries.

PATERSON ASBESTOS MFG. CO.—Paterson, N. J. Manufacturer of asbestos paper and other asbestos products.

PATERSON-SARGENT CO.—Cleveland, Ohio. Manufacturer of insulating paints and varnishes.

PATHE FRERES PHONOGRAPH CO.—20 Grand Ave., Brooklyn, N. Y. Manufacturer of electrically operated phonographs. President and general manager, E. W. Widmann.

PATHESCOPE CO. OF AMERICA, INC.—Aeolian Hall, New York, N. Y. Manufacturer of motor-driven motion-picture machines.

PATHFINDER.—Trade name for tungsten lamps manufactured by the Bettalyte Incandescent Lamp Co., Inc., 366-372 W. 15th St., New York, N. Y.

PATHFINDER.—Trade name for flashlights manufactured by the International Battery Co., 453-455 Broome St., New York, N. Y.

PATTEN CO., PAUL B.—Salem, Mass. Manufacturer of railroad ticket destroyer.

PATTERSON.—Trade name for floor outlet boxes, receptacles and tank float indicators manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

PATTERSON-BERRYMAN.—Trade name for feed water heaters and purifiers manufactured by the Patterson-Kelley Co., Inc., 28 Cortlandt St., New York, N. Y.

PATTERSON-KELLEY CO., INC., THE.—28 Cortlandt St., New York, N. Y. Manufacturer of feed water heaters and purifiers.

PATTERSON SCREEN CO., THE.—625 Main St., Towanda, Pa. Manufacturer of X-ray fluoroscopes. Business established 1916. Partnership, Carl V. S. Patterson and Frederic W. Reuter.

PATTON-MAC GUYER CO.—31 Mathewson St., Providence, R. I. Manufacturer of fuse parts, cable lugs, terminals, screw shells, and brass and copper stampings. Business established 1900. President, Ralph C. Patton; vice-president, Charles L. Patton; secretary and treasurer, Herman F. MacGuyer.

PATTON PAINT CO.—Milwaukee, Wis. Manufacturer of insulating paints. Factories, Milwaukee, Wis.; Newark, N. J.

PAUL.—Trade name for electric water pumping systems manufactured by the Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.

PAUL UNIPIVOT.—Trade name for galvanometer manufactured by the Rawson Electrical Instrument Co., 4 Norfolk St., Cambridge, Mass.

PAULDING, INC., J. I.—New Bedford, Mass. Manufacturer of wiring devices. Factory, Acushnet, Mass.

PAULERO.—Trade name for electrically operated calking tools manufactured by the Electric Tool Mfg. Co., Petersburg, Va.

PAULING PROCESS.—An arc process for the fixation of atmospheric nitrogen. The two electrodes for carrying the arcs are close together at the bottom and separated at the top. A high-tension alternating current is applied to the electrodes, with a sufficiently high voltage to force an arc across the narrow gap at the bottom. This arc is then carried up along the diverging electrodes by a blast of air from below, to be immediately superseded by another arc. In this way a rapid series of arcs is maintained. A furnace carrying sets of electrodes uses 400 to 600 kw. and the gases contain 1 to 1.5% nitrous oxide, with yields of 60 to 70 grams of nitric acid per kilowatt-hour.

PAVING MATERIALS, STREET CAR TRACK.—When car tracks lie in public highways, as is frequently the case with street-railway tracks, it is generally necessary that they be paved in order to facilitate the movement of vehicular traffic. On new permanent heavy construction where the vehicular traffic is heavy, dressed granite on a concrete foundation with grouted joints will generally be found most satisfactory. On light construction or on old track where vehicular traffic is light other forms of paving can be used, such as brick, creosote block, concrete, asphalt and in some cases macadam.

Manufacturers:

Barrett Co., The, 17 Battery Pl., New York, N. Y.
Compressed Wood Preserving Co., Winton Bank Bldg., Cincinnati, Ohio.
International Creosoting & Construction Co., Galveston, Tex.
International Steel Tie Co., The, 16702 Waterloo Rd., Cleveland, Ohio.

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PAWLING & HARNISCHFEGER CO.—Milwaukee, Wis. Manufacturer of electric cranes, hoists and excavators. Business established 1884. President and treasurer, H. Harnischfeger; vice-president and general manager, A. G. Henricks; secretary, M. J. Yocom; sales manager, B. Van Horn. Main office, 38th & National Aves., Milwaukee, Wis.. Branch offices, 50 Church St., New York, N. Y.; Stephen Girard Bldg., Philadelphia, Pa.; Whitney Central Bldg., New Orleans, La.; Fidelity Bldg., Pittsburgh, Pa.; Monadnock Block, Chicago, Ill.; Yeon Bldg., Portland, Ore.; Central Bldg., Los Angeles, Cal.; Monadnock Bldg., San Francisco, Cal.; L. C. Smith Bldg., Seattle, Wash.

PAWTUCKET MFG. CO.—327 Pine St., Pawtucket, R. I. Manufacturer of bolts, lag screws and nuts.

PAWTUCKET SCREW CO.—Pawtucket, R. I. Manufacturer of bolts, screws and rivets. Business established 1910.

PAXTON & VIERLING IRON WORKS.—Omaha, Neb. Manufacturer of tank alarms, annunciators and street lamp posts. Prcsident, A. J. Vierling; secretary, F. R. Vierling. Main office and factory, Omaha, Neb. Branch office, Vierling Steel Works, 23rd St. & Stewart Ave., Chicago, Ill.

PAY-AS-YOU-ENTER CAR.—A type of electric street or interurban car, which has become very popular in recent years, and which provides for the collection of fares as the passenger enters the car. Its principal advantages are that it permits the conductor to be at the car entrance continually, thus guarding against accidents to passengers entering or alighting; permits him to handle crowds better and more quickly; and avoids disputes and loss of fares as sometimes occur under the old system. There are several types of the P-A-Y-E car, some having the entrance at the rear and exit at the front, others both entrance and exit at the middle, and others at the front, or combinations of these types. A further modification gives the "one-man" car in which the entrance and exit are at the front and the motorman acts also as conductor; this type is used on lines with relatively light traffic, especially in small cities and towns; it is sometimes called the "safety" car.

PAY STATION.—This is an installed telephone instrument for the use of the general public upon the payment of fees. If the telephone is equipped with a coin box, it is called an unattended pay station. For large places there is often an attendant to answer questions, collect fees, and switch calls. Also see Coin collectors, telephone station and toll.

P-A-Y-E.—Abbreviation for pay-as-you-enter car, a type much used on electric street railways.

PAYOUT REELS.—See Reels, payout and takeup.

P. D.—Abbreviation for potential difference or potential drop.

P. D.—Trade name for electric dishwashers and knife cleaning machines manufactured by the Hamilton-Low Co., Jersey City, N. J.

P. D. Q.—Trade name for electric dishwashers manufactured by the Dow Mfg. Co., Braintree, Mass.

PEACOCK.—Trade name for brakes for electric railway cars made by the National Brake Co., Inc., 888 Ellicott Sq., Buffalo, N. Y.

PEACOCK STAFFLESS.—Trade name for brakes for electric railway cars made by the National Brake Co., Inc., 888 Ellicott Sq., Buffalo, N. Y.

PEAK LOAD.—The highest load during a particular period of time, most commonly a day. If the load in kilowatts, or other suitable power units, of a generating station or system or of a consumer is plotted as to time, giving a so-called load curve, the peak load appears like a mountain peak on a profile of a mountainous district. Although peak loads refer most commonly to electric light and power loads of central stations, they may also refer to the high traffic loads of electric railways, telephone and telegraph companies, electrochemical plants, industrial plants, etc. See Load curves.

PEARCE.—Trade name for sleevings, tapes and webbings manufactured by the R. T. Pearce Co., Inc., 12-16 E. Pike St., Covington, Ky.

PEARCE CO., INC., THE R. T.—12-16 E. Pike St., Covington, Ky. Manufacturer of sleevings, tapes and webbings. Business established 1914. President and general manager, R. T. Pearce; vice-president, J. A. La Boiteaux; secretary and treasurer, W. H. Pearce; sales manager, William E. Richards.

PEARL.—Trade name for polishing wheels manufactured by the Eastern Felt Co., Winchester, Mass.

PEARLMAN & CO., VICTOR S.—533 Wabash Ave., Chicago, Ill. Manufacturers of lighting fixtures.

PEASE.—Trade name for belt dressing manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

REASE CO., THE C. F.—Chicago, Ill. Manufacturer of electric blueprint machinery and drafting room supplies. Business established 1908. President and general manager, C. F. Pease; vice-president and sales manager, P. M. Morgan; secretary, Oscar O. Mertz; treasurer, Thomas Lord. Main office and factory, 829 N. Franklin St., Chicago, Ill. Branch offices, Grand Central Palace, New York, N. Y.; 934 Schofield Bldg., Cleveland, Ohio; 414 Dallas County State Bank Bldg., Dallas, Tex. Sales representatives, W. P. Balderson Co., Mills Bldg., San Francisco, Cal.; Charles E. Barteau, L. C. Smith Bldg., Seattle, Wash.

PEAVEYS, POLE HANDLING.—A tool used for handling poles in line construction and in pole storage yards. The tool is exactly like a canthook except that the blunt end of that tool is replaced by a sharp pointed spike in the peavey.

Manufacturers:

Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)
Warren Axe & Tool Co., Warren, Pa.

PECHSTEIN IRON WORKS.—Box 344, Keokuk, Iowa. Manufacturers of manhole covers and frames and boiler grates. President and general manager, Paul T. Pechstein; vice-president, G. R. Hombs; secretary and treasurer, T. T. Meyling

PECK.—Trade name for bucket type coal and ash conveyor manufactured by the Link-Belt Co., 329 W. 39th St., Chicago, Ill.

PECK, STOW & WILCOX CO., THE.—Southington, Conn. Manufacturer of electricians' and machinists' tools. Business established 1819. President, L. E. Fichthorn; vice-president, T. J. Ray; secretary, Frank Taylor; treasurer, E. N. Walkley. Main office, Southington, Conn. Factories, Southington, Conn.; Cleveland, Ohio. Branch offices, Cleveland, Ohio; 46 W. Broadway, New York, N. Y.

PECK'S.—Trade name for electricians' bit braces manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

PECO.—Trade name for small motors manufactured by the Persons Electric Co., 506 Jersey St., Quincy, Ill.

PECO.—Trade name for motor-driven churns, ice-cream freezers and other electrical specialities manufactured by the Piedmont Electric Co., Electrical Bldg., Asheville, N. C.

PEDESTAL. LAMP.—The base supporting the upright standard or shaft of a floor lamp or outdoor lighting standard or post. The term pedestal is also used loosely to designate any ornamental rigid post complete, especially one that has a rather massive base merged into the standard, such as is used for indoor indirect lighting or for direct lighting at the entrance to buildings. See Bases and pedestals, floor lamp; Pedestals, ornamental lighting.

PEDESTALS, INSTRUMENT. — Instrument pedestals are used whenever it is desirable to mount certain instruments in a central location in a power plant rather than to provide a separate instrument switchboard. They permit a very convenient and ornamental mounting for instruments and may be located so as not to obstruct the general view of the turbine or engine-room floor. All the wiring for the instruments is contained in the post. The posts are sometimes used to form a support for the railing of an operating gallery. The instruments may be arranged in various groupings. The pedestals are made to hold standard types of switchboard instruments.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PEDESTALS, ORNAMENTAL LIGHTING.—These are ornamental pedestals on which are mounted some form of lamp or group of lamps constituting a complete lighting unit. One of the more common types of unit is an inverted shallow bowl equipped with reflectors for indirect illumination. The same material as is used in the column is commonly used for the bowl, though ornamental glass bowls are sometimes used, particularly with the metal and wooden pedestals. The pedestal is made of such materials as marble, wood and various metals such as bronze and iron which may be wrought or cast into ornamental designs. These pedestals are used in such rooms as lobbies, reception halls and dining rooms in notels, theaters, churches, club houses, etc. In some cases the bowl is more nearly urn or vase-shaped and has flowers or green plants trailing over the edges so as to almost disguise the real purpose of the unit. Ornamental iron, bronze, marble and other pedestals are also used for diffuse direct lighting in large rooms. At the entrances to imposing buildings they are occasionally used, in this case being of weather-proof type.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Fremont Foundry & Machine Co., Fremont, Nebr.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Keystone Iron & Steel Works, 2931 Santa Fe Ave., Los Angeles, Cal.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Pedestals for indirect lighting to harmonize with any architectural detail. See adv. page 1405.—Adv.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PEELERS, FRUIT.—See Parers and peelers, vegetable and fruit, motor-driven.

PEERBLOW MFG. CO.—Leetsdale, Pa. Manufacturer of gasoline torches.

PEERLESS.—Trade name for soldering paste and flux manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

PEERLESS.—Trade name for reamers made by the Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio.

PEERLESS.—Trade name for battery box enamels manufactured by the Columbus Varnish Co., 264 Cozzins St., Columbus, Ohio.

PEERLESS.—Trade name for monsonized and purple electrical slate used for switch bases, panelboards and switchboards, produced by the Davis Slate & Mfg. Co., 610-618 E. 40th St., Chicago, Ill.

PEERLESS.—Trade name for electric phonograph motors manufactured by the Electric Phonograph Corp., 4132 Park Ave., New York, N. Y.

PEERLESS.—Trade name for transformers manufactured by the Enterprise Electric Co., Warren, Ohio.

PEERLESS.—Trade name for battery clips made by Charles F. Hartung, 802 Higgins Bldg., Los Angeles, Cal.

PEERLESS.—Trade name for insulated wire manufactured by the Indiana Rubber & Insulated Wire Co., Jonesboro, Ind.

PEERLESS.—Trade name for power transmission chains manufactured by the Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.

PEERLESS.—Trade name for armature skeleton bells manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

PEERLESS.—Trade name for projecting arc lamp compensators manufactured by the J. E. McAuley Mfg. Co., 30 N. Jefferson St., Chicago, Ill.

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PEERLESS.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

PEERLESS.—Trade name for lamp guard manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

PEERLESS.—Trade name for insulating paper manufactured by the National Fibre & Insulation Co., Yorklyn, Del.

PEERLESS.—Trade name for mica and mica products manufactured by the New England Mica Co., Waltham 54, Mass.

PEERLESS.—Trade name for automobile jacks manufactured by the Oliver Mfg. Co., 326 S. Desplaines St., Chicago, Ill.

PEERLESS.—Trade name for blueprinting, washing and drying machines, carbons and globes manufactured by the C. F. Pease Co., 829 N. Franklin St., Chicago, Ill.

PEERLESS.—Trade name for incandescent lamps manufactured by the Peerless Brilliant Lamp Division, National Lamp Works of General Electric Co, Warren, Ohio.

PEERLESS.—Trade name for electric fans, motors and generators manufactured by the Peerless Electric Co., Warren, Ohio.

PEERLESS.—Trade name for motor-driven armature repairing machines manufactured by the Peerless Equipment Co., Hanover, Pa.

PEERLESS.—Trade name for motor-driven ice-cream freezers manufactured by the Peerless Freezer Co., Winchendon, Mass.

PEERLESS.—Trade name for electric refrigerators and refrigerating machines manufactured by the Peerless Ice Machine Co., 503 S. Jefferson St., Chicago, Ill.

PEERLESS.—Trade name for flashlights and flashlight batteries manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

PEERLESS.—Trade name for soot cleaners manufactured by the William B. Pierce Co., 45 N. Division St., Buffalo, N. Y.

PEERLESS.—Trade name for electrical testing and other scientific instruments manufactured by the Thompson-Levering Co., 327 Arch St., Philadelphia, Pa.

PEERLESS.—Trade name for adjustable wrenches manufactured by J. H. Williams & Co., 187 Vulcan St., Buffalo, N. Y.

PEERLESS BELTING CO.—Gardenville, N. Y. Manufacturer of belting. President, E. F. Gingras; secretary and treasurer, E. J. Ballard. Main office and factory, Gardenville, N. Y. Branch office, 9 S. Clinton St., Chicago, Ill.

PEERLESS BRILLIANT LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Warren, Ohio. Manufacturer of incandescent lamps. E. E. Nash, general manager.

PEERLESS ELECTRIC CO.—Warren, Ohio. Manufacturer of electric fans, motors and generators. President, G. H. Jones; vice-president and treasurer, W. C. Ward; secretary, C. R. Siegfried; sales manager, J. E. Goding. Sales representatives, J. E. Hoffman, 280 Caroling St., Buffalo, N. Y.; Electrical Machinery Sales Co., 327 S. LaSalle St., Chicago, Ill.; L. B. Gottschall, 2002½ Live Oak St., Dallas, Tex.; C. O. Hall, 147 W. 35th St., New York, N. Y.; F. Bissell Co., Toledo, Ohio; L. M. Sperry, 910 Pine St., St. Louis, Mo.; Garland Affolter Engineering Co., Rialto Bldg., San Francisco, Cal.

PEERLESS EQUIPMENT CO.—Hanover, Pa. Manufacturer of motor-driven machinery. Sales representative, Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa.

PEERLESS FREEZER CO., THE.—Winchendon, Mass. Manufacturer of motor-driven ice-cream freezers. Sales representative, J. C. McCarty & Co., 29 Murray St., New York, N. Y.

PEERLESS ICE MACHINE CO., THE.—503 S. Jefferson St., Chicago, Ill. Manufacturer of electric refrigerators and refrigerating machines. Business established 1912. President, Charles C. Kritzer; vice-president, Henry E. Kritzer; secretary, R. W. Kritzer; treasurer, C. C. Kritzer.

PEERLESS INSULATED WIRE & CABLE CO.—90 West St., New York, N. Y. Manufacturer of weatherproof wire. President, W. E. Cook; sales manager, B. S. Stewart. Factory, Pennington, N. J.

PEERLESS LIGHT CO.—Chicago, Ill. Manufacturer of lighting fixtures, wiring devices, portable lamps, etc. Business established 1893. President, Max Herskovitz; vice-president, William Herskovitz; secretary and treasurer, Abraham Herskovitz; sales manager, Benjamin Henshel. Main office, 663 W. Washington Blvd., Chicago, Ill. Branch office, 537-539 Broadway, New York, N. Y.

PEERLESS MIDGET.—Trade name for electric cloth cutting machine manufactured by the Wolf Electrical Promoting Co., 810 Main St., Cincinnati, Ohio.

PEERLITE.—Trade name for lighting fixtures manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

PEG COUNT, TELEPHONE.—A record of the number of calls made for traffic study. Formerly it was done by moving a peg or a spare plug along in the multiple jacks; now it is done by a meter or register. See Meters, telephone, call counting.

PEGS OR WEDGES, ARMATURE SLOT.—These pegs are inserted in the armature slots after the armature has been completely wound. They serve to hold the conductors firmly in place within the slot. The common materials used for these pegs or wedges are treated hard wood and fiber.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WHITE ELECTRICAL SUPPLY CO., T. C., 1122 Pine St., St. Louis, Mo.
Wilmington Fibre Specialty Co., Wilmington, Del.

PEIRCE.—Trade name for line construction specialties manufactured by Hubbard & Co., 6301 Butler St., Pittsburgh, Pa.

PELCRANE.—Trade name for electric laboratory furnaces, dental lamps, pumps, sterilizers and other electric dental equipment manufactured by the Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.

PELICAN.—Trade name for cutout boxes, sheet metal cabinets and signs manufactured by the Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.

PELOUZE MFG. CO.—232 E. Ohio St., Chicago, Ill. Manufacturer of electric heating appliances and electrically operated scales. President and treasurer, William N. Pelouze; vice-president, H. T. Pelouze; secretary, K. M. Healy; general manager and sales manager, A. A. Guardia.

PELTON.—Trade name for electric bakers manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

PELTON.—Trade name for electric laboratory furnaces, dental lamps, pumps, sterilizers and other electric dental equipment manufactured by the Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.

PELTON & CRANE CO., THE.—Detroit, Mich. Manufacturer of electric dental equipment. Business established 1902. President, Chauncey R. Pelton; vice-president, Jay A. Hand; secretary and treasurer, Harold W. Houghton; general manager, C. R. Pelton; sales manager, H. W. Houghton. Main office and factory, 632 Harper Ave., Detroit, Mich. Branch offices, Candler Bldg., New York, N. Y.; Masonic Temple, Chicago, Ill.

PELTON WATER WHEEL CO.—San Francisco, Cal. Manufacturer of hydraulic turbines, governors and centrifugal pumps. President, Edward L. Brayton; vice-president, David Donzel. Main office and factory, 19th & Harrison Sts., San Francisco, Cal. Branch office, 90 West St., New York, N. Y.

PEMCO.—Trade name for street lighting equipment, transmission line material and commercial lighting fixtures manufactured by the Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa.

PEMKO.—Trade name for ignition specialties made by the Eastern Parts Mfg. Co., Inc., 135 Spring St., New York, N. Y.

PEN-DAR.—Trade name for steel cabinets and shelving manufactured by the Edward Darby Sons Co., 416 N. 18th St., Philadelphia, Pa.

PENATROL.—Trade name for oil for treating leather belts manufactured by the F. Raniville Co., 241-247 Pearl St., Grand Rapids, Mich.

PENBERTHY INJECTOR CO.—1242 Holden Ave., Detroit, Mich. Manufacturer of ejectors, injectors, valves and other power plant specialties. Business established 1886. President, S. Olin Johnson; vice-president and general manager, Homer S. Johnson; secretary, Clarence L. Lamson; treasurer, Charles B. Johnson; sales manager, Hugh S. Horton. Factories, Detroit, Mich.

PENBERTHY INJECTOR CO., LTD.—Windsor, Ont., Can. Manufacturer of steam specialties, oilers and other lubricating devices. President and treasurer, S. Olin Johnson; vice-president, Homer S. Johnson; secretary and manager, Seth J. North.

PENCILS AND PENS, ILLUMINATED.—See Flashlights, hand and pocket type.

PENDANT.—Anything that hangs. In electrical work a pendant is chiefly a type of hanging fixture of relatively simple design and using only one lamp, as distinguished from a chandelier which more often has a number of arms and lamps. The word "pendant" is properly a noun, although occasionally and less correctly used as an adjective. The form "pendent" is the adjective and should be used in referring to pendent switches, pendent cord, etc.

PENDANTS, STREET LIGHTING.—This is a form of street lamp which is freely suspended, at a fixed or variable distance from the support, by a ring, hook, chain or rope. It is commonly provided with an enclosing globe, and in some types a refractor or merely a reflector. Pendants usually resemble in shape the familiar arc lamp, having a housing in the upper part for the socket and cutout or compensator. When this housing is a shallow hood the fixture is often called a streethood, which see.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Flour City Ornamental Iron Co., 27th St. & 28th Ave., S., Minneapolis, Minn.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Novalux" Pendent Units



particularly suited for economical illumination of large interiors and exteriors. The different light directing equipments produce such a variety of illuminating characteristics that a selection can be made to meet any individual requirement. Made for use with Mazda series lamps. Since these lamps of 400, 600 and 1000 cp. are more efficient when operated at currents higher than that of most constant-current circuits, an auto transformer is mounted in each unit to supply the higher current. The auto transformer operates at an efficiency of 94 to 95%, with a power factor of 99.5%, and is furnished in sizes so as to provide for more light in the future. For special frequencies special auto transformers can be furnished. Both Pendent and Bracket type "Novalux" units are described fully in Booklet Y-785-B. For general information on G-E service in illumination see page 1209.—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Smyser-Royer Co., York, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PENDENT PUSH BUTTONS.—See Push buttons, pendent.

PENDENT SWITCH.—One supported from the ceiling or a high fixture on a pendent cord. See Switches, pendent and cord, snap.

PENETRATOR.—Trade name for electric vibrator manufactured by the Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y.

PENMAC.—Trade name for farm lighting plants and oil engines manufactured by the Petroleum Engine & Mfg. Co., 120 Broadway, New York, N. Y.

PENN.—Trade name for pressure switch manufactured by the Penn Electric Machine Co., 114 8th St., Des Moines, Iowa.

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PENN.—Trade name for switches, switchboards, panelboards, safety panels and cabinets manufactured by the Penn Electrical & Mfg. Co., Irwin, Pa.

PENN.—Trade name for conduit and benders manufactured by the Penn Engineering Co., 2nd & Chestnut Sts., Reading, Pa.

PENN ELECTRIC MACHINE CO.—114 8th St., Des Moines, Iowa. Manufacturer of pressure switches. President, Albert Penn; secretary and treasurer, Ralph Penn.

PENN ELECTRICAL & MFG. CO.—Irwin, Pa. Manufacturer of switches, switchboards, panelboards, safety panels and cabinets. Business established 1890. President, F. C. Hockensmith; vice-president, W. D. Hockensmith; treasurer and general manager, W. F. O'Neill.

PENN ENGINEERING CO.—2nd & Chestnut Sts., Reading Pa. Manufacturer of conduit and pipe benders and vises. President, C. E. Long; vice-president and general manager, James A. Long; secretary and sales manager, H. A. Kissinger; treasurer, J. E. Tothero.

PENNANT.—Trade name for lubricating oils manufactured by the Pierce Oil Corp., 25 Broad St., New York, N. Y.

PENNEFATHER, JAMES S.—358 W. 43rd St., New York, N. Y. Manufacturer of electric signs and theater lighting equipment. Business established 1907. James S. Pennefather, sole owner.

PENNGOLD.—Trade name for lubricating compounds, oils and greases manufactured by the Franklin Oil Works, Franklin, Pa.

PENNSYLVANIA.—Trade name for electric peanut and grain threshers manufactured by Heebner & Sons, Lansdale, Pa.

PENNSYLVANIA.—Trade name for coal crushers manufactured by the Pennsylvania Crusher Co., Stephen Girard Bldg., Philadelphia, Pa.

PENNSYLVANIA.—Trade name for brass castings, compressors and pumps manufactured by the Pennsylvania Pump & Compressor Co., Easton, Pa.

PENNSYLVANIA CRUSHER CO.—Stephen Girard Bldg., Philadelphia, Pa. Manufacturer of coal crushers. Branch offices, 50 Church St., New York, N. Y.; Peoples Bank Bldg., Pittsburgh, Pa.

PENNSYLVANIA ELECTRIC ASSOCIATION, STATE SECTION OF N. E. L. A.—President, Henry Harris, Wilmerding, Pa.; secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.—Philadelphia, Pa. Manufacturer of armored flexible hose and automobile conduit. President, S. H. Collom; vice-president and treasurer, H. A. Ansell. Main office, Broad & Race Sts., Philadelphia, Pa. Branch offices, 447 Peoples Gas Bldg., Chicago, Ill.; New York, N. Y ; Boston, Mass.; Cleveland, Ohio.

PENNSYLVANIA FORGE CO.—Bridesburg, Philadelphia, Pa. Manufacturer of steel forgings.

PENNSYLVANIA GLASS & MFG. CO.—Pittsburgh, Pa. Manufacturer of illuminating glassware.

PENNSYLVANIA OIL PRODUCTS REFINING CO.—Warren, Pa. Manufacturer of transformer and lubricating oils. Factory, Eldred, Pa.

PENNSYLVANIA PARAFFINE WORKS.—Titusville, Pa. Manufacturers of paraffin.

PENNSYLVANIA PUMP & COMPRESSOR CO.—Easton, Pa. Manufacturer of pneumatic and hydraulic pumping machinery. Business established 1920. President and general manager, N. A. Messinger; vice-president, W. Raymond; secretary, F. M. Godley; treasurer, E. R. Snovel; sales manager, W. E. Anderson. Main office and factory, Easton, Pa. Branch offices, 50 Church St., New York, N. Y.; 2222 Chestnut St., Philadelphia, Pa. Sales representatives, C. W. Gellinger, 631 Fulton Bldg., Pittsburgh, Pa.; W. F. Delaney, 203 Mutual Bldg., Richmond, Va.; Coates & Zarling, 604 1st National Bank Bldg., Milwaukee, Wis.; L. E. Pollard Co., 423 5th St., S., Minneapolis, Minn.; J. B. Laird, 788 Potomac Ave., Buffalo, N. Y.; C. H. Jones Co., 804 Newhouse Bldg., Salt Lake City, Utah; L. J. Wakefield, 232 St. Clair Ave., N., Cleveland, Ohio; H. I. Kahn, 2027 Jefferson County Bank Bldg., Birmingham, Ala.

PENNSYLVANIA SALES & EXPORT CO.—1414 S. Penn Sq., Philadelphia, Pa. Manufacturer of lighting fixtures.

PENNSYLVANIA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Chairman, Fred Smith, 507 Linden St., Scranton, Pa.; secretary-treasurer, M. G. Sellers, 1518 Sansom St., Philadelphia, Pa.

PENNSYLVANIA STATE TELEPHONE AND TRAFFIC ASSOCIATION.—President, H. E. Beadley, Harrisburg, Pa.; secretary, E. H. Reeve, Harrisburg, Pa.

PENNTROY CORP., THE.—Troy, Pa. Manufacturer of rigid shaft couplings. General sales agents, Smith & Serrell, Central Ave. at Halsey St., Newark, N. J.

PENNY.—Trade name for conduit plugs manufactured by the Thomas & Betts Co., 63 Vesey St., New York, N. Y.

PENSTOCKS.—A penstock is a closed channel or pipe supplying water to a water wheel or turbine; it runs from the headrace to the gate or valve at the rotating element. Penstocks are usually built of riveted steel plates but are sometimes made of reinforced concrete or wooden staves. Both strength and carrying capacity are considered in the design and they must be able to withstand the pressure due to the head plus the effect of water hammer.

Manufacturers:

Biggs Boiler Works Co., Kent St., & B. & O. R. R., Akron, Ohio.
Dilion Steam Boiler Works, D. M., Fitchburg, Mass.
Dow, Inc., L. B., Keene, N. H.
Fabricated Steel Products Corp., Leetonia, Ohio.
Forest City Paint & Varnish Co., The, Cleveland, Ohio.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., 404 Ross St., Pittsburgh, Pa.
Reeves Bros. Co., 338 Rush St., Alliance, Ohio.
Riter-Conley Co., Pittsburgh, Pa.
Smith Co., S. Morgan, Lincoln & Hartley Sts., York Pa.
Stevens Tank & Tower Co., 9-23 Center St., Auburn, Me. "Dirigo."
Struthers-Wells Co., Warren, Pa.
Treadwell Construction Co., Midland, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

PENTZ SYSTEM.—Trade name for electric sterilizers for hospitals, laboratories, etc., made by Santiseptic Mfg. Co., 26 Bay St., New Brighton, Staten Island, N. Y.

PENUMBRA.—In lighting, the partially shaded portion which lies between the fully lighted area and the dense black shadow, or umbra, that receives no light at all. The broader the source of light the wider is the penumbra and the narrower the umbra. The size and density of the shadows is a matter of considerable importance in direct lighting where a relatively small number of light sources is employed, especially in street lighting.

PEP.—Trade name for bell ringing transformers manufactured by the Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

PEPCO.—Trade name for electric toaster and disk stove manufactured by the Perfection Electric Products Co., New Washington, Ohio.

PERCHLORATES.—The sodium, potassium, and ammonium perchlorate salts are made by electrolytic oxidation from the chlorate, which has in turn been produced from the corresponding chloride.

PERCOLATORS, COFFEE, ELECTRIC.—With an electric coffee percolator coffee can be made quickly and cleanly at the table. It has been one of the most popular of all household electrical appliances. The percolators are usually made in attractive designs and are in themselves ornamental when not in use. As they are designed for heating to the boiling temperature of water they may be damaged in case the current were turned on when no water is in the vessel. To protect against such accident, in some types of percolators a fusible plug is placed in the bottom of the vessel which cuts off the current when a temperature sufficient to damage the vessel is reached. The main body of the device is usually made of copper or brass with a highly polished natural copper or nickel-plated or silver-plated finish; aluminum is also used in some models. Two main types of percolators are made, the coffee pot or long spout type and the faucet or urn type. The household sizes range from 5 to 9 cups capacity, as a rule. For restaurant sizes see Urns, coffee, electric, restaurant and hotel.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric coffee percolators, made in three sizes, six, seven and nine cups, of heavy copper, finished in polished nickel and lined with pure tin, have aluminum fittings and safety fuse plug which prevents burning out element. Furnished complete with a 6-ft. cord, detachable plugs and attachment plug. —Adv.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Edison and Hughes electric appliances. In addition to the percolator illustrated, this company manufactures about seven other styles, including complete sets of sugar, creamer and tray. These percolators vary in capacity, 5, 6 and 9 cup. The one shown holds six cups. They are made of copper, and finished in polished nickel. Handle is of ebonized wood. Feet are fiber. All equipped with famous Hotpoint percolating apparatus and safety switch. The latter prevents burnouts by automatically breaking the current when percolator boils dry. See also Urns and Kettles and display adv. pages 1292-3.—Adv.



"Hotpoint" Percolator

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."

LANDERS, FRARY & CLARK, New Britain, Conn. Heavy gage copper bodies, highly polished, nickel or silver-plated finish, with ebonized handles and feet. Heat-proof glass tops. Inside coated with pure tin, silver finished. Aluminum interior fittings. Complete with 6-ft. cord and plug. Equipped with safety fuse plug (in circuit); prevents injury to appliance should the liquid boil dry.—Adv.



"Universal" Percolator

Manning, Bowman & Co., Meriden, Conn.

Renfrew Electric Products, Ltd., Renfrew, Ont., Can. "Canadian Beauty."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PERFECLITE.—Trade name for commercial and industrial lighting units manufactured by the Perfeclite Co., 119 Main St., Seattle, Wash., and the First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.

PERFECLITE MFG. CO.—119 Main St., Seattle, Wash. Manufacturer of portable lamps, commercial and industrial lighting

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fixtures. Business established 1916. President, C. C. Dose; secretary, treasurer and general manager, J. L. Jaffe. For territory east of Mississippi River, see First National Lighting Corp.

PERFECT.—Trade name for motor-driven ice cream freezers manufactured by Henry G. Lange, 162 N. May St., Chicago, Ill.

PERFECT.—Trade name for farm lighting and power plant manufactured by J. B. Tilley, Pen Yan, N. Y.

PERFECT REFILLABLE FUSE CO.—Brooklyn, N. Y. Manufacturer of refillable fuses.

PERFECT TOP.—Trade name for one-piece top upright lightning rods manufactured by Moore Bros. Lightning Rod Co., Maryville, Mo.

PERFECTION.—Trade name for belting manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

PERFECTION.—Trade name for motor-driven ice cream freezers manufactured by the J. G. Cherry Co., Cedar Rapids, Iowa.

PERFECTION.—Trade name for storage batteries manufactured by the Dealers Electric Lighting Co., 500 E. 40th St., Chicago, Ill.

PERFECTION.—Trade name for soldering flux produced by the Grasselli Chemical Co., Cleveland, Ohio.

PERFECTION.—Trade name for linemen's rubber gloves, rubber mats and matting manufactured by the Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.

PERFECTION.—Trade name for electric milking machines manufactured by the Perfection Mfg. Co., 2125 E. Hennepin Ave., Minneapolis, Minn.

PERFECTION.—Trade name for storage batteries and direct-connected automatic and semiautomatic farm lighting and power plants manufactured by the Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill.

PERFECTION.—Trade name for commutator brushes manufactured by the Perfection Supply Co., 98 Park Pl., New York. N. Y.

PERFECTION.—Trade name for boiler and condenser tube cleaner manufactured by Ruggles & Ruggles, Batavia, Ill.

PERFECTION.—Trade name for radio and telegraph equipment manufactured by Tresco, 1201 Kahl Bldg., Davenport, Iowa.

PERFECTION ELECTRIC PRODUCTS CO.—New Washington, Ohio. Manufacturer of electric toasters and table stoves. Sales representative, George Borgfeldt & Co., 16th St. & Irving Pl., New York, N. Y.

PERFECTION MFG. CO.—2125 E. Hennepin Ave., Minneapolis, Minn. Manufacturer of electric milking machines. Business established 1914. President, J. C. Hallum; vice-presidents, J. Morck; L. Dinesen; secretary and treasurer, E. B. Ringham; general manager, J. Morck.

PERFECTION QUALITY.—Trade name for sheet metal cabinets manufactured by the Robertson Electric Construction Co., Mohawk & Niagara Sts., Buffalo, N. Y.

PERFECTION STORAGE BATTERY CO.—500 E. 40th St., Chicago, Ill. Manufacturer of storage batteries, switchboards and farm lighting and power plants. Business established 1913. President and general manager, Howard Glen; vice-president, Edward A. Ferguson; secretary, treasurer and sales manager, F. A. Emmons.

PERFECTION SUPPLY CO.—98 Park Pl., New York, N. Y. Manufacturer of commutator brushes and cement. Business established (about) 1898. Robert Harding, owner.

PERFECTO-SOTE.—Trade name for wood preservatives produced by the C-A Wood Preserver Co., Arcade Bldg., St. Louis, Mo.

PERFORATING MACHINES, MOTOR-DRIVEN.—Motion-picture film is perforated along the edges to fit into the sprocket mechanism used for guiding the film through the machine. Either standard size or the special sizes used for slow-burning films may be perforated in these machines. Special perforating machines are used for making the music rolls for player pianos. Perforating machines are also used for loose-leaf catalogs, ledgers, account books, etc.

Manufacturers:

American Perforator Co., 617 W. Jackson Blvd., Chicago, Ill. "American."
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill. "Standard Cinemachinery."
Capital Novelty Co., 138 N. 12th St., Lincoln, Neb. "Success."
Cummins Co., The B. F., 4740 Ravenswood Ave., Chicago, Ill. "Cummins."
Powers Accounting Machine Co., Inc., 137 S. LaSalle St., Chicago, Ill.

PERFORATOR, TRANSMITTER TAPE.—A machine used in printing telegraph systems which has the appearance of a typewriter, having a standard keyboard. It is used to perforate a paper tape which is fed into the transmitter and which carries, on it the coded message to be sent. The perforator is operated by a typist and as each key is depressed it perforates one or more small holes in the tape, the combinations of the holes forming the basis for the code. As the tape comes from the perforator it is usually sent directly into the transmitter or the tape may be kept for some time until there is an opportunity to send the message.

PERIOD.—The period of an alternating current is the duration of one cycle. It equals one second divided by the frequency. The period of a 25-cycle current is 0.04 second.

PERIODICALS, ELECTRICAL.—The electrical industry owes to its numerous periodicals much of the extent and rapidity of its progress. The electrical journals have recorded weekly, monthly or at other regular intervals all the important technical and business developments of the numerous branches of the industry and promptly placed before their readers engineering and commercial news of special interest and value in stimulating further developments. Because of the prevailing high degree of specialization in the electrical industry, practically all electrical periodicals now devote themselves to one or to a limited number of branches of the industry. The following is a list of American and Canadian electrical periodicals in general circulation. In the case of publications of electrical societies, only those are given for which nonmembers may subscribe. The subscription price given is the rate per year and as a rule does not include postal zone additions; the latter can be obtained from the publishers.

Aera. Monthly. American Electric Railway Association, Lyon Black, Market Sq., Albany, N. Y. $2 in U. S.
Association of Iron and Steel Electrical Engineers. Monthly. Association of Iron and Steel Electrical Engineers, 1006 Empire Bldg., Pittsburgh, Pa. $5 in U. S.
Central Station, The. Monthly. H. C. Cushing, Jr., 8 W. 40th St., New York, N. Y. $2 in U. S., $3 in Canada.
Electric Journal. Monthly. The Electric Journal, 1204 Keenan Bldg., Pittsburgh, Pa. $2 in U. S., $2.50 in Canada.
Electric Railway Journal. Weekly. McGraw-Hill Co., Inc., 10th Ave. & 36th St., New York, N. Y. $4 in U. S.
Electric Traction. Monthly. Kenfield-Davis Publishing Co., 431 S. Dearborn St., Chicago, Ill. $1.50 in U. S., $2 in Canada.
Electrical Contractor and Dealer. Monthly. National Association of Electrical Contractors and Dealers, 110 W. 40th St., New York, N. Y. $2 in U. S., $2.50 in Canada.
Electrical Export. Monthly. Gage Publishing Co., Inc., 114 Liberty St., New York, N. Y. $3 in U. S.
Electrical Merchandising. Monthly. McGraw-Hill Co., Inc., 10th Ave. & 36th St., New York, N. Y. $2 in U. S., $2.50 in Canada.
Electrical News. Semimonthly. Hugh C. MacLean, Ltd., 347 Adelaide St., West, Toronto, Ont., Canada. $2 in Canada, $2.50 in U. S.
Electrical Record. Monthly. Gage Publishing Co., Inc., 114 Liberty St., New York, N. Y. $3 in U. S. and Canada.
ELECTRICAL REVIEW. Published weekly by the International Trade Press, Inc., 53 W. Jackson Blvd., Chicago, Ill. The oldest electrical weekly in America, having appeared regularly since March 22, 1883. Covers all the important developments of the electrical industry and especially in the fields of central stations, power plants, electric lighting, contractor-dealers, new appliances, and manufacturers. Annual subscription, $3 plus zone postage in U. S., $5 in Canada, $6 in other countries.—Adv.
Electrical South. Monthly. The Electrical South, 1020 Grant Bldg., Atlanta, Ga. $1 in U. S.
Electrical World. Weekly. McGraw-Hill Co., Inc., 10th Ave. & 36th St., New York, N. Y. $5 in U. S., $6.50 in Canada.
General Electric Review. Monthly. Publication Dept. of General Electric Co., Schnectady, N. Y. $3 in U. S.
JOBBER'S SALESMAN, THE. Published monthly by the Electrical Trade Publishing Co., 53 W. Jackson Blvd., Chicago, Ill. A human-interest journal for wide-awake electrical salesmen, especially those engaged in the electrical jobbing business. Annual subscription, $1 in U. S.; $2 in Canada, $3 in other countries.—Adv.
Journal of Electricity and Western Industry. Semimonthly. McGraw-Hill Co., Inc., Rialto Bldg., San Francisco, Cal. $2.50 in U. S., $3.25 in Canada.
Journal of American Institute of Electrical Engineers. Monthly. American Institute of Electrical Engineers, 33 W. 39th St., New York, N. Y. $10 in U. S., $11 in Canada.
National Electric Light Association Bulletin. Monthly. National Electric Light Association, 29 W. 39th St., New York, N. Y. $3.
Proceedings of the Institute of Radio Engineers. Bimonthly. The College of the City of New York, 140th St. and Convent Ave., New York, N. Y. $9 in U. S., $9.60 in Canada.
Public Service Management Monthly. Utilities Publishing Co., 431 S. Dearborn St., Chicago, Ill. $3 in U. S. Also Public Service Magazine to subscribers of above at $0.10 per copy.
QST. Monthly. American Radio Relay League, Hartford, Conn. $2 in U. S.
Railway Electrical Engineer. Monthly. Simmons-Boardman Publishing Co., 608 S. Dearborn St., Chicago, Ill. $3 in U. S. and Canada.
Railway Signal Engineer. Monthly. Simmons-Boardman Publishing Co., 608 S. Dearborn St., Chicago, Ill. $3 in U. S. and Canada.
Telegraph and Telephone Age. Semimonthly. John B. Taltavall, 253 Broadway, New York, N. Y. $2 in U. S.
Telephone Engineer. Monthly. Telephone Engineer Co., 443 S. Dearborn St., Chicago, Ill. $2 in U. S.
Telephony. Weekly. Telephony Publishing Corp., 116 S. Michigan Ave., Chicago, Ill. $3 in U. S., $4 in Canada.
Transactions of the Illuminating Engineering Society. Published every 40 days. Illuminating Engineering Society, 29 W. 39th St., New York, N. Y. $5.
Wireless Age. Monthly. Wireless Press, Inc., 326 Broadway, New York, N. Y. $2 in U. S., $2.50 in Canada.

PERIODICITY.—Another name for frequency of an alternating current. The word "frequency" is preferable, as periodicity may be confused with period.

PERIODICITY OF CHEMICAL ELEMENTS.—A term applied to the fact that if the chemical elements are arranged in the order of their atomic weights, certain physical and chemical properties or analogies recur periodically, so that the elements may be divided into periods or groups having similar or related properties. This is the basis of the periodic classification of the elements.

PERIPHERAL SPEED.—The velocity of the periphery of any revolving body, usually given in feet per second or minute. The peripheral speed is a matter of considerable importance in the design of large or high-speed rotating machinery on account of the severe strains set up at the surface by centrifugal force.

PERIPHERY.—The circumference or line bounding any curved or polygonal figure, as the outer circumference of an armature or flywheel. Also used loosely in referring to the outer surface.

PERKINS.—Trade name for flush switches manufactured by the Bryant Electric Co., Bridgeport, Conn.

PERKINS & SON, INC., B. F.—2 Crescent St., Holyoke, Mass. Manufacturer of exhaust fans and shaft hangers. Business established 1873. President, J. Lewis Perkins; vice-president, William H. Bond; secretary, J. Lewis Perkins, Jr.; treasurer, B. F. Perkins; general manager, P. W. Bidwell.

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PERKINS CORP.—Mishawaka, Ind. Manufacturer of farm lighting and power plants. Business established 1860. President, C. A. Carlisle; secretary-treasurer, C. A. Carlisle, Jr.; general manager, E. H. Williams.

PERKINS MACHINE CO.—Warren, Mass. Manufacturer of motor-driven metal presses.

PERMACOLOR.—Trade name for lamp coloring compound manufactured by C. E. Franche & Co., 440 Orleans St., Chicago, Ill.

PERMANENT MAGNET.—A magnet that is permanently magnetized as distinguished from an electromagnet or other temporary magnet. See Magnets, permanent.

PERMANENT WAVE MACHINE & SUPPLY CO.—465 Greenwich St., New York, N. Y. Manufacturer of electric hair wavers. President, Ernest Unger.

PERMANGANATES.—Can be made by electrolyzing a manganate solution with iron or nickel electrodes.

PERMEABILITY.—The property of a medium which modifies the interaction of magnets immersed in it is called its permeability. It is the entity that distinguishes magnetic quantities from the mechanical. It may also be defined as the relative magnetizability as compared with air, that of air being unity. Its symbol is μ. Also see Reluctivity. On the basis of their permeability, substances are classed as diamagnetic, paramagnetic and ferromagnetic. The first have a permeability less than unity (such as bismuth). The second have a permeability somewhat greater than unity, but below that of iron (such as cobalt). The third have a high permeability of the order of that of iron.

PERMEABILITY OF DIAPHRAGMS.—The relative porosity or openness of a diaphragm. The diaphragm consists of capillary passages from one side to the other, which form a continuous path for electricity to pass, but prevent free mixing of the two solutions on the two sides of the partition. The ratio of the total cross-section of these passages to the cross-sectional area of the diaphragm, measures the porosity or permeability. It ordinarily varies between 10% for unglazed porcelain to 25% for paper, duck or asbestos partitions.

PERMEAMETERS.—These are instruments for measuring permeability. The more commonly known instruments are the Thompson, DuBois, Koepsel, Esterline, and Picout. In the Thompson and DuBois permeameters the force exerted between the pole of a magnetized bar and a piece of steel in direct contact with the pole is employed as a test for the magnetic property of the bar. In the Koepsel permeameter a magnetic flux is induced in the test piece by a magnetizing coil, and this flux is measured by its reaction with the magnetic field surrounding a small pivoted coil through which a known current flows. The Esterline permeameter is a modification of the Koepsel apparatus, the small pivoted coil being replaced by an armature which can be driven at constant speed. The e. m. f. generated is a measure of the flux in the test piece. The Picout instrument consists of a rectangular core of iron around two opposite sides of which are wound two identical coils. The test piece with its magnetizing coil extends between the two other sides of the rectangle. The magnetizing force of the three coils is adjusted so that the flux through the rectangular core is the same when the test piece coil is open and the e. m. f. of the other two coils is in series. This condition is determined by a ballistic galvanometer. Theoretically, such an arrangement compensates for the reluctance of the junctions between the test piece and the yoke. In practice it is extremely difficult to adjust the magneto-motive forces to secure the supposed equality of conditions.

Manufacturer:

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. The Burrows permeameter is the standard instrument designed and used at the Bureau of Standards, and recommended by the American Society for Testing Materials, for accurate determinations of normal induction, permeability, hysteresis, residual induction, and coercive force of magnetic materials.—Adv.

PERMITIVITY.—See Dielectric constant.

PERMITTANCE.—A name once proposed for electrostatic capacity or what is now called "capacitance," which see.

PERMUTIT CO., THE.—New York, N. Y. Manufacturer of water filtration and softening apparatus. Vice-presidents, Sheridan S. Norton, H. Kriegsheim; secretary, O. K. Fraenkel; sales manager, A. T. Smith. Main office, 440 4th Ave., New York, N. Y. Branch offices, 310 Journal Co., Bldg., Albany, N. Y.; 1153 Old South Bldg., Boston, Mass.; 304 Brisbane Bldg., Buffalo, N. Y.; 435 Volunteer State Life Bldg., Chattanooga, Tenn.; 208 S. LaSalle St., Chicago, Ill.; 779 Oxford Ave., Dayton, Ohio; 507 Lathrop Bldg., Kansas City, Mo.; 404 Wright Collender Bldg., Los Angeles, Cal.; 1046 McKnight Bldg., Minneapolis, Minn.; 311 Widener Bldg., Philadelphia, Pa.; 921 Union Arcade, Pittsburgh, Pa.; 2211 Olive St., St. Louis, Mo.

PEROLIN CO. OF AMERICA., THE.—Chicago, Ill. Manufacturer of water treating compounds. Business established 1906. President and treasurer, J. I. Kopperl; vice-president and sales manager, E. L. Gross; secretary, P. B. Gerdes. Main office, 2010 Peoples Gas Bldg., Chicago, Ill. Branch offices and warehouses, Woolworth Bldg., New York, N. Y., 50 Park Pl., New York, N. Y. Sales representatives, N. B. Falls Lubricating Co., Buffalo, N. Y. Eagle Oil & Supply Co., Boston, Mass.; Eastern Coal & Export Corp., Richmond, Va.; Cotter Supply Co., Houston, Tex.; A. M. Conway Co., Portland, Ore.

PERPETUO.—Trade name for insulated screw drivers manufactured by Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y.

PERRY.—Trade name for wire skinners manufactured by Paul W. Herbst, 180 N. Dearborn St., Chicago, Ill.

PERRY HARTMAN.—Trade name for ball bearings manufactured by Holden & White, Inc., 343 S. Dearborn St., Chicago, Ill.

PERRY ROTARY FIXTURE CO., INC.—Meridian, Miss. Manufacturer of display boards, fixtures, etc., for electrical stores.

PERSONS-ARTER MACHINE CO., THE.—72 Commercial St., Worcester, Mass. Manufacturer of magnetic chucks. Business established 1914. President, William Arter; vice-president, William Arthur; secretary, Harold Tattersall; treasurer, William Hague; sales manager, Albert B. O'Donnell.

PERSONS ELECTRIC CO.—506 Jersey St., Quincy, Ill. Manufacturer of small motors. Business established 1920. President, William J. Ruff; vice-president, W. E. Persons; secretary, John H. Breitstadt; treasurer, A. R. Dick; general manager, L. M. Persons.

PERSULPHATES.—The potassium and ammonium salts can be made by electrolytic oxidation of a concentrated solution of the sulphate at low temperature.

PETALUMA ELECTRIC MFG. CO.—2-4 E. Washington St., Petaluma, Cal. Manufacturer of electric incubators and brooders. Sale owner, Wilbur E. Byce.

PETER WITT.—Trade name for electric railway cars manufactured by the J. G. Brill Co., 62nd St. & Woodland Ave., Philadelphia, Pa.

PETERS CO., H. J.—227-229 W. Huron St., Chicago, Ill. Manufacturer of lighting fixtures and portable electric lamps. President, H. J. Peters; secretary and treasurer, Fred D. Fox.

PETERSEN MFG. CO., A. H.—1614 Fratney St., Milwaukee, Wis. Manufacturer of portable electric drills. Business established 1914. President, treasurer and general manager, A. H. Petersen.

PETERSON CO., F. W.—18 Greene St., New York, N. Y. Manufacturer of wood turnings and specialties for electrical purposes. Business established 1907.

PETERSON CO., INC., CHARLES J.—723-729 Fulton St., Chicago, Ill. Manufacturer of lighting reflectors, panels, panelboards, switches, switchboards, etc. Business established 1917. President, treasurer and general manager, Charles J. Peterson; secretary, Charles Bergh.

PETITE.—Trade name for changeable pulleys manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PETRITE.—Trade name for mica insulators manufactured by the Dielectric Mfg. Co., St. Louis, Mo.

PETROBESTOS.—Trade name for asbestos metalic sheet packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St. Charleston, S. C.

PETROLEUM ENGINE & MFG. CO.—New York, N. Y. Manufacturer of farm lighting plants and oil engines. Main office, 120 Broadway, New York, N. Y. Branch office, 1049 Drexel Bldg., Philadelphia, Pa.

PETROLEUM IRON WORKS CO., THE.—Sharon, Pa. Manufacturer of steel construction work for power plants. Business established 1893. Vice-presidents, J. L. Considine, H. A. Bishop, G. E. Mittinger; secretary, H. C. Knowles; treasurer, A. S. Maitland; general manager, G. E. Mittinger; sales manager, H. A. Bishop. Main office and factory, Sharon, Pa. Branch offices, 25 W. 45th St., New York, N. Y.; 1110 Carter Bldg., Houston, Tex.; Third National Bank Bldg., St. Louis, Mo.; 503 Market St., San Francisco, Cal.

PETTES & RANDALL CO.—152 Nassau St., New York, N. Y. Manufacturer of telephones, time recorders, etc.

PETTINOS, GEORGE F.—Real Estate Trust Bldg., Philadelphia, Pa. Manufacturer of graphite and graphite products. Branch office and warehouse, Massachusetts Trust Bldg., Boston, Mass. District office, 50 Church St., New York, N. Y.

PEXTO.—Trade name for tools for electricians, mechanics, etc., manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

PHANTOM BRACKETS.—See Brackets, phantom.

PHANTOM CIRCUIT.—In telephony, the equivalent of an additional circuit or wire, not existing in reality but obtained by certain arrangements of real circuits. The most common arrangement is to use two independent two-wire or complete metallic circuits as the two respective sides of the phantom circuits, thus securing three telephone circuits from four line wires instead of six, a saving of 33⅓%. Phantom circuits are most used in toll and long-distance telephony. Two types of phantom circuits are in use, one derived from the other circuits by means of phantom repeating coils, the other by bridged impedance coils. The repeating coils are tapped at the centers of the line-side windings for the derived or phantom circuit. The impedance coils are also tapped at their centers. The side circuits or actual circuits should be identical for the best results. This is necessary for the proper electrical balance of the phantom. Special transpositions are also required.

PHANTOM LOADS.—See Loads, artificial or phantom.

PHANTOM REPEATING COILS, TELEPHONE.—Repeating coils for use on phantom telephone circuits are simply unity-ratio or one-to-one transformers having both windings divided into two equal parts. The connections for the phantom circuits are made from the middle points of the windings. It is very essential for successful operation that the windings should be very carefully balanced electrically in order to prevent cross-talk between the side circuits and the phantom. The toroidal type of coil having two inner and two outer windings is extensively used.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

PHANTOMED CABLE.—One adapted for the use of phantomed circuits. See Circuits, telephone.

PHASE.—The fraction of a period which has elapsed since an alternating e. m. f. or current passed through its zero value in the positive direction is called its phase. It is also defined as the distance, usually in angular measure, of the base of any ordinate of an alternating wave from any chosen point on the time axis. To be "in phase" means to alternate with some other quantity having zero phase difference with it; for instance, the e. m. f. and current are in phase when both reach their maximum values and minimum values at the same respective and identical instants.

PHASE ADVANCERS. — Also called phase modifiers and phase shifters. See Phase shifters.

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PHASE CONVERTER, ROTARY.—A machine for changing alternating current of one or more phases to a different number of phases but of the same frequency. See Converter.

PHASE DIFFERENCE.—The interval of time between the occurrence of the corresponding values of two sinusoidal quantities of the same frequency is called the phase difference. When the sinusoidal quantities are considered as being produced by two rotating vectors, the angle between these vectors is also called the phase difference. Physically, the phase difference is a time interval, mathematically it is represented by an angle. The phase difference most often considered is between the e. m. f. and current in an a-c. circuit. Also see Lead and lag.

PHASE FAILURE OR PHASE REVERSAL PROTECTION.—In polyphase circuits it is of importance that in case of the failure or reversal of one phase, the remaining phases be opened and held open till the trouble is corrected. While a polyphase motor will not start satisfactorily if one phase is dead, it will continue to carry load if running when power fails on one phase, but at an increased and dangerous current in the other phase or phases. Under most conditions, reversal of a phase would cause reversal of the direction of rotation of a motor. Either of these results might be disastrous to the equipment and is commonly guarded against by the installation of the proper relays at the central station or on the premises of the customer if the equipment is extensive. See Relays, A-C. reverse phase and phase failure.

PHASE INDICATOR.—A device for showing when two alternating-current machines or circuits are in synchronism or "in step," that is, have their e. m. f. waves rising and falling exactly in unison. See Synchroscope.

PHASE LAG.—See Lead and lag.

PHASE LEAD.—See Lead and lag.

PHASE-ROTATION INDICATORS.—See Indicators, phase rotation.

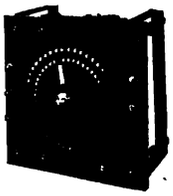
PHASE SHIFTERS.—These are devices by means of which the power-factor of a testing circuit may be changed. One form of phase shifter is a transformer with a movable secondary. The instrument is constructed on somewhat the same design as an induction motor, except the rotor, which in the secondary, is stationary but may be turned on its axis by a handwheel. When the supply is single-phase or two-phase the stator is wound with two sets of coils at right angles to each other. For three-phase circuits there are three coils 120 space degrees apart. The phase of the secondary voltage with reference to any phase voltage of the primary is changed by changing the angular position of the secondary.

The principle of the other form is essentially the same, but the results are obtained in a different manner. A transformer with a number of taps is connected across one phase of a polyphase circuit. The phase relation of the voltage between one of these taps and one of the terminals of the other phase transformer is varied by changing the position of the tap connection. The principle involves the vector addition of electromotive forces that are out of phase. The connections for different power-factors are made by either a plug or dial switch. Phase shifters are very useful in testing wattmeters and watt-hour meters.

Manufacturers:

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

STATES CO., THE, 71 Francis Ave., Hartford, Conn. The potential phase shifter is used in testing watthour meters. It is independent of meter capacity, and gives any desired power factor conditions, which may be obtained simply by setting a pointer on a dial. The illustration shows the simplicity of the equipment. No skill is required in its operation. A portable type of phase shifter is also furnished by this company for testing meters at fractional power factors. It is light and convenient to carry.—Adv.



Potential Phase Shifter

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PHASES IN ALTERNATING-CURRENT SERVICE.—When electricity is delivered from a single winding of a generator it is called single-phase current. If delivered from two windings so placed that they are one-quarter of a field-pole span apart, the machine delivers two-phase or quarter-phase current. If the windings are so placed that they are one-third of a pole span apart the current delivered is three-phase current. All systems having more than one phase are classed as polyphase or multiphase. Two-phase and three-phase currents are used because polyphase motors have better characteristics and are less expensive than single-phase motors. The three-phase system permits a more economical use of line copper than other systems.

PHELPS GUARDANT TIME LOCK CO.—114-118 Liberty St., New York, N. Y. Manufacturer of electric time recording locks. Business established 1884. President, Edwin S. Phelps; vice-president, Henry Doscher; secretary, William L. Stout; treasurer, L. R. Phelps; general manager, E. S. Phelps; sales manager, L. A. Flach.

PHELPS, JAMES C.—Springfield, Mass Manufacturer of conduit fittings.

PHELPS LIGHT & POWER CO.—Rock Island, Ill. Manufacturers of farm lighting plants. Business established 1917. President, R. W. Phelps; vice-president and general manager, H. C. Thompson; secretary, A. G. Bush; treasurer, W. J. Moore; sales manager, A. C. Graham.

PHENIX.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

PHENIXLITE.—Trade name for illuminating glassware manufactured by the Phoenix Glass Co., Pittsburgh, Pa.

PHENOLEUM.—Trade name for wood preservative manufactured by the Dielectric Mfg. Co., St. Louis, Mo.

PHILADELPHIA.—Trade name for motor-driven sealing machines manufactured by the American Machinery Co., Inc., 330 N. 12th St., Philadelphia, Pa.

PHILADELPHIA.—Trade name for pole brackets manufactured by the St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

PHILADELPHIA BELTING CO.—Philadelphia, Pa. Manufacturer of leather belting. Business established 1908. Partnership, H. Perpall and R. W. McKee. Main office, 601-03 Spring Garden St., Philadelphia, Pa. Branch offices, 540 W. Lake St., Chicago, Ill.; 17 Battery Place, New York, N. Y.; 126 High St., Boston, Mass.; 317 Oliver Bldg., Pittsburgh, Pa.

PHILADELPHIA ELECTRICAL & MFG. CO.—1228-36 N. 31st St., Philadelphia, Pa. Manufacturer of street-lighting equipment, transmission line material and commercial lighting fixtures. C. L. Bundy, secretary and treasurer.

PHILADELPHIA GEAR WORKS.—E. Vine St., Philadelphia, Pa. Manufacturer of power transmission chains and rawhide gears.

PHILADELPHIA INSULATED WIRE CO.—200 N. 3rd St., Philadelphia, Pa. Manufacturer of insulated wire. Business established 1820. President, John W. Pearce; vice-president, Edwin B. Bartram; secretary, William W. Pawling; treasurer, A. A. Wireback. Sales representatives, E. P. Bartlett & Co., 15 N. Jefferson St., Chicago, Ill.; Mueller Electric Co., 2135 Fairmount Rd., Cleveland, Ohio; James Goldmark Co., 83 Warren St., New York, N. Y.

PHILADELPHIA MFG. CO.—Howard St. & Montgomery Ave., Philadelphia, Pa. Manufacturer of lighting fixtures. Partnership, George Fox and Paul J. Startzman.

PHILADELPHIA STORAGE BATTERY CO.—Philadelphia, Pa. Manufacturer of storage batteries. Business established 1906. President, Edward Davis; vice-president and general manager, James M. Skinner; secretary, Edward S. Peyton; treasurer, John St. Thomas; sales manager, Walter S. Cranmer. Main office and factory, Ontario & C Sts., Philadelphia, Pa. Branch offices, Atlanta, Ga.; Boston, Mass.; 1621 S. Michigan Ave., Chicago, Ill.; Los Angeles, Cal.; Minneapolis, Minn.; Rochester, N. Y.; San Francisco, Cal. District offices, Cleveland, Ohio; Columbus, Ohio; Huntington, W. Va.; Pittsburgh, Pa.; St. Louis, Mo. Sales representatives, W. L. Thompson, 1789 Broadway, New York, N. Y.; Sterrett & Fleming, Inc., Washington, D. C.

PHILADELPHIA THERMOMETER CO., THE.—54 N. 9th St., Philadelphia, Pa. Manufacturer of hydrometers, hygrometers and thermometers. Business established 1906. Partnership, Ferdinand Stuhl and Samuel L. Baily, Jr.

PHILBRIN CORP.—Kennett Square, Pa. Manufacturer of automobile ignition outfits. Business established 1916. President, treasurer and general manager, Edwin S. Philips; vice-president, E. B. Sharpless; secretary, Jesse D. Philips; sales manager, H. L. Archey.

PHILCO.—Trade name for storage batteries manufactured by the Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.

PHILCO RETAINER.—Trade name for storage batteries manufactured by the Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.

PHILLIPS.—Trade name for spring hammer and drill manufactured by the Daugherty-Smith-Phillips Co., 1537 Cortland St., Chicago, Ill.

PHILLIPS.—Trade name for bare copper wire and cable manufactured by the Phillips Wire Co., Pawtucket, R. I.

PHILLIPS ELECTRICAL CO., INC.—75 South Ave., Rochester, N. Y. Manufacturer of heating elements for hand shoe irons and potential reducers. Business established 1908. President, treasurer and general manager, James J. Phillips; vice-president, William F. Philips; secretary, Mrs. L. E. Weyrauch.

PHILLIPS ELECTRICAL WORKS, LTD., EUGENE F.—Montreal, Que., Can. Manufacturer of cables and wires.

PHILLIPS-LAFFITTE CO., THE.—Philadelphia, Pa. Manufacturer of welding flux, brazing compounds, etc. President W. Vernon Phillips; vice-president, F. Rees Phillips; secretary and treasurer, John J. H. Phillips; general manager, R. H. Nichols. Main office, Pennsylvania Bldg., Philadelphia, Pa. Factory, Paris, France. Branch office, 170 Broadway, New York, N. Y.

PHILLIPS WIRE CO.—Pawtucket, R. I. Manufacturer of bare and insulated wire and cable. Business established 1892. President, H. F. Bassett; secretary, B. S. Hawkins; treasurer and general manager, H. O. Phillips; sales manager, W. F. Field.

PHLEXARM.—Trade name for flexible arm for portable lamps manufactured by S. Robert Schwartz & Bro., 729-31 Broadway, New York, N. Y.

PHOENIX.—Trade name for a-c. motors manufactured by the Phoenix Electric Co., Mansfield, Ohio.

PHOENIX ELECTRIC CO.—Mansfield, Ohio. Manufacturer of a-c. motors. Business established 1889. President, A. C. Linzee; sales manager, C. J. Blair.

PHOENIX GLASS CO.—Pittsburgh, Pa. Manufacturer of portable electric lamps and illuminating glassware. President, T. H. Howard; vice-president, A. H. Patterson; secretary and treasurer, E. P. Eberts. Main office, Federal Reserve Bank Bldg., Pittsburgh, Pa. Factory, Monaca, Pa. Branch offices, 161 Summer St., Boston, Mass.; 1521 Garland Bldg., Chicago, Ill.

PHOENIX HARDWARE MFG. CO.—49-53 Illinois St., Buffalo, N. Y. Manufacturer of armatures, armature winding, testing and taping machines, chains, clamps, vises and other hardware specialties. Business established 1885. President, A. Z. Gerlitz; vice-president, E. W. Gerlitz.

PHOENIX LIGHT CO.—525 Market St., Milwaukee, Wis. Manufacturer of portable electric lamps, lighting fixtures, fixture fittings and parts. Business established 1899. President, Joseph Sable; vice-president, D. Sable; secretary, H. R. King; treasurer, A. M. Rodems; sales manager, A. G. Nygren.

PHOENIX SPECIALTY MFG. CO.—48-50 Duane St., New York, N. Y. Manufacturer of gaskets, washers and other metal specialties. President and secretary, A. W. Wagenseller; vice-president and treasurer, L. R. L. Wagenseller.

PHON-ARM.—Trade name for telephone bracket and telegraph sounder box bracket

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made by the Cleveland Phone-Arm Co., 1265 W. 2nd St., Cleveland, Ohio.

PHONO-ELECTRIC.—Trade name for wire manufactured by the Bridgeport Brass Co., Bridgeport, Conn.

PHONOGRAPH APPLIANCE CO., THE.—174 Wooster St., New York, N. Y. Manufacturer of mica products. Business established 1913. J. L. Frazee, owner.

PHONOGRAPH LIGHTS.—See Lights, phonograph.

PHONOGRAPH MOTORS.—See Motors, phonograph.

PHONOGRAPH MOTORS CORP.—341 N. Crawford Ave., Chicago, Ill. Manufacturer of motors. Business established 1916. President and general manager, J. M. Johnson; vice-president, H. A. Sanderson; secretary, H. G. Saal; sales manager, H. T. Skillin.

PHONOGRAPHS, MOTOR-DRIVEN.—In these phonographs the rotating disk or table is directly connected to the shaft of an electric motor, or the regular spring-wound motor, which is automatically rewound by a small electric motor, is employed. The electric motor is automatically started and stopped by a mechanical device controlled by the arm which supports the diaphragm. The motors used in these phonographs are especially designed for quiet running and uniform speed.

Manufacturers:

Aeolian Co., The, 29 W. 42nd St., New York, N. Y.
Arion Mfg. Co., 250 Devonshire St., Boston, Mass. "Arionola."
Columbia Graphaphone Co., Woolworth Bldg., New York, N. Y. "Columbia Grafonola."
Edison, Inc., Thomas A., Belmont Ave., Orange, N. J.
Electric Phonograph Co., Kalamazoo, Mich. (Coin operated.) "Automatic."
Endless Graph Mfg. Co., The, 4200 W. Adams St., Chicago, Ill. "Fairy." (Combined with lamp.)
Kurtzmann Phonograph Co., Inc., 700 Main St., Buffalo, N. Y. "Kurtzmanola."
Lakeside Supply Co., 416 S. Dearborn St., Chicago, Ill. "Electrophone."
Lampagraph Co., 320 Republic Bldg., Chicago, Ill. ("Lampagraph" combination lamp and phonograph.)
Ohio Electric Works, 6304 Ellen Ave., Cleveland, Ohio.
Pathe Freres Phonograph Co., 20 Grand Ave., Brooklyn, N. Y. "Pathe."
Racine Phonograph Co., Inc., Racine, Wis.
Victor Talking Machine Co., Camden, N. J. "Victor Autoxophone," "Victor Electrola."

PHONOLAMP.—Trade name for electric phonograph lamp manufactured by the Electric Phonograph Corp., 4132 Park Ave., New York, N. Y.

PHOSPHOR BRONZE INGOTS, RODS, SHEETS, WIRE, ETC.—This alloy is made of copper, tin and phosphorus. The tin content is about 8 to 12%, the phosphorus seldom more than 2%, the exact proportions depending upon the quality of alloy desired. Its general properties are high resistance to corrosion, high tensile strength and hardness. It is largely used in rod, sheet or wire in machinery, apparatus, and in locations where it is exposed to corrosive liquids or gases, as in mines or near salt water, etc.

Manufacturers:

Bridgeport Brass Co., Bridgeport, Conn.
Electrical Alloy Co., The, Morristown, N. J.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand"
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.
Seymour Mfg. Co., The, Seymour, Conn.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
United American Metals Corp., Brooklyn, N. Y.

PHOSPORESCENCE.—The condition of giving light without appreciable heat, as by means of phosphorus. This occurs in the animal and vegetable kingdom, but man so far has not been able to produce the so-called "cold light," that is light without at the same time producing considerable heat, which in most cases is an unavoidable accompaniment but nevertheless a waste of energy.

PHOSPHORUS.—An element occurring in several allotropic forms. Symbol P; at. wt. 31; m. p. 30° C.; b. p. 287° C. Ordinary phosphorus is a pale yellow translucent, waxy solid at ordinary temperatures, but brittle when cold. Its vapor is extremely poisonous. Its principal uses are in making poisons and matches, particularly safety matches. The chief method of production is an electric furnace method, and is carried on at Niagara Falls. Boneash and calcined calcium phosphate or calcined wavellite are mixed with carbon and sand and heated to a high temperature in a gas-tight arc furnace. The charge is heated by radiation from an arc between two electrodes. The phosphorus is reduced from the charge, distills off and is collected.

PHOT.—The C. G. S. unit of illumination is one lumen incident per square centimeter. The name "phot" has been proposed for this unit, which is equivalent to 10,000 lux. One millilumen per square centimeter, called a milliphot, is a derivative of this unit, since it equals 0.001 phot.

PHOTOENGRAVING AND PHOTOGRAPHIC LAMPS.—See Lamps, blueprinting, photoengraving and photographic.

PHOTOGRAPHIC PRINTING MACHINES, ELECTRIC.—There are several types of these machines suitable to the varied character of this work. The essential parts of these machines are a light source, usually one or several carbon arc or mercury arc lamps mounted in a frame, together with various holders, control devices, switches, etc. Such work as printing in the rotogravure process, motion-picture film and ordinary commercial work is done by various types of these machines.

Manufacturers:

Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill. "Standard Cinemachinery."
Burke & James, 240 E. Ontario St., Chicago, Ill. "Rexo."
Cameragraph Co., Kansas City, Mo. "Cameragraph."
Gelb Co., Joseph, 512 W. 36th St., New York, N. Y. "Spectro."
Prizma, Inc., 71 W. 23rd St., New York, N. Y.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

PHOTOGRAPHING MACHINES, ELECTRIC, AUTOMATIC.—Certain laboratory instruments instead of reading on a scale to indicate the measurement, photograph the movement of the needle or indicator. These photographic devices are particularly used in such instruments as the oscillograph and electrocardiograph where an exact record of the instantaneous variations of the indicator is desired or where the movement of the indicator is too small or too rapid for sight reading. The photographing machine usually includes a device for continually exposing a photographic film to light thrown as an image from the indicating device. The film is usually reeled from spool to spool by driving one of the spools with a small synchronous motor which, because of its known definite speed, is suitable for such work. Mirrors, magnifying lenses, etc., may be included in the photographic outfit. Machines for taking motion or progress pictures of physical or other interesting scientific phenomena have been built but are as a rule special and applicable to one purpose only.

Manufacturers:

Gelb Co., Joseph, 512 W. 36th St., New York, N. Y. "Spectro."
Hindle, Charles F., 45 Spring St., Ossining, N. Y. "American."
Prizma, Inc., 71 W. 23rd St., New York, N. Y.

PHOTOLITE.—Trade name for adjustable lamp stand for photographic studio lighting manufactured by the Nela Specialties Division, National Lamp Works of G. E. Co., Nela Park, Cleveland, Ohio.

PHOTOMETERS, LABORATORY.—Instruments for laboratory use to measure the candlepower or intensity of any source of light. This is done by comparison with a light source of known candlepower. A device called a photometer screen is placed between the known and unknown light and the point where there is an equal amount of light from both of the light sources is carefully determined by observation of the screen, as the sources are moved relatively to the screen. The relative candlepowers of the two sources are then inversely as the square of the distance of each source from the screen. A number of varieties of screen are used and the arrangement of the apparatus and the details of the methods followed in the various photometers are quite different.

The simple bar photometer is often used to measure candlepower in one direction only. This has the standard lamp at one end of the bar and the lamp being compared at the other. The screen is moved along the graduated bar until the illumination is balanced. Sphere photometers are also used for candlepower measurement. The lamp to be measured is placed at the center of a large sphere, the inside of which is painted flat white. The values obtained in this method are proportional to the mean spherical candlepower or to the total lumen output of the lamp. Other photometers, such as the flicker photometer, are used for the comparison of differently colored lights. In the flicker photometer the basis for comparison is that each light, though of different color, will produce light sensations equally intense for the purpose of distinguishing outlines. Some of the photometer types used are the Lummer-Brodhun, Weber, Bunsen, Matthews integrating photometer, etc.

Manufacturers:

Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Precision photometers of the Reichsanstalt type, with all accessories for candle-power measurements by means of the Lummer Brodhun sight box. The latter can be provided with the Kingsbury flicker attachment for matching lamps of different colors. In combination with the precision photometer, integrating spheres can be furnished for measurement of mean spherical candlepower of incandescent lamps.—Adv.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)

PHOTOMETERS, PORTABLE.—An instrument for measuring the intensity of light at a given point, so equipped as to be portable to the degree desired. The principle employed is the same as that employed in laboratory photometers, (see Photometers, laboratory) but accuracy is sacrificed for convenience and portability. The standard lamp and means of moving it along its scale are usually provided with a cover in the shape of a tube or box. The portable photometer is generally used in measuring the foot-candle illumination falling on a certain plane, although these results can be calculated in candlepower by multiplying by the square of the distance from the test surface to the source of light. The usual arrangement is to have the light to be measured fall on a test plate of glass, and the brightness of this test plate is balanced against the brightness of the plate in the photometer, which is illuminated by a known source of light in the photometer. Current is usually supplied to the photometer lamp by dry batteries. It is necessary to have an accurate instrument to measure the amount of current flowing through the test lamp, or the voltage supplied to the test lamp, in order that the photometer lamp give the proper predetermined amount of light, otherwise the indications of the photometer are worthless. Several types of portable photometer, being designed to measure illumination, are called illuminometers. The foot-candle meter is a special type of portable photometer made so as to be used and read with special ease. For this type see Foot-candle meters.

Manufacturers:

Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "Sharp-Millar."
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. The Macbeth Illuminometer is a complete portable photometer employing a Lummer Brodhun cube for the intensity match. With it, illumination and candlepower measurements can be readily made, as well as measurements of relative surface brightnesses. Illumination intensities from a small fraction of a foot-candle to several thousand foot-candles can be readily measured. Color filters can be provided for measurement of illumination

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from different sources of light, which ordinarily do not match the comparison standard lamp in the instrument. A reference standard is provided so that the user can at all times check his measurements.—Adv.

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.

PHYSICAL VITALIZER.—Trade name for electrotherapeutic apparatus manufactured by Adon Products, Inc., 516 5th Ave., New York, N. Y.

PHYSICS.—The science of dealing with the inanimate natural forces of the universe that produce motion or other phenomena without affecting the composition of the forms of matter involved. It was formerly called natural philosophy; as science developed, however, the field was found to be too broad to be included under one title and various branches, as astronomy, biology, chemistry, geology, etc., were separated as distinct sciences. Physics now includes principally the study of mechanics, heat, electricity, light and sound, but excludes any phenomena involving chemical action. It is sometimes called the science of matter and motion.

PIANO LAMPS.—See Lamps, piano.

PIANO MOTORS CORP.—5 S. 3rd St., Camden, N. J. Manufacturer of motor drive equipment for pianos. Business established 1919. President, Stanley S. Cramer; vice-president, Frank S. Rodan; secretary and treasurer, J. J. Leinmiller; sales manager, G. W. Gorman.

PIANOLITE.—Trade name for portable electric lamps manufactured by the Franks Mfg. Co., Rock Island, Ill.

PIANOS, ELECTRICALLY OPERATED.—Player pianos are now frequently being operated by a small universal motor, usually of 1/6 or 1/4 hp., instead of the fatiguing foot-pedal method. They are largely used in the finest player pianos where their smooth uniform running is especially desirable as it does not detract from the music by noisy operating mechanism nor from the appearance of the instrument, as it can be entirely concealed within the body. The motor operates the pneumatic action so that the same music rolls and player mechanism (without the pedals) are used.

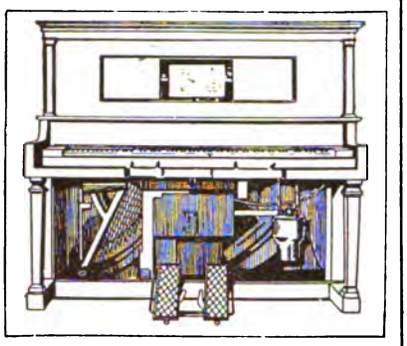
Manufacturers:

Aeolian Co., The, 29 W. 42nd St., New York, N. Y.
Cable Co., The, 301 S. Wabash Ave., Chicago, Ill. "Euphona."
French & Sons Piano Co., Jesse, New Castle, Ind.
Kimball Co., W. W., 308 S. Wabash Ave., Chicago, Ill. "Kimball."
Lagonda Piano Co., New Castle, Ind.
Link Piano Co., Inc., 183 Water St., Binghamton, N. Y. "Link."
Lyon & Healy, 245 S. Wabash Ave., Chicago, Ill. "Lyon & Healy."
National Piano Mfg. Co., Grand Rapids, Mich. "National."
North Tonawanda Musical Instrument Works, North Tonawanda, N. Y.
Operators Piano Co., 16 S. Peoria St., Chicago, Ill. "Coinola."
Poole Piano Co., Cambridge, Mass.
Seeburg Piano Co., J. P., 419 W. Erie St., Chicago, Ill.
Waltham Piano Co., Becker Ave. & 1st St., Milwaukee, Wis.
Watson Music Co., St. Joseph, Mo.
Wurlitzer Mfg. Co., The Rudolph, North Tonawanda, N. Y. "Wurlitzer."

PIANOS, MOTOR DRIVE EQUIPMENT FOR.—Motor drive has recently been applied to player pianos to replace pedal bellows operation. The equipment, which can be readily attached directly to the pneumatic system of the piano, consists of a small motor, usually of the universal type, with a suction fan directly connected to it. The whole unit is completely enclosed in an aluminum or similar casing and is generally suspended by straps to prevent vibration being transmitted to the piano case. The outfit does not interfere in any way with the operation of the piano either manually or by means of the pedals. It includes a control switch and automatic rewind arrangement.

Manufacturers:

MOTOR PLAYER CORP., 536 Lake Shore Drive, Chicago, Ill. The "Electora" motor player is designed to operate all makes of player pianos. It is easily installed and very dependable in every particular. Its use eliminates the manual labor of pumping the player piano by foot. The "Electora" has a universal type motor, which operates equally



"Electora" Motor Player

efficiently on either direct or alternating current. It runs smoothly and without noise, is well housed, and built for durability. The equipment includes a sensitive expression lever, which permits the most delicate shadings of tone as required, an automatic reroll device and automatic stop, also all accessories necessary for making any installation complete.—Adv.

Piano Motors Corp., 5 S. 3rd St., Camden, N. J. "Motora."
Yeager & Co., Inc., H. W., 154 N. 11th St., Philadelphia, Pa. "Aerex."

PICK MFG. CO., RICHARD.—224 N. Wells St., Chicago, Ill. Manufacturer of lamp filaments, contact points and molybdenum wire.

PICKERING GOVERNOR CO., THE.—Portland, Conn. Manufacturer of engine governors.

PICKERS, ELECTRIC, PEANUT AND OTHER NUT.—The function of the peanut picker is to facilitate the picking of foreign substances, such as dried peanut vines and sticks, from the peanuts. The actual picking is done by hand, the machine serving only to spread the peanuts uniformly over a conveyor belt and carry them continuously in front of the operator. The same or similar machine can be used for picking and assorting other nuts, such as chestnuts, hazel nuts, etc.

Manufacturer:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.

PICKS, POLE AND TRACK DIGGING.—A tool used for breaking ground in construction and maintenance of power lines, street car and interurban lines, etc. The tool consists of a long handle, on the end of which is mounted a double-pronged steel tool. Both ends or prongs may be pointed or one pointed and the other wedge-shaped.

Manufacturer:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

PICKS, TAMPING.—A pick used for forcing the ballast material under the ties in a track. Such picks have a blunted and enlarged end so shaped that when the pick is brought down it will exert a powerful force in pushing the ballast material under the tie.

PICKUPS, TROLLEY WIRE.—A device used to pick up the broken end of a live trolley wire without danger to the operator. The usual form consists of an insulated handle with a hook or grip, which can be made to engage the trolley wire without the operator coming in contact with the live wire. Several feet of rope are provided so that the wire can be drawn up over a tree limb or other convenient object and tied out of harm's way. It is customary to carry these devices on the line wagons and on many railway properties each car is equipped with one of them.

Manufacturers:

BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "St. Louis."
OHIO BRASS CO., THE, Mansfield, Ohio. A live, broken trolley wire is handled safely with an O-B trolley wire pickup.—Adv.

PICO.—Trade name for insulating varnishes, paper, tape and other insulating material manufactured by the Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa.

PICTURE MACHINES, MOTION.—See Motion-picture machines, motor-driven, miniature; Motion-picture machines, motor-driven, standard.

PICTURE PROJECTING LAMPS.—See Lamps, projecting and stereopticon.

PIEDMONT ELECTRIC CO.—Electrical Bldg., Asheville, N. C. Manufacturer of motor-driven churns, ice cream freezers, etc. Business established 1902. President and general manager, William Farr; secretary, F. O'C. Fletcher; treasurer, Harmon Miller.

PIERCE, BUTLER & PIERCE MFG. CORP.—282 James St., Syracuse, N. Y. Manufacturer of gages and valves. President, J. T. Dwyer; secretary, C. F. Bennett; general manager, W. S. Affleck.

PIERCE CO., THE WILLIAM B.—Buffalo, N. Y. Manufacturer of boiler-tube cleaners and flue gas analysis instruments. President, C. S. Davis; vice-president, M. C. Davis; secretary and treasurer, Leo Shire. Main office and factory, 45 N. Division St., Buffalo, N. Y. Branch office, Grand Central Palace, New York, N. Y.

PIERCE FUSE CORP.—Buffalo, N. Y. Manufacturer of renewable cartridge and plug fuses. Business established 1917. President and general manager, William N. Pierce; vice-president, P. S. Klees; secretary, George Clinton, Jr.; treasurer, F. A. Meyer; sales manager, E. M. Coffin. Main office and factory, 752 Main St., Buffalo, N. Y. Branch offices, 39 Cortlandt St., New York, N. Y.; 1017 Race St., Philadelphia, Pa.; P. O. Box 1401, Pittsburgh, Pa. Sales representatives, Doherty Hafner Co., 618 W. Jackson Blvd., Chicago, Ill.; Baker-Joslyn Co., San Francisco, Cal.; Los Angeles, Cal.; Seattle, Wash.

PIERCE FUSE CORP. OF CANADA, LTD.—8 Lewis St., Bridgeburg, Ont., Can. Manufacturer of renewable fuses. Business established 1919. President, William N. Pierce; vice-president, F. A. Meyer; secretary and general manager, B. C. Candee; treasurer, F. A. Meyer.

PIERCE OIL CORP.—New York, N. Y. Manufacturer of lubricating oils. President, H. Clay Pierce; vice-presidents, C. A. Pierce, Eben Richards, W. La Wagner, B. L. Winchell; secretary, J. L. Spear; general manager, G. A. Steele. Main office, 25 Broad St., New York, N. Y. Branch offices, 420 Olive St., St. Louis, Mo.; Boyle Bldg., Little Rock, Ark.; Pierce Bldg., Oklahoma City, Okla.; Waggoner Bldg., Fort Worth, Tex.; Pierce Bldg., Dallas, Tex.; Alamo Bank Bldg., San Antonio, Tex.; Pierce Bldg., Houston, Tex.; Simon Bldg., Shreveport, La.

PIERSEN MFG. CO., THE.—700 E. 8th St., Topeka, Kans. Manufacturer of telegraph transmitters, farm lighting and power plants and gasoline engines. Business established 1912. President, Edwin H. Piersen; vice-presidents, Lauren E. Conger and Paul B. Sweet; secretary and treasurer, William H. Metzdorf; sales manager (motor department), H. L. Taite.

PIGNOLET, LOUIS M.—78-80 Cortlandt St., New York, N. Y. Manufacturer of ammeters, voltmeters and voltammeters. Business established 1900. General manager, William Mikulas.

PIGOT, SAYRE CO., THE.—17 Battery Pl., New York, N. Y. Manufacturer of lubricating oils and greases. President and treasurer, Joseph N. Pigot; vice-president, C. N. Pigot; secretary, M. Stout.

PIGTAILS AND FLEXIBLE LEADS.—A pigtail is a flexible connection of braided copper wire used to connect electrically a carbon brush to the brush holder of a motor or generator. Flexible leads then complete the circuit from the brush holder to the machine terminals. The pigtails are not covered with insulation, while the flexible leads are. Cable of extreme flexibility is required, as the brushes are often shifted, and it has a large cross section as the current carried may be large. In cases of exceptionally large currents, two or more cables in parallel may be used as the leads. Flexible leads are also used to carry the current to tilting type electric furnaces or other apparatus of large current rating for which flexible connections are required.

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Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
MORGANITE BRUSH CO., INC., 519 W. 38th St., New York, N. Y. "Battersea."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
New England Electrical Works, Lisbon, N. H.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PIKE POLES.—See Poles, pike.

PILASBRASGO.—Trade name for illuminating glassware manufactured by the Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.

PILERS, LUMBER, MOTOR-DRIVEN.—An effective means of saving labor in lumber yards is by means of motor-driven lumber pilers that pile up or stack the lumber with a minimum of handling. In the western lumber yards they are known as "pilers," while in the central and eastern yards of the United States they are more commonly called "stackers." (For further details and manufacturers, see Stackers, lumber, motor-driven.)

PILLARS, STREET, FOR UNDERGROUND CABLE, POLICE AND FIRE-ALARM BOXES, ETC.—These pillars are hollow metal columns for supporting fire or police-alarm boxes, underground cable-testing stations, etc. The columns, usually placed in residential districts, are generally more or less ornamental. Alarm boxes are sometimes mounted on street-lighting or power poles, but this is not considered good practice by some municipal authorities, as the proximity of the high-voltage lighting or power circuits on the poles may be the cause of trouble in the low-voltage circuits.

PILLEY PACKING & FLUE BRUSH MFG. CO.—606-10 S. 3rd St., St. Louis, Mo. Manufacturer of steam packings and boiler tube cleaners. President, L. B. Shultz; secretary, M. P. Shultz.

PILLING & SON CO., G. P.—23rd & Arch Sts., Philadelphia, Pa. Manufacturer of medical batteries.

PILLIOD LUMBER CO., THE.—Swanton, Ohio. Manufacturer of electricians' tool chests. President, L. N. Pilliod; vice-president, F. E. Pilliod; secretary, L. L. Pilliod; treasurer and general manager, T. J. Pilliod.

PILLOWBLOCK.—The metal box or housing which supports the bearing for a journal. It is commonly separable, being held together by bolts, so that the bearing may be adjusted as to tightness, renewed or otherwise treated as desired.

PILOT.—Trade name for leather belting manufactured by the Webb Bros. Belting Co., Kansas City, Mo.

PILOT LAMP.—A small lamp often mounted on a remote or distant control switchboard and other similar locations, to indicate whether circuits are alive or dead. Lamps behind red lenses or bull's eyes are generally used to indicate live circuits and green for dead circuits. Small pilot lamps are being used to an increasing extent in connection with heater circuits, for ranges, flatirons, etc., to indicate when the current is on.

PILOT LAMP RECEPTACLES.—See Receptacles, heater, indicating or pilot lamp.

PIN, POLE.—A name given to the pin which is next to the pole on the cross-arm. Each crossarm has two pole pins in a telephone or telegraph line (unless it is a side arm) and may have several others. It is merely a term used to designate the position of the various lines on a crossarm.

PINCH EFFECT.—The phenomenon which occurs when a heavy current is sent through a liquid conductor. It tends to narrow down the cross-section of the conductor, and finally to squeeze or pinch it down until it breaks the circuit. When this happens, the liquid rushes together again, and the phenomenon is repeated. It occurs particularly in induction furnaces, where melted metal lies in a groove or gutter, and very heavy currents are sent through. It is an electromagnet effect, the parallel elements of current attracting each other and thus squeezing the conductor towards its center. The existence of this centripetal or squeezing force has been experimentally demonstrated by suitably arranged pressure gages.

PINCO.—Trade name for porcelain insulators manufactured by the Porcelain Insulator Corp., Lima, N. Y.

PINES MFG. CO.—208 N. Wabash Ave., Chicago, Ill. Manufacturers of wire terminals and other hardware and automobile specialties. President, Charles A. Pipenhagen.

PINIONS.—A small gear wheel, usually operated with a larger gear for speed reduction. See Gears and pinions (eight types).

PINS, CHANNEL BONDING.—Channel bonding pins are used on steam railways and some street railways for connecting the bonding wire or cable to the rail. Where the current carried is very large, however, it is necessary to have a welded joint. These pins are therefore most widely used for signal systems on steam railways. The pin is tapered throughout its length with an extra taper on the point. It has a deep circular groove or longitudinal channel just the size of the bond wire to be used extending the entire length. The wire or cable is inserted in the groove and the pin is then driven into the hole in the rail which is slightly smaller than the pin. The pressure and the wedge action cause the wire to be tightly gripped in the groove and the outside of the pin makes a good contact with the rail.

Manufacturers:

American Mine Door Co., The, Canton, Ohio. "Economy."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, CLAMP.—This form of pin is used in connection with a cross-arm strap or clamp by which the pin is bolted in place on the side of the cross-arm. The pins are made of iron or steel with channel or similar cross-section to give them greater rigidity. They are formed and drilled in various sizes to fit the standard types of wood and iron or steel cross or side arms and small standard pipe and are made for either high or low-voltage service.

Manufacturers:

DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Insulator pins, cement head and stud types, for upright, inverted and 45° mounting either on pipe or flat surface. See display advertisement on page 1261.—Adv.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, COMPOSITE METAL AND WOOD.—A form of pin made up of two parts, a steel pin or bolt which passes through the crossarm and is bolted to it, and an oak cob which is mounted on the steel pin. The steel pins are made with long shanks for wooden crossarms or with short shanks for use with transposition brackets and on angle steel arms. This type of pin is most used on telegraph and railway signal lines.

Manufacturers:

EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, IRON AND STEEL.—Iron and steel pins are resorted to where conductors are very heavy, where a high voltage requires extra length and where the tension of the line is extra heavy. When made of malleable iron they are arranged to encircle the crossarm as a clamp pin, the clamp being held by bolts. Steel rod is used as the base in many cases in order to permit the use of a ⅝ or ¾-in. hole in the arm instead of the 1½-in. hole used with wood pins, thus saving some of the strength of the arm. Stability against bending is secured by making the portion above the arm in the form of a saddle resting on the top of the arm. The pin is held secure by a nut and washer on the under side. The insulator is cemented to the pin before erection or is attached by screwing it to the top of the pin after erection. In the latter case a threaded thimble is cemented into the insulator.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Ajax."
Eastern Malleable Iron Co., The, Naugatuck, Conn. (Malleable iron.) "Beardsley."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.



Keystone Truss Pin

Keystone truss pins consist essentially of a ribbed malleable iron thimble. They are made for use on various sizes of wood and metal cross-arms and other pole top equipment. Keystone truss pins, by virtue of their form of construction, give the greatest possible strength because a strain applied to the groove of the insulator places the bolt in tension. In addition, it allows the assembly of the bases complete on the cross-arms before the cross-arms are erected, the insulators to be applied after all other work is completed.—Adv.

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover," "Electrose."
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Galvanized Products Co., First St., Phillipsburg, N. J.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Son., Mathew, Pittsburgh, Pa.

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LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
PARKER & SON, INC., J. H., Parkersburg, W. Va.
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Nebraska."
St. Louis Screw Co., Clarence & Bulwer Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas," "Lee."
Threadless Pipe Fittings Corp., Newark, N. J. Exclusive distributors, Rubino & Liebstein, Newark, N. J.)
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, MINE.—These insulators are particularly adapted to fastening to the timbers or other supports used in mine lines. They may be specially designed to conform with the peculiar requirements of mine construction due to excessive moisture, gases. etc.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio. "Efficiency."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Mountain Lumber & Supply Co., Mount Union, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, POLE TOP.—Pole top insulator pins are fastened directly to the top of the pole by through bolts and used for supporting a single wire above the pole top. Steel pipe, angle iron or channels are the common forms of the material used in their construction. They are commonly used on lines of moderately high voltage. Wood pins for this construction are used chiefly for telephone service.

Manufacturers:

Cottage Planing Mill Co., Everett, Pa.
Eastern Malleable Iron Co., The, Naugatuck, Conn. "Beardsley."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th & Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
McGlauflin Mfg. Co., Petaluma, Cal.
Mountain Lumber & Supply Co., Mount Union, Pa.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
United States Hardware & Mfg. Co., 16 Warren Ave., Pawtucket, R. I.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PINS, INSULATOR, WOOD.—Insulator pins are preferably of locust, though elm, oak and other woods are used as substitutes where necessary. Locust is durable and retains its strength longer than the crossarm as a rule. The wood must be straight-grained and free from dry rot or large knots. Wood pins are used very generally for distribution lines, the usual length being 9 ins. and the diameter at the pin hole 1½ ins. They have a straight cylindrical portion that fits into the crossarm, with a shoulder and tapered portion above which extends to the threaded portion at the top.

Manufacturers:

AMERICAN LINE MATERIALS CO., 1461 McCormick Bldg., Chicago, Ill.
Carolina Cross Arm Co., Inc., P. O. Box 122, Elkin, N. C.
Cook Tie & Pole Co., Commercial Trust Bldg., Philadelphia, Pa.
Cottage Planing Mill Co., Everett, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.
Locust Pin Co., Front Royal. Va.
Lord & Co., Lee H., Box 693, Peoria, Ill.
Mountain Lumber & Supply Co., Mount Union, Pa.
McGlauflin Mfg. Co., Petaluma, Cal.
National Pin & Bracket Co., North Vernon, Ind.
Newport Pin Mills, Newport, Pa.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Ette."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas," "Max-Son."
United States Hardware & Mfg. Co., 16 Warren St., Pawtucket, R. I.
Western Electric Co., New York.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Williams Cypress Co., Ltd., F. B., Patterson, La.

PINTITE.—Trade name for rigid shaft couplings manufactured by the Penntroy Corp., Troy, Pa.

PIONEER.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

PIONEER.—Trade name for storage batteries and safety lanterns manufactured by the Pioneer Storage Battery Co., 1415 Race St., Philadelphia, Pa.

PIONEER CORP., THE.—1255 W. 63rd St., Chicago, Ill. Manufacturer of luminous switch plates, attachments for switch buttons, etc. Business established 1899. President and treasurer, A. M. Hannan; secretary R. B. Hannan.

PIONEER STORAGE BATTERY CO.—1415 Race St., Philadelphia, Pa. Manufacturer of storage batteries and safety lanterns. Michael Marks, sole owner.

PIPE ANCHORS.—Pipe fittings that correspond to the ordinary guy-wire anchor, used to prevent endwise movement. Particularly suitable for use with pipe railings or other pipe supports set in concrete.

Manufacturer:

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. This anchor is made of malleable iron, galvanized; and is so constructed that the concrete will flow through its walls, so that when installed it does not weaken the cross section of the concrete. Two sizes are furnished, for ⅜ and for ½ in. pipe tap.—Adv.



Concrete Pipe Anchor

PIPE BENDERS AND BENDING MACHINES.—See Benders, conduit and pipe, portable; Bending machines for large conduit and pipe.

PIPE, BRASS AND COPPER.—Both brass and copper piping have been used to a limited extent for boiler-room service, brass for connecting the feed main with the boiler drum and copper more commonly in marine work where its flexibility made its use advantageous. Such pipe is also used for various other purposes, particularly where rust and corrosion make iron pipe unsuitable. It is made in the standard iron pipe sizes.

Manufacturers:

Chase Rolling Mill Co., 236 Grand St., Waterbury, Conn.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Midwest Brass & Copper Co., 480 Broome St., New York, N. Y.
Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa.
United Lead Co., 111 Broadway, New York, N. Y.
Walworth Mfg. Co., Boston, Mass.
Wheeler Condenser & Engineering Co., Carteret, N. J. "Crescent."
Wolverine Tube Co., Detroit, Mich.

PIPE CAPS.—See Caps, ground pipe.

PIPE CLAMPS.—See Clamps, conduit and pipe hanging.

PIPE COUPLINGS, NIPPLES AND UNIONS.—See Conduit couplings, nipples and unions.

PIPE CUTTERS.—See Cutters, pipe and conduit.

PIPE DIES.—See Dies, pipe thread cutting.

PIPE FITTINGS.—See Fittings, pipe, for air, steam, water, etc.

PIPE HANGERS AND HOOKS.—See Hangers, conduit and pipe; Hooks, pipe and conduit.

PIPE, HIGH PRESSURE, POWER PLANT.—Mild steel pipe, lap or butt welded for higher pressures, is used in the average steam power plant. Wrought iron which seems to have a longer life in service than the mild steel is also used but to a more limited extent. Cast steel, which is not affected by temperature variations to the same extent as mild steel, is sometimes used for headers carrying highly superheated steam. Wrought iron and mild-steel pipes are sold in standard sizes. Those most commonly used in power plants are designated as standard, full-weight, large O. D., extra heavy and double extra heavy. Pipes larger than 12 ins. are designated by their actual outside diameter. Extra heavy and double extra heavy have the same external diameter as the standard pipe but have a greater thickness and consequently lower inside diameter.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Spiral Pipe Works, W. 14th & S. 48th Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
McAvity & Sons, Ltd., T., St. John, N. B., Can.
National Valve & Mfg. Co., Arsenal Station, Pittsburgh, Pa. "Navco."
Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Whitlock Coil Pipe Co., Hartford, Conn.

PIPE MACHINERY CO., THE.—930 E. 70th St., Cleveland, Ohio. Manufacturer of pipe cutting, threading and tapping machines.

PIPE, MISCELLANEOUS, POWER PLANT.—Cast-iron pipe is extensively used for power plant service particularly for water service and sanitation and other low pressure work. Riveted pipes made of thin sheets of boiler steel, with seams either longitudinal and circumferential, or spiral are commonly used for low pressures or large diameters. Wrought iron and mild steel pipes, discussed more fully under Pipes, high pressure, are also used for miscellaneous service.

Manufacturers:

American Spiral Pipe Works, W. 14th & S. 48th Ave., Chicago, Ill.
Cox, J. Fillmore, Bayonne, N. J.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
McAvity & Sons, Ltd., T., St. John, N. B., Can.
McMann & Taylor Co., 104 John St., New York, N. Y.
National Pipe Bending Co., The, River & Lloyd Sts., New Haven, Conn. (Bends.)
National Valve & Mfg. Co., Arsenal Station, Pittsburgh, Pa. "Navco."
Walworth Mfg. Co., Boston, Mass.

PIPE TAPLETS.—Trade name for conduit fittings manufactured by the H. T. Paiste Co., Philadelphia, Pa. Exclusive

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distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

PIPE TAPS.—See Taps, threading or pipe.

PIPE-THAWING OUTFITS.—See Thawing outfits, pipe, complete electric; Transformers, pipe-thawing.

PIPE VISES.—See Vises, pipe or conduit.

PIPE WRENCHES.—See Wrenches, pipe.

PIPER CO., LTD., THE HIRAM L.—75 St. Remi St., Montreal, Que., Can. Manufacturer of marine lamps, reflectors, lanterns and supplies. Business established 1902. President, James Carruthers; vice-president, H. L. Piper; secretary and treasurer, F. E. Portions; general manager, R. H. Piper.

PIPES, GROUND.—Galvanized iron pipe is used for ground connections where water-pipe connections cannot be secured. Pipe is preferable to rod because of the increased area of contact for a given weight of metal. One-half, three-quarter and one-inch pipe are used for transformer secondary grounds as a rule. Where one pipe does not give a suitably low resistance it is better to use several than to increase the size of the pipe. The pipe is usually driven about 8 ft. into the soil.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. on page 1278.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PIPING, BOILER ROOM.—Power plant piping is to the steam power plant what the electrical conductors are to the distributing system. The piping systems are divided according to their use. For example, there are the high-pressure, low-pressure and exhaust steam piping systems, the high and the low-pressure water pipe systems, the oil piping system for lubrication and the compressed air piping system.

The different pipings should be distinguishable by standardized colors as recommended by the A. S. M. E. All pipes leaving one room or floor to another and passing through walls, should be stenciled and tagged. All valves, etc., should be tagged and stenciled so that identification is quick and sure.

The use of higher steam pressures and temperatures of superheat call for the use of steel instead of cast and wrought iron pipe. Welded joints are taking the place of flanges and gaskets and more generous provision must be made for contraction and expansion. Another tendency is to install remote controlled valves, operated either by electric motor or hydraulic valve; chain control is a compromise for long-distance control. As boilers and turbines increase in capacity, it is becoming more and more the custom to segregate units, apportioning boilers, steam lines and turbines as a unit. This somewhat complicates piping but makes for reliability.

High fuel prices make heat insulating coverings for all pipes carrying heat almost imperative. Live steam pipes should be covered, as should also feed-water heaters and feed lines, boiler drums, etc. Exhaust steam and hot water lines, and condensate returns should also be covered. Pipe fittings, valves, flanges, etc., should also be covered. These things waste much heat. Pipe covering having long life is properly protected against damage due to mechanical injury, water and oil. Pipe coverings generally pay for themselves in one year while they improve the performance of the plant.

PIQUA HANDLE & MFG. CO., THE.—Piqua, Ohio. Manufacturer of handles and wood turnings. President, William C. Rogers; vice-president, A. M. Leonard; secretary and treasurer, C. H. Barnett. Main office, Piqua, Ohio. Factories, Piqua, Ohio; Marquette, Mich.; Osceola, Ark. Branch office, 18 Broadway, New York, N. Y.

PITCH, COMMUTATOR.—The number of commutator segments of an electric machine passed over in going from one segment through a coil to the next segment that is joined to the winding.

PITCH FOR ELECTRICAL PURPOSES.—Pitch occurs naturally as asphalt or is obtained artificially in the distillation of coal tar and similar products. Both forms are used for insulating compounds, for sealing dry batteries, in the manufacture of weatherproof wire, for sealing storage batteries, filling screw holes in backs of switchboards and panelboards and covering live parts of electrical fittings.

Manufacturers:

Barrett Co., The, 17 Battery Pl., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
INTERNATIONAL PAINT CORP., ST. LOUIS, MO. "Inco Insulite." (See display adv. page 1320.)
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill. "Sarco."
Standard Varnish Works, 90 West St., New York, N. Y.

PITCH, WINDING.—The distance measured around a machine armature from one active conductor to the next one in series with it. This distance may be measured in electrical degrees, in percentage of 180 degrees or by the number of active conductors passed over. Since the pitches at the two ends of the armature are very often different, one is cal'ed the front pitch and the other the back pitch. In commutating machines, the commutator end of the armature is called the front. A number of different rules govern the selection of winding pitches for different kinds of windings.

PITT.—Trade name for folding gates manufactured by the William R. Pitt Composite Iron Works, 548 W. 27th St., New York, N. Y.

PITT COMPOSITE IRON WORKS, WILLIAM R.—548 W. 27th St., New York, N. Y. Manufacturer of electric car gates. Business established 1880. President and treasurer, William R. Pitt; secretary, H. M. Coomes.

PITT ENGINEERING CO.—120 W. Kinzie St., Chicago, Ill. Manufacturer of electric elevators, hoists and controlling devices. Business established 1908. President and general manager, A. A. Pitt; vice-president, William Pitt; secretary, treasurer and sales manager, R. I. Phillips.

PITTROIL.—Trade name for insulating, transformer and lubricating oils manufactured by the William C. Robinson & Son Co., 32 South St., Baltimore, Md.

PITTSBURG.—Trade name for insulators manufactured by the Pittsburg High Voltage Insulator Co., Derry, Pa.

PITTSBURG HIGH VOLTAGE INSULATOR CO.—Derry, Pa. Manufacturer of insulators and insulator accessories. Business established 1905. President, H. P. Davis; vice-president, E. M. Herr; secretary, treasurer and general manager, C. M. Semler; sales manager, C. D. Byers.

PITTSBURGH.—Trade name for rigid metallic conduit made by the Enameled Metals Co., 61 Bridge St., (Etna) Pittsburgh, Pa.

PITTSBURGH.—Trade name for electric irons, lamps, automobile spotlights, vacuum cleaners and other electrical specialties manufactured by the Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y.

PITTSBURGH.—Trade name for transformers manufactured by the Pittsburgh Transformer Co., Columbus & Preble Aves., Pittsburgh, Pa.

PITTSBURGH.—Trade name for splicing compound manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PITTSBURGH CARBON BRUSH CO.—Pittsburgh, N. S., Pa. Manufacturer of carbon brushes. President, R. F. Hansen.

PITTSBURGH-DES MOINES STEEL CO.—Pittsburgh, Pa. Manufacturer of steel tanks for power plants, steel plate construction, etc. President, E. W. Crellen; secretary and treasurer, W. H. Jackson. Main office, 404 Ross St., Pittsburgh, Pa. Branch offices, New York, N. Y.; Des Moines, Iowa; Dallas, Tex.; San Francisco, Cal.; Chicago, Ill.; Washington, D. C.; Chatham, Ont., Can.

PITTSBURGH ELECTRIC FURNACE CORP.—714 Union Bank Bldg., Pittsburgh, Pa. Manufacturer of electric furnaces. President, Frank Wright; vice-president and sales manager, E. A. Wilcox; secretary and treasurer, J. L. Cawthon, Jr. Sales representatives, R. D. Thomas & Co., Philadelphia, Pa.; J. M. Bloke, Erie, Pa.; Ambler & Bratt, Seattle, Wash.; Coast Equipment Co., San Francisco, Cal.; Sutor & Co., Los Angeles, Cal.; A. W. Henry, St. Louis, Mo.

PITTSBURGH ELECTRIC SPECIALTIES CO.—New York, N. Y. Manufacturer of electric irons, vacuum cleaners, automobile spotlights and other electrical specialties. Business established 1910. President, W. D. Uptegraff; vice-president and general manager, Max Harris; secretary, D. H. Shoemaker; treasurer, T. Jones; sales manager, William L. Loeb. Main office, 451-453 Greenwich St., New York, N. Y. Factories, New York, N. Y.; Pittsburgh, Pa. Branch office, Columbus Memorial Bldg., Chicago, Ill.

PITTSBURGH ELECTRICAL & MACHINE WORKS, THE.—1-3 Barker Pl., Pittsburgh, Pa. Manufacturer of panelboards, switchboards, switches, etc. Business established 1896. President, treasurer and general manager, C. Schuster; secretary, F. A. Schuster. Sales representatives, Williams-Beasley Co., 53 W. Jackson Blvd., Chicago, Ill.; R. R. Piper Engineering Co., Cincinnati, Ohio.

PITTSBURGH GAGE & SUPPLY CO.—30th St. & Liberty Ave., Pittsburgh, Pa. Manufacturer of electrical household specialties. Business established 1893. President, W. L. Rodgers; vice-presidents, E. J. Checkley and R. F. Blair; secretary, C. B. Barton; treasurer, J. G. Reuter.

PITTSBURGH INSULATING CO.—96-100 43rd St., Pittsburgh, Pa. Manufacturer of insulating varnishes, paper, cloth, tape, etc. President, Philip F. Norvell; vice-president, Richard F. Norvell; secretary, Clifton F. Schmidt, Jr.

PITTSBURGH LAMP BRASS & GLASS CO.—Pittsburgh, Pa. Manufacturer of illuminating glassware and portable lamps. President, W. L. Curry; secretary, treasurer and assistant general manager, W. S. McNaugher; general manager, Nichols Kopp; sales manager, H. A. Ross. Main office, 607 Chamber of Commerce Bldg., Pittsburgh, Pa. Branch offices, 17 N. Wabash Ave., Chicago, Ill.; 35 23rd St., New York, N. Y.; 816 Arch St., Philadelphia, Pa.; 127 Federal St., Boston, Mass.; Mezzanine Maclead Gas Light Bldg., St. Louis, Mo.; 321 Charles St., Denver, Colo.; 1322 Commerce St., Dallas, Tex.; 327 Broadway Market Bldg., Detroit, Mich.; 428 Grand Ave., Milwaukee, Wis.; 122 W. Baltimore Ave., Baltimore, Md.

PITTSBURGH METAL SPINNING & STAMPING CO.—821-823 Locust St., Pittsburgh, Pa. Manufacturer of lighting fixtures, fixture fittings and parts, metal spinnings and stampings, etc. Business established 1915. President, E. R. Cochran; secretary, M. L. Gross; treasurer, J. C. Weinberger. Sales representatives, N. W. T. Knott, 164 Federal St., Boston, Mass.; Baker-Smith Co., Rialto Bldg., San Francisco, Cal.

PITTSBURGH REFLECTOR & ILLUMINATING CO.—Pittsburgh, Pa. Manufacturer of lighting fixtures and reflectors. Business established 1912. President, Charles F. Over; vice-president, E. W. Utzler; secretary, treasurer and general manager, E. S. Simons; sales manager, J. J. McParland. Main office, 3rd & Ross Aves., Pittsburgh, Pa. Factory, Irwin, Pa. Branch office, 565 W. Washington St., Chicago, Ill. Sales representatives, Myers & Schwartz, 75 New Montgomery St., San Francisco, Cal.

PITTSBURGH STEEL TUBE CO.—Beaver, Pa. Manufacturer of boiler tubes and seamless steel tubing. Main office and factory, Beaver, Pa. Branch offices, Woolworth Bldg., New York, N. Y.; Moffat Bldg., Detroit, Mich.

PITTSBURGH TRANSFORMER CO.—Pittsburgh, Pa. Manufacturer of transformers and transformer parts. Business established 1897. President, R. V. Bingay; secretary, S. M. Johnston. Main office and factory, Columbus & Preble Aves., Pittsburgh, Pa. Branch offices and warehouses, 525 Hudson Terminal Bldg., New York, N. Y.; 724 Harris Trust Bldg., Chicago, Ill.; 601 Electric Bldg., Buffalo, N. Y. Sales representatives, Rumsey Electric Co., Philadelphia, Pa.; Verne W. Shear & Co., Akron, Cleveland and Youngstown, Ohio; Eicher & Bratt, Seattle, Wash.; Electric Supply & Equipment Co., Charlotte, N. C.; Piper Engineering Co., Cincinnati, Ohio; General Machinery Co., Birmingham, Ala.; W. L. Rose Equipment Co., St. Louis, Mo.; J. F. Schaefer & Co.,

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Kansas City, Mo.; Triumph Electric Co., Minneapolis, Minn.; R. M. Cass, Indianapolis, Ind.; Herr-Rubicam Supply Co., Denver, Colo.; Iron City Electric Co., Pittsburgh, Pa. Wetmore-Savage Co., Boston, Mass.; F. R. Jennings Co., Detroit, Mich. F. H. Boyer, Des Moines, Iowa.

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.—Pittsburgh, Pa. Manufacturer of pipe fittings, valves, steam separators, etc. President, Charles A. Anderson; vice-president and sales manager, James D. Robertson; vice-president and general manager, J. Roy Turner; secretary and treasurer, Samuel G. Patterson. Main office and factory, Pittsburgh, Pa. Branch offices, New York, N. Y.; Philadelphia, Pa.; Chicago, Ill.; Cleveland, Ohio.

PITTSBURGH WHITE METAL CO.—Pittsburgh, Pa. Manufacturer of solder and babbitt metal. Business established 1882. President, M. C. Rinehart; vice-president, E. E. Rinehart; secretary and sales manager, F. J. Murphy; treasurer, Harold Roberts. Main office, 3116 Penn Ave., Pittsburgh, Pa. Branch offices, 160 Leroy St., New York, N. Y.; 136 Pearl St., Boston, Mass.

PITTSFIELD MACHINE & TOOL CO.—Pittsfield, Mass. Manufacturer of electric washing machines. Business established 1915. President, William Shillaber, Jr.; secretary, Walter C. Reed; treasurer, Philip W. Goervey; sales manager, Samuel W. Phelps.

PIVOTS, FOR METERS AND INSTRUMENTS.—The pivots of instruments, due to their very small bearing surface must, despite the extreme lightness of the rotating parts which they carry, withstand stresses beyond the crushing point of ordinary steel. Such pivots are therefore made of steels of very high strength and designed to carry the load with the least friction and wear on the pivot and bearing. The pivot may be formed as a part of the bearing shaft or a small detachable pivot fastened to the shaft by a sleeve may be used.

Manufacturers:

Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Koch & Sons, A. S., Lancaster, Pa.

PL.—Trade name for street-lighting bracket manufactured by J. P. Hebendahl Co., 228-232 Broadway, Elizabethport, N. J.

P-L.—Trade name for oilless bearings manufactured by the Massachusetts Oilless Bearings Co., 518 Main St., Worcester, Mass.

PLANERS, MOTOR-DRIVEN.—The motor is mounted as an integral part of the metal planers and is connected to the driving mechanism of the planers by direct coupling, gears or belting. The motor is usually of the d-c. type and is extremely flexible in speed variation. The operation of the motor and planer is entirely automatic. An automatic panel is furnished with the motor which performs the necessary steps to furnish suitable operation of the complete equipment. The machine is started forward at a slow speed while the tool is cutting the material; as soon as the cut is finished, the carriage strikes a stop on the platen which actuates a switch and the motor is stopped almost immediately; the contactors on the panel operate and reverse the direction of rotation of the motor, at the same time decreasing the strength of the motor field so that the planer returns much more rapidly than it advanced. The return stroke is usually three times the cut stroke. When the carriage strikes a stop on the return another switch is actuated and the operation is repeated.

Manufacturers:

Pratt & Whitney Co., 111 Broadway, New York, N. Y.
Pratt & Whitney Co. of Canada, Ltd., Dundas, Ont., Can.
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill. "Ryerson-Conradson."
Whitcomb-Blaisdell Machine Tool Co., 53 Franklin St., Boston, Mass.

PLANERS, MOTOR-DRIVEN, BENCH AND PORTABLE.—Much time is lost in woodworking shops in waiting in turn to use the large machines and carrying work to and from these machines. With a view to saving some of this lost time bench machines which are capable of handling small work are employed. These machines are similar in essential cutting machinery to the larger machines but are on a smaller scale and mounted in a frame suitable for mounting on the work bench. Saws, planers, and jointers are made in this bench or portable form, the cutting knives and saws being directly driven by a small electric motor mounted in the frame of the machine.

Manufacturers:

Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y. "Crescent."
Wallace & Co., J. D., 1401 W. Jackson Blvd., Chicago, Ill. "Wallace Universal."

PLANERS, MOTOR-DRIVEN, FLOOR AND DECK.—Where a perfectly smooth surface is desired as on ship decks, dance floors, etc., the floor is planed smooth by a special machine planer. These planers are motor-driven, semiportable machines utilizing knives of the form commonly used in large stationary wood planers.

Manufacturers:

Power & Co., L., 20 S. 23rd St., Philadelphia, Pa.
Wagner Machine Works, F., Laurel Hill, N. Y. "Wagner."

PLANERS OF WOODS.—Trade name for motor-driven grinders and other tools manufactured by the S. A. Woods Machine Co., 27 Damrell St., Boston, Mass.

PLANETLITE CO., INC.—15 E. 40th St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1920. President, treasurer and general manager, M. A. Elias; vice-president, A. A. Morck; secretary and sales manager, H. Gardner.

PLANIMETERS.—An instrument for accurately measuring the areas of plane figures. The commonest form of planimeter, the polar planimeter, consists of two legs jointed with points at their ends, one of which is fixed and the other, the tracer, is moved over the diagram. At their juncture is a small shaft with a rolling wheel whose axis is in the vertical plane of the tracing arm. A cylindrical section with a graduated scale is read from a fixed vernier scale. A worm screw and index wheel indicate the number of revolutions of the wheel. The reading on the scale denotes the net amount of lineal travel of the circumference of the wheel. The amount of the rotation of the wheel and the length of the arm from pivot to tracing point, determine the area of the surface traced by the pointer. The accuracy of this instrument is dependent largely upon the accuracy with which the wheel registers the distance traversed which in turn depends upon the surface over w[hich] the wheel is rolling. To increase the accuracy of these instruments the polar type is sometimes so modified that it includes its own specially prepared surface. Another type, called a roller planimeter, has only the tracing point in contact with the surface. The tracing arm is pivoted and is attached to a rolling carriage on which is mounted a device controlled by the carriage rollers and the tracing arm in such a way as to measure the area traversed in essentially the same manner as the polar type but with greater accuracy as the instrument is independent of the character of the surface over which it rolls. These planimeters are largely used in obtaining the mean ordinate of recorder charts and the area of indicator card and dynamometer diagrams. In the electrical field, planimeters are also used in the analysis of current and voltage waves obtained by using the oscillograph, and other laboratory or research work.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Crosby Steam Gage & Valve Co., Boston, Mass. "Amsler."
Foxboro Co., Inc., The, Foxboro, Mass.
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Robertson & Sons, James L., 78-80 Murray St., New York, N. Y. "Improved Willis."
Star Brass Mfg. Co., 53 Oliver St., Boston, Mass.
Thompson & Co., Richard, 187 Greenwich St., New York, N. Y.

PLANT.—In the electrical and manufacturing industries the term "plant" is used to refer to the buildings and the equipment, including machinery, fixtures, etc., used in producing any commodity, whether this be some form of service, as electric light and power, or a definite article, as an automobile. An electrical generating station is frequently referred to as a power plant. In a commercial sense, the term plant may also include real estate, in fact, any physical or tangible property used in making the product except raw materials and stock, finished or in process.

PLANT EFFICIENCY.—The ratio of the energy delivered to that received by a plant.

PLANT ENGINEERING & EQUIPMENT CO., INC.—192 Broadway, New York, N. Y. Manufacturer of steam traps and separators. President, Courtenay R. Rothwell; vice-president and general manager, Theodore Haight; secretary and treasurer, S. J. Connell.

PLANT-FACTOR.—The ratio of the average load to the rated capacity of the power plant, that is, to the aggregate ratings of all the generators installed.

PLANTE' PLATES.—The original type of plates for lead storage batteries, in which the necessary lead peroxide and spongy lead are formed on a lead plate by repeated electrolysis or, in later "forming" processes, by the addition of nitric acid or other agent to hasten the action. Various schemes have been devised for increasing the surface of the plate by ridges, grooves, etc., in order to increase the amount of active material available. This type of plate is more expensive and heavier than the "pasted" or Faure plate and has been practically superseded by the latter. Also see Faure plates; Batteries, storage.

PLANTS, CREOSOTING.—See Creosoting Plants.

PLANTS, FARM LIGHTING.—See Farm lighting and power plants.

PLANTS, PORTABLE, LIGHTING AND POWER.—Portable lighting plants are built to furnish light and power for contractors, traveling circuses or other shows, temporary theaters and dance halls, military camps and works, summer resorts, etc. Their motive power is usually a gasoline or kerosene engine; however, for construction or other work where steam is available, steam engines or turbines are occasionally used. The generators are generally shunt or compound-wound d-c. machines. Compound-wound machines simplify the controlling apparatus as they do not need a field rheostat for ordinary work. Control apparatus for these plants is as simple as is commensurate with their duty. The switchboard may contain only a pilot lamp, fuses, and switches, although a rheostat, ammeter, and voltmeter are sometimes included. Water cooling is generally used on the gasoline and kerosene engines. The plants are compactly mounted on a single base. For portability the base may be mounted on skids or a truck.

Manufacturers:

A-C Electrical Mfg. Co., The, U. B. Bldg., Dayton, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ashbrook Electric Co., 4111 Ravenswood Ave., Chicago, Ill. "Ashbrook."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Carlton, Young & Catlin, Inc., Grand Central Palace, New York, N. Y. "C-Y-C."
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."
Cushman Motor Works, 932 N. 21st St., Lincoln, Nebr. "Does More."
Eli Bridge Co., Inc., Jacksonville, Ill. "Big Eli."
Engberg's Electric & Mechanical Works, St. Joseph, Mich.
EVERLITE CO., 928 S. 3rd St., Minneapolis, Minn. (See display adv. page 1321.)
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Great Lakes Electric Mfg. Co., 11-17 S. Desplaines St., Chicago, Ill.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."
Holt Farm Light Co., Toledo, Ohio. "Holt."
Kewanee Private Utilities Co., Kewanee, Ill. "Kewanee."
Lalley Light Corp., Detroit, Mich.
Langstadt-Meyer Co., Appleton, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Lister & Co. (Canada), Ltd., R. A., 58 Stewart St., Toronto, Ont., Can. "Lister-Bruston."
Lucey Mfg. Co., Woolworth Bldg., New York, N. Y. "Turbolite."
Matthews Engineering Co., Sandusky, Ohio. "Matthews Full Automatic," "Little Husky."

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Merritt Co., S. W., 133rd St. at 12th Ave., New York, N. Y.
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill. "Perfection," "Jupiter."
Reliable Tractor & Engine Co., Portsmouth, Ohio. "Reliable Heer." (also welding)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Willys Light Division of the Electric Auto-Lite Corp., Toledo, Ohio. "Willys Light."

PLAS-MICA CO., THE.—26th St. & Andrews Place, Yonkers, N. Y. Manufacturer of commutator cement.

PLASTIC-ARC.—Trade name electric welding equipment manufactured by the Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y.

PLATE WARMERS.—See Warmers, plate or dish.

PLATES, BATTERY.—Primary battery plates are seldom furnished separately from the complete cell. Certain renewal parts of primary cells, such as zinc rods or zinc electrodes of other forms are supplied but these are seldom in plate form. For zinc renewals see Zincs, battery.

The principal types of battery plates that are furnished separately are those for lead type storage batteries. The positive plates frequently deteriorate more rapidly than the negative lead plates and consequently are replaced before the negatives. Sometimes a battery which has had its positive ones renewed may require a renewal of negatives. Storage battery plates are furnished in sizes and types to correspond to the standard makes produced by the various manufacturers and renewal plates should preferably be purchased from the original manufacturer. Some manufacturers make a specialty of producing lead plates in large quantities for use by smaller manufacturers of storage batteries.

Manufacturers:

"Ads-it" Battery Mfg. Co., 825 Hennepin Ave., Minneapolis, Minn.
Alberta Battery Co., Ltd., 420-22 9th Ave., E., Calgary, Alta., Can. "A B C."
Ashbrook Electric Co., 4111 Ravenswood Ave., Chicago, Ill. "Ashbrook."
Atlas Electric Storage Battery Co., Greenville, Mich.
Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."
Campbell Electric Co., 1529 Wyandotte St., Kansas City, Mo.
Carlisle & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C & D."
Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y. "Champion."
Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill.
Edes Mfg. Co., The, Water St., Plymouth, Mass.
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C.
Ferry Mfg. Co., 2113 S. 4th St., St. Louis, Mo.
Gold Seal Storage Battery Co., Green Bay, Wis. "Gold Seal."
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Heissler Storage Battery Co., 2506-10 Cottage Grove Ave., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex. "Captor."
Star Storage Battery Co., 309-313 N. Jefferson St., Muncie, Ind.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
Universal Battery Co., 3410-3424 S. LaSalle St., Chicago, Ill. "Universal."
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."

PLATES, BLANK.—These plates are made to cover unused switch or receptacle boxes, where the box has been installed for future use or is no longer in use. The plates are made of the same size and materials as the standard plates for flush switches and are drilled with holes for the supporting screws.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."

PLATES, CANOPY BASE.—A form of raised brass or other plate used with certain types of fixtures. The canopy of the fixture, instead of fitting directly onto the ceiling or wall, fits into the canopy base which is mounted on the ceiling. This plate is sometimes also called a shell.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, CARBON RHEOSTAT.—These are rectangular or round plates for use in compression type carbon rheostats Their size and thickness depends on the current carrying capacity of the rheostat. If a wide range of resistance is desired, a large number of plates is used since most of the resistance is in the variable contact surface of the plates which is changed by applying more or less pressure at the ends of the stack. For the round plates used with compression graphite rheostats see Disks, graphite resistance; for other resistance carbons see Carbons, resistance.

PLATES, CEILING AND WALL OUTLET.—Stamped steel plates, without sides, having a number of knockouts provided for conduit or flexible tubing, and designed to be used where the conditions will permit a device of this sort to be used in place of the regular outlet box, as on unplastered walls or ceilings, and especially where nonmetallic conduit (flexible fabric tubing) is employed. The fixture is supported by a fixture stud and the plate concealed by the regular canopy.

Manufacturers:

Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Colgan Co., W. H., West Newton, Mass. "Rex."
COLLINSON-HOLLAND CO., 253 Medford St., Malden, Mass. Algor BX type for old and new work, straight electric and combination, fitted with the special Algor cable clamps, which provide the perfect terminal bushing and clamp for BX or flexible steel cable installations. The Algor cable clamps fulfill three Underwriters' requirements: 1—Securely mechanically hold end of cables. 2—Thoroughly electrically bond armor of cables. 3—Perfectly bush end of cable and fully protect insulation.—Adv.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Kunlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Michigan Stamping Co., Detroit, Mich.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Sterling Mfg. Co., 1014 Chestnut St., Erie, Pa. "Ideal."
Walworth Mfg. Co., Boston, Mass.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

PLATES, COMBINATION HEATER CONTROL.—Combination heater control receptacles include a pilot lamp or a switch or both. The plates for these receptacles are flat plates usually of brass, drilled for the proper screw holes, pilot lamp or bull's eye, and with a hole for the plug which may be provided with a hinged cover. The plate also covers the push-button or rotary snap switch, if one is included. For the receptacles used with these plates see Receptacles, heater, indicating or pilot lamp.

Manufacturers:

Bryant Elctric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

PLATES, COMBINATION, MISCELLANEOUS.—These plates are made in the same manner as the standard types of receptacle or switch face plates, but are made up as one plate to cover any combination of the standard fittings. The plates are made for any method of grouping of the standard switches or receptacles, as in horizontal gangs or rows, or vertical or tandem rows, or special combination gang and tandem. Other special combinations are occasionally required.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

PLATES, COMBINATION SWITCH AND RECEPTACLE.—Occasionally one or more attachment-plug receptacles and control switches are mounted in the same switch or outlet box or in a gang box. Metal plates, usually brass though sometimes steel, are provided for covering the switch and receptacle. The plates are made for standard push, rotary or toggle switches and for screw-plug receptacles or receptacles to receive standard or special plug caps. Sometimes, as in the case of a heater receptacle, an indicating or pilot lamp is provided between the switch and the receptacle. Also see Receptacles, heater, indicating or pilot lamp.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, END, SWITCH BOX, CUT-OUT BOX, ETC.—A form of flat plate made to fit snugly in the end of switch box and distributing cabinets for adapting the box to the type of wiring or number of circuits entering the box. They are made in blank forms for closing either end and in plates with knockouts for conduit or with multiple hole porcelain outlet covers for open wiring installations.

Manufacturer:

SQUARE D CO., 1400 Rivard St., Detroit, Mich. (See display adv. pages 1279-81.)

PLATES, FIXTURE.—A term applied to stampings having the general form of flat or embossed plates which are used on fixtures. The plates may be used in place of canopies for supporting bracket arms and concealing the outlet on wall brackets or in place of ceiling canopies. In this case the plate usually supports the several chains of a shower fixture. Another form of plate is used on some of the fixtures made up of an inverted bowl surrounded by several pendent or drop lights. This plate, really a ring form, in this case acts as a holder for the semi-indirect bowl and as a support for the pendent lamp.

Manufacturers:

Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont., Can.
American Pin Co., The, Waterbury, Conn. "Ampinco."
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Best Electric Corp., 476 Broadway, New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. "600."
Faries Mfg. Co., Decatur, Ill.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio.
Friedley-Voshardt Co., 733-737 S. Halsted St., Chicago, Ill.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.

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Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

PLATES, FLOOR OUTLET. — Face plates for covering floor outlet boxes in which are mounted receptacles for attachment plugs. The joint between the plate and box is usually made with a gasket to exclude moisture and dirt. The plate may be provided with a tight fitting hinged or threaded cover to protect the interior from moisture and dust when the receptacle is not in use. In some cases, a metal bell-shaped protective cover fits over the attachment-plug cap and screws into the face plate in the floor.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."

PLATES FLUSH PUSH-BUTTON.—Push buttons are often installed with flush plates for remote-control switches or for signaling circuits. In either case only a single button is used and many times the mechanism is merely that of an ordinary surface type push button for a door bell, but arranged for flush mounting. The face plates are made in square and rectangular forms and also in special forms. Sometimes buttons are installed in a row or gang and a single plate is used for all of them. This form is frequently used on a desk where the plate is set flush with the surface of the desk near the edge; gang plates are also arranged for wall mounting. These plates are made up and finished like flush switch plates.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Build-Craft Electric Mfg. Co., 37-39 Maspeth Ave., Brooklyn, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, FLUSH RECEPTACLE.—Metallic face plates for covering attachment-plug receptacles mounted in flush outlet boxes in walls, baseboards, etc. The receptacles are made in several forms; see Receptacles. The plates for covering these several types are therefore of several forms. Some have hinged covers, lids or doors to keep dust and dirt out of the receptacle when the plug is removed. Others have only two bushed holes in the plate where the prongs of the plug can enter, but the majority have circular openings that permit the receptacle surface to come flush with the plate surface. Duplex receptacle plates are made with or without covers. All types are supplied for gang receptacles also and are finished in the same way as flush switch plates.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, FLUSH SWITCH.—These are face plates for covering flush switches of the rotary, push-button or toggle types mounted in flush switch boxes. The plates are generally made of brass, either cast solid with the edges beveled or stamped from thin sheet brass to give the same appearance. They are finished in various ways with brush brass the most widely used, some of the other more common finishes being white enameled, nickel-plated, oxidized copper and polished brass. Flush switches are often mounted in gang switch boxes, having two, three, four or more switches adjoining. Single plates are made up to cover the entire gang of switches, thus having a much better appearance than separate plates in a row and permitting a closer spacing of the switches. These are known as two-gang, three-gang, etc., plates and are made to conform to the single switch plates in design and finish. They are generally arranged for horizontal mounting, but in some cases have a vertical or tandem arrangement.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Banfield & Sons, Ltd., W. H., 370-86 Pope Ave., Toronto, Ont., Can.
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Cavin, F. T., 400 W. Ave. 26, Los Angeles, Cal. "Cavin."
Gaynor Mfg. Co., The, Bridgeport, Conn
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hubbell, Inc., Harvey, Bridgeport, Conn.
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. "Lumo-Vitro." (Porcelain enameled.) (See display adv. pages 1276-1277.)
Machen Electric Mfg. Co., 4639-43 E Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave. Pittsburgh, Pa. "Steel City."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, FLUSH, TELEPHONE.—Face plates having small bushed holes for telephone cords intended for covering special telephone outlet jacks in wals or baseboards, for convenience in making temporary telephone connections near desks or tables in hotel, club and restaurant dining and lounging rooms, etc. They are used with portable telephones that are plugged in at the extension outlet nearest to where the guest or other called party happens to be dining or resting.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PLATES, GROUND.—Where excavation is easy a ground plate is sometimes used instead of a pipe. The plate must have at least 4 sq. ft. of surface exposed to the soil and may be of iron or copper, the latter being more reliable and less liable to corrosion. The plates are surrounded by coke or charcoal to secure low resistance. Copper plates are required to be at least No. 16 Stubbs gage in thickness and cast iron plates at least 0.25 inch.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Burn Boston Battery & Mfg. Works, 80 Boviston St., Boston, Mass.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PLATES, HOT, HOUSEHOLD AND PORTABLE.—Small electric stoves, usually portable, having one or more electrically operated heating units in the form of disks mounted in low frames and controlled by switches giving one or more degrees of heat. They are usually made with one or two burners. These plates are used in small kitchens for preparing food and for similar uses to which small stoves are put.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hughes." (See display adv. pages 1292-1293.)
ESTATE STOVE CO., THE, Hamilton, Ohio. "Estate."
Globe Stove & Range Co., The, Kokomo, Ind. "Globe."
Kneeland Mfg. Co., Inc., The, 216 N. Main St., Wethersfield, Conn.
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PLATES, HOT, MISCELLANEOUS.—Electrically heated units mounted individually and controlled by switches giving one to three degrees of heat, intended for general use, such as for wax, chocolate or glue melters, or in special forms for specific uses in the arts. They are often used in manufacturing processes where it is desired to moderately heat a material before cutting or forming it and for many other similar purposes.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric hot plate is used in laboratories and for other places where a heating surface of large area and fairly high temperature is required. Maximum surface temperature approximately 600° F. Made in six sizes from 8x12 ins. to 18x30 ins., furnished with a

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5-ft. cord and three heat porcelain plug and receptacle switch for series multiple connection.—Adv.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Electric Heating Apparatus Co., 18-34 Nesbitt St., Newark, N. J. "Multiple-Unit," "Hevi-Duty."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Dodge."
Reimers Mfg. Co., 513 W. 50th St., New York, N. Y.
Rutenber Electric Co., Marion, Ind. "Rutenber."
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PLATES, LUMINOUS SWITCH.—Face plates for flush switches provided with a coating of special paint to render them luminous in the dark. Instead of covering the entire plate with the luminous compound a small luminous spot only is often provided on the plate. They are particularly useful in residences when walls may be marred by unsightly finger prints around the plate unless some such means of readily locating the plate is provided.

Manufacturers:

American Luminous Products Co., Huntington Park, Cal.
Cold Light Mfg. Co., 18th & Blake Sts., Denver, Colo.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill. "Eradium Luminous."
Radium Luminous Material Corp., 58 Pine St., New York, N. Y. "Undark."

PLATES, NAME.—See Name plates for machinery, appliances, etc.

PLATES, PANELBOARD MOUNTING.—Backing plates on which are mounted the various branch-circuit switches used in panelboard assembly of the dead-front type.

Manufacturers:

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.

PLATES, POLE BUTT OR HUB, STRAIN, ETC.—The butts of wood poles are subject to damage by wagon hubs at corners and on much traveled thoroughfares. A wrought iron plate of ⅜-inch stock attached to the pole by spikes or lag screws is often used as a protection to the pole. These are sometimes called butt plates or hub guards. Where strain guys are fastened around a pole the latter is also protected by strain plates.

Manufacturer:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

PLATES, RAIL JOINT.—The plates used in a rail joint to hold the ends of two adjacent rails in the proper relation to each other. These plates are made in a great variety of forms, a considerable number of which have certain special features covered by patents. Joint plates are sometimes referred to as joint bars or, due to the shape of the bars most frequently used on standard tee rail sections, as angle bars. (Also see Joints, rail.)

Manufacturers:

Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont., Can.
Handlan-Buck Mfg. Co., 212 N. Third St., St. Louis, Mo.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PLATES, SEALING.—A small brass ring or plate which is used in certain conduit fittings for vaporproof lamps. In connection with a receptacle they seal the opening in the fitting so that gas or vapor cannot enter when the globe is removed or broken.

Manufacturers:

Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Standard Fibre Co., 11 Miller St., Somerville, Mass.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

PLATES, SWITCH ADAPTER AND ADJUSTER.—A device by which, if the outlet or switch box is not set so as to bring the switch or receptacle even with the outer surface of the plaster, the desired adjustment may be readily made without disturbing the box or plaster. It usually includes an arrangement or screws by which the ends of the switch may be raised or lowered in the box.

Manufacturers:

Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

PLATES, TIE, ELECTRIC RAILWAY.—The plate, usually of metal, placed between the rail and the supporting ties, chiefly to protect the latter from cutting by the rail. Such plates are offered in a great variety of forms, many of which have certain special patented features. It was formerly quite common to use a tie plate that not only separated the rail and tie but also had a brace supporting the head of the rail. This necessitated a different type of plate for each kind of rail. The present tendency would seem to be away from this type of plate and toward plates that can be used on all rails having the same width of base. Such plates do not have the brace against the rail head but are either flat plates or have only a slight ridge near one side that can be placed against the edge of the rails to resist the tendency of the rails to shift outward or "spread." Such plates are generally referred to as shoulder tie plates.

Manufacturers:

Atlas Railway Supply Co., 1526 Manhattan Bldg., Chicago, Ill. "Atlas."
Handlan-Buck Mfg. Co., 212 N. Third St., St. Louis, Mo.
Inland Steel Co., 1st National Bank Bldg., Chicago, Ill.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
St. Louis Frog & Switch Co., St. Louis, Mo.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

PLATFORM, CABLE SPLICER'S.—This is the same as a cable car, except that it is larger and is adapted to the greater amount of material which a cable splicer must have within reach.

PLATFORMS AND BALCONIES, POLE.—Small platforms or seats attached to a telephone pole for the use of repairmen on cable boxes or cable terminal houses of any kind. When it has a back or a guard around it, it is termed a "balcony." Platforms and baconies are supported by special braces and in some cases where a large one is required two poles are placed close together and the platform supported between the two.

Manufacturers:

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Lanz & Son, Mathew, Pittsburgh, Pa.
Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.

PLATING.—The very extensively used process of electrically depositing a thin coating of one metal on another. See Electroplating; also Electrogalvanizing.

PLATING EQUIPMENT.—See Electroplating equipment.

PLATING GENERATORS.—See Generators, electroplating and electrolytic.

PLATINIZED PLATINUM ELECTRODES.—Electrodes of platinum upon which spongy or finely divided platinum has been deposited, giving them a rough surface. Such are found to act more intensely in absorbing hydrogen, or performing catalysis, or in liberating gases, than smooth, polished electrodes.

PLATINUM.—A grayish white metal, very malleable and ductile; not easily oxidized and not attacked by most acids Symbol Pt; at. wt. 194.8; sp. gr. 21.3; m. p. 1755° C. It occurs associated with other metals, usually in very small amounts Considerable is now recovered by treatment of the slimes from electrolytic refining of other metals, but the bulk comes from the platinum ores of Russia and Colombia. The world's production in 1918 was about 60,000 troy oz., less than one-fifth of the annual production before the war, due to the conditions in Russia. The average price in New York in 1919 was $114.60 per troy oz. Platinum will absorb many times its own volume of certain gases; it is valuable as a catalytic agent in a number of processes, notably the production of sulphuric acid by the contact process and in the fixation of atmospheric nitrogen. It is also used extensively in jewelry manufacture, as a material for laboratory apparatus, and as an electrode material for electrolysis.

PLATINUM BLACK.—Very finely divided platinum, which is found to be quite as inactive in resisting acids as ordinary platinum, and yet to be much more active in absorbing hydrogen and in acting catalytically. It is made chemically by precipitating a platinum salt solution by sugar, or other organic reagent; it can also be deposited by electrolysis.

PLATINUM CATHODES, CRUCIBLES ETC.—For many purposes, due to its chemical and physical characteristics, platinum is the only suitable metal. Among the most important uses of platinum is that in chemical laboratories for crucibles, dishes, etc. In physical laboratories and for other scientific purposes it also has extensive uses, as it has in much electrical apparatus and appliances. Among the latter uses are for electrolytic cathodes and anodes, for electrodes in electron, X-ray and other vacuum tubes, cautery points and sometimes for lightning rod tips, etc.

Manufacturers:

American Platinum Works, 225-231 New Jersey Railroad Ave., Newark, N. J.
Baker & Co., Inc., 54 Austin St., Newark, N. J.
Bishop & Co. Platinum Works, J., Malvern, Pa.
Holz & Co., Inc., 18 Madison Ave., New York, N. Y.

PLATINUM ELECTRODES.—Sheets, foil or wires of platinum used as electrodes, usually as anodes, in an electrolytic process. As anodes they are unattacked in conditions where many other metals are attacked; as cathodes they are conveniently cleaned by acids, for reuse.

PLATINUM SHEET, WIRE, GAUZE, ETC.—Platinum wire has been extensively used in incandescent electric lamps to lead the current through the glass, because its temperature expansion coefficient is so nearly equal to that of glass. Electrical contact points must be able to stand high temperature with very little oxidation. Platinum and platinum alloys have been found to meet these requirements very satisfactorily. It is consequently used for contact points in automotive ignition devices, induction coils, relays and for telephone apparatus. The sheet and gauze is largely used in the construction of electrodes in vacuum tubes, etc.

Manufacturers:

American Platinum Works, 225-231 New Jersey Railroad Ave., Newark, N. J.
Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.
Baker & Co., Inc., 54 Austin St., Newark, N. J.
Bishop & Co. Platinum Works, J., Malvern, Pa.
Hagstoz & Son, T. B., 709 Sansom St., Philadelphia, Pa.
Handy & Harman, 59 Cedar St., New York, N. Y. (Sheet and wire.)
Schawel & Co., James, 26 John St., New York, N. Y.
Wilson Co., The H. A., 97 Chestnut St., Newark, N. J. "Wilco."

PLATT IRON WORKS.—Dayton, Ohio. Manufacturers of feed water heaters. Branch offices, San Francisco, Cal.; Atlanta, Ga.; 53 W. Jackson Blvd., Chicago, Ill.; Boston, Mass.; Cleveland, Ohio; Philadelphia, Pa.; Pittsburgh, Pa.; New York, N. Y.

PLAUT & CO., L.—434 E. 23rd St., New York, N. Y. Manufacturers of lighting fixtures, portable electric lamps, illuminating glassware, reflectors and decorative fans.

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Partnership, Herman Plaut and Leopold Plaut.

PLAY-O-LITE CO., INC.—1760 Main St., Buffalo, N. Y. Manufacturer of piano lamps. President, Allan Fraser; vice-president, Mary R. Cass; secretary and treasurer, Charles H. Brown, Jr.

PLIA DUCT.—Trade name for non-metallic flexible conduit manufactured by the Short Electrical Mfg. Corp., Penn Yan, N. Y.

PLIA STEEL.—Trade name for flexible metallic conduit manufactured by the Short Electrical Mfg. Corp., Penn Yan, N. Y.

PLIBRICO.—Trade name for fire brick manufactured by the Jointless Fire Brick Co., 1130 Clay St., Chicago, Ill.

PLIER INSULATING SLEEVES.—Rubber or composition sleeves intended to slip over and cover the handles of electricians' pliers to protect the user against electric shock from handling live current-carrying parts. These sleeves are made to fit the common sizes of standard type pliers.

Manufacturers:

Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."

PLIER POCKETS.—For carrying pliers or other tools while at work, electricians and linemen sometimes use a leather pocket strapped to the belt. The pocket is simply a small leather case or pouch formed to fit the ordinary lineman's pliers. The back is usually slotted to accommodate the belt.

Manufacturers:

BUHRKE CO., R. H. 1238 Fullerton Ave., Chicago, Ill.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."

PLIERS, ARC LAMP CARBON.—Arc lamp carbons when in use become extremely hot and consequently to remove or adjust them requires some form of hand tool. Special forms of pliers which have jaws suitably designed for holding arc lamp carbons are usually employed.

Manufacturer:

Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.

PLIERS, CRIMPING.—These pliers are of a special design particularly suited to crimping cable rings onto the messenger or suspension strand. However, they are also used for crimping similar hangers onto wire for other than this particular use. They are commonly used on the heavier galvanized rings, which are difficult to crimp with ordinary pliers.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."

PLIERS, CUTTING.—This term is generally applied only to such pliers that are designed with special cutting edges on the jaws for cutting wire. The commonest type, side-cutting, has the blades on the side of the jaws, the tool otherwise being similar to general-purpose pliers. End-cutting pliers have cutting edges on the ends of the jaws and are used for cutting wire only. The side-cutting pliers are made in many forms for particular use in line construction, telephone switchboard work, house wiring, etc.

Manufacturers:

Billings & Spencer Co., The, Hartford, Conn.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Columbus Handle & Tool Co., The, Columbus, Ind.
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Kilborn & Bishop Co., The, Chapel & Lloyd Sts., New Haven, Conn. "Reliance."
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. See page 1259 for illustrations and other information concerning Klein products, and write for our catalog of construction tools.—Adv.
Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J. "Griptite," "Gripall," "Gripkut," "Victor."
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Mayhew."
NEVERSLIP WORKS, THE, New Brunswick, N. J. "Neverslip" side cutting pliers with renewable blades of crucible steel are made of the best drop forged steel and are so constructed that when the blades become worn out or broken, they can be removed and replaced by new ones, thus making the tool almost indestructible. The plier



"Neverslip" Side-Cutting Pliers

being made in two parts permits the manufacturer to select the best possible steel for each purpose and this has been done by making the blades of the highest grade of crucible steel, giving a tough, sharp cutting edge, while the handle or body is made of the best drop forged steel. Neverslip pliers are used by linemen, electricians, mechanics, motorists, etc.—Adv.
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Scholhorn Co., William, New Haven, Conn. "Bernard's."
Schriver Co., O. P., Cincinnati, Ohio. "IXL."
SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 1950 "Red Devil" heavy electrician plier. Made in 6, 7,



"Red Devil" No. 1950

8 and 9 in. sizes. This company also makes other kinds.—Adv.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLIERS, GAS.—Pliers having jaws curved on the inside and provided with notched or serrated surfaces intended particularly for use with pipe or tubing of small size, such as is used in gas and electric fixtures. These pliers usually have one set of notches for endwise working and one or more of different size for sidewise working. They are sometimes provided with one handle fashioned to form a screw driver.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Barcalo Mfg. Co., Buffalo, N. Y.
Billings & Spencer Co., The, Hartford, Conn.
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLIERS, INSULATED.—Electricians' pliers, the handles of which are permanently covered with insulating compound or sleeves to protect the user from shock in working on circuits. They are commonly used by linemen, service and repairmen when it is not desired to interrupt service to make minor repairs or changes in circuits.

Manufacturers:

Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Service."
NEVERSLIP WORKS, THE, Hamilton & Neilson Sts., New Brunswick, N. J.
Rubber Insulated Metal Corp., Plainfield, N. J.
SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 4950 "Red Devil" insulated plier is tested and tagged by



"Red Devil" No. 4950

the Electrical Testing Laboratories to stand 10,000 volts.—Adv.
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLIERS, INSULATION STRIPPING.—For rapidly removing insulation from wires in making joints, etc., this special form of pliers is used. It is equipped with special cutting edges which cut a length of insulation at the same time splitting the cut strip so that it may be readily removed. The cutting blades are mounted on the jaws of the pliers which are otherwise similar to the ordinary form of these tools.

Manufacturers:

Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLIERS, LONG NOSE.—Pincers or pliers having long narrow and pointed jaws for convenience in handling small or relatively inaccessible parts, such as connections, screws, etc., in telephone switchboard equipment, meters or other apparatus. Though ordinarily straight nosed these pliers are for convenience in working on otherwise inaccessible points, sometimes curved into a right-angled bend.

Manufacturers:

Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. See page 1259 for illustrations and other information concerning Klein products, and write for our complete catalog of construction tools.—Adv.
Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J. "Dreadnought."
Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Mayhew."
Peck, Stow & Wilcox Co., The Southington, Conn. "Pexto."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLIERS, MISCELLANEOUS.—These are pincers or pliers of special forms or combinations of the ordinary types to adapt them to special work. They embody various features, such as having auxiliary cutters for cutting wire, notches for piping, for stripping wire, etc. Purely special pliers are made for particular uses as heat coil pliers for removing heat coils from telephone terminals, switchboards and pliers having tapering jaws for adjusting springs on telephone switchboards, etc.

Manufacturers:

Au-to Compressor Co., The, 233 Mulberry St., Wilmington, Ohio. "Oro."
Barcalo Mfg. Co., Buffalo, N. Y.
Billings & Spencer Co., The, Hartford, Conn.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Crescent Tool Co., Jamestown, N. Y. "CeeTeeCo." "Crescent."
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.

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Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill. (Fixture chain.)
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. Klein pliers are the standard for all electricians and mechanics and are known the world over. They are made in the following styles: Side cutting, long nose, long-nose side cutting, long flat nose, long flat nose with side cutters, duck bill or weavers pliers with or without cutters, oblique cutting pliers, diagonal cutting pliers, end cutting pliers, and slip-joint pliers. All of the above are made of high grade steel, carefully tempered and closely inspected to insure the highest grade workmanship. See page 1259 for illustrations and information concerning other Klein products. Also send for our complete catalog of construction tools.—Adv.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Mayhew."
Mayhew Tool Co., Williamstown, Pa. "Link Key."
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y. "Utica."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLOW, CURRENT COLLECTING.—The collector, corresponding to a trolley wheel, used with a conduit or underground collector street-car system, to convey current to the car. Only a few such systems are in use.

PLUGALL.—Trade name for heater cord plug manufactured by the Magnus Electric Co., Inc., 109 Broad St., New York, N. Y.

PLUG AND JACK.—A very much used device in telephone work to connect a stationary conductor and a flexible one. The plug is attached to a flexible conductor and is shaped to fit into the jack and to make good contact. Most used in manual switchboards but also found in automatic work. See Plugs, telephone cord, also Jacks, telephone switchboard.

PLUGGING.—A method of braking a motor to bring it to a rapid stop by reversing the armature connections while it is still running. It is applied chiefly to d-c. series or compound motors in railway, truck, hoist and crane service. It imposes severe stresses on the motor, controller and gears and should be used in emergencies rather than in normal operation, unless the equipment is specially designed for the purpose. Also see Controllers, plugging type.

PLUGS.—In electrical uses, a plug is commonly employed as a switching or connecting device. It usually consists of an insulated part or handle to which is firmly attached one or more metallic contacts which, upon proper manipulation, complete the circuit, either from one side to the other of the plug or through the apparatus connected to the plug. Another common form is the spark plug screwed into the cylinder head of an internal combustion engine to furnish the igniting spark. Specially formed plugs are also used by electricians to close the temporarily unused ends of conduit and to attach their fish wire to flexible steel conduit when it is being installed. More detailed descriptions will be found under the individual classifications.

PLUGS, ATTACHMENT, NON-SEPARABLE.—Non-separable plugs are provided with standard Edison screw shell and center contacts mounted on bodies of insulating material and provided with terminal connections for flexible cord. They are designed for insertion in ordinary lamp sockets or receptacles to provide means for obtaining current for portable appliances, table, floor or other lamps, etc. The plugs are often made of porcelain, some having a metal protective casing, but molded insulating material is also widely used. To avoid twisting the cord when the plug is inserted or removed, swivel attachments are provided on some plugs, these consisting of a rotating sleeve or a swivel shell which is screwed into the socket without turning the body of the plug. Other plugs provide for this by having a short thread in the screw shell. Weatherproof plugs are made which have a molded body with two short pieces of rubber-covered wire securely fastened in place and extending through close-fitting holes to make the connections to the cord.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "9-0-3" Swivel." (See display adv. pages 1231-1234.)
Best Electric Corp., 476 Broadway, New York, N. Y. "Use," "Best."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Swivel Attachment Plug, (C-H 8000.) The unique construction makes a positive swivel possible. After being attached to the cord there is no possibility of the parts becoming separated when being unscrewed from the socket. See display adv. pages 1225-1230.—Adv.


C-H 8000

Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
GARFIELD MFG. CO., Garfied, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Standard." See adv. pages 1203-1223.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Magnus Electric Co., Inc., 109 Broad St., New York, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio. "Attacho."
PARKER & SON, INC., J. H., Parkersburg, W. Va.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Stuart," "Lock Fast."
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Campbell."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.
WALSH ELECTRICAL SUPPLY CO., Inc., 151 W. 18 St., New York, N. Y. This is a one-piece, solid molded plug, hot-molded under pressure, of a high heat-resistant composition, which is


Walsh Weatherproof Plug

also impervious to water or weather. Has copper screw shell, conical contact button of porcelain, and is fitted with 6-in. leads of No. 14 stranded, rubber-covered wire. Also see display adv. page 1305.—Adv.

PLUGS, ATTACHMENT, SEPARABLE.—Separable plugs are designed to be screwed into ordinary electric lamp sockets or receptacles to obtain current for portable lamps, fans, heaters or other appliances through flexible cords. The plugs are made in two parts, the cap and body; the cap carries projecting prongs or blades that can be inserted into corresponding recesses in the body portion which screws into the receptacle or socket. This affords means for opening or closing the circuit without unscrewing the plug body. There are many styles of separable plugs made, no attempt having been made to standardize their contacts until recently. The prongs or blades of the cap are generally either parallel or in tandem and for polarized plugs at right angles to each other. Porcelain and molded composition are both used for the cap and plug body; porcelain caps are very often covered with metal. Special split bushings which grip the cord and relieve the strain from the cord terminals are provided in some caps.

Separable attachment plugs have several advantages. The appliance may be plugged in by merely inserting the cap into the body and there is no bother with a twisted cord. If any violent strain is put on the cord accidentally while the appliance is connected, the plug will generally separate and prevent damage to the appliance or fixture. The caps may be used directly as plugs in receptacles having contacts that fit the blades or prongs of the cap, which is true in several standardized interchangeable types of receptacles now available.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., St. Louis, Mo. Ajax No. 33 two-piece attachment plug is ruggedly built and extensively used for household appliances. The body consists of a high heat-resisting composition, which ensures long life and permanent service.


Ajax No. 33

Bronze springs grip the prongs securely, ensuring perfect contact. The shell fits snugly into all standard receptacles. Base or cap can be supplied separately if desired, and both are designed for all well known makes of standard receptacles and attachment plugs.—Adv.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Convert-A-Cap has two pivoted parallel blades which may be turned into line and vice versa with the fingers. This adapts the cap to either parallel or line blade attachment plugs or receptacles. This line of separable plugs also includes the standard parallel blade attachment plug and the short blade separable attachment plug with cap which separates at an angle.—Adv.



Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The arrangement of outlet contact slots and the attaching caps employed in the C-H 7700 line of "Standard" Attachment Plugs conforms to the standard adopted by the leading electrical manufacturers. The cap has parallel contact blades riveted to a Thermoplax body. Riveting holds the blades in permanent alinement and there are no screws to loosen. The cap has no weak sections; the appearance of the knurled finish is improved by use. See display adv. pages 1225-1230.—Adv.


C-H 7700

FITZGERALD MFG. CO., THE, Torrington, Conn. "Fitz E-Z."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Standard." (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn. "Paraline."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Manhattan."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

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Paiste Co., H. T., Philadelphia, Pa. "Pa ste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
RICHARDS & CO., GEORGE, 557 W. Monroe St., Chicago, Ill.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y. "Fitrite," "Switch-all."
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

PLUGS, ATTACHMENT, SPECIAL.—Plugs for making temporary connection to sources of supply furnished in special forms for specific uses, such as three-pole plugs for motors that operate on three-phase circuits; three-pole plugs are also used on some heating devices which have three or four possible heats, and with some portable tools, such as drills or grinders, where the third wire is provided to give a ground connection for the tool casing at all times as a protection to the operator. Polarity plugs also belong in this class; they are used on d-c. circuits mostly for charging small batteries or for other electrochemical or polarized magnetic work. Plugs with rotatable blade contacts are also available that can be used in receptacles with either tandem or parallel contact slits.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Becker Electric Works, 2055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin swivel attachment plugs are small, compact plugs with a threaded metal sleeve that rotates about the center portion or base permitting the plug to be screwed into any standard screw base socket without twisting the appliance cord. A one-piece plug of various types, with bushings to fit all sizes of cord. Rating, 660-watts, 250-volts.—Adv.

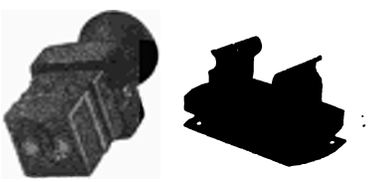


Best Electric Corp., 476 Broadway, New York, N. Y. "Use." "Best."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Eectric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Conneaut Metal Works Co., The, Conneaut, Ohio. "Colan."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.
GARFIELD MFG. CO., Garfield, N. J.
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hubbell, Inc., Harvey, Bridgeport, Conn. "Signalite."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Magnus Electric Co., Inc., 109 Broad St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive Distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.
PARKER & SON, INC., J. H., Parkersburg, W. Va. Attachment plugs. No. 1159 is a weather-proof plug.—Adv.
RICHARDS & CO., GEORGE, 555 W. Monroe St., Chicago, Ill. Exclusive distributor of the Hemco Twin-Lite Plug; a practical utility, giving twin service from a single socket. The Twin-Lite can be used wherever an extra light is needed or an attachment desired for operating an electric fan, washing machine, vacuum cleaner, flat iron, percolator, etc. It is made of indestructible Condensite, molded into one piece, with a highly-polished, seamless surface, and will stand up under continuous rough usage. The Twin-Lite has a wide field of application in homes, hotels, clubs, factories, etc.—Adv.



Hemco Twin-Lite Plug

Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Campbell" attachment plugs, designed for use with Campbell receptacles, are particularly adapted to railway repair shop, roundhouse and other classes of service where rough usage demands rugged construction. The plug is made of well-seasoned hard wood, boiled in paraffine until thoroughly impregnated.



"Campbell" Attachment Plug

The receptacle proper (right figure above) has a moulded composition base, with strong phosphor bronze spring contacts. The receptacle is usually enclosed in a 3½-in. round, cast-iron box, with square or round cover as desired.



"Campbell" Plug in Type "A" Box With Round Cover

Cover is fitted with spring-hinged lid, which automatically closes when plug is removed. Single or double pendant boxes are also furnished.—Adv.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

PLUGS, ATTACHMENT, SWIVELING.—The swiveling plug is non-separable but is provided with a rotating sleeve so that it may be inserted without twisting the cord. These plugs are made for lamp cord or for use with armored cable.

PLUGS, BATTERY-CHARGING.—These are special heavy-duty plugs designed for connecting to receptacle outlets in the charging circuits, and sometimes also to the receptacle on the vehicle, for the storage batteries of electric vehicles or trucks. Similar plugs are used for charging connection to the batteries of railway cars while in the yards or depots. Battery-charging plugs are usually of heavy, rugged construction with large contacts capable of carrying heavy currents for a long time. There are several styles of receptacles in use, but the plugs are generally cylindrical in shape. It is necessary that the plugs be polarized and with the cylindrical form one terminal is a solid rod in the center of the plug and the other a concentric ring or sleeve. Rectangular blocks with the contacts at the sides are used in some cases as this gives a very substantial and simple plug.

The use of charging plugs and cords makes possible the charging of a battery in an electric vehicle or in the train without removing the battery. In railroad yards the outlets are placed at convenient distances alongside the tracks so that several cars may have their batteries charged at one time.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See receptacles, battery charging.—Adv.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
GENERAL ELECTRIC CO., Schenectady, N. Y. Plugs and receptacles with molded contact interiors which are easily removed and renewed. Contact surfaces designed to stand 100% overload for an indefinite time for boosting battery charge. Made in two sizes: 50-amp. for electric vehicles and 200-amp. for extremely heavy service. (Booklet Y-759-2.) See adv. pages 1203-1223.—Adv.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

PLUGS, FIXTURE.—This form of plug is used in interchangeable fixtures for fastening the fixture to the outlet and making the necessary connections. At the present time efforts are being made to standardize these plugs for the value of the interchangeable fixture lies to a large extent in its universal application which would not be possible if these plugs were not standardized. At the time of this writing manufacturers of these plugs have not come to an agreement upon a standard type but it is hoped that a settlement will be reached in the near future. Likewise, since patent agreements between two holding companies are under consideration at the time this is written it is impossible to give an accurate list of the licensee manufacturers.

PLUGS, CONDUIT SEALING.—Wooden plugs to be used for corking conduit systems during construction to keep out moisture, dirt, concrete, etc., and insure a dry clean raceway for wires and cables. They are made in sizes suitable for conduit of standard sizes from ½ in. to 3 ins.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y. "Clermont."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B." "Penny."
WALKER BROS. & HAVILAND, Otis Bldg., Philadelphia, Pa. (See descriptive advertisement under Bushings, conduit, box and cabinet.)—Adv.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

PLUGS, EDI-SWAN.—Separable attachment plugs largely used as automobile fittings, made with a body of insulating material and a metal center contact to complete one side of the circuit. The other side of the circuit is completed through a metal ring concentric with the center contact or through two small projections on opposite sides of the body which engage slots in the corresponding receptacle form-

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ing a so-called "bayonet-joint" when assembled. They are used for making connections for use of automobile trouble lamps, small auxiliary devices, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass.
Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass. "Universal."

PLUGS, EXPANSION.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

PLUGS, FISH, FLEXIBLE, STEEL, CONDUIT.—Metal plugs provided with an eye at one end and threaded to fit the convolutions of flexible cable armor at the other, intended to be screwed into the squared off end of flexible conduit. The fish wire or drawing-in line is attached to the eye for fishing flexible cord under floors, etc., and furnishes a firm grip on the cable eliminating the possibility of the fish wire slipping off and dropping the conduit.

PLUGS, FLASHING SOCKET.—Devices designed to be screwed in ordinary electric light sockets and provided with thermostatic mechanism which opens and closes the circuit at short intervals to a lamp holder forming a part of the device to flash a lamp for advertising or other purposes. The flashing interval is adjustable over a limited range. Though designed for use with one lamp, they may be used to flash a set of small lamps of equivalent wattage.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "Wynk-A-Lyte."
SOLAR ELECTRIC CO., 124-6 W. Lake St., Chicago, Ill. The Skedoodle plug is one of nine different types of motorless flashers, made exclusively under Phelps Patents. Fits any standard socket. Requires no wiring. Flashes any type of metallic or carbon lamps at regular intervals. Can be easily ad-



Skedoodle Plug.

justed to suit various requirements. Skedoodle plugs are designed for window signs, store fronts, illuminated figures, lettered globes, Christmas tree lights and electric advertising displays of all kinds. Made in 32-110 and 220 voltages and in 60 and 100-watt sizes. Other types will handle up to 2750 watts. Approved by National Board of Underwriters and fully protected by guarantees.—Adv.

PLUGS, HEATING DEVICE.—A common form of attachment plug for completing electrical connections through portable cords between heating devices and source of supply. The more common form of these plugs is found on electric irons. The plug is essentially two spring contacts, usually of bronze, encased in a molded heat-resisting, insulating cover. This cover is generally made in two parts, easily separable to allow for replacement of cords or repairs on the plug. The contacts are made to fit snugly and make a good contact to prevent arcing which pits the contacts and causes considerable loss of current. Various other devices besides irons use this form of plug. Another form of plug commonly used on percolators, grills, toasters, etc., is a one-wire plug, consisting of a single spring clip contact encased in a molded insulating cover. Devices making connection to heating coils through a handle, such as soldering irons, curling irons, etc., use a form of plug which fits into the end of the handle. This plug has a center contact separated from a second contact, a concentric ring, by insulating material. Other special forms of plugs are made up for some special device but are applicable only to that device.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich.
Best Electric Corp., 476 Broadway, New York, N. Y. "Useplug."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GARFIELD MFG. CO., Garfield, N. J.
Gray-Heath Co., 544 N. Parkside Ave., Chicago, Ill. "Sturdy."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa. "Attach-all."
Interstate Electric Co., 356 Baronne St., New Orleans, La.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Magnus Electric Co., Inc., 109 Broad St., New York, N. Y. "Plugall."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
Propp Co., M., 108 Bowery, New York, N. Y. "One-4-All."
Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y. "Fitzall."
Smith & Co., T. C., 1531 Cherry St., Philadelphia, Pa. "Real."
T. & W. Electrical Mfg. Co., Inc., Register Bldg., Santa Ana, Cal. "T. & W."
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y. "Fitrite," "Switch-all."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PLUGS, MARINE.—Receptacles for attachment plugs and plugs designed with special tight-fitting gasketed joints to exclude moisture for use on shipboard, docks or other moist locations. The plug is usually encased in some form of cap which fits tightly over a fitting on the receptacle so as to form a water-tight joint and entirely seal all live parts from the action of water or spray. The receptacles are usually provided with a cap to cover the receptacle when the plug is not in use.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See Receptacles, conduit box. —Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conneaut."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
GARFIELD MFG. CO., Garfield, N. J.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Parkin Mfg. Co., San Rafael, Cal.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
SAMSON ELECTRIC CO., Canton, Mass.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Campbell."

PLUGS, MOTOR AND HEAVY DUTY.—Attachment plugs designed to complete connections to electric motors, heating devices, etc., of a portable nature and having the line contacts recessed to prevent accidental short circuit when the parts of the plugs are separated. They are heavily constructed usually for three-wire power circuits. As these plugs are commonly used outdoors in switchyards, along electric railways, on docks, piers, etc., many types are weather or waterproof to protect the live parts from rain and moisture.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Motor Attachment Plugs are rated for 10 amperes at 250 volts. The riveted blade construction is an outstanding characteristic. Riveting holds the blades in permanent alinement, and there are no screws to work loose. C-H 7758 is equipped with a polarity base. See display adv. pages 1225-1230.—Adv.



C-H 7755

DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
GLEASON & CO., J. L., 241 Franklin St., Boston, Mass.
Hubbell, Inc., Harvey, Bridgeport, Conn.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-81.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

PLUGS, SIGNAL OR PILOT LAMP.—One form of this type of device consists of a separable attachment plug with a side outlet for the connecting cord and a socket for a candelabra type pilot lamp with protecting guard. The lamp is illuminated when plug is inserted in a receptacle, giving a visual indication that the circuit is completed. Another type similar to the one described above but without the side outlet has a small-candlepower candelabra base lamp which forms a part of a plug cap, which when plugged in is connected in multiple with the current-consuming device. The lamp burns when current is being consumed and thereby acts as a warning. Such plugs are used mostly with heating appliances, such as flatirons, that are liable to be left with current "on" unless a visual caution signal is provided.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Hubbell, Inc., Harvey, Bridgeport, Conn.

PLUGS, SPARK.—These plugs are threaded to fit into the cylinder head of internal combustion engines. A porcelain or mica insulated high-tension spark gap is mounted at one end and a wire terminal at the other, a spark across the gap serving to fire the explosive charge at definite intervals. The usual spacing of the gap is 0.03 in. One contact is connected to the ignition system, the other grounded to the engine frame. The contacts are made of metals which resist the destructive action of the arc and at the same time do not tend to collect carbon or other residue of the gas combustion.

Manufacturers:

Air-Friction Carburetor Co., The, 1st & Madison Sts., Dayton, Ohio. "Air-Friction."
American Bosch Magneto Corp., Springfield, Mass. "Bosch."
Belvidere Screw & Machine Co., Belvidere, Ill.
Bethlehem Spark Plug Co., Inc., Bethlehem, Pa. "Bethlehem."
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "American Ace."
Buettner Co., The Charles H., 1924-1926 W. 8th St., Cincinnati, Ohio. "B-Brand."
Champion Spark Plug Co., Toledo, Ohio. "Champion," "Center Fire."
Charland, E. W., Tilton, N. H. (core only).
Derf Mfg. Co., Inc., 9 Walker St., New York, N. Y. "360-Point." (Exclusive distributor, Derf Sales Co., 1311 S. Figueroa St., Los Angeles, Cal.)
Eclipse Mfg. Co., 424 N. Meridian St., Indianapolis, Ind. "Hercules."

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Excelsior Leather Washer Mfg. Co., Inc., 921 W. State St., Rockford, Ill. "X-L."
Express Spark Plug Co. of America, Westory Bldg., Washington, D. C. "Express."
Fan Flame Spark Plug Co., Inc., 30-32 Nepperhan St., Yonkers, N. Y.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
Firol Spark Plug Co., 1526 Manhattan Bldg., Chicago, Ill. "F-I-R-O-L."
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y.
Fyrac Mfg. Co., 214-16 E. State St., Rockford, Ill. "Fyrac."
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn. "Bull-Dog," "H. M. S.," "Master."
Kokomo Electric Co., Kokomo, Ind. "Kingston."
Leich Electric Co., Genoa, Ill. "Radd."
Lockwood-Ash Motor Co., Jackson, Mich. "Sterling."
Long Distance Spark Plug Co., Birmingham, Ala. "Long Distance."
Milwaukee Auto Specialty Mfg. Co., Inc., 711 Chestnut St., Milwaukee, Wis.
Morgan Mfg. Co., Inc., Keene, N. H. "Morgan."
Mosler & Co., A. R., Mt. Vernon, N. Y. "Mica Vesuvius," "Vesuvius," "Spit Fire," "Superior."
Motor Spark Plug Co., 93-107 Lafayette St., Newark, N. J. "Motor King."
New York Mica & Mfg. Co., Auburn, N. Y. "Auburn," "Wright."
Northwind Spark Plug Corp., 42 W. 39th St., New York, N. Y.
Oakes & Dow Co., The, 311 Atlantic Ave., Boston, Mass. "Sootless."
Porter Co., 20 W. Jackson Blvd., Chicago, Ill.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Clean-EZ-Prime."
Pro-Mo-Tor Fabricating Corp., 182 Locust Ave., New York, N. Y. "Herz."
Rajah Auto-Supply Co., Bloomfield, N. J. "Rajah."
Reflex Ignition Co., The, 3068-3086 W. 106th St., Cleveland, Ohio. "Giant Reflex," "Diamond Reflex," "Arrow Reflex," "Conical Reflex," "Primer Reflex," "Baby Reflex," "Kid Reflex."
Scientific Spark Plug Co., R. R. 8, Janesville, Wis.
Sharp Spark Plug Co., Wellington, Ohio. "Kopper King," "Kopper King Junior," "Goliath."
Silvex Co., Bethlehem, Pa.
Simmons, George T., R. R. 8, Janesville, Wis. "Scientific."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J. "Green Jacket."
Stark-Inland Machine Works, Inc., 1629 Locust St., St. Louis, Mo.
Superior Motor Power Co., 75 Spring St., New York, N. Y. "Su-Dig," "Twin-Tact."
Utility Co., 636 W. 44th St., New York, N. Y. "Utility," "Uko."
Vital Mfg. Co., Cleveland, Ohio. "Vital," "Leader."
V-Ray Co., Marshalltown, Ohio. "V-Ray."
Washington Auto Supply Co., Washington, Ill. "Washington," "Wasco."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn. (Metal parts only.)
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

PLUGS, STAGE.—Attachment plugs of the heavy-duty type intended specially for theatrical use in making temporary connections in desired locations for banks of lamps, picture machine equipment, stereopticons, spot-lights, etc. The plugs usually of hard fiber with a cable grip and copper blades are constructed to fit into the standard stage pockets or floor receptacles.

Manufacturers:

Chase-Shawmut Co., The, Newburyport, Mass. "Cushing."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
GARFIELD MFG. CO., Garfield, N. J.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.
Morse, Frank W., 289 Congress St., Boston, Mass.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pennefather, James S., 358 W. 43rd st., New York, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

PLUGS, TELEPHONE CORD.—Telephone plugs are special forms of line terminals attached to a flexible conductor (switchboard cord) to make easy and quick connections to the jack. They have a metal tip, a small ring, and a long sleeve or tube, all insulated from each other. Each carries a separate circuit. These parts give their names to the parts of the jack which they engage and also to the circuits which are called the tip, ring and sleeve circuits, respectively. Plugs are classed according to their place in the circuit as answering plug or calling plug.

The answering plug is one of the two plugs of a switchboard cord pair which the operator uses to answer the calling subscriber. The other plug of that pair is used to connect to the called line or to a trunk to another office. The calling plug is that plug of a pair on a manual switchboard which the operator uses to call the desired subscriber. The answering plug and the calling plug make the pair used together. Often two plugs are made up into one handle to fit into a twin jack. These are known as twin plugs.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Hall Switch & Signal Co., Garwood, N. J.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Leich Electric Co., Genoa, Ill.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

PLUGS, WELDING.—Attachment plugs of the heavy-duty type designed for use with flexible cables in making separable connections between the electrode and material being worked, and the transformer, converter or other source of supply in electric welding operations. Among the uses of these plugs is welding in shops and industrial plants when they may be exposed to dust, dirt and rain or excessive moisture and for such service these plugs are made weatherproof or water-tight.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

PLUME & ATWOOD MFG. CO.—Waterbury, Conn. Manufacturer of fixture parts and trimmings, brass and brass products. Vice-president, R. L. French; secretary, J. L. Scott; treasurer and general manager, J. H. Hurlburt; sales manager, George A. Boomer. Main office, 470 Bank St., Waterbury, Conn. Factories, Waterbury, Conn.; Thomaston, Conn. Branch offices, Rialto Bldg., San Francisco, Cal.; 30 E. 42nd St., New York, N. Y.; Hayworth Bldg., Chicago, Ill.

PLUMWOOD.—Trade name for shade holder and portable lamps manufactured by the Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.

PNEUVAC CO.—164 Fremont St., Worcester, Mass. Manufacturer of electric vacuum cleaners and snap switches. Business established 1908. President, M. S. Wright; secretary, C. L. Wright; treasurer, H. H. Wright; sales manager, H. R. King.

POCKET INSTRUMENTS AND METERS.—See Ammeters, battery and pocket; Voltmeters, battery or pocket.

POCKET LAMPS.—See Flashlights, hand and pocket type.

POCKETS, PLIER.—See Plier pockets.

POCKETS, STAGE.—The receptacles used on the floor or walls of theater stages are very commonly called stage pockets. They are a special form of receptacles and are described and manufacturers given under Receptacles, stage.

POGGENDORFF CELL.—A type of primary cell using the combination carbon-sodium bichromate plus sulphuric acid-zinc; also known as the bichromate cell, which see.

POINTLITE.—Trade name for attachment for pull chain socket manufactured by the O'Hara Waltham Dial Co., Inc., Waltham, Mass.

POINTS, CONTACT AND SPARKING, PLATINUM, SILVER, TUNGSTEN, ETC.—Contact and sparking points are used to make or break an electric circuit or to serve as spark-gap electrodes in an ignition, radio or testing device. To be suitable for contacts a material must be hard enough to withstand the mechanical wear of continual hammering and when closed must offer a contact of as low resistance as possible. It must also have a melting point sufficiently high to withstand the heat of the arc formed when the circuit is opened or when a spark jumps the gap.

Platinum is the best metal for this purpose from the electrical standpoint; it is rather soft mechanically, however, and is generally hardened by making an alloy of platinum and iridium. Silver has a better conductivity than platinum and about the same mechanical strength, but its melting point is considerably lower. Tungsten, which has been produced in the form of a ductile metal within the last few years, is an extremely hard metal with a higher tensile strength in the form of wire than any other metal, and has an extremely high melting point, 5432° F. It is cheaper than either platinum or platinum-iridium, and is therefore being rapidly adopted for contact purposes, although it requires a larger contact surface as its conductivity is lower. It has been adopted for contact purposes on practically all types of automobile ignition apparatus except the magneto.

These contacts are usually made in the form of rivets which are mounted on steel, brass or other metallic contact springs or backings. Flat disks which may be welded directly to the springs or to a contact screw are also widely used. The contacts are used on internal-combustion-engine ignition devices, radio apparatus, spark-gap electrodes, X-ray apparatus, key contacts, push buttons, bells and buzzers and many other similar appliances.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
American Platinum Works, 225-231 New Jersey Railroad Ave., Newark, N. J.
Baker & Co., Inc., 54 Austin St., Newark, N. J.
Bishop & Co., Platinum Works, J., Malvern, Pa.
Commercial Research Co., The, 18 E. 41st St., New York, N. Y. "Comreco."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
ELKON WORKS OF GENERAL ELECTRIC CO., 515 Gregory Ave., Weehawken, N. J. Tungsten contacts have been found superior to platinum for use in relays, interrupters, and other make-and-break ignition devices. Made by attaching a disc of tungsten to an iron base. Can be supplied in a number of sizes.—Adv.
Fansteel Products Co., Inc., North Chicago, Ill.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
Gilfillan Bros., Inc., Los Angeles, Cal.
Handy & Harman, 59 Cedar St., New York, N. Y. (Silver.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
K-W Igniton Co., The., E. 30th St. & Chester Ave., Cleveland, Ohio. "K-W."
Liberty Electric Corp., Port Chester, N. Y.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Pick Mfg. Co., Richard, 224 N. Wells St., Chicago, Ill.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Wilson Co., The H. A., 97 Chestnut St., Newark, N. J. "Wilco."
Wolverine Motor Works, Bridgeport, Conn.

POINTS, LIGHTNING ROD.—As the principal function of a lightning rod is to discharge, gradually and continuously, the electrical charge which accumulates in time of storm, all rods are equipped with sharp points or tips. These permit the charge to escape more readily than from

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blunt points. The point is usually made as a separate piece, approximately a foot in length, which is firmly attached to the top of the rod and is usually coated to prevent corrosion. In shape it may be single, hollow round point, (sometimes filled with a cast iron core), a single bayonet point, a number of points arranged in fan shape or a group scattered over the upper surface of a glove. The most common metal is copper, of a high degree of purity, nickel plated. Some points are gold plated and it is even claimed that some are finished with platinum. Solid aluminum or hollow, nickel plated silver, is also sometimes used instead of the hollow copper.

Manufacturers:

Bajohr Lightning Conductor Co., Carl, 4055 Keokuk St., St. Louis, Mo.
Electra Lightning Rod Co., 30 N. LaSalle St., Chicago, Ill. "Electra."
Goshen Lightning Rod Co., Goshen, Ind.
Kress Co., George R., 1900-1902 Brighton Rd., Pittsburgh, Pa.
Moore Bros. Lightning Rod Co., Maryville, Mo.
Nebraska Lightning Rod Co., Inc., 205 N. 17th St., Omaha, Neb. "Nebco."
Owen, J. D. & E. G., Janesville, Wis.
St. Louis Lightning Rod Co., 2135 DeKalb St., St. Louis, Mo. "Kretzer Brand."
Security Lightning Rod Co., The, 606-612 S. Pine St., Burlington, Wis.
Thompson Lightning Rod Co., Inc., The George E., Owatonna, Minn. "Silver Tip."
Western Cable & Light Co., Baldwin, Wis.

POINTSWITCH.—Trade name for luminous switch attachment manufactured by the O'Hara Waltham Dial Co., Inc., Waltham, Mass.

POLACHECK & BRO. CO., CHARLES.—217 3rd St., Milwaukee, Wis. Manufacturer of lighting fixtures, fixture fittings and parts, electric signs, etc. Business established 1879. President, treasurer and general manager, Arthur Polacheck; vice-president, Sigmund Polacheck; secretary and sales manager, Philip Polacheck.

POLAR CUB.—Trade name for electric fans, motors, vibrators, drink mixers and other labor-saving devices manufactured by the A. C. Gilbert Co., Blatchley Ave., New Haven, Conn.

POLARALITE.—Trade name for electric signs manufactured by I. P. Frink, Inc., 239-43 10th Ave., New York, N. Y.

POLARITY CHANGERS.—See Changers, polarity.

POLARITY INDICATORS.—See Indicators, voltage or current.

POLARITY PLUGS.—See Plugs, attachment, special.

POLARITY RECEPTACLES.—See Receptacles, polarity.

POLARIZATION. — The condition of electrodes when they are partly or wholly covered by gas bubbles or film, which keeps the electrolyte from contact with the electrodes, thus introducing a variable, sometimes very large, extra resistance. It is particularly noticeable in primary cells, where it nearly stops the generation of electromotive force and nearly or quite stops the current the cell can furnish.

POLE ARC.—The angle subtended by the pole face of salient-pole machines. The angle from one pole to the corresponding point on an adjacent pole is taken as 180 electrical degrees and the pole arc may be expressed in degrees or in per cent of 180.

POLE ARMS.—See Crossarms and side arms, wood; Crossarms, iron or steel.

POLE BALCONIES AND PLATFORMS.—See Platforms and balconies, pole.

POLE BANDS.—See Bands or collars, pole.

POLE BRACE.—A wooden pole or post placed from the ground to some point on a pole carrying lines to brace it against the pull of the wires. It is used where the conditions will not permit a guy to be used on the opposite side.

POLE BRACKETS.—See Brackets, pole top.

POLE CABLE TERMINAL HOUSE.—A wooden box placed on a telephone cable pole to shelter the cable terminals and protectors. It is generally larger than the usual cable box. See Houses, pole cable terminal.

POLE-CHANGER.—A form of relay used in polar duplex telegraphy, replacing the transmitter, which when operated connects one pole of the battery to the line, and when open connects the opposite pole, thereby sending alternate positive and negative impulses to the receiving station.

POLE CHANGERS.—See Changers, polarity or pole.

POLE CLAMPS.—See Clamps, pole.

POLE CLIMBERS.—See Climbers, linemen's pole.

POLE, COMMUTATING.—See Commutating pole.

POLE COUNTERS.—See Counters, pole and tally.

POLE DINKEYS.—See Dinkeys, pole.

POLE ERECTORS, See Erectors, pole

POLE HOUSES,—See Houses, pole cable terminal.

POLE JACKS.—See Jacks, pole.

POLE-LINE HARDWARE, MISCELLANEOUS.—Practically all common pole-line hardware will be found separately listed elsewhere. However, various hardware, due to its special or uncommon use has not been so listed. A partial list would include cross-arm grounding plates, double-arm channels and spacers, guard irons, steps for steel towers, various special clamps and crossarm fixtures, and hub guards and pole protection strips.

Manufacturers:

BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Galvanized Products Co., First St., Phillipsburg, N. J.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hi-Ten."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. "Way," "Ette."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

POLE LOCKS.—See Locks, pole.

POLE MEASURERS.—See Measurers, pole.

POLE, NONSALIENT.—A nonprojecting pole, such as is used in induction motors and the rotating field structure of turbo-alternators. Nonsalient pole construction gives a uniform air gap all around the armature, except at the slots. The field winding for nonsalient-pole turboalternators is often distributed in several slots, instead of being concentrated in one coil per pole, as in the salient pole type.

POLE PINS.—See Pins, insulator, pole top.

POLE PLATES.—See Plates, pole butt or hub, strain, etc.

POLE REINFORCING SLEEVES.—See Reinforcing sleeves, pole.

POLE RINGS.—See Rings, pole.

POLE, SALIENT.—A projecting pole, such as is generally used in direct-current machines and slow and moderate-speed alternating-current machines.

POLE SEATS.—See Seats, linemen's pole.

POLE, SELF-SUPPORTING.—A pole used in overhead line construction which sustains the stresses put upon it without any guy or brace.

POLE SHIMS.—See Shims, pole or guy.

POLE SHOE.—An extension at the armature end of the pole core which increases the area of the air gap and thereby lowers the reluctance of the magnetic circuit of an electric machine. Pole shoes are usually laminated to reduced eddy-current loss which is caused by pulsation of the flux from the armature teeth.

POLE STEP.—This is a device attached to a pole to enable a person to climb it without using "climbers." The steps near the ground on a wooden pole are usually wooden, those higher up are steel, driven and screwed into the wood. See Steps, pole.

POLE STEPS.—See Steps, pole.

POLE STRIPS.—See Strips, pole protection.

POLE SUPPORTERS.—See Supporters, pole.

POLE TAGS.—See Tags, cable, circuit, pole and wire.

POLE, TELEPHONE.—Most telephone poles are wood, although concrete and steel have been tried. Wood poles vary from 4 in. in diameter at the top to 8 in. and more, and from 25 ft. long to 40 ft., 50 ft., and even longer in special cases. The top is roofed by sawing so that water will drain off. They weaken most at the ground line by rotting, which has given rise to many forms of treatment to prevent it.

In a small exchange there is often one pole just outside the office where the open wires enter cable which leads into the office. This is known as the "office pole." The office pole disappears in the plant all of whose cables run out underground for a distance.

POLECAT BRAND.—Trade name for cedar poles produced by the Lindsley Bros. Co., Peyton Bldg., Spokane, Wash.

POLES, CEDAR, TREATED.—The constantly decreasing supply of pole timber has led to the extensive use of preservative treatment of poles. The relative cost of the pole treated and untreated, due to its increased life when treated, will frequently more than pay for the cost of the treatment. The poles are sometimes treated over their entire length but more commonly over the butt. The preservative paint is also applied to the top of the pole to prevent water soaking into the grain, and also when the pole is gained for crossarms. The U. S. Forest Service estimates that the life of a butt treated western cedar pole at 20 years and a northern white cedar pole at 22 years.

Manufacturers:

Bell Lumber Co., Security Bldg., Minneapolis, Minn. (Northern white and Western red.)
Brown Land & Lumber Co., Merchants State Bank Bldg., Rhinelander, Wis. (Northern white and Western red.)
Carney & Co., B. J., Grinnell, Iowa.
Cascade Timber Co., Tacoma, Wash.
CHAPIN CO., E. T., Spokane, Wash. (Western red.)
Cook Tie & Pole Co., 919 Commercial Trust Bldg., Philadelphia, Pa.
Eggers Pole & Supply Co., 610 Paulsen Bldg., Spokane, Wash. (Western red.)
Humbird Lumber Co., Sandpoint, Idaho.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill.
Lindsley Bros. Co., Peyton Bldg., Spokane, Wash. "Polecat Brand."
Lord & Co., Lee H., Box 693, Peoria, Ill.
MacGillis & Gibbs Co., The, 1201-09 Wells Bldg., Milwaukee, Wis.
Morrison Lumber Co., J. W., Minneapolis, Minn.
NATIONAL POLE CO., Escanaba, Mich. (See display adv. page 1254.)
Naugle Pole & Tie Co., 5 S. Wabash Ave., Chicago, Ill.
Norfolk Creosoting Co., Norfolk, Va.
Northern Cedar & Timber Co., Menominee, Mich.
Northern Pole & Lumber Co., Palladio Bldg., Duluth, Minn.
Pacific Coast Pole Co., Spokane, Wash.
Page & Hill Co., 814 Plymouth Bldg., Minneapolis, Minn.
PARTRIDGE LUMBER CO., T. M., Lumber Exchange, Minneapolis, Minn. (See display adv. page 1254.)
Pendleton & Gilkey, Minneapolis, Minn.
Stiles & Co., H. A., 93-97 Oliver St., Boston, Mass. "Hasco."
VALENTINE-CLARK CO., THE, Spokane, Wash. and Minneapolis, Minn., producers of and dealers in Western and Northern cedar poles and piling. Established in 1892. Our long experience in the pole business, together with our exceptional facilities enables us to promptly and satisfactorily meet the requirements of any and all pole users. We have supplied the poles used in many of the largest and most important transmission lines in the country because our poles possess all the vital requirements—strength, durability, slightliness, light weight, low cost, safety and adaptability, and are "Giants of Transmission." We can furnish treated or untreated poles. We are pioneers in butt-treating and own and operate between Minneapolis and St. Paul, one of the largest and most modern treating plants. Our

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original plant was installed in 1907, and was the first commercial plant in America. Our present plant was completed in November, 1919, and is the last word in treating plants. It has a capacity of 2500 poles per day. Our treating facilities in Minnesota and Idaho enable us to meet all standard specifications. Write us for further information. See display adv. page 1255.—Adv.
Walsh Tie Co., 914 Security Bldg., Minneapolis, Minn.
Western Electric Co., New York.
Western Lumber & Pole Co., Peyton Bldg., Spokane, Wash. (Western red.)
Weyerhaeuser Sales Co., Sandpoint, Idaho.

POLES, CEDAR, UNTREATED.—The question of use of untreated poles is largely a matter of the relative cost of the pole considering the life of the pole when it is treated or untreated. This varies with the locality and conditions affecting the life of the pole. In some localities the untreated pole may be used at a lower cost and it is therefore employed.

Manufacturers:

Baudette Cedar Co., Box 615, Baudette, Minn.
Bay De Noquet Co., 817 Railway Exchange, Chicago, Ill.
Bell Lumber Co., Minneapolis, Minn.
Brooks, Hall L., Tomahawk, Wis.
Brown Land & Lumber Co., Merchants State Bank Bldg., Rhinelander, Wis. (Western red.)
Burk & Co., Spokane, Wash. (Red cedar.) "Trade Winners."
Canadian Cedar & Lumber Co., Ltd., 301 Electric Ry. Chambers, Winnipeg, Man., Can.
Carney & Co., B. J., Grinnell, Iowa.
Cascade Timber Co., Tacoma, Wash.
Cedar River Lumber Co., 914 Plymouth Bldg., Minneapolis, Minn. (White cedar.)
Central Wisconsin Supply Co., Beaver Dam, Wis. ("Monogram" western red.)
Chaney Co., W. G., Peyton Bldg., Spokane, Wash. "Diamond Brand."
CHAPIN CO., E. T., Spokane, Wash. (Western red.)
Clark Pole & Tie Co., Bemidji, Minn.
Cloquet Tie & Post Co., Cloquet, Minn.
Cook, Fulton, St. Maries, Idaho.
Cook Tie & Pole Co., 919 Commercial Trust Bldg., Phialdelphia, Pa.
Coolidge & Schussler, 826 Metropolitan Life Bldg., Minneapolis, Minn.
Eggers Pole & Supply Co., 610 Paulsen Bldg., Spokane, Wash. (Western red.)
Gilbert, Willis H., 710 Conway Bldg., Chicago, Ill. "Dixie Brand."
Goodman Lumber Co., Goodman, Wis.
Humbird Lumber Co., Sandpoint, Idaho.
Jentz Cedar & Lumber Co., Appleton, Wis.
Johnson Lumber Co., A. C., Bemidji, Minn.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago.
Krueger Lumber Co., A. L., 511 Lumber Exchange, Minneapolis, Minn.
Lord & Co., Lee H., Box 693, Peoria, Ill.
MacGillis & Gibbs Co., The, 1201-09 Wells Bldg., Milwaukee, Wis.
McCulloch & Moss Lumber Co., Lumber Exchange Bldg., Minneapolis, Minn. (White cedar.)
McFarland, L. D., Sandpoint, Idaho. "Service Brand." (Western red.)
Meredith Cedar Co., J. P., Memphis, Tenn.
Miller Lumber Co., J. W., 512 Lumber Exchange, Minneapolis, Minn.
Morrison Lumber Co., J. W., Minneapolis, Minn.
National Lumber Co., Plymouth Bldg., Minneapolis, Minn. (White cedar.)
NATIONAL POLE CO., Escanaba, Mich. (See display adv. page 1254.)
Naugle Pole & Tie Co., 5 S. Wabash Ave., Chicago, Ill.
Nebraska Bridge Supply & Lumber Co., Peters Trust Bldg., Omaha, Neb.
Northern Cedar & Timber Co., Menominee, Mich.
Northern Pole & Lumber Co., Palladio Bldg., Duluth, Minn.
Pacific Coast Lumber Co., Lumber Exchange Bldg., Seattle, Wash.
Pacific Coast Pole Co., Spokane, Wash.
Paducah Pole & Timber Co., City National Bank Bldg., Paducah, Ky.
Page & Hill Co., 814 Plymouth Bldg., Minneapolis, Minn.
Park Falls Lumber Co., Park Falls, Wis. (Exclusive distributor, Edward Hines Lumber Co., 2431 S. Lincoln St., Chicago, Ill.)
PARTRIDGE LUMBER CO., T. M., 729-732 Lumber Exchange, Minneapolis, Minn. (Northern white and western red.) (See display adv. page 1254.)
Pendleton & Gilkey, Minneapolis, Minn.
Republic Cedar Co., Marinette, Wis.
Standard Cedar & Lumber Co., 511 Lumber Exchange, Minneapolis, Minn.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Three States Cedar Co., Plymouth Bldg., Minneapolis, Minn.
Torrey Cedar Co., Clintonville, Wis.
VALENTINE-CLARK CO., THE, Spokane, Wash. and Minneapolis, Minn. See Poles, cedar, treated, and display adv. page 1255.
Virginia & Rainy Lake Co., The, Virginia, Minn.
Walsh Tie Co., 914 Security Bldg., Minneapolis, Minn.
Warner Lumber Co., Grand Rapids, Mich.
Western Electric Co., New York.
Western Lumber & Pole Co., Peyton Bldg., Spokane, Wash. (western red)
Weyerhaeuser Sales Co., Sandpoint, Idaho.
Wheeler-Arnold Co., Wittenberg, Wis.

POLES, CHESTNUT, PINE, ETC., TREATED.—The National Electric Light Association gives the average life of a pine pole untreated as 6.5 years. The U. S. Forest Service estimates the average life of butt-treated pine poles in dry climates as 20 years. This marked increase in life of the pole has led to their use with butt treatment. Other timbers are also commonly given the same treatment. They are sometimes treated over all instead of the butt only. The treatments used are commonly referred to as butt, brush and pressure treatment. The butt treatment consists of immersing the pole butts in a tank of heated oil. The oil is kept hot until the moisture is driven from the butt. The oil is then allowed to cool for about two or three hours and the poles are then withdrawn. The brush treatment generally consists of painting the butt of the pole with a preservative paint. In the pressure treatment the poles are placed in a large cylinder and then prepared to receive the liquid. The cylinder filled with the preservative and applied and maintained until the proper quantity of oil is injected into the poles.

Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
Atlantic Creosoting & Wood Preserving Works, Norfolk, Va.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky.
Cook Tie & Pole Co., Commercial Trust Bldg., Philadelphia, Pa.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
Gulf Cross Arm Co., Dothan, Ala. (pine)
Gulfport Creosoting Co., Gulfport, Miss.
Indiana Creosoting Co., 401 W. Main St., Louisville, Ky.
International Creosoting & Construction Co., Galveston, Tex.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Long-Bell Lumber Co., R. A. Long Bldg., Kansas City, Mo.
Norfolk Creosoting Co., Norfolk, Va.
Southern Creosoting Co., Slidell, La.
Southern Exchange Co., New York.
SOUTHERN WOOD PRESERVING CO., Atlanta, Ga. (pine)
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. (pine) "Hasco."
Western Electric Co., New York.

POLES, CHESTNUT AND PINE, ETC., UNTREATED.—Chestnut poles are used where service conditions call for unusual strength and durability. They will withstand severe storms and, due to their large butts, even when attacked by butt rot have a high degree of permanency. Other pole timbers are sometimes employed without treatment.

Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
Chattanooga Pole Co., Chattanooga, Tenn.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
Cook Tie & Pole Co., 919 Commercial Trust Bldg., Philadelphia, Pa.
Davison & McBryde, 1217 Independent Life Bldg., Nashville, Tenn.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
Gulf Cross Arm Co., Dothan, Ala.
Gulfport Creosoting Co., Gulfport, Miss.
Indiana Creosoting Co., 401 W. Main St., Louisville, Ky. (pine)
International Creosoting & Construction Co., Galveston, Tex.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Long-Bell Lumber Co., Kansas City, Mo.
Lord & Co., Lee H., Box 693, Peoria, Ill.
Meredith Cedar Co., J. P., Memphis, Tenn. (chestnut)
Mountain Lumber & Supply Co., Mount Union, Pa.
Nebraska Bridge Supply & Lumber Co., Peters Trust Bldg., Omaha, Neb.
Rice, John H., 509 Ford Bldg., Wilmington, Del.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco." (pine)
Western Electric Co., New York.
Williams Cypress Co., Ltd., F. B., Patterson, La.

POLES, CONCRETE.—Various types of concrete, steel reinforced, poles have been tried from time to time. Such poles are of greatest value where the life of wood poles is unduly shortened by local conditions. They have been used where improved appearance was of value also. Types of concrete poles have not been standardized to any considerable extent. Such poles are not desirable for use with 2200-volt distribution lines, as it is difficult to do work on live circuits with safety. It is claimed that these poles may be made in lengths as high as 75 ft.

Manufacturers:

Massey Concrete Products Corp., 122 S. Michigan Ave., Chicago, Ill. "Hollowspun."
Universal Concrete Products Co., 122 S. Michigan Ave., Chicago, Ill.

POLES, IRON AND STEEL, TUBULAR.—Poles used for supporting trolley, transmission, and other overhead wires. The tubular type consists of wrought iron or steel pipe. A common form uses a larger size pipe for the butt with one or more smaller sections above. The sections telescope each other and the joints are swaged.

Manufacturers:

Aermotor Co., 2500 W. Roosevelt Rd., Chicago, Ill. "Aermotor."
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Smyser-Royer Co., York, Pa.
U. S. Metal & Mfg. Co., 165 Broadway, New York, N. Y.

POLES, PIKE.—In setting wood poles, the pole is held by means of pike poles while being raised into position. These are about 12 ft. long and are provided with an iron spike or point to prevent slipping. The pike poles are used to lift and brace the pole until the earth is back-filled sufficiently to hold it.

Manufacturers:

Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
HERBST, PAUL W., Chicago, Ill. We specialize in pike poles. We have the plain pike pole, or guarded, or raising fork, for use with iron or wood poles. See display adv. page 1258.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.
Novelty Turning Co., 34 Main St., Norway, Me.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)

POLES, STEEL, EXPANDED OR LATTICED.—For lines crossing rivers or railroads at elevations above normal the most feasible pole is one of steel lattice construction set in concrete. Such poles require less ground space than a tower and are used where a tower cannot be installed. The size and design depend on the local conditions. A special form of this type of poles is made by cutting and expanding the web of an I-beam by special machinery, making what is termed an expanded steel truss pole. One end is made wider, and is used as the base of the pole. In the smaller sizes these poles have been used for trolley span wires to some extent. They have also been used for transmission lines instead of wood poles. A lattice type pole built up of structural steel shapes with the lattice work riveted, bolted or welded in place, is sometimes used at points in railway systems where heavy strains occur, as at curves involving large spans.

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Manufacturers:

Archbold-Brady Co., Syracuse, N. Y.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Coombs & Co., R. D., 30 Church St., New York, N. Y.
Hull & Co., S. W., 3729 Prospect Ave., Cleveland, Ohio.

POLES, TROLLEY-WHEEL CARRYING.—A long tapered steel tube of circular cross section made of thin metal and of variable lengths suitable for the required operating conditions, and which forms the conecting link between the trolley wheel and the trolley base on the roof of the car. The small tapered end is fitted with a fork-shaped casting called the harp, which carries the axle and on it the trolley wheel. The butt or large end of the pole is inserted into the socket of the trolley base. When changing direction the trolley pole must be swung around so as to be in a trailing position, or when two poles are used, as is most frequently done on long double-truck cars, one pole is hooked down and the other placed in the trailing position.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

POLES, WOOD.—Wood poles are desirable for electric power distribution because of their low cost, good insulating qualities and durability. Northern white cedar, western red cedar and chestnut are the most commonly used woods. The western red cedar is variously known as red cedar, western cedar or Idaho cedar. White pine, cypress and oak are also used but commonly, particularly the latter two, only in the locality where they are found. Western red cedar is superseding other woods because of the diminishing supply. The desirable qualities in poles which the timber must possess are durability in contact with the soil, straightness together with relatively small size and little taper, minimum weight, and reasonable softness so that the spikes of a climber may enter readily but at the same time having strength to support considerable weight. To decrease the decay and weakening of the poles they are commonly treated with creosote or other wood preservative, generally the butt only. It is claimed this treatment will almost double the life of poles of the common timbers.

Poles are rated in length by steps of five feet, according to top diameter, e. g., a 30 ft. 7-inch pole. The lengths in common use vary from 25 to 60 ft. The 7-in. top is usually made to read 22 ins. circumference in pole specifications as the circumference is more definitely measured where pole tops are not circular. The tops of the poles are roofed by sawing so that water will drain off and not rot the top of the pole. The condition of the poles is generally specified to conform with the recommendations of the Committee on Overhead Line Construction of the National Electric Light Association, or with the Western Red Cedar Association's official specifications for red cedar, or the Northern White Cedar Association's standard specifications of white cedar products for white cedar poles. These specifications cover what defects are allowable, the maximum allowable butt rot, the amount of dead or dry streaks, the allowable crook or sweep, etc.

POLICE TELEPHONE AND SIGNALING SYSTEMS.—Telephone circuits connecting call stations located in weatherproof boxes on street corners or other prominent locations, and police headquarters where a telephone switchboard of special design and an operator are provided to register the incoming calls, reports, etc., and disseminate information to calling parties. The equipment usually consists of a code signaling mechanism similar to those used on fire alarms operated by pulling a handle, turning a disk, etc., together with a telephone transmitter and receiver and signal bells for calling back. The code signaling mechanism indicates the location of the calling party to the operator or register. Police signal systems also include warning or calling signals which consist of bells, horns or colored lamps in conspicuous or prominent locations and connected by wire to police headquarters where signals may be transmitted to one or more districts to attract the attention of police officers or patrolmen causing them to communicate immediately with headquarters from the nearest call-box to receive instructions or other information.

Manufacturers:

Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
Leich Electric Co., Genoa, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

POLISHERS, ELECTRIC.—These outfits consist of one or two polishing wheels mounted directly on the armature shaft of an electric motor. The motor is usually set in a base which may be fastened on a bench top or mounted on a pedestal. These machines when equipped with the proper wheels or buffs may be used for polishing castings, plated work, table ware, etc. They are made in sizes ranging from small outfits for use in the home to the large types used in foundries and factories. See also Buffers.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Chicago." (automobile)
Dilg Mfg. & Trading Co., The, 27 E. 125th St., New York, N. Y. "Acme."
Excelsior Tool & Machine Co., East St. Louis, Ill. "Excelsior."
Hanson & Van Winkle, Newark, N. J.
Munning & Co., A. P., Church St., Matawan, N. J. "Optimus."

POLISHING MACHINES, FLOOR.—See Rubbing and polishing machines, motor-driven.

POLISHING MACHINES, SHOE.—See Shoe shining machines, electric.

POLISHING WHEELS AND BUFFS.—See Wheels, polishing; Wheels, buffing.

POLLAK TOOL & STAMPING CO.—81-85 Freeport St., Dorchester, Boston, Mass. Manufacturer of automobile plugs, connectors, sockets, and sheet metal specialties. Business established 1909. President, treasurer and general manager, Joseph Pollak; sales manager, H. D. Stein.

POLLY MFG. CO.—Milwaukee, Wis. Manufacturer of lighting fixtures and specialties. Business established 1920. President and general manager, William Polacheck; vice-president, Richard Seer; secretary, H. S. Polacheck; treasurer and sales manager, Stanley L. Polacheck.

POLLYANNA.—Trade name for electric washing machines manufactured by the Manufacturers Distributing Co., 403 Fullerton Bldg., St. Louis, Mo.

POLYCASE.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.

POLYCHROME ART WORKS.—2700 Diversey Ave., Chicago, Ill. Manufacturers of portable electric lamps and parchment lamp shades. T. R. Ferguson, sole owner.

POLYPHASE.—This term is applied to a generator or circuit which consists of more than one phase. Quarter-phase, three-phase and six-phase systems are all polyphase systems, the three-phase being the most common.

POLYPHASE ALTERNATOR.—A synchronous generator producing polyphase alternating current as distinguished from a single-phase generator. See Alternator.

POLYSINE.—Trade name for electro-therapeutic high-frequency generators manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

PONDAGE.—A term having reference to the storing of water for future use. It usually refers to small ponds or storage reservoirs which permit of the impounding of the night flow of a stream for use during the working hours of the day when the load on the water-power plant is heavy. (Also see Storage.)

PONTIUS.—Trade name for sealing wax manufactured by the Dicks-Pontius Co., 123-131 Wayne Ave., Dayton, Ohio.

PONY.—Trade name for relays and small dynamos manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

POOLE PIANO CO.—Cambridge, Mass. Manufacturer of electrically operated pianos.

POPPER & SONS, LEO.—143 Franklin St., New York, N. Y. Manufacturers of glass cutters, lenses, copper foil, etc. Business established 1880.

POPPERS.—See Corn poppers, electric.

PORCE-LUTE.—Trade name for commutator cement manufactured by the Perfection Supply Co., 98 Park Pl., New York, N. Y.

PORCELAIN.—Porcelain has three principal constituents, feldspar, clay and silica. Ball clay and china clay or kaolin are used and the feldspar may be one of three, either potash, soda or lime feldspar, called orthoclase, albite and anorthite, respectively. Two methods of producing porcelain are generally used, the dry process and the wet process. The wet process is probably used more than the other for electrical porcelain, especially for high-voltage line insulators. The compounds are first mixed into a fluid state for both processes, and then filtered and stored in a plastic state.

In the dry process the clay is then dried out and pulverized to a crumbly condition in which there is just enough moisture present so that a handful of the material will cling together when squeeezed. The material is then pressed in steel molds of the shape required, and after drying and glazing, the pieces are fired in kilns. This grade of porcelain is very porous and therefore has a disruptive strength almost the same as atmospheric air. It heats rapidly and is suitable only for low-voltage insulation where it is used extensively in the form of knobs, cleats, snap-switch parts, terminal and fuse bases, etc.

In the wet process the material in a plastic state, about the consistency of putty is molded or jiggered into an approximate shape in plaster of paris molds which rotate on a table. The work is allowed to dry slightly in these molds and when nearly dried out is firm enough to be turned to more accurate dimensions. It is then dried further and dipped in a glazing bath and placed in the kilns for firing. The glazing mixture is similar to the porcelain but contains a large proportion of feldspar or flux which melts at a temperature barely sufficient to vitrify the porcelain, giving a coating which is really a species of glass. Porcelain made in this way is much more dense and homogeneous in structure than dry-process ware, and is used for all high-tension insulators.

Porcelain is not affected by oils, acids or alkalies, but absorbs a small amount of water. The resistivity of unglazed porcelain is about 10^{14} to 10^{15} ohm-cm. at ordinary temperatures, but decreases very fast with an increase in temperature. The dielectric strength is about 13,200 to 20,000 volts per mm. and at low frequencies the disruptive voltage for thicknesses of 0.1 in. is 30 kv., and for 0.5 in. thicknesses from 110 to 120 kv. The tensile strength of American porcelains varies from 650 to 2200 lbs. per sq. in., with the compressive strength ten times that. European porcelains are reported to have tensile strength of 4500 to 6500 lb. per sq. in.

PORCELAIN BINDING POST CO.—Jersey City, N. J. Manufacturer of binding posts.

PORCELAIN BUSHINGS.—See Bushings, porcelain.

PORCELAIN CLEATS. — See Cleats, porcelain.

PORCELAIN ENAMELS.—See Enamels, porcelain.

PORCELAIN ENAMELING & MFG. CO.—1263 Bellevue St., Detroit, Mich. Manufacturer of lighting reflectors, etc.

PORCELAIN INSULATOR CORP., THE.—Lima, N. Y. Manufacturer of porcelain insulators.

PORCELAIN INSULATORS. — Glazed porcelain is probably the best commercial material for very high-tension insulators and is often used, even on low voltage, in preference to other materials. See Insulators, porcelain.

PORCELAIN KNOBS. — See Knobs, porcelain, split; Knobs, porcelain, solid.

PORCELAIN MAKING MACHINERY AND DIES.—The machinery and dies for porcelain manufacture are very extensive in shapes and patterns. The porcelain mixture is put into the die and then completely covered while the porcelain is forced into the molds under pressure. The various porcelain shapes are then taken out of the molds or dies and placed on a

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conveying belt which transmits them through baking ovens which serves the purpose of hardening the porcelain.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bucher-Smith Co., East Liverpool, Ohio.
National Electric Porcelain Co., The, Carey, Ohio.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

PORCELAIN SOCKETS.—See Sockets, porcelain.

PORCELAIN SPECIAL DESIGN AND NOT OTHERWISE LISTED.—Porcelain of special design made to meet the specifications of other manufacturers is sometimes furnished by manufacturers of porcelain insulators and other insulating parts, who have the complete equipment necessary to meet the needs of others. Porcelain is used in a large number of articles, where its insulating value is important, such as in many parts of special switches, sockets, receptacles, plugs, resistances, etc.

Manufacturers:

Boch-Metsch Porcelain Co., The, East Liverpool, Ohio.
Colonial Sign & Insulator Co., Akron, Ohio.
Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.
Globe Porcelain Co., 127 Mulberry St., Trenton, N. J.
Hartford Faience Co., The, Hamilton St., Hartford, Conn.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display adv. page 1301.)
Imperial Porcelain Works, Trenton, N. J.
Mogadore Insulator Co., The, Mogadore, Ohio.
National Electric Porcelain Co., The, Carey, Ohio.
Parker & Son, J. H., Parkersburg, W. Va.
SQUARE D CO., Detroit, Mich.
Star Porcelain Co., The, Trenton, N. J.
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
Wheeling Tile Co., Wheeling, W. Va.

PORCELAIN TUBES. — See Tubes, porcelain.

POROSITY.—As applied to porous diaphragms, the proportion of the cross-section of the same which is filled with electrolyte and is therefore capable of carrying electric current. The degree of porosity may vary from 2% in a very dense unglazed porcelain partition to 20 or 30% in a paper, cardboard, sand or asbestos diaphragm.

POROUS CUPS, BATTERY.—Certain types of batteries employ two solutions which are separated from each other by a porous cup. The cup serves to separate the main body of the solutions but allows a partial mixture of the fluids by diffusion through the porous cup usually made of unglazed earthenware.

Manufacturer:

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

PORTABLE BASES (LAMP). — See Bases and pedestals, floor lamp; Bases and stands, table lamp.

PORTABLE BENCHES.—See Benches, electricians' portable.

PORTABLE BUFFERS.—See Buffers, electric, bench and portable.

PORTABLE DRILLS.—See Drills, electric portable.

PORTABLE FLEXIBLE ARMS.—See Flexible arms for portable lamps.

PORTABLE GRINDERS.—See Grinders, electric, portable.

PORTABLE GUARDS (LAMP).—See Guards, lamp, non-locking, portable and miscellaneous.

PORTABLE HOISTS.—See Hoists, electric, portable.

PORTABLE INSTRUMENT.—One which is designed to be moved from place to place, as distinguished from the stationary type which is made to be mounted on a panel, switchboard, pedestal, etc. While there are many small electrical instruments which are strictly portable, the term is usually applied to those of medium size and of considerable accuracy, used for general laboratory or field work.

PORTABLE LAMPS.—See Lamps, boudoir; Lamps, clamp, bed or dresser; Lamps, desk; Lamps, floor; Lamps, hand, inspection and trouble; Lamps, piano; Lamps, table and reading; Lamps, portable, miscellaneous, not otherwise listed.

PORTABLE LIGHTING OUTFITS.—See Lighting outfits, portable, construction and emergency.

PORTABLE MACHINERY CO.—Passaic, N. J. Manufacturer of portable conveying machinery. President, J. L. Wentz; 1st vice-president, C. M. Lindsay; 2nd vice-president, W. H. Trowbridge; secretary, C. A. Bryant; treasurer, F. R. Allen.

PORTABLE OVENS.—See Ovens, electric, baking and roasting, portable.

PORTABLE PLANTS (LIGHTING).—See Plants, portable, lighting and power.

PORTABLE PLATES, HOT. — See Plates, hot, household and portable.

PORTABLE PUNCHES.—See Punches, portable.

PORTABLE SEWING MACHINES.—See Sewing machines, motor-driven, household, portable.

PORTABLE TELEPHONES.—See Telephones, portable.

PORTABLE WINCHES.—See Winches, electric.

PORTABLES.—See Lamps, boudoir; Lamps, clamp, bed or dresser; Lamps, desk; Lamps, floor; Lamps, piano; Lamps, table and reading; Lamps, hand, inspection and trouble; Lamps, portable, miscellaneous, not otherwise listed.

PORTER.—Trade name for car track derailers manufactured by the Cleveland Frog & Crossing Co., Cleveland, Ohio.

PORTER.—Trade name for motor-driven jointers manufactured by the P. Pryibil Machine Co., 512-524 W. 41st St., New York, N. Y.

PORTER CO.—20 W. Jackson Blvd., Chicago, Ill. Manufacturer of spark plugs, etc.

PORTER CO., THE.—241 Water St., New York, N. Y. Manufacturer of lighting fixtures, portable lamps and lighting specialties. Business established 1845. President, John A. Porter; secretary and treasurer, Samuel B. Madara.

PORTER, H. K.—6 Ashland St., Everett, Mass. Manufacturer of bolt clippers, bolt, rivet, wire and storage battery cutters.

PORTLAND CO., THE.—Portland, Me. Manufacturer of electric freight and passenger elevators. George F. Reynolds, general manager.

PORTLAND-MONSON SLATE CO.—Portland, Me. Manufacturer of slate for electrical purposes. Quarries, Monson, Me.

PORTRAITLITE.—Trade name for photographic lamps manufactured by the Simplex Photo Products Co., Richmond Hill, N. Y.

POSITION, TELEPHONE OPERATOR'S.—That part of a manual switchboard which is arranged for the use of one operator. It contains answering jacks and line lamps, plugs and cords for connecting the lines, and an operator's telephone set. An operator's position on a toll switchboard is known as a toll position.

POSITIVE.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

POSITIVE AND NEGATIVE.—In mathematics, physics, etc., these terms are used to indicate a value greater or less than zero, either in quantity or direction. If no sign (+ or —) is shown it is understood that the value is positive; negative values are indicated by the minus sign before the quantity. Temperatures above zero are called positive, those below zero negative. Algebraic values, whether numeral or literal are classed as positive or negative. Motion in a given direction may be called positive, that in the opposite direction negative. In trigonometry all angels in the right-hand half of a circle, or in the upper half, depending on the function considered, are called positive, the others negative.

In photography a plate or print having lights and shadows the same as the object photographed is called a positive; one with lights and shadows reversed (as in the original plate or film) is a negative.

In electricity, due to the old theory that electricity was a substance that flowed from one pole to the other of the apparatus, that from which it flowed was called positive, the other (to which it flowed) was the negative. If glass is rubbed with silk, the electric charge accumulating on the glass is called positive, that on the silk negative. Other static charges similar to the one on glass and repelling it are positive charges; those like the one on the silk are negative.

In primary cells the positive plate is the zinc or equivalent material (anode) from which the current is assumed to flow through the electrolyte to the negative copper or carbon plate (cathode). The exterior connection or binding post of the zinc plate is, however, known as the negative pole of the battery, since the current flows to it from the external circuit. In lead storage batteries, the positive is the peroxide-coated lead plate from which the current flows through the external circuit when the battery is discharging; the negative is the spongy lead plate. In a generator the positive terminal is that from which the current flows to the external circuit, while in a motor the positive terminal is that designed to be connected to the positive side of the line. In electroplating and other electrolytic work the positive is the electrode (anode) at which the current enters the liquid; the negative is the electrode (cathode) to which the current flows; also see Anode, Cathode.

This old notion that the current in a direct-current circuit flows from the positive to the negative electrode is at variance with the modern electron theory, which holds a current to be a flow of electrons (negative charges) from the negative to the positive; see Electron, Electron theory. At any rate, there is a marked distinction between positive and negative charges and also between positive and negative electrodes or terminals of a circuit which consists of a flow of electrons or charges, and whose direction may be assumed to be the convehtional one from positive to negative inasmuch as the actual direction is not yet clearly proven.

The terms positive and negative are also generally applied to the two sides of a direct-current circuit or apparatus which are connected, respectively, to the positive and negative electrodes of the current source. When the circuit is a three-wire circuit with the neutral wire grounded, the neutral is at (or practically at) the potential of the earth, while the positive wire is assumed to be at a potential higher than that of the earth and the negative to be at a potential lower than that of the earth.

POSITIVE LEAK.—Trade name for protective paints manufactured by the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa.

POSITIVE ROTATION.—A term sometimes used to designate counterclockwise rotation.

POST CAPS OR CAPITOLS, FOR ORNAMENTAL LAMPS.—These are small metal shells which fit onto the top of the street lighting post and form a holder for certain types of post tops. The capitols sometimes enclose the compensator coils and lamp socket.

Manufacturers:

Faries Mfg. Co., Decatur, Ill.
Flour City Ornamental Iron Co., 27th St. & 28th Ave., S., Minneapolis, Minn.
Union Metal Mfg. Co., Canton, Ohio. "Union."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sol-Lux." (See display adv. pages 1395-1402.)

POST CO., THE FREDERICK.—319 S. Wabash Ave., Chicago, Ill. Manufacturer of electric blueprint machines, drawing tables and other drawing material.

POST-GLOVER ELECTRIC CO.—308 W. 4th St., Cincinnati, Ohio. Manufacturer of steel cabinets, panel-boards, switchboards, etc. President, F. D. Van Winkle; vice-president, George N. Devou; secretary and sales manager, E. L. Van Winkle; treasurer, M. T. Salling.

POST HOLE AUGERS.—See Augers, earth, pole or post hole.

POST HOLE DIGGERS.—See Bars, pole or post hole, digging and tamping; Boring machines, earth, pole or post hole; Shovels and spoons, pole or post hole.

POST HOLE SHOVELS AND SPOONS.—See Shovels and spoons, pole or post hole.

POSTS, BINDING.—See Binding posts.

POSTS, FENCE, WOOD, FOR ELECTRIC RAILWAY RIGHT-OF-WAY, ETC.—Electric railways are usually required to fence in their right-of-way. For this purpose wooden fence posts, often cedar posts, are used. In some sections the roads utilize local available timber or old trolley, telegraph, telephone poles, cut off above the decayed portion, etc. Generally, however, such supply is inadequate and fence posts are purchased for that purpose. They are also used to fence in other property such as power plant, substations, etc.

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Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky.
Bell Lumber Co., Security Bldg., Minneapolis, Minn.
Burk & Co., Spokane, Wash. "Trade Winners."
Chaney Co., W. G., Peyton Bldg., Spokane, Wash. "Diamond Brand."
CHAPIN CO., E. T., Spokane, Wash. (western red).
Cloquet Tie & Post Co., Cloquet, Minn.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky.
Eggers Pole & Supply Co., 610 Paulsen Bldg., Spokane, Wash.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky.
Goodman Lumber Co., Goodman, Wis.
Indiana Creosoting Co., 401 W. Main St., Louisville, Ky.
MacGillis & Gibbs Co., The, 1201-09 Wells Bldg., Milwaukee, Wis.
Martin Bros., 618 Manhattan Bldg., Duluth, Minn.
NATIONAL POLE CO., Escanaba, Mich. (See display adv. page 1254.)
Naugle Pole & Tie Co., 5 S. Wabash Ave., Chicago, Ill.
Northern Pole & Lumber Co., Palladio Bldg., Duluth, Minn.
Pacific Coast Pole Co., Spokane, Wash.
Paducah Pole & Timber Co., City National Bank Bldg., Paducah, Ky.
Park Falls Lumber Co., Park Falls, Wis. (Exclusive distributor, Edward Hines Lumber Co., 2431 S. Lincoln St., Chicago, Ill.)
PARTRIDGE LUMBER CO., T. M., Lumber Exchange, Minneapolis, Minn. (See display adv. page 1254.)
Pendleton & Gilkey, Minneapolis, Minn.
Southern Creosoting Co., Slidell, La.
Three States Cedar Co., Plymouth Bldg., Minneapolis, Minn.
Tinkham, C. P., 1011 Majestic Bldg., Milwaukee, Wis.
VALENTINE-CLARK CO., THE, Spokane Wash. and Minneapolis, Minn. (See display adv. page 1255.)
Virginia & Rainy Lake Co., The, Virginia, Minn.
Western Lumber & Pole Co., Peyton Bldg., Spokane, Wash. "Lifetime."
Weyerhaeuser Sales Co., Sandpoint, Idaho.

POSTS, ORNAMENTAL AND PLAIN STREET LAMP, CONCRETE.—Concrete for street posts is ordinarily cast in horizontal molds of various forms, usually a slight taper and widened at the base for stability. The posts commonly have a circular or regular polygon cross-section and are in themselves more or less ornamental. The concrete is sometimes mixed with crushed granite to give the post an attractive appearance. Reinforcement bars or structural forms are used in their construction. A pipe running through the center provides for wiring for the lamp. Though commonly cast in horizontal molds other methods have been used. One of these methods, which it is claimed has particular advantages for poles of greater than the ordinary lengths, is of some interest. In this method the mold, together with the necessary reinforcing is so mounted that it may be rotated on its vertical axis. The concrete is poured into the mold and the mold rotated. The speed of rotation is gradually increased up to a definite point and there maintained while the concrete gradually sets. The rotating speed is sufficient to cause the concrete to be thrown to the side of the mold, creating a hollow center post.

Among the advantages of the concrete post is that it requires practically no maintenance. It also has the advantage that in case of a vehicle colliding with the pole there is very little possibility of the pole snapping off and falling on the vehicle, an advantage of considerable importance in posts along boulevards and other streets where the traffic is heavy and accidents common.

Manufacturers:

Chicago Concrete Post Co., 608 S. Dearborn St., Chicago, Ill. "Star."
Massey Concrete Products Corp., 122 S. Michigan Ave., Chicago, Ill.
Service Electric Co., Inc., 2337 N. Hoyne Ave., Chicago, Ill.
Universal Concrete Products Co., 122 S. Michigan Ave., Chicago, Ill.

POSTS, ORNAMENTAL AND STREET LAMP, IRON AND STEEL.—The ease with which these metals may be cast led to the design of a great variety of these posts of a very ornamental character. The more simple posts are made of a straight or fluted column designed to support a single lamp. For park and white-wa lighting, however, the posts are muc more elaborate and support a group c four or five lamps from brackets or rin forming a part of the post or may suppo ornaments of various character on th pole top. The poles are cast with smooth surface and when given a coa of suitable paint have a very long life.

Manufacturers:

BATES EXPANDED STEEL TRUS CO., 208 S. LaSalle St., Chicago, Il (See display adv. page 1258.)
Calgary Iron Works, Ltd., The, 410-4 9th Ave., East, Calgary, Alta., Can.
Canadian Westinghouse Co., Ltd., Sar ford & Myler Sts., Hamilton, Ont.
Electric Railway Equipment Co., 29 Cormany Ave., Cincinnati, Ohio.
Flour City Ornamental Iron Co., 27th S & 28th Ave., S., Minneapolis, Minn.
Fremont Foundry & Machine Co., Fre mont, Nebr.
Keystone Iron & Steel Works, 2931 San Fe Ave., Los Angeles, Cal.
KING MFG. CO., THE, St. Joseph, M "Monolite." (See display adv. pa 1257.)
McAvity & Sons, Ltd., T. King St., S John, N. B., Can.
Mesker & Co., George L., 1st & Ing Sts., Evansville, Ind. "Meskerlite."
Mott Iron Works, The J. L., Trento N. J.
Newman Mfg. Co., 717-21 Sycamore S Cincinnati, Ohio.
Paxton & Vierling Iron Works, Omah Neb.
Philadelphia Electrical & Mfg. Co., 122 36 N. 31st St., Philadelphia.
Republic Structural Iron Works Divisi of the Consolidated Iron-Steel Mf Co., East 53rd St., Cleveland, Ohio.
Smyser-Royer Co., York, Pa. (iron)
Union Metal Mfg. Co., Canton, Ohi "Union."
WESTINGHOUSE ELECTRIC & MF CO., East Pittsburgh, Pa. "Cutter (See display adv. pages 1395-1402.)

POTASSIUM.—An alkali metal, Symb K; at. wt. 39.10; sp. gr. 0.8621; m. p. 62.5 C.; b. p. 760° C. It is a silver-white met which tarnishes instantly in moist air as takes fire when thrown on water. It very little used as a metal, but forms th base of many important compound Among these are potassium chloride, pt tassium chlorate, potassium iodide, potassium nitrate, potassium carbonate, potassium hydroxide, etc.

POTASSIUM CHLORATE.—$KClO_3$; pr duced electrolytically by the oxidation a potassium chloride (KCl) solution.

POTASSIUM CHLORIDE. — KCl; th starting material for the electrolytic pr duction of caustic potash, potassium chl rate, and potassium perchlorate.

POTASSIUM CYANIDE.—See Cyanid

POTASSIUM FERRICYCANIDE. $K_3Fe(CN)_6$; is made electrolytically by t oxidation of the ferrocyanide, $K_4Fe(CN)_6$.

POTENTIAL DIFFERENCE.—The di ference in electromotive force or electric potential between any two points in a electrostatic field or electrical circuit; between any point and earth; for instanc the potential difference across the term nals of a series arc lamp, or between th two ends of a feeder, or along a resistan element. A distinction is often made be tween e.m.f., which is the potential ap plied at the source, and potential diffe ence (p.d.) which is the drop in potenti along the circuit. Both are measured in volts. The potential difference equals th current multiplied by the resistance (in d-c. circuits) or impedance (in a-c. cir cuits).

POTENTIAL DROP.—See Potential dif ference.

POTENTIAL ENERGY.—Stored up en ergy or capacity to do work, on account of position or condition, as of a stone raise in the air, a spring wound up, a storag battery fully charged, a charged electro static condenser.

POTENTIAL GRADIENT.—The poten tial gradient at any point is the drop in potential per unit distance at that point. In other words, it is the space rate of change of potential. The unit of potential gradient is the volt per centimeter.

POTENTIAL REDUCERS, D-C.—Whe bells, annunciators and other low-voltag signal circuits are to be operated direct from the d-c. mains some means must be provided for reducing the potential from the usual 110 or 220 volts to the 6 volts or so required for the other circuits. The use of series resistance to give the proper voltage for the bell circuit, while satis

years and the two postwar years of 1919 and 1920. Even before the period mentioned and especially since 1907 there has been a gradual increase in the output of electricity for industrial uses, and nearly every year has seen the proportion of increase grow.

Analyzing the experiences of capable men in the industry, it is apparent that one of the outstanding factors contributing to the phenomenal growth of the central-station business to its present position of popularity and stability is the wisdom of the directing minds in maintaining intelligent and highly efficient selling forces. More and more each year has the capacity of the sales engineer increased to a point where he sells not only electricity but courteous, intelligent consulting engineering service as well or, in other words, he sells the electricity and gives with it the engineering knowledge and co-operation which tend toward economical operation of his customer's plant.

Central-station officials by employing men who in addition to selling and engineering ability can comprehend the importance of courteous co-operation with the customer have at once created a valuable asset; and the wisdom of this policy is apparent from the fact that some of the largest isolated plants in the country have been scrapped and rearranged for central-station service without the factory or mill owner ever conferring with an official of the central-station company.

The phenomenal increase in demands upon the central station brought with it serious problems of planning, financing and engineering to be met by the directing men of the industry, and the successful manner in which great plant additions, extensions and betterments have been put into operation in the face of unusual obstacles is an achievement worthy of the men responsible for the stability of the central-station industry, the men who have furnished the kind of management which has placed the central station in the front rank of American industry.

The great war brought tremendous increase in industrial activity. Managers of large industrial establishments operating isolated plants were confronted with the problem of increasing their power facilities in the face of increased coal and labor costs and rapidly increasing prices and slow delivery of generating equipment.

Previously the power salesman had pointed out the advantages of purchased electrical power. Why not call upon him? They did, with the result that negotiations were begun which resulted in a sort of partnership between the central station and the power user; negotiations which shut down many isolated plants and which brought growth and prosperity to the central-station industry.

The manner in which these added great demands upon the output of the power companies of the country were met is a striking indication of the ability and genius of electric public utility men. The results of years of experimenting and study in economy in fuel consumption and the installing of large and highly efficient turbine-generating units were the principal factors having to do with economical output and when big industrial men were looking around for more power to meet the war-time demands upon their industries, they were impressed with the high degree of proficiency which characterized the operations of the electric power companies, and their confidence and co-operation were soon established.

With the power companies' distributing lines already pretty well loaded, the abnormal demand for additional service brought with it necessity for large and expensive line extensions. And here is where the buyer and seller of electrical energy were again brought to closer friendship. Co-operative effort had already been enhanced with the adjustment of rates, especially an arrangement for some larger power users by which the power company supplied electricity at generator voltage and the customer furnished and maintained all transformers and switching equipment, the operation of same being under the supervision of the power company.

But the installation of new mains and feeders added to the power companies' already great need of new capital, and it was then that the industrial power users again showed their faith in the central-station industry by advancing funds equal in amount to the cost of their particular line extension, said amounts being refunded on a basis represented by a certain percentage of credit against subsequent power bills.

Contrary to the general curtailment of war-time industrial activity, statistics

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conveying belt which transmits them through baking ovens which serves the purpose of hardening the porcelain.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bucher-Smith Co., East Liverpool, Ohio.
National Electric Porcelain Co., The, Carey, Ohio.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

PORCELAIN SOCKETS.—See Sockets, porcelain.

PORCELAIN SPECIAL DESIGN AND NOT OTHERWISE LISTED.—Porcelain of special design made to meet the specifications of other manufacturers is sometimes furnished by manufacturers of porcelain insulators and other insulating parts, who have the complete equipment necessary to meet the needs of others. Porcelain is used in a large number of articles, where its insulating value is important, such as in many parts of special switches, sockets, receptacles, plugs, resistances, etc.

Manufacturers:

Boch-Metsch Porcelain Co., The, East Liverpool, Ohio.
Colonial Sign & Insulator Co., Akron, Ohio.
Cook Pottery Co., Prospect St. & P. & R. Ry., Trenton, N. J.
Globe Porcelain Co., 127 Mulberry St., Trenton, N. J.
Hartford Faience Co., The, Hamilton St., Hartford, Conn.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display adv. page 1301.)
Imperial Porcelain Works, Trenton, N. J.
Mogadore Insulator Co., The, Mogadore, Ohio.
National Electric Porcelain Co., The, Carey, Ohio.
Parker & Son, J. H., Parkersburg, W. Va.
SQUARE D CO., Detroit, Mich.
Star Porcelain Co., The, Trenton, N. J.
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
Wheeling Tile Co., Wheeling, W. Va.

PORCELAIN TUBES. — See Tubes, porcelain.

POROSITY.—As applied to porous diaphragms, the proportion of the cross-section of the same which is filled with electrolyte and is therefore capable of carrying electric current. The degree of porosity may vary from 2% in a very dense unglazed porcelain partition to 20 or 30% in a paper, cardboard, sand or asbestos diaphragm.

POROUS CUPS, BATTERY.—Certain types of batteries employ two solutions which are separated from each other by a porous cup. The cup serves to separate the main body of the solutions but allows a partial mixture of the fluids by diffusion through the porous cup usually made of unglazed earthenware.

Manufacturer:

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

PORTABLE BASES (LAMP). — See Bases and pedestals, floor lamp; Bases and stands, table lamp.

PORTABLE BENCHES.—See Benches, electricians' portable.

PORTABLE BUFFERS.—See Buffers, electric, bench and portable.

PORTABLE DRILLS.—See Drills, electric portable.

PORTABLE FLEXIBLE ARMS.—See Flexible arms for portable lamps.

PORTABLE GRINDERS.—See Grinders, electric, portable.

PORTABLE GUARDS (LAMP).—See Guards, lamp, non-locking, portable and miscellaneous.

PORTABLE HOISTS.—See Hoists, electric, portable.

PORTABLE INSTRUMENT.—One which is designed to be moved from place to place, as distinguished from the stationary type which is made to be mounted on a panel, switchboard, pedestal, etc. While there are many small electrical instruments which are strictly portable, the term is usually applied to those of medium size and of considerable accuracy, used for general laboratory or field work.

PORTABLE LAMPS.—See Lamps, boudoir; Lamps, clamp, bed or dresser; Lamps, desk; Lamps, floor; Lamps, hand, inspection and trouble; Lamps, piano; Lamps, table and reading; Lamps, portable, miscellaneous, not otherwise listed.

nects the circuit. For currents up to 200 amperes a cylindrical slip contact is used, but for larger currents screw connections or spring clips are required. With potheads having no detachable cap the disconnect consists of a waterproof nut on top of the cap which is removed with a wrench when disconnection is necessary. Where single-conductor cable is used the pothead is made of porcelain entirely, except for an iron bracket to support it. The porcelain tube is mounted on a crossarm after the manner of other overhead line equipment. Single-conductor potheads of this type are found very economical and practical as disconnectives where no cable terminal is involved, as at test points on overhead lines. For general construction features see the description below under the non-disconnecting type.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
G & W Electric Specialty Co., 7430-52 S. Chicago Ave., Chicago, Ill. "G & W."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Davis."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

POTHEADS, POWER AND LIGHTING CABLE, NON-DISCONNECTING TYPE.—The early types of brass open-top endbell have largely been superseded by cast iron bells or pots with covers to protect the surface of the compound from the accumulation of dirt. The cover carries suitable porcelain tubes to insulate the individual conductors as they emerge from the pot. One type has a bell of porcelain with an all-porcelain cover. With the indoor type, the outlet tubes are of corrugated porcelain the size and spacing being made suitable for the voltage. The base of the pot is equipped with suitable fittings to insure connection to the lead sheath and prevent leakage of the compound. After it is attached to the cable the pot is filled with an asphaltic compound in the molten state.

Potheads are made in four voltage classifications: (a) up to 600, (b) up to 7500, (c) up to 15,000, (d) up to 30,000 volts. Outdoor potheads are provided with longer tubes and the tops are protected from moisture by a porcelain cap which prevents leakage from the line to the metal of the pot.

The line wires are connected to the cable conductors by sleeves which may be inside the pot or above the caps. If above, the cable insulation above the caps must be well taped and waterproofed.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
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Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

POTHEADS, TELEPHONE CABLE.—A device for closing the end of paper-insulated, lead-covered telephone cable where the terminal wires are brought out. It consists generally of a lead sleeve with a tinned joint to the cable sheath and the other end filled with a sealing compound. The terminal wires are rubber-covered and are sometimes called pothead wires.

Manufacturers:

BRADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

POTS, COOKING.—See Cooking pots, electric.

POTS, FIRE.—See Fire pots, electricians'.

POTS, GLUE.—See Glue pots, electrically heated.

POTS, MELTING.—See Melters, metal, electrically heated; Melters, wax, electrically heated.

POTS, SOLDER.—See Melting pots, lead and solder.

POTTER.—Trade name for sheet steel boxes and cabinets, and ground clamps manufactured by the Potter-Acme Mfg. Co., 912-920 Champlain Ave., Cleveland, Ohio.

POTTER-ACME MFG. CO., THE.—912-920 Champlain Ave., Cleveland, Ohio. Manufacturer of sheet steel cabinets and boxes and ground clamps. President, G. M. Potter; vice-president, F. H. Neff; secretary, Joseph Kahsky; treasurer, W. A. Neff. Sales representatives, F. W. Oettinger Corp., New York, N. Y.; J. S. Jacobson Co., Chicago, Ill.; Electric Sales Co., Louisville, Ky.; Keeler White Co., San Francisco, Cal.

POTTERY LAMP BASES.—See Bases, and stands, table lamp, pottery, glass, etc.

POUCHES, LEATHER, ELECTRICIANS'.—These pouches are small leather bags which may be strapped to the belt or hung by straps over the shoulder. They are made in several sizes and are used to carry miscellaneous tools or small supplies, such as screws, staples, nails, etc.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.

POULSEN ARC.—See Oscillators, radio.

POUNDAL.—The force which acting for one second upon a mass of one pound will give it a velocity of one foot per second. It is a British unit, equal to 13,825 dynes.

POWDERED COAL ENGINEERING & EQUIPMENT CO.—2401 W. Washington Blvd., Chicago, Ill. Manufacturer of pulverized coal equipment. President, H. B. Truden; secretary and treasurer, C. C. Wallace.

POWELL, F. W.—420 Penn Ave., Pittsburgh, Pa. Manufacturer of plug fuses. Business established 1915. President and general manager, F. W. Powell.

POWELL CO., WILLIAM.—2531 Spring Grove Ave., Cincinnati, Ohio. Manufacturer of lubricators, valves and other steam specialties. President and general manager, Charles E. McFarlan; secretary, George E. Weitkamp; treasurer, H. H. Coombe.

POWER.—Power is the time rate of doing work or the work done per unit time. The power required to do a certain amount of work varies inversely as the time in which it must be done. The common unit of mechanical power in the English system is the horsepower. The unit of electric power is the watt. In d-c. circuits the power in watts is the product of amperes by volts, or $P = E I$ watts. In single-phase a-c circuits the power is equal to the product of volts, amperes and power-factor, or $P = KEI$ watts, where F is the power-factor; in three-phase circuits power equals $P = 1.732\ KEI$ watts. See Watt, power-factor. If the power is constant, the total amount of work done is the product of the power by the time in seconds or hours; see Work.

POWER.—Trade name for steam driven blowers and turbines manufactured by the Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y.

POWER.—Trade name for belting manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

POWER & CO., L.—20 S. 23rd St., Philadelphia, Pa. Manufacturers of motor-driven deck planers and other wood working machinery.

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POWER, A-C.—The power in an alternating-current circuit is the average value of the products of the coincident instantaneous values of the current and e.m.f. for a complete cycle, as indicated by a wattmeter in watts or kilowatts. It is often called the true power to distinguish it from the apparent power.

POWER, APPARENT.—The product of the effective or r.m.s. values of the e.m.f. and current in a circuit is called the apparent power and is expressed in volt-amperes or kilovolt-amperes. In d-c. circuits apparent power equals true power. Also see Power, a-c.

POWER CABLE.—A cable used for transmitting power, either electrically or mechanically.

POWER CAPACITY.—The power that a machine can safely carry, usually determined by its current capacity.

POWER CIRCUITS—Those used for transmitting power. See Circuits, light and power.

POWER DISTRIBUTION LINES.—See Distribution lines for power and lighting.

POWER FACTOR. — The power-factor of a circuit is the ratio of the true power in the circuit (expressed in watts) to the apparent power (expressed in volt-amperes.) In a balanced alternating-current circuit in which both the e.m.f. and current are sinusoids, the power-factor is the cosine of the phase difference, when this is represented by an angle. In a direct-current circuit the true power and apparent power are equal, hence the power-factor is unity or 1.

POWER-FACTOR METERS. — Power-factor meters are instruments which operate on the principle of a wattmeter and indicate directly the power-factor of the circuit. The principles of both the electrodynamometer and induction types of wattmeter are used in commercial instruments. In one form of single-phase instruments of the electrodynamometer type, there are two coils at right angles on the moving element connected across the line and a set of fixed coils in series with the load. One moving coil is connected in series with a resistance and the other in series with an inductance. The currents in the two coils are then 90° out of phase and their reaction with the fixed coils therefore depends on the power-factor. At unity power-factor the coil with resistance in series has all the torque exerted on it, giving one deflection. At zero power-factor the other has full torque exerted, giving a deflection 90° away. Intermediate power-factors combine the action and the deflection is the resultant of the two torques.

Polyphase instruments have three coils in the moving system and the inductance is eliminated. The three coils, which are connected one across each phase, combine their torques so that the moving system takes up a position of minimum resultant torque which varies with the power-factor.

The induction principle is also employed. Coils are placed so as to produce a rotating magnetic field and an iron vane free to rotate is placed in it. This vane is magnetized by a stationary coil, which is the series coil. The rotating field either attracts or repels the vane and it takes up a position where the zero of the rotating field occurs at the same instant as zero of its own field, and thus indicates the phase angle or power-factor.

These instruments are used on circuits where the control of power-factor is required or where it is desirable to know what it is. They are frequently used on panels for controlling generators, synchronous converters and condensers or motors.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.

GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments made in horizontal edgewise pattern with several standard scales showing power factors as low as 0.25, with either leading or lagging current. They can be furnished self-contained for any potential up to 650 volts, and in capacities up to 200 amp. For use on circuits above 1150 volts or 200 amp., instruments are furnished with current transformers. (Bulletin 46045.) See adv. pages 1203-1223.—Adv.

Roller-Smith Co., 233 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

POWER HOUSE.—Strictly speaking, a term applied to the building containing power-generating equipment but often loosely used, especially with small systems, to refer to the apparatus as well as the building.

POWER, INDUSTRIAL, DEVELOPMENT AND STATUS OF.—Careful study of the events of recent years in the industrial power field and of statistics covering the last few years offers much of value to central-station interests, power users and manufacturers throughout the United States.

Growth in the industrial power load followed development of the lighting load. The first central-station companies were purely lighting companies, not having any power load whatever. Even this lighting load, which seems to have been a very specialized service as we view it today, was a comparatively concentrated load. The distribution lines of the early generating stations were short and they attempted to supply only the central or downtown districts in the larger cities. The first appearance of what may be called the power load was about the middle of the decade 1880-90, when desk fans were introduced in some offices. Electric elevators and other applications of the motor soon followed, the invention of the induction motor aiding the increase so that by 1890 the power load was defintely established in some of the central stations. The uses of electric power at that time included motor drive for various machines and tools in industrial service, electrically operated street railways, fans, blowers, elevators, etc.

The power load was then and is still largely determined by local conditions. Many generating stations supplied districts in which very little or no manufacturing was done, while others were and have since been established close to manufacturing centers and would have a large industrial load. The importance of this class of service was not fully realized by the central stations at first, and the rapid increases in their power service came as the result of natural industrial growth, and the ever increasing perfection and adaptability of electrical apparatus for industrial service. Within the last few years, especially the last seven, many of the large progressive central stations have made a definite effort to secure as much as possible of this desirable power load. Consequently growth in the industrial power load during this seven-year period has been phenominal though the increase has been gradual and continuous from year to year. The central-station output of electrical energy for industrial purposes has been far in excess of the most optimistic expectations.

An average taken from statistics emanating from three reliable sources indicates that electrical energy sold for power consumption in the United States amounted in kilowatt-hours to 7,451,000,000 in 1914; 9,352,000,000 in 1915; 13,023,000,000 in 1916; 16,594,000,000 in 1917; 20,197,000,000 in 1918; 22,010,000,000 in 1919 and 25,240,000,000 in 1920 (latter part of 1920 estimated).

The power load by which this energy was consumed was very largely motor-driven machinery. The motor load has increased from about 6,100,000 hp. connected in 1915 to nearly 13,000,000 hp. in 1920, and the remainder of the connected power load has increased from about 700,000 hp. in 1915 to 1,900,000 hp. in 1920. Some of the important applications of the motor included are for driving numerous kinds of machine tools and woodworking machinery, traveling cranes, electric hoists and lifting magnets, elevators, pumps, air compressors, fans and blowers, coal mining and ore handling machinery, steel, cement, flour, textile, paper, plup and sugar mill machinery, printing presses and machinery, laundry machinery, etc. In addition to this motor load, there are these important branches of the industry: electric railways, electrochemistry, electrometallurgy, storage batteries, telephone, telegraph and radio communication, etc., each having an important power, electrochemical or industrial heating load. Among these miscellaneous power applications are electric furnaces, ovens, electroplating, electrolytic separation and refining of metals, electric smelting and metal melting, welding, pipe thawing, X-ray production, etc.

The above figures of electrical power sold are especially interesting since they cover the prewar year of 1914, four war years and the two postwar years of 1919 and 1920. Even before the period mentioned and especially since 1907 there has been a gradual increase in the output of electricity for industrial uses, and nearly every year has seen the proportion of increase grow.

Analyzing the experiences of capable men in the industry, it is apparent that one of the outstanding factors contributing to the phenomenal growth of the central-station business to its present position of popularity and stability is the wisdom of the directing minds in maintaining intelligent and highly efficient selling forces. More and more each year has the capacity of the sales engineer increased to a point where he sells not only electricity but courteous, intelligent consulting engineering service as well or, in other words, he sells the electricity and gives with it the engineering knowledge and co-operation which tend toward economical operation of his customer's plant.

Central-station officials by employing men who in addition to selling and engineering ability can comprehend the importance of courteous co-operation with the customer have at once created a valuable asset; and the wisdom of this policy is apparent from the fact that some of the largest isolated plants in the country have been scrapped and rearranged for central-station service without the factory or mill owner ever conferring with an official of the central-station company.

The phenomenal increase in demands upon the central station brought with it serious problems of planning, financing and engineering to be met by the directing men of the industry, and the successful manner in which great plant additions, extensions and betterments have been put into operation in the face of unusual obstacles is an achievement worthy of the men responsible for the stability of the central-station industry, the men who have furnished the kind of management which has placed the central station in the front rank of American industry.

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The manner in which these added great demands upon the output of the power companies of the country were met is a striking indication of the ability and genius of electric public utility men. The results of years of experimenting and study in economy in fuel consumption and the installing of large and highly efficient turbine-generating units were the principal factors having to do with economical output and when big industrial men were looking around for more power to meet the war-time demands upon their industries, they were impressed with the high degree of proficiency which characterized the operations of the electric power companies, and their confidence and co-operation were soon established.

With the power companies' distributing lines already pretty well loaded, the abnormal demand for additional service brought with it necessity for large and expensive line extensions. And here is where the buyer and seller of electrical energy were again brought to closer friendship. Co-operative effort had already been enhanced with the adjustment of rates, especially an arrangement for some larger power users by which the power company supplied electricity at generator voltage and the customer furnished and maintained all transformers and switching equipment, the operation of same being under the supervision of the power company.

But the installation of new mains and feeders added to the power companies' already great need of new capital, and it was then that the industrial power users again showed their faith in the central-station industry by advancing funds equal in amount to the cost of their particular line extension, said amounts being refunded on a basis represented by a certain percentage of credit against subsequent power bills.

Contrary to the general curtailment of war-time industrial activity, statistics

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for the postwar years of 1919 and 1920 show a continued increase in the output of the central stations, and seemingly almost as a reward for merit the deflation which has come to the lumber, iron, leather, grain, cotton, wool, coffee, sugar and other markets has not been felt by the electrical industry. On the contrary, the electrical utilities have been able, largely through their own selling organizations, readily to market public utility securities, thus making more funds available and at the same time adding to the great number of persons directly interested in this formidable industry.

The central station in the hands of able men undoubtedly has established itself as the most convenient, economical, efficient, flexible and reliable source of industrial power supply. With improved and better balanced legislative and regulatory policies even greater advancement may be looked for in the industrial power field.

Improvement in industrial power equipment has kept pace with the growth in electrical energy output, the most recent advancements being more especially along economical lines rather than technical.

POWER LOSS IN CONDUCTORS.—Whenever a current flows through a conductor some of the energy is converted into heat and is dissipated. The energy thus lost per second is equal to the square of the current times the resistance, or $W=I^2R$ Joules, when I is in amperes and R in ohms. The same formula gives the power loss in watts due to this heating. This is also known as "copper loss" when the conductor is of copper. Another name for it is "resistance loss," since the heating is ascribed as due to overcoming the resistance. The above formula is commonly known as Joule's law.

POWER MFG. CO., THE.—Marion, Ohio. Manufacturer of oil engines. President, George L. Craig; vice-president and general manager, J. M. Primm; secretary and treasurer, F. B. Morrison. Main office and factory, Marion, Ohio. Branch offices, Stuttgart, Ark.; Crowley, La.; Houston, Tex.; Dallas, Tex.; Phoenix, Ariz.; Roswell, N. Mex.

POWER PLANT, MISCELLANEOUS EQUIPMENT.—The power plant has need for much miscellaneous equipment for men and machine, for routine and for emergency.

Men work best when working under favorable conditions. Every power plant should possess a comfortable washroom where the men may wash, take a shower bath and change their clothes. Every man is entitled to a private clothes locker, towel and soap. First-aid cabinets and equipment such as stretchers, lung motor, etc., should be provided in case of sickness, broken limbs, electric shock, etc.

Prevention is better than cure. It is better to maintain equipment than to have to repair or replace it after a shut down has happened. A well-equipped machine shop with lathes, drill press, milling machine, blacksmith's facilities, pipe cutting and threading machines, etc., is indispensable to economical and efficient maintenance. Boiler-room instrument repair shop and a fuel testing outfit are also good investments for plants of almost any size.

Air washers for cleaning the air before it goes to the turbogenerators and, for lowering air temperature, lessens the chance of insulation failures, keeps generators clean and increases their current-carrying capacity.

Air compressors, stationary and portable serve many useful purposes such as supplying pneumatic tools, cleaning generator and motor windings and general use.

The oxyacetylene outfit for welding and cutting is an asset to any plant. It permits metal to be cut rapidly and broken castings and worn shafts to be built up and made like new. Many companies are welding boiler tubes instead of buying new ones.

POWER PLANT SPECIALTY CO.—Monadnock Block, Chicago, Ill. Manufacturer of power plant specialties. President, F. F. Vater; secretary, W. H. Stevenson.

POWER PLANT, TELEPHONE OFFICE.—That part of the central office equipment which contains the storage battery, charging machine, ringing machine, and power board.

POWER SPECIALTY CO.—New York, N. Y. Manufacturer of superheaters and economizers. Business established 1894. President, P. W. Foster; vice-president, E. H. Foster; secretary and sales manager, L. B. Nutting; treasurer, H. M. Baldwin. Main office, 111 Broadway, New York, N. Y. Factory, Dansville, N. Y. Branch offices, 50 Congress St., Boston, Mass.; Harris Trust Bldg., Chicago, Ill.; Land Title Bldg., Philadelphia, Pa.; Balboa Bldg., San Francisco, Cal.; Park Bldg., Pittsburgh, Pa.; Reliance Bldg., Kansas City, Mo.; Ling Bldg., Dallas, Tex. Sales representative, General Supply Co. of Canada, Ltd., 356 Sparks St., Ottawa, Ont., Can.

POWER STATION.—The plant where power is generated and from which it is distributed. See Central station.

POWER SWITCHBOARD.—See Switchboards, general lighting and power.

POWER TABLES, KITCHEN.—See Kitchen power units of power tables.

POWER TABLES, SEWING MACHINE.—See Sewing machine power tables.

POWER TRANSMISSION.—See Transmission.

POWER TUBES.—Specially developed electron tubes which may be used as high-frequency generators for radio telephone or telegraph transmitting stations. The limiting factor in such tubes is the amount of heat energy due to electronic bombardment which can be dissipated in the plate. (Also see Electron tubes.)

POWER TURBO-BLOWER CO.—New York, N. Y. Manufacturer of steam-driven turbines and blowers. A. N. Hammerston, owner. Main office, 347 Madison Ave., New York, N. Y. Branch offices, Chicago, Ill.; Philadelphia, Pa.; Scranton, Pa.; Trenton, N. J.; Albany, N. Y.; Boston, Mass.; Pueblo, Colo.; Toronto, Ont., Can.

POWER UTILITY STANDS, FARM.—See Farm power utility stands.

POWERLET.—Trade name for rigid conduit fittings manufactured by the Multi Electrical Mfg. Co., 703 Fulton St., Chicago, Ill.

POWERPAKS.—Trade name for ignition and lighting batteries manufactured by the Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.

POWERS.—Trade name for draft regulator manufactured by the Powers Regulator Co., 989 Architects Bldg., New York, N. Y.

POWERS ACCOUNTING MACHINE CO., INC.—137 S. LaSalle St., Chicago, Ill. Manufacturer of electrically operated tabulating, perforating and sorting machines.

POWERS REGULATOR CO., THE.—New York, N. Y. Manufacturer of draft regulators. Main office, 989 Architects Bldg., New York, N. Y. Branch offices, 2771 Greenview Ave., Chicago, Ill.; 522 Boston Wharf Bldg., Boston, Mass.; Canadian Powers Regulator Co., Ltd., Toronto, Ont., Can.

POWERS-WEIGHTMEN-ROSENGARTEN CO.—Phiadelphia, Pa. Manufacturer of electroplating chemicals. Main office and laboratories, Philadelphia, Pa. Branch offices, 145 Front St., New York, N. Y.; Broadway & Clark Ave., St. Louis, Mo.

POWRKOLD.—Trade name for electric refrigerating machines made by George Spalt & Sons, Inc., 904 Broadway, New York, N. Y.

PR.—Trade name for bells and buzzers manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

PRATT & CADY CO., INC.—Hartford, Conn. Manufacturer of electrically operated gate valves. J. B. Champlin, secretary. Main office and factory, Hartford, Conn. Branch offices, Chicago, Ill.; Boston, Mass.; New York, N. Y.; Detroit, Mich.; Houston, Tex.; Cleveland, Ohio; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; Minneapolis, Minn.

PRATT & WHITNEY CO.—New York, N. Y. Manufacturers of milling and wood working machinery. President, James K. Cullen; vice-president, C. L. Cornell; secretary, Fay Ingalls; treasurer, J. B. Cornell. Main office, 111 Broadway, New York, N. Y. Branch office, 33 S. Jefferson St., Chicago, Ill.

PRATT & WHITNEY CO. OF CANADA, LTD.—Dundas, Ont., Can. Manufacturers of milling and wood working machinery.

PRATT-CHUCK CO., THE.—Frankfort, N. Y. Manufacturers of armored cable and conduit fittings. President and treasurer, R. U. Sherman; vice-president and general manager, G. H. Sicard; secretary, W. T. Scarritt. Main office, Frankfort, N. Y. Factories, Frankfort and Oneida, N. Y. Sales representatives, R. B. Corey & Co., 1170 Broadway, New York, N. Y.; O. D. Allen, 1123 Broadway, New York, N. Y.; F. B. Smith & Co., 170 Summer St., Boston, Mass.; George C. Richards & Co., 557 W. Monroe St., Chicago, Ill.; Electrical Sales Co., Kenyon Bldg., Louisville, Ky.; Electrical Sales Co., 2 E. Redwood St., Baltimore, Md.; W. H. Beaven, Jefferson City Bank Bldg., Birmingham, Ala.; B. K. Sweeney, 231 15th St., Denver, Colo.; Garnett Young & Co., 612 Howard St., San Francisco, Cal. (boxes, covers, etc.); H. B. Squires & Co., 587 Howard St., San Francisco, Cal. (cable).

PRATT MFG. CO., WILLIAM E.—190 N. State St., Chicago, Ill. Manufacturer of roller and thrust bearings. William E. Pratt, sole owner. Factory, Joliet, Ill.

PRECIPITATION EQUIPMENT, ELECTRICAL, FOR CEMENT AND SMELTER DUST, ETC.—The Cottrell process for electrical precipitation of dust, smoke and other suspended particles is now frequently employed in smelters, cement plants, acid and other chemical works, etc. For some details regarding it see Cottrell process of electrical precipitation. The equipment for carrying it into effect includes a means of producing direct or pulsating current of 30,000 to 250,000 volts, and treaters or precipitators in which the smoke or fume is subjected to this high-tension negative corona discharge. The high-tension current is produced indirectly; usually there is a motor-generator set with polyphase synchronous motor and single-phase generator, the current from which is stepped up in a special transformer to approximately the voltage desired and then rectified in a special rectifier capable of handling such high voltage. In most cases the rectifier has been of the mechanical type consisting of rotating brushes contacting with stationary arcs of large radius, the rotating element being driven at synchronous speed by a synchronous motor, which may be the motor of the motor-generator set; other rectifiers have been tried, including the electron-discharge type. The treaters are metallic tubes or pipes, forming the positive or collecting electrodes, in which an axial wire or other conductor is suspended that forms the discharging or negative electrode; the metals used for the treater pipes depend on the character of the gases and suspended matter under treatment, lead and cast iron being probably most used. Every part of the high-tension circuit, especially the transformer, rectifier and discharge electrodes, must be specially insulated. High-tension sphere gaps and other measuring instruments are provided, also in many cases automatic means for restoring normal operation after a temporary short-circuit in the treater due to some conducting material bridging between the axial electrodes and the pipe.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. All of the special electrical equipment required for Cottrell Electrical precipitation plants. This Company has co-operated from the beginning with the owners of the Cottrell process and thoroughly understands the requirements. Other G-E service to the chemical industries, to which precipitation equipment is particularly applicable, is portrayed on page 1213.—Adv.

Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PRECISION.—Trade name for tachometers manufactured by the McDonnell Odometer Co., 3501-03 S. Kedzie Ave., Chicago, Ill.

PRECISION INSTRUMENT CO.—21 Halsey St., Newark, N. J. Manufacturer of boiler efficiency and gas plant instruments. Business established 1910. President, C. P. Baldwin; vice-president, L. D. Vorse; secretary-treasurer, M. G. Borgman.

PRECISION SCIENTIFIC CO.—820-822 S. Tripp Ave., Chicago, Ill. Manufacturer of water stills for gas, gasoline or steam.

PRECISION THERMOMETER & INSTRUMENT CO.—Philadelphia, Pa. Manufacturer of precision instruments. Business established 1910. President, Lewis G. Wilson; vice-president and treasurer, Edward Collins, Jr.; secretary, Henry L. Balderston; general manager, Carl Waser. Main office, 1434 Brandywine St., Philadelphia, Pa. Branch office, 760 Monadnock Block, Chicago, Ill. Sales representatives, Rodgers & Reitz, 15 E. Fayette St., Baltimore, Md.; W. P. Balderston Co., Inc., Mills Bldg., San Francisco, Cal.; Foxboro

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Co., Oklahoma Gas Bldg., Tulsa, Okla.; Splitdorf Electric Co., 1621 Locust St., Kansas City, Mo.

PREMIER.—Trade name for motor-driven pumps manufactured by the Barnes Mfg. Co., N. Main St., Mansfield, Ohio.

PREMIER.—Trade name for electric vacuum cleaners manufactured by the Electric Vacuum Cleaner Co., Inc., Ivanhoe Rd., Cleveland, Ohio.

PREMIER.—Trade name for vibrating bells and electric vibrators manufactured by the Manhattan Electrical Supply Co., 17 Park Pl., New York, N. Y.

PREMIER.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

PREMIER.—Trade name for buffing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

PREMIER.—Trade name for mine trolley clamps manufactured by the Ohio Brass Co., Mansfield, Ohio.

PREMIER.—Trade name for farm lighting plants and electric vulcanizers manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

PREMIER.—Trade name for electric air pumps and fractional horsepower motors manufactured by the Premier Emergency Corp., 767 3rd Ave., New York, N. Y.

PREMIER.—Trade name for name plates and meter dials manufactured by the Premier Metal Etching Co., 14th St. & Van Alst Ave., Long Island City, N. Y.

PREMIER ELECTRIC CO.—3800-3819 Ravenswood Ave., Chicago, Ill. Manufacturer of storage batteries, telephone equipment, farm lighting plants, hand inspection lamps, spark plugs, vulcanizers. Business established 1905. President, treasurer and general manager, O. C. Dennis; secretary, R. M. Dennis; sales manager, A. J. Peifer.

PREMIER EMERGENCY CORP.—767 3rd Ave., New York, N. Y. Manufacturer of electric forge blowers, air pumps and motors. President, Otto A. Fuchs; vice-president, E. F. Collins; secretary, E. Fuchs; treasurer, J. Connolly.

PREMIER HANDYVAC.—Trade name for electric vacuum cleaners manufactured by the Electric Vacuum Cleaner Co., Inc., Ivanhoe Rd., Cleveland, Ohio.

PREMIER MFG. CO., INC.—Sandy Hook, Conn. Manufacturer of screw machine products.

PREMIER METAL ETCHING CO.—14th St. & Van Alst Ave., Long Island City, New York, N. Y. Manufacturer of name plates and meter dials.

PREMO.—Trade name for insulating and protective shellac manufactured by the California Paint Co., 11th, 12th & Pine Sts., Oakland, Cal.

PREPAY CAR.—See Pay-as-you-enter car.

PREPAYMENT METER.—A type of electric meter designed to receive a coin, as for example a quarter dollar, and to permit the use of current to that value, when, if another coin is not inserted, the service will be cut off. Used to avoid the cost of reading meters and making collection. See Meters, watthour, service, prepayment.

PREPAYMENT METERS.—See Meters, watthour, service, prepayment.

PRESERVATIVES, WOOD.—The commonest preservative used for wood is creosote. However, this product and carbolineum oil, both derivatives of coal tar, have been separately discussed elsewhere and here only the less common preservatives will be discussed. Among these preservatives zinc chloride is perhaps the most important. This substance is cheaper than creosote and because it is shipped in solid form the freight charges may be considerably less. It has the disadvantage that it is soluble in water and will in time be gradually dissolved out of the wood. Its use, therefore, is largely confined to comparatively dry locations. Corrosive sublimate and various patented mixtures also have been employed. The patented mixtures usually have creosote or zinc chloride for their base.

Manufacturers:

C-A Wood Preserver Co., Arcade Bldg., St. Louis, Mo. "Perfecto-Sote."
Carney & Co., B. J., Grinnell, Iowa.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Dielectric Mfg. Co., St. Louis, Mo. "Phenoleum."
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
International Creosoting & Construction Co., Galveston, Tex.
Northeastern Co., The, 80 Beverly St., Boston, Mass. "Letteney."
Page & Hill Co., 814 Plymouth Bldg., Minneapolis, Minn.
Protectors Paint Co., 1001 North American Bldg., Philadelphia, Pa.
Reeves Co., The, 3110 S. Carrollton Ave., New Orleans, La.
Spirittine Chemical Co., Wilmington, N. C.
Standard Oil Co. of California, 200 Bush St., San Francisco, Cal.
Suydam Co., M. B., 61st & Butler Sts., Pittsburgh, Pa.

PRESS CO., WELLS H.—Streator, Ill. Manufacturer of electric washing machines. President and treasurer, G. M. Stokes; vice-president, M. M. Press; secretary, general manager, O. E. Stokes.

PRESS-SURE.—Trade name for terminal tongs manufactured by the Thompson Mfg. Co., Meadville, Pa.

PRESSBOARD.—See Paper, fullerboard and pressboard.

PRESSED PRISM PLATE GLASS CO.—25 N. Dearborn St., Chicago, Ill. Manufacturer of glass sign letters. President and general manager, William A. Bond; secretary and treasurer, William Scott Bond.

PRESSED STEEL CAR CO.—Pittsburgh, Pa. Manufacturer of cars for electric railways, subways, etc., and electric steel castings. Business established 1899. President, F. N. Hoffstot; vice-presidents, N. S. Reeder and J. F. MacEnulty; vice-president and general manager, J. B. Rider; secretary, C. E. Church; treasurer, H. E. Swartz; sales manager, C. E. Postlethwaite. Main office, 307—5th ave., Pittsburgh, Pa. Factories, Pittsburgh, Pa.; McKees Rocks, Pa.; Hegewisch, Ill. Branch offices, 24 Broad St., New York, N. Y.; 122 S. Michigan Ave., Chicago, Ill.; E. Street, Washington, D. C.; 4th & Roberts Sts., St. Paul, Minn.

PRESSED STEEL CO., THE.—39 8th St., Muskegon, Mich. Manufacturer of electric foundry vibrators. Business established 1914. President and general maanger, W. B. Lakey; vice-president, Charles H. Adams; secretary, Mathias C. Young; treasurer and sales manager, W. Earl Lakey.

PRESSES, ARMATURE, FIELD AND TRANSFORMER COILS.—Coils used in armature, field and transformers, particularly those of the pancake type must be made to exact dimensions. To bring the wound coil into the exact shape and size desired they are subjected to pressure in a special press designed for this work. The machines used for forming armature coils though they may involve the same methods as the press are more commonly referred to as forming machines.

Manufacturers:

Enterprise Machinery Co., The, 30 S. Clinton St., Chicago, Ill. "Emco."
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Southwark Foundry & Machine Co., Philadelphia, Pa.

PRESSES, ARMATURE, FIELD AND TRANSFORMER CORES.—The assembled laminations of the armature, field, or transformer cores must be pressed flat and to exact dimensions in some form of press. The presses employed provide some means of holding the core in position and striking a blow upon the pile of laminations, the equipment being designed for the particular work done in the press.

Manufacturers:

Caldwell & Co., E. R., Bradford, Pa.
Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Segur."
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Southwark Foundry & Machine Co., Philadelphia, Pa.

PRESSES, CAR WHEEL, HYDRAULIC.—A railway shop tool utilizing the principle of the hydraulic press in obtaining the high pressures required to press wheels and motor gears onto or remove them from their seats on a car axle. The pump which produces the pressure in the large cylinder is power-driven, either by belt from a line shaft or by a small direct-connected electric motor. Suitable gages are provided to show the pressure at which the wheel is pressed on or comes off the axle. Wheel presses, especially in the shops of large companies, are fitted with graphic recording instruments so that a record, which may be retained and filed, is made of the pressures at which wheels are put on or removed. In electric railway practice wheels are usually pressed on axles with a pressure amounting to about ten tons per inch of diameter of axle at the wheel seat.

Manufacturers:

Caldwell & Co., E. R., Bradford, Pa.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Morgan Engineering Co., The, Alliance, Ohio.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Union Iron Works Co., Selma, Ala.
Watson-Stillman Co., The, 40 Dey St., New York, N. Y.
Wood & Co., R. D., Wood Bldg., Philadelphia, Pa.

PRESSES, MICA.—These are small power presses that may be either belt or motor-driven and are used for two purposes. One is for pressing together sheets of built-up mica. The other is for punching small mica disks or rings, such as are used for plug fuse tops, mica washers, etc. Bench type presses are generally used.

Manufacturers:

Dunning & Boschert Press Co., Inc., Syracuse, N. Y.
Enterprise Machinery Co., The, 30 S. Clinton St., Chicago, Ill. "Emco."
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.

PRESSES, MOLDED INSULATION.—Hydraulic presses capable of exerting pressures up to about 2000 lbs. per square inch are used for forming various molded insulation products. Steel dies are held in the press and it is provided with heating coils to maintain an operating temperature of about 350° F.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J. (also performing).
Dunning & Boschert Press Co., Inc., Syracuse, N. Y.
Farrel Foundry & Machine Co., 25 Main St., Ansonia, Conn.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.

PRESSES, MOTOR-DRIVEN, MISCELLANEOUS.—Motor drive is now applied to a very large number of machine tools, among which are several types of presses. Some of the types of presses described above are motor-driven. In addition, motor drive is very extensively used on punch presses for various purposes. Bulldozers are also motor-driven in a large number of cases. In making electrical equipment, such as armature laminations, transformer cores, etc., presses for notching the iron and steel sheets are required. These are usually motor-driven presses and differ slightly from punch presses. There are also motor-driven presses that are used for forming insulating materials of various kinds and for baling scrap sheet metal, paper, straw, hay, etc., and for various other special purposes.

Manufacturers:

Bliss Co., E. W., Adams & Plymouth Sts., Brooklyn, N. Y.
Dunning & Boschert Press Co., Inc., Syracuse, N. Y. (baling).
Elmes Engineering Works, Charles F., 230 N. Morgan St., Chicago, Ill.
Excelsior Tool & Machine Co., East St. Louis, Ill. "Excelsior."
Myers Machine Tool Corp., Columbia, Pa. "Myers."
Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. "Niagara."
Perkins Machine Co., Warren, Mass. "Perkins."
Stecher Co., Inc., The Charles, 2301 Knox Ave., Chicago, Ill.

PRESSES, OIL FILTER.—See Oil filters, dehydrators and purifiers.

PRESSES, PORCELAIN.—See Porcelain making machinery and dies.

PRESSES, PRINTING, MOTOR-DRIVEN,—One of the chief requirements of motive power in printing presses is a certain amount of speed variations and easy and ready control of the press. These speed variations and instant control can be most readily obtained by electric motor drive. This form of drive is very extensively employed, generally individual motor drive. A wide variety of control systems, motor equipment, etc., are used each being suitable to the form of press. On the large

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newspaper presses two motors using automatic control in connection with push button stations are employed.

Manufacturers:

American Multigraph Sales Co., The, E. 40th St. & Kelly Ave., Cleveland, Ohio. "Multigraph."
Babcock Printing Press Mfg. Co., The, 38 Pequot Ave., New London, Conn.
Goss Printing Press Co., The, 1535 S. Paulina St., Chicago, Ill.
Meisel Press Mfg. Co., 944-948 Dorchester Ave., Boston, Mass.
Miehle Printing Press & Mfg. Co., 14th & Robey Sts., Chicago, Ill. "The Miehle."
Regina Co., The, 47 W. 34th St., New York, N. Y. "New Era."
Scott & Co., Walter, Plainfield, N. J.
Thomson Press & Mfg. Co., John, 253 Broadway, New York, N. Y.
United Printing Machinery Co., 38 Park Row, New York, N. Y.
Wesel Mfg. Co., F., 70 Cranberry St., Brooklyn, N. Y.

PRESSES, PULLEY.—Instead of fastening a pulley to a shaft by clamp or key the pulley may be forced onto the shaft. This is done by having a slight taper in the hole of the pulley and forcing it onto the shaft by means of a press. The pulley put on in this manner practically forms a one-piece pulley and shaft and is free from projecting set screws or keys.

Manufacturers:

Southwark Foundry & Machine Co., Philadelphia, Pa.
Wood & Co., R. D., Wood Bldg., Philadelphia, Pa.

PRESSING IRONS.—See Irons, pressing, household; Irons, pressing, laundry; Irons, pressing, tailors'; Irons, pressing, travelers'.

PRESSURE CONTROLLERS OR GOVERNORS.—See Governors, compressor or pressure pump.

PRESTO.—Trade name for automobile electrical specialties manufactured by the Metal Specialties Mfg. Co., 338-352 N. Kedzie Ave., Chicago, Ill.

PRESTO.—Trade name for annunciators manufactured by the Partrick & Wilkins Co., 51 N. 7th St., Philadelphia, Pa.

PRESTO.—Trade name for electric heating appliances manufactured by the Presto Electric Co., Inc., 1008 C. Spreckels Bldg., San Francisco, Cal.

PRESTO ELECTRIC CO., INC.—1008 C. Spreckels Bldg., San Francisco, Cal. Manufacturer of electric heating appliances. Business established 1912. President, George Newman; vice-president, M. S. Shoenberg; secretary and treasurer, L. Adelsdorfer.

PRESTO HOLDER.—Trade name for blueprint racks manufactured by the National Co., Cambridge 39, Boston, Mass.

PREST-O-LITE.—Trade name for storage batteries manufactured by the Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind. and Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.

PREST-O-LITE CO.—533 N. Capital St., Indianapolis, Ind. Manufacturer of storage batteries, battery-charging equipment, insulators, welding outfits, etc.

PREST-O-LITE CO. OF CANADA, LTD.—Toronto, Ont., Can. Manufacturer of storage batteries, battery-charging equipment, insulators, welding outfits, etc. President, M. J. Carney; vice-president, P. A. Rose; secretary, H. F. Reiss; treasurer, G. W. Mead; general manager, R. H. Combs; sales manager, S. L. Mongomery. Main office, Hillcrest Park, Toronto, Ont., Can. Factories, Toronto, Ont., Can.; Merrilton, Ont., Can.; Shawinigan Falls, Que., Can.; St. Boniface, Man., Can. Branch offices and warehouses, 831 St. Catharines St., W., Montreal, Que., Can.; 605 Tosche Ave., Winnipeg, Man., Can.

PRESTON MICA CO., ROBERT K.—804 Monadnock Block, Chicago, Ill. Manufacturer of insulating tape, varnish, mica and mica products.

PRESTONITE.—Trade name for mica plate, rings and tubes manufactured by the Robert K. Preston Mica Co., 804 Monadnock Block, Chicago, Ill.

PRESTOPAL.—Trade name for illuminating glassware manufactured by the Gleason-Tiebout Glass Co., 99 Commercial St., Broklyn, N. Y.

PRESTURN.—Trade name for sockets and switches manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

PRIESS-BARTH.—Trade name for radio transmitter manufactured by the Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

PRIEST'S.—Trade name for electric horse clipping and grooming machines manufactured by the American Shearer Mfg. Co., Nashua, N. H.

PRIMA.—Trade name for electric washing machines manufactured by the Buckeye Prima Co., Sidney, Ohio.

PRIMARY BATTERY OR PRIMARY CELL.—An electrochemical cell which serves as a primary or original source of electrical energy. This energy is produced as the result of nonreversible chemical action in the cell. See Batteries.

PRIMARY COIL.—This term frequently has been applied to the high-voltage coil of a transformer, whether on the incoming or outgoing side, but more accurately describes the coil, whether on transformer, induction coil or induction motor, that is connected to the source of energy. See Primary and primary transformer.

PRIMARY LUMINOUS STANDARD.—Defined as "a recognized standard luminous source reproducible from specifications." The most widely used standard is the international candle which is used in the United States, France, Great Britain and many other countries. See Candles.

PRIMARY REFLEX.—Trade name for spark plugs manufactured by the Reflex Ignition Co., 3068-3086 W. 106th St., Cleveland, Ohio.

PRIMARIES IN DISTRIBUTION.—In a transformer the winding that is connected to the source of supply is known as the primary coil, the delivery coil being known as the secondary. In 2200-volt distribution the distributing or service transformer usually steps down to a lower voltage and popular usage has extended the meaning of these words so that 2200-volt wires are commonly called primaries and the lower-voltage wires are called secondaries.

PRIMARY.—The electric circuit or circuits to which electric power is given and from which electric power is transferred to a secondary circuit by means of electromagnetic induction. It is commonly used to designate one of the windings of induction coils, transformers and induction machines.

PRIMARY CELL.—A device for the conversion of chemical energy into electrical energy, consisting of a positive and a negative electrode in an electrolyte. Numerous combinations have been devised for various purposes, of which some of the more prominent types are the following: Daniell, Grove, Poggendorff, Lalande, Leclanche' and dry cells. Aside from the different metals used as electrodes in the different cells, the chief item of variation in the cells is the method of securing depolarization, that is, of disposing of the products of the reaction at the electrodes when the cell is in operation. See Batteries.

PRIMARY CUTOUT.—See Cutouts, fusible, primary.

PRIMARY CURRENT.—The current flowing in the coils connected to the source of power.

PRIMARY FUSE BOX.—A box for mounting a high-tension or primary fuse. Frequently mounted out of doors on the pole. See Boxes, cutout or fuse.

PRIMARY OF INDUCTION MOTOR.—The winding, usually the stator, connected to the source of power.

PRIMARY, TRANSFORMER.—That one of the two coils of a transformer winding which is connected to the supply circuit and receives therefrom the energy which is to be transformed by magnetic induction.

PRIME MOVER.—In the broad sense, any device or machine utilized by man to convert the forces of nature into mechanical motion or electrical forms of energy; examples, the muscles of men or animals, windmills, water wheels, engines driven by steam produced by heat from coal or wood, and explosives depending for their strength on chemical action. In the electrical field the use of the term "prime mover" is usually restricted to a machine or group of machines first developing the energy in electrical form. This includes an electrical generator connected to or driven by either a steam engine, a steam turbine, a water wheel or turbine, or an internal combustion engine. These latter machines are also frequently classed as prime movers when used to drive machinery directly or by belting, without the intervention of the electrical current. In a secondary sense an electric motor, supplying power to a group of machines, may be considered a prime mover but this is scarcely true in a primary sense.

PRIME MOVERS REGULATION OF.—A term used to indicate the variation in speed between full load and no load. In steam engines, steam turbines and internal combustion engines, it is usually considered as the ratio (in per cent) of the maximum variation in speed when slowly reduced from full load to no load, to the speed at full load, supply conditions being constant. For example, if a direct-connected engine generator set, under constant steam pressure, has a full load speed of 400 r.p.m., but runs up to a maximum of 420 at some point between there and no load, the variation would be 20 r.p.m. and the regulation would be 20 to 400 or 5%. In a hydraulic turbine, or water motor, it is usually considered as the same ratio, under conditions of constant head of water.

PRIMERS, ELECTRIC, FOR INTERNAL-COMBUSTION ENGINES.—Electrical primers are made for use on automobiles and other internal-combustion engines to facilitate starting during cold weather. They are electrically heated vaporizers which operate as an auxiliary carburetor. Gasoline is drawn from the carburetor and heated to high temperature by means of a small heating element operating from the battery. A rich, hot gas is thus formed that will ignite readily when a spark occurs. The heating coil need only be connected to the battery for a few seconds (one to seven) depending upon the outdoor temperature. Also see Heaters, electric, automobile.

Manufacturers:

Master Primer Co., 34 Larned St., E., Detroit, Mich. "Master."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

PRIMM.—Trade name for oil engines manufactured by the Power Mfg. Co., Marion, Ohio.

PRIMO.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

PRINCESS.—Trade name for electric pressing irons manufactured by the Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill.

PRINCESS.—Trade name for boudoir lamps manufactured by the Hygrade Lighting Fixture Corp., 38 Park St., Brooklyn, N. Y.

PRINCESS.—Trade name for electric washing machines manufactured by the Princess Wash Machine Mfg. Co., 433 E. Pearl St., Cincinnati, Ohio.

PRINCESS.—Trade name for electric vacuum cleaners manufactured by the Suction System Cleaning Co., Sidney, Ohio.

PRINCESS WASH MACHINE MFG. CO., THE.—433 E. Pearl St., Cincinnati, Ohio. Manufacturer of electric washing machines. Business established 1907. President, treasurer and general manager, C. W. Crawford; vice-president, W. J. Fitterer; secretary, William J. Spiegel.

PRINCO.—Trade name for precision instruments manufactured by the Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa.

PRINGLE ELECTRICAL MFG. CO.—1906-12 N. 6th St., Philadelphia, Pa. Manufacturer of panelboards, switchboards, switches, steel cabinets, boxes, etc. Business established 1891. President, secretary and treasurer, William T. Pringle; vice-president and general manager, Arthur E. Pringle; sales manager, Herbert Muehlberger.

PRINTING MACHINERY, MOTOR DRIVEN.—In modern printing shops not only the presses but auxiliary machinery as well is equipped with individual motor drive. There are a number of these machines which come under this classification, such as linotype, monotype, folding and cutting machines, automatic feeding devices, etc.

Manufacturers:

American Multigraph Sales Co., The, E. 40th St. & Kelly Ave., Cleveland, Ohio. "Multigraph."
Babcock Printing Press Mfg. Co., The, 38 Pequot Ave., New London, Conn.
Challenge Machinery Co., The, Grand Haven, Mich. "Diamond" paper cutter.
Hall, A. W., 633 Plymouth Ct., Chicago, Ill.
Meisel Press Mfg. Co., 944-948 Dorchester Ave., Boston, Mass.

PRINTING SYSTEMS, TELEGRAPH.—See Telegraph printing systems.

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PRINTING TELEGRAPH.—See Telegraph systems, printing.

PRINTOMETER.—Trade name for printing demand meter manufactured by the Mineralac Electric Co., 1045 Washington Blvd., Chicago, Ill.

PRISMS, CHANDELIER.—See Crystals and prisms, chandelier.

PRISMS FOR SCIENTIFIC APPARATUS AND INSTRUMENTS. — Various scientific instruments used in the measurement of light or employing light as a part of the measuring or indicating device use very accurately cut prisms to control the light. Such instruments as the oscillograph, and various photometers employ these prisms.

Manufacturers:

Newton, Charles I., 305 W. 15th St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Standard Scientific Co., 9 Barrow St., New York, N. Y.

PRIVAPHONE.—Trade name for telephone mufflers manufactured by the Standard Appliance Co. of America, 380 Lafayette St., New York, N. Y.

PRIVATE BRANCH EXCHANGE SWITCHBOARDS. — See Switchboards, telephone, private branch exchange.

PRIVATE LINE.—See Lines, telephone.

PRIZMA, INC.—New York, N. Y. Manufacturer of motor-driven photographic and motion-picture machinery. Business established 1915. President, Lee Benoist; vice-president, C. H. Dunning; secretary, George P. Kelly; treasurer, C. K. D. Walsh; general manager, W. V. Kelly; sales manager, H. R. LeRoy. Main office, 71 W. 23rd St., New York, N. Y. Branch office, 3193-7 Hudson Blvd., Jersey City, N. J.

PROCTOR.—Trade name for electric driers manufactured by Proctor & Schwartz, Inc., 7th St., & Tabor Rd., Philadelphia, Pa.

PROCTOR & SCHWARTZ, INC.—Philadelphia, Pa. Manufacturer of electric driers. President, C. W. Schwartz, Jr.; vice-presidents, W. M. Schwartz, E. B. Ayres; secretary and treasurer, F. Kershaw. Main office and factory, 7th St. & Tabor Rd., Philadelphia, Pa.; Branch offices, Hearst Bldg., Chicago, Ill.; Howard Bldg., Providence, R. I.; 291 Broadway, New York, N. Y. Sales representative, W. J. Westaway Co., Hamilton, Ont., Can.

PRODUCER GAS.—Gas generated from coal in a gas producer. See Gas producers, power plant.

PRODUCTIMETER.—Trade name for electric revolution counting machines manufactured by the Durant Mfg. Co., 655-665 Buffum St., Milwaukee, Wis.

PRODUCTION ENGINEERING CORP.—64 Pearl St., Boston, Mass. Manufacturer of electric vacuum cleaners and brazing torches.

PRODUCTION EQUIPMENT CO., INC.—5 Union Sq., New York, N. Y. Manufacturer of electrical engraving machines and micrometer gages. Business established 1917. President, W. W. Gibbons; vice-president and general manager, F. Robertson; secretary and treasurer, L. W. Byrne.

PRODUCTION OF AN A-C. E.M.F.—An e.m.f. is induced in any conductor when the intensity of the magnetic field around the conductor is varied. This variation of magnetic flux around a conductor may be produced in several ways. In an alternator the conductor is either moved to cut across the magnetic flux, or the conductor is kept stationary while the flux is made to move or change so as to cut the conductor. The e.m.f. induced depends upon the length of the conductor and the rate at which the flux is varied. If the conductor is in the form of a coil of N turns and the flux changes through all of the turns, the numerical value of the induced e.m.f. will equal N times the e.m.f. induced in one turn. Algebraically $e=N(dO)/(dt)$ where $(dO)/(dt)$ is the rate at which the flux changes. The shape of the e.m.f. curve will be determined by this rate. If the magnetic field of the alternator is designed so that $(dO)/(dt)$ is a sine function, the e.m.f. wave will be a simple sine curve. In a transformer the e.m.f. is induced by a current in the primary producing a magnetic flux which fluctuates with the current. The e.m.f. induced in the secondary is produced by mutual induction.

PRODUCTS CORP., THE.—Maywood, Ill. Manufacturer of soldering irons, blow torches and soldering coppers. Business established 1920. President, John T. Peterson; vice-president, C. J. Gruschow; secretary and treasurer, J. W. Benes.

PROGRAM CLOCKS.—See Clocks, electric, program.

PROGRESS.—Trade name for power transmission belting manufactured by the H. N. Cook Belting Co., Howard & Fremont Sts., San Francisco, Cal.

PROGRESS.—Trade name for motor-driven can washing machines manufactured by the Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.

PROGRESSIVE.—Trade name for electric irons manufactuerd by the Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

PROGRESSIVE FIXTURE & BRASS CO.—2171-3 E. 2nd St., Cleveland, Ohio. Manufacturer of lighting fixtures. Partnership, Fred G. Kuhlman and George W. Joyce.

PROGRESSIVE SHOE MACHINERY CO.—Minneapolis, Minn. Manufacturer of motor-driven shoe repairing equipment. Business established 1908. President, J. H. Martin; vice-president, L. J. Bedord; secretary, A. C. Bedord; treasurer and general manager, I. O. Abrams; sales manager, G. B. Benton. Main office and factory, 3116-36 Snelling Ave., Minneapolis, Minn. Branch offices, San Francisco, Cal.; Eastern Shoe Machinery Co., 243 Greenwich St., New York, N. Y. Sales representatives, Detroit Shoe Machinery Co., Detroit, Mich.; Union Shoe Machinery Co., 619 Milwaukee Ave., Chicago, Ill.

PROJECTING LAMPS AND APPARATUS.—See Lamps, projecting and stereopticon; also Motion-picture machines; also Searchlights; Spotlights.

PROJECTOGRAPH.—Trade name for electrical advertising specialty manufactured by the New York Engravers' Supply 230-234 W. 17th St., New York, N. Y.

PROJECTORS. FLOOD-LIGHT.—A lamp equipped with a reflector which is parabolic or nearly parabolic in form, so as to project a beam of light for flooding some distant object or area with light. As flood lights are most commonly used for outdoor purposes, they are usually mounted in weatherproof cases with provision for adjustment in both horizontal and vertical planes. Some flood lights are made to take special concentrated-filament lamps, others are made for common standard lighting service lamps.

Flood-light projectors have a wide field of application which has increased rapidly during the past few years. They have replaced searchlights in a number of places where such a strong light is not necessary; for instance, they are used on small ships and pleasure boats, usually mounted over the pilot house and controlled from within, and used for picking out docks, buoys and guide marks to determine the course, etc. These throw a concentrated beam of light. Most other uses require reflectors and lamps that will throw a wide beam of light, such as is needed for general illumination of large areas. These are extensively used for illuminating railroad and industrial yards, construction projects, the exteriors of buildings, monuments, sign boards, playgrounds, skating ponds, bathing beaches, tennis courts, etc.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
CROUSE-HINDS CO., Syracuse, N. Y. Made in types to take lamps from 25 to 1000 watts, and with reflectors from 9½ ins. to 20 ins. Scientifically designed to render long service, to give maximum illumination, and to minimize maintenance. There is a type made for every need. Copy of catalog sent upon request.—Adv.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. Golden Glow and Crystal Mirror floodlighting projectors are distinctive in that they are fitted with the famous Golden Glow or Crystal Mirror reflectors which never tarnish nor require repolishing. These reflectors are made of glass by a special patented process and are without question the most highly developed reflectors on the market which can be manufactured



Golden Glow Flood Lighting Reflector

and sold at a commercial price. They are made into many types of portable and stationary projectors and also as marine searchlight projectors.—Adv.
Fowler Lamp & Mfg Co., 61 E. 24th St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E Flood Lighting Projectors with the modern reflectors and high intensity Mazda lamps make possible improvements over any previous outdoor lighting system. They are available in such variety that any number of lights in any combination and for any conceivable purpose can be selected. The thousands in use here and abroad meet the demand for efficient and, quality considered, inexpensive units. Described in Bulletin 43850-B. See adv. pages 1203-1223.—Adv.



Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Liberty Appliance Corp., 249 E. 43rd St., New York, N. Y.
Milburn Co., The, Alexander, 1420-28 W. Baltimore St., Baltimore, Md.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. X-Ray projectors, for flood lighting, are designed for supplying various distributions of light. Every floodlighting requirement met. All classes built for any type of mounting, and utilize X-Ray mirror-glass reflectors. A wipe with a cloth restores the reflector surface to original brilliancy. Reflectors for each unit are interchangeable. See adv. page 1405.—Adv.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago. The "Flood-O-Lite." A very efficient cast iron weatherproof flood lamp for use with 500-watt "C" lamps. Has guaranteed Pittsburgh reflector and mechanically perfect lamp adjustment. Supplied with bracket, pedestal or portable base.—Adv.



Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.
Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y. "Star."
Sunbeam Electric Mfg. Co., Evansville, Ind.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Midnight Sun," "Daylight Flood."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

PROJECTORS FOR POST CARDS AND OTHER OPAQUE OBJECTS.—These are outfits designed to be used in halls, lecture rooms, homes, etc., to project on a screen picture post cards, drawings, printed matter, etc. They usually consist of a light source, sometimes an arc lamp, but more frequently an incandescent lamp, and an arrangement of mirrors, to deflect the rays and direct them to the lens in such a manner that the enlarged image will be shown upon the screen.

Manufacturers:

Mirroscope Co., The, Cleveland, Ohio. "Mirroscope."
Thompson & Co., A. T., 15 Tremont Pl., Boston, Mass. "Radioscope."

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WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
White Co., H. C., North Bennington, Vt. "Radioptican."

PROJECTORS, PICTURE.—See Motion-picture machines; also Stereopticons.

PROJECTORS, SIDEWALK AND SIGN. See Advertising specialties.

PROMETHEUS ELECTRIC CO.—511 W. 42nd St., New York, N. Y. Manufacturer of electric heating devices. Business established 1901. President, George T. Schreiber; vice-president, Arthur M. Hess; secretary, E. F. Hermann; treasurer, A. Haussmann; general manager, A. L. Schneider; sales manager, Henry L. Leeb.

PRO-MO-TOR FABRICATING CORP.—182 Locust Ave., New York, N. Y. Manufacturer of spark plugs, motor-driven air compressors and ignition accessories. President, Gustav L. Herz; vice-president, Russel A. Cowles; secretary, Mark Eisner; treasurer, Edward S. Rothchild; general manager, Henry Hamel; sales manager, Gustav L. Herz.

PRONY BRAKE.—A form of friction dynamometer used to measure the energy delivered by a revolving shaft. It consists of an adjustable brake or band fitted to a pulley attached to the shaft. This brake has a long arm which is prevented from revolving by a bearing on a platform or spring scale. See Dynamometers, motor and engine testing.

PROPP CO., M.—108 Bowery, New York, N. Y. Manufacturer of Christmas tree lighting outfits, heater plugs, lamp testing outfits and electrical novelties. Partnership, Morris Propp and Louis Propp.

PROSSEN.—Trade name for piston ring manufactured by the Nilson-Miller Co., Hoboken, N. J.

PROTECTION, ELECTRICAL. — This falls naturally into two groups, first, that including protection for electrical equipment and second, that in which electrical circuits and apparatus are used to protect non-electrical equipment. 1. The first group may be subdivided into apparatus to protect the electrical systems against internal dangers and that to guard it from external disturbances. For internal protection, chiefly from the danger of overload, small size machines or transformers are protected by fuses while the larger sizes are usually protected by circuit breakers or a combination of fuses and circuit breakers. These breakers are frequently operated by relays which respond to overload, no voltage, reverse current and other abnormal conditions. Motor starters are almost invariably provided with no voltage release coils, which allow the handle to come to the "off" position if power goes off the line. For protection against lightning (and also against internal surges on the line) lightning arresters of types suitable to the voltage are required.

Telephone, telegraph and other signal circuits are protected from overload by fuses or by heat coils (which guard against leakage currents known as "sneak" currents) and from outside disturbance, such as accidental contact with high-voltage lines or lightning stroke, by these same fuses, and by properly designed lightning arresters. For details of protecting apparatus see under individual titles.

2. The application of electricity has rendered possible many safety or protection systems, some of which are extremely intricate. Among the most common are the various burglar alarm systems used on buildings, vaults, etc., which depend for their operation upon the disturbance of some part of the usually hidden circuit by the intruder, to ring a bell or give an alarm, perhaps at some distant point. Some of the systems are of the closed circuit type (as those ordinarily used on store windows) and set off the alarm when broken, while others are of the open circuit type and give the alarm when certain contacts are made, as by the opening of a door. Fire and police alarm systems also fall into this class. Watchman or private alarm signals are extensively used to permit a watchman to report regularly or to give an alarm if necessary. In buildings equipped with automatic sprinklers the system may be extended to cover low-water signals, flow of water in valves, as when a sprinkler head opens or a pump is started, and other similar purposes. Usually these signals are given at some central location where the company installing and maintaining the system keeps attendants at all hours of the day and night to report alarms to the fire department or to the owners of the building.

Practically all systems of railway safety block signaling are electrically operated and some of these are very extensive and quite intricate. For details see under individual titles.

PROTECTIVE COMBINATIONS, SERVICE.—See Service protective units.

PROTECTIVE GROUNDING. — See Grounding; also Grounding devices, miscellaneous.

PROTECTIVE REACTOR. — See Reactor.

PROTECTIVE SIGNAL MFG. CO., THE.—1900 W. 32nd Ave., Denver, Colo. Manufacturer of electric railway signals and accessories. Business established 1890. President, D. B. Turner; vice-president, W. H. Leonard; secretary, W. C. Neahr; treasurer, H. E. Fiske; sales manager, A. E. Bacon.

PROTECTOR.—Trade name for non-locking lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

PROTECTORS, A-C. NETWORK.—The protection of a-c. transmission and important distribution networks is provided for by means of relays which are so arranged as to operate the circuit breakers or oil switches in case of short-circuit, ground, reversal of power, serious overload or other trouble on the system. Three-wire three-phase systems require relays in two of the three wires. In three-phase four-wire circuits with the neutral point grounded relays are installed in each phase wire. The placing of relays and the type used depends largely upon the method of laying out the transmission circuits, i. e., whether open loop, parallel loop, ring or tree circuits are used. One system, the Mertz-Price system, depends on unequal currents at the two ends of the conductor in trouble. Series transformers at the two ends are interconnected so that normally no current flows through the relay. Unbalance, under trouble, cuts out the apparatus.

The three principal types of relays used in the protection of networks are overload, reverse power, and differential. The network is often divided into loops and a suitable arrangement of the relays is worked out for each loop or section thereof. The relays so function that in case trouble occurs on one section the others will be disconnected from this, thus eliminating any chance of the trouble spreading to sections or loops in which things are working satisfactorily.

The overload relay functions when the current exceeds the setting value for a predetermined length of time. This relay is of the inverse-time-limit type so that the greater the current the quicker the relay will close. The reverse-power relay has the same characteristic described above, except that it operates when the power flows in one direction only and will not operate when the power flows in the opposite or normal direction. The differential relay is for service protection and cuts out the defective lines instantaneously. The latter relays operate on an unbalance of current in two windings; they are used successfully for protection of cables in ring systems.

A-c. secondary networks for 115-230-volt distribution are rapidly gaining favor because of their high efficiency and many other desirable features. A new form of network protector has been developed for the protection of service on such networks and is usually made a part of the stepdown distribution transformer. The protector consists essentially of a transformer device with two windings magnetically balanced and a third set of windings connected so as to blow fuses in the low-voltage transformer leads, when the magnetic balance is disturbed.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. A-C Network Protector is made as part of step-down transformer and placed in same tank. Secondary fuses placed in separate compartment, made a part of the transformer cover. Suitable indicating devices for showing transformer out of service. May be supplied on 50, 75, 100 kv-a. transformers—standard voltages. See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See adv. pages 1395-1402.)

PROTECTORS, CABLE AND CABLE SPLICE.—A rigid support attached to the framework for clamping a cable near the point where it is soldered into a lug or terminal. The purpose is to take the strain, due to vibration or the weight of a long span, away from the soldered joint. Used with disconnecting switches and in similar locations.

Manufacturer:

Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."

PROTECTORS, CORD. — Helical wire coils for use with portable utilization devices such as flatirons, soldering-irons, etc., to prevent kinking of the flexible cords connected to the devices.

Manufacturers:

Dodge Bros., 66 E. 1st St., Salt Lake City, Utah. "Dodge's."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

PROTECTORS, CROSSING SPAN.—Crossing span protectors are guards or "cradles' mounted below overhead wires to catch the loose ends in case of wire breakage, to prevent accidental contact or damage from contact with other circuits. The usual form consists of two parallel supporting wires with cross sticks several feet long forming a "cradle."

Manufacturers:

Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."

PROTECTORS, GUY WIRE. — Where guy wires or the upper ends of anchor rods emerge from the ground, especially if in a public highway, it is desirable to protect them against accident, as well as to guard passers-by from injury by running into them, as they are small and not easily seen in the dim light. Wooden boxes or iron pipes surrounding the guy wire or rod, and extending from a point a short distance below the surface of the ground to from five to ten feet above, are frequently used as protectors. Sometimes posts are set close to the wire as a warning. Special forms of protectors are also manufactured, which are claimed to be easier to install as well as more satisfactory and permanent in their results.

Manufacturers:

Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."
Specialty Device Co., The, 106 W. 3rd St., Cincinnati, Ohio. "Bierce."

PROTECTORS, LIGHTNING.—While all equipment installed to guard either buildings or electrical apparatus against the effects of lightning strictly forms lightning protection, the term "lightning protector" is usually applied to special combinations of devices used for telephone, telegraph, fire alarm and other signal circuits. Protective equipment for higher voltage circuits is classed under the heading, lightning arresters (see Arresters, lightning; also Lightning protection; also Rods, lightning).

The common form of lightning protector includes, usually mounted on the same base, a fuse and a lightning arrester for each side of the line. The fuse may be of any size up to approximately 15 amperes, 7 amperes being a common size for telephone and 8/10 or 3 amperes for telegraph circuits. They are of a type suitable for protection against accidental contact with foreign circuits up to 2300 volts. The arrester may be two small carbon blocks, one connecting to line, the other to ground, with a plain or perforated sheet of mica between them; or a small sheet of metal having sharp saw teeth along one edge, which is carefully spaced from a grounded carbon; or, especially in railway signal service, a similar spark gap mounted in a vacuum tube. On telegraph and fire-alarm systems it is frequently necessary to protect delicately wound apparatus, such as relays, etc., against leakage or stray currents which are too small to blow the fuses. For this purpose heat coils or "sneak" coils are used, which will ground the line if a weak current flows continuously for some time. This heat coil is usually mounted on the same base with the main fuse and the lightning arrester, but connected between the latter and the equipment to be protected. See Protectors, telephone, telegraph and fire alarm.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. A vacuum tube arrester designed to meet the exacting requirements of railway signal and similar work. An elaborate sealing system used in construction insures maintaining a good vacuum. Current-carrying parts, which are made of the same metals as used successfully in arresters for power circuits have proved to be unaffected in tests which subjected the arrester to currents as high as 1000 amp. The arrester has also been

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thrown repeatedly on a 500-volt trolley circuit blowing 35-amp. fuses without causing an internal short circuit. R. S. A. standard terminals are used throughout. (Bulletin Y-1557.) See adv. pages 1203-1223.—Adv.

PROTECTORS, LINEMEN'S.—In doing work on live primary circuits on poles, the clearances are at times such that the lineman's safety is endangered unless protectors are used. The protector may consist of a rubber blanket or large pad or a special device made somewhat like a rubber tire, which encircles the wire. About 4 ft. of the live wires on which work is not being done are covered while the work on the exposed wire proceeds. Such protection not only minimizes accidents but expedites the work.

Manufacturers:

Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."
Linemen Protector Co., 850 Penobscot Bldg., Detroit, Mich. "Marshall's."

PROTECTORS PAINT CO.—1001 North American Bldg., Philadelphia, Pa. Manufacturer of wood preservatives, etc.

PROTECTORS, RAIL BOND.—Where copper rail bonds are used in open track it is often necessary to protect them from being accidentally knocked loose and in some cases to prevent intentional theft. Rail-bond protector is a name applied to the various means used for properly protecting such exposed bonds.

Manufacturer:

P. & M. Co., 80 E. Jackson Blvd., Chicago, Ill. "P. & M."

PROTECTORS, TELEPHONE, TELEGRAPH AND FIRE ALARM.—Lightning protectors are used extensively on telephone and telegraph lines and in connection with fire-alarm, railroad and other signaling systems having overhead circuits exposed to lightning. They are necessary on these systems to protect the users and the equipment not only against lightning, but against foreign currents of a hazardous character, such as might be occasioned by exposure to high-potential circuits. The protectors usually consist of a lightning arrester combined with a fuse, heat coil or "sneak" coil or other protective device that will operate on a moderate-voltage foreign current. Also see Arresters, lightning, telephone and telegraph; also see Heat coils.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Ericsson Mfg. Co., Buffalo, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "W.B.G."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Michigan Electric Specialty Co., Muskegon, Mich. "Vac-M."
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

PROVIDENCE BASE WORKS OF GENERAL ELECTRIC CO.—586 Atwells Ave., Providence, R. I. Manufacturer of incandescent lamp bases. General manager, T. I. Walker.

PROVIDENCE ELECTRIC MFG. CO.—23 Broad St., Providence, R. I. Manufacturer of flashlights and electrical novelties.

PROVIDENCE ENGINEERING CORP.—Providence, R. I. Manufacturer of steam engines. Business established 1890. President and sales manager, W. E. Hussey; vice-president and general manager, William A. Drewett; secretary and treasurer, F. L. Vaughn. Main office, 521 S. Main St., Providence, R. I. Branch office, 5 Nassau St., New York, N. Y.

PROX CO., FRANK.—Terre Haute, Ind. Manufacturer of electric coal cutting and mining machines.

PRUNERS, TREE.—See Tree trimmers or pruners.

PRUNING SAWS AND SHEARS, TREE.—See Saws, pruning; also Tree trimmers or pruners.

PRYIBIL MACHINE CO., P.—512-524 W. 41st St., New York, N. Y. Manufacturer of power transmission appliances, motor-driven saws, jointers and other woodworking machinery. President, Albert Pryibil; vice-president, P. Lester Pryibil; treasurer, Paul Pryibil.

PRYZOAK.—Trade name for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

Pt.—Abbreviation for point. The form Pt is the chemical symbol for the metallic element platinum.

PUBLIC RELATIONS SECTION, N. E. L. A.—Chairman, J. E. Davidson, Omaha, Nebr.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. — Secretary-treasurer, R. M. Booker, Newport News & Hampton Railway, Gas & Electric Co., Hampton, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA.—Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

PUBLICATIONS, ELECTRICAL.—For a complete list of the American and Canadian electrical publications periodically issued and having a national or international circulation see Periodicals, electrical.

PUFFER-HUBBARD MFG. CO.—Minneapolis, Minn. Manufacturer of electric washing machines. President, A. O. Hubbard; vice-president, George D. Puffer; secretary and treasurer, H. M. Puffer.

PUL UP.—Trade name for electric blasting apparatus manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

PULL-A-LITE.—Trade name for lighting fixtures manufactured by H. A. Bauer, Inc., Lansdowne, Pa.

PULL ATTACHMENTS, CHAIN.—See Attachments, pull chain.

PULL BOXES, CONDUIT.—See Boxes, conduit, junction and pull.

PULL CHAIN.—See Chains, ball or bead, for pull sockets, etc.

PULL CLEAN.—Trade name for industrial lighting fixtures manufactured by the Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.

PULL ROSETTES.—See Rosettes, pull switch.

PULL SOCKETS.—See Sockets, medium and mogul, standard.

PULL SWITCHES.—See Switches, pull, plug-socket type.

PULLERS, CABLE.—See Capstans, cable pulling.

PULLERS, GEAR AND PINION.—Portable tools to remove gears or pinions from their shafts, such as removing the pinion from the shaft of a railway motor armature. The pinion of such an armature has a taper driving fit on the shaft and considerable pressure is required to remove it. The tools are known as "pinion pullers" or "gear pullers" and utilize the principle of the screw in obtaining the required pressure. One form is a U-shaped forging with one side of the U hinged at its junction with the connecting cross member. Lugs, projecting inwardly to form two ends of the forging, engage the pinion on its inside face. A screw or threaded bolt having a square or hexagon head passes through a threaded opening in the center of the connecting cross member of the forging. This screw is turned until contact is made with the end of the armature shaft, and then further forced in by means of a long-handled wrench till the pinion is loosened and easily removed. Other forms are made, but all utilize the principle of the screw.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. & Chestnut St., Brooklyn, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. A pinion puller consisting of a ring or puller designed in the form of an internal gear and connected to a yoke containing the jack screw by two adjustable studs. It grips all the teeth, and thus reduces to a minimum the possibility of localizing the removing stress on two or more teeth. See adv. pages 1203-1223.—Adv.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Little Giant."
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PULLERS, NAIL AND STAPLE.—These devices, for pulling nails enable boxes to be opened without destroying the boards or injuring the contents. The nail pullers usually consist of hardened steel jaws at one end of a bar, a heavy casting sliding over the other end so that it can be used as a hammer to drive the jaws into the wood, and thus get a grip under the nail head. The staple pullers are special forms of pliers particularly adapted to grip and draw staples. They are especially used in taking up telephone, annunciator or other signaling circuits which have been installed by means of insulated staples.

Manufacturers:

Bridgeport Hardware Mfg. Corp., Bridgeport, Conn. "Suregrip."
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Eclipse," "Indian."

PULLEY BLOCKS, LINEMEN'S.—In bringing overhead conductors up to the proper tension, the pulling power must often be multiplied by the use of pulley blocks. Such blocks are equipped with a wire grip or "comealong" to seize the wire without bending it sharply. They are sometimes provided with a strap for pulling in the smaller sizes and a rope for large blocks.

Manufacturers:

Dicke Tool Co., The, Downers Grove, Ill.
HERBST, PAUL W., Chicago, Ill. We specialize in all kinds of tackle blocks used in construction work. See display adv. page 1258.—Adv.



PULLEYS, CAST IRON AND STEEL.—The simplest form of pulley is one made from cast iron, with the hub and rim properly machined to fit the shaft and to give a true surface for the belt. Very small pulleys are often attached to the shaft by one or more set screws, but usually a tapered steel key is used. Another type of pulley has a cast iron hub and spokes, but the rim is made from a band of steel riveted to the ends of the spokes. A third type has only the hub cast and uses both rim and spokes of bar or band steel, all being riveted into position. The edges of the rim are frequently turned in to give it greater stiffness. While some pulleys have their outer surface flat, most of them are crowned, or slightly raised in the center, which tends to centralize the belt and prevent it from running off. This is also accomplished in isolated cases by flanging or raising the edges of the pulley.

Tight and loose pulleys are usually mounted together on a shaft, the belt being shifted from one to the other as desired. Cone pulleys consist of two or more pulleys of different diameters cast or bolted together. They offer a simple and efficient means of speed regulation for lathes and similar machines, one cone pulley being mounted on the driving shaft and the other, in reverse direction, on the machine. The belt is readily shifted from one to another combination of pulleys. Frequently, as in internal-combustion engines, the flywheel is given a broad flat outer surface and is also used as a pulley. This is also occasionally true of shaft couplings and frequently of friction clutches. For the transmission by pulley of very large amounts of power, rope drive is frequently used, the outer surface of the pulleys being grooved to carry the rope. These are usually called rope sheaves, rather than pulleys.

Manufacturers:

American Pulley Co., The, 4200 Wissahickon Ave., Philadelphia, Pa. "American."
Bond Co., Charles, 617-19 Arch St., Philadelphia, Pa.
Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Brown Co., The A. & F., 79 Barclay St., New York, N. Y.
Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Chicago Pulley & Shafting Co., 40 S. Clinton St., Chicago, Ill.
Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.
Elmira Machinery & Transmission Co., Ltd., Elmira, Ont., Can.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.

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Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
Medart Patent Pulley Co., Inc., Potomac & DeKalb Sts., St. Louis, Mo.
National Foundry Mfg. & Supply Co., Hepburn & Canal Sts., Williamsport, Pa. "National." (Cast iron.)
O. K. Clutch & Machinery Co., Columbia, Pa. "O. K." (Clutch type.)
Pechstein Iron Works, Box 344, Keokuk, Iowa.
Pryibil Machine Co., P., 512-514 W. 41st St., New York, N. Y.
Pyott Co., George W., North Ave. & Noble St., Chicago, Ill.
Smith. Winfield H., 10-16 Lock St., Buffalo, N. Y. (For light power transmission.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PULLEYS, CORK INSERT.—There is a tendency, when pulleys have been in use for some time, for their outer surfaces to become so highly polished that the belt will slip more easily than it should. This is sometimes prevented by inserting small plugs of cork into the rim, allowing their upper surface to stand just above that of the surrounding surface and so catch the belt and increase the friction.

Manufacturers:

American Pulley Co., The, 4200 Wissahickon Ave., Philadelphia, Pa. "American."
Cork Insert Co., 164 Federal St., Boston, Mass.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PULLEYS, FRICTION-CLUTCH.—Friction-clutch pulleys are widely used on line shafts, for various classes of service. They are mounted on the shaft and when the clutch is out of gear run idle on it, in some cases for long periods of time. Their operation is very similar to that of a friction clutch or friction-clutch coupling (see Clutches, friction). Two plates or disks of dissimilar substances are brought together when the clutch is in. One disk is fastened to the pulley, the other to a collar on the line shaft, so that the two will turn together when engaged. Special forms of bearings are usually provided so that the pulley may run idle on the shaft without excessive friction or wear.

Manufacturers:

Brown Clutch Co., The, Sandusky, Ohio. "Brown."
Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Challenge Co., Batavia, Ill.
Conway Clutch Co., The, 1956 W. 6th St., Cincinnati, Ohio.
Hill Clutch Co., The, W. 65th St. & Breakwater Ave., Cleveland, Ohio.
Jones Foundry & Machine Co., W. A., 4401 W. Roosevelt Rd., Chicago, Ill.
Medart Patent Pulley Co., Potomac & DeKalb Sts., St. Louis, Mo.
Nilson-Miller Co., Hoboken, N. J. "Prossen."
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
Schultz & Son, A. L., 1675 Elston Ave., Chicago, Ill. "S & S."

PULLEYS, LAMP LOWERING.—Lamps mounted about 20 ft. or more above the ground or floor are difficult of access for cleaning or other maintenance unless a tower wagon, traveling crane or other safe means of reaching them is available. To overcome the danger and inconvenience of using long ladders, lamp lowering pulleys are employed. Where specially made for this service they include a method of suitably supporting the pulley from the mast-arm, center cable suspension, outrigger, ceiling or bracket. The rope end at the lamp often has a special clamp knob to engage in the pulley housing so as to support the lamp independently of the rope when the lamp has been raised to proper position; in lowering the first tug at the rope releases this clamp. The pulleys at the pole, post or wall do not have this clamping arrangement. Pulleys with cut-outs are commonly called automatic cut-out hangers.

Manufacturers:

Hebendahl Co., J. P., 228-232 Broadway, Elizabethport, N. J.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Jumbo," "Midget" "Petite." (See display adv. pages 1395-1402.)

PULLEYS, LAMP LOWERING, WITH CUTOUT.—See Hangers, arc lamp; also Hangers, incandescent lamp.

PULLEYS, LEATHER OR RAWHIDE.—These pulleys are made by riveting together disks of leather or rawhide sufficient to make the proper width of face, afterward drilling or boring out the center for the shaft, slotting a keyseat and turning off the rim to the proper diameter. The great advantage of such a pulley is that it will retain its hold upon the belt better than an iron or steel pulley.

Manufacturers:

Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

PULLEYS, MAGNETIC SEPARATING.—The magnetic pulley is a special form of wide pulley for use in magnetic separators. It is magnetized by an electromagnet within the pulley and kept magnetized during operation. It has a wide belt running over it which carries the ore or other material to be separated. The magnetic material remains on the belt as it passes around the pulley and drops off when it leaves the bottom of the pulley and starts back towards the driving pulley. All other material on the belt falls off as it passes over the pulley. Also see Separators, magnetic.

Manufacturer:

Magnetic Mfg. Co., 774 Windlake Ave., Milwaukee, Wis. "High Duty."

PULLEYS, PAPER.—Pulleys made much like rawhide pulleys except using heavy paper or pasteboard, which is thoroughly compressed. Paper pulleys are light in weight, and practically unbreakable, also retain a very good hold on the belt, but like rawhide this material is only adapted to the smaller sizes of pulleys.

Manufacturers:

Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Rockwood Mfg. Co., The, 1801 English Ave., Indianapolis, Ind. "Rockwood."

PULLING JACKS, POLE.—See Jacks, pole.

PULLITE.—Trade name for canopy switch manufactured by the Canadian Duplexalite Co., Ltd., 745 St. Catharine St., W., Montreal, Que., Can.

PULLITE.—Trade name for canopy switches manufactured by the Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y.

PULLMAN VENTILATOR & MFG. CO.—York, Pa. Manufacturer of electric ventilating fans. President, H. B. Mehring; vice-president and treasurer, John F. Rudisill; general manager, W. S. Gilbert.

PULLRITE.—Trade name for push and pull switches for automobile lighting manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

PULSATING CURRENT.—A direct or unidirectional current that pulsates or increases and decreases in intensity at regular intervals.

PULVERIZED COAL. — Pulverized or powdered coal, long used in metallurgical processes and in the production of cement, is gradually being used for steam raising in power plants. Already several large installations, notably in Milwaukee and Seattle, are in satisfactory service.

The advantages of powdered coal are the same as those for liquid fuel, namely closer control and better mixing of fuel and air. The disadvantages are the high initial cost of the installation, the cost of maintenance (as yet an unknown quantity), difficulty in disposing and removing the molten ash and, it is reported, eliminating the ash dust emanating from the stack. It is claimed pulverized coal is not feasible for plants of less than 2400 boiler horsepower.

For use as pulverized fuel, the coal must first be crushed to uniform sizes, dried, then pulverized and fed to the burner. Pulverized coal cannot be stored any great length of time so that storage before pulverizing is necessary. The powdered coal is conveyed by screw conveyor from pulverizer to the intermediate powdered-coal hopper. Here air under pressure transmits the coal dust to the burner where additional air for combustion is taken up.

The forced draft for combustion is used for moving the powdered coal. Blowers and screw conveyors work together, so that if the latter stop the former stop also, otherwise the screw conveyors may cause clogging of the powdered coal in the pipe lines and result in trouble. A banked fire is not feasible with powdered coal. Active steam making is started by turning on the coal and air stream and igniting it. The heat of the furnace does this within several hours after having been shut down, as with oil fuel.

Coals high in sulphur and ash, inherent and extraneous, and of such small size as to cause extremely high ash-pit loss, can be burned efficiently by pulverizing. It is believed that such coals will be burned in close proximity to the mines some day after being pulverized.

PULVERIZED COAL EQUIPMENT, PREPARING, DRYING AND FIRING.—Coal to be pulverized for use as a fuel requires rather extensive equipment for preparing it. This fact limits the use of pulverized coal to large boiler rooms chiefly. The coal as obtained from the mine must be crushed to a uniform size as the first step in the process. It is sometimes necessary to remove tramp iron, etc., by a magnetic separator before crushing. Crushing is done by heavy cast-iron rolls usually studded with teeth and rotating together. After being crushed to a uniform size it is necessary that the coal be dried to remove the excess moisture and bring it into a condition in which it can most easily be pulverized and uniformly controlled by feeders into furnaces. A mechanical drier is used, consisting of a double rotating cylinder so arranged that hot gases from a small furnace are passed through the coal as it travels by gravity through the shell of the drier and is delivered to the pulverizer. In the pulverizers the coal is ground to a powder. It is then conveyed to storage bunkers adjacent to the furnaces and is ready for firing. The feeding equipment usually operates on the screw principle. Feeder screws are driven by variable-speed motors to carry the coal from the storage bins to the air-mixing chambers from which it is blown as a mixture through pipes to the burners and then into the furnaces. The entire equipment for this service for any particular installation is usually furnished by one manufacturer.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Amsler-Morton Co., The, Farmers Bank Bldg., Pittsburgh, Pa.
Bartlett & Snow Co., The C. O., Cleveland, Ohio.
Combustion Engineering Corp., 43-47 Broad St., New York, N. Y. "Lopulco."
Fuller-Lehigh Co., Fullerton, Pa.
Grindle Fuel Equipment Co., 1901-11 S. Rockwell St., Chicago, Ill. "Grindle System."
GRUENDLER PATENT CRUSHER & PULVERIZER CO., 928 N. 1st St., St. Louis, Mo. "Hercules," "Gruendler."
Jeffrey Mfg. Co., 1st Ave. & 4th St., Columbus, Ohio.
K-B Pulverizer Co., Inc., 92 Lafayette St., New York, N. Y.
Powdered Coal Engineering & Equipment Co., 2401 W. Washington Blvd., Chicago, Ill. "Syncronator."
Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y.
Raymond Bros. Impact Pulverizer Co., 1319 N. Branch St., Chicago, Ill.
Stroud & Co., E. H., 928-934 Fullerton Ave., Chicago, Ill.

PUMP GOVERNORS OR REGULATORS, ELECTRICAL.—See Governors, compressors or pressure pump.

PUMP MOTOR CONTROLLERS.—See Controllers, compressor and pump, automatic.

PUMPING AND PUMPS.—Since the beginning of civilized community life the handling of liquid and gaseous materials has presented a problem of constantly increasing importance.

The lifting of water was naturally the first and most important consideration and gave rise to the earlier forms of treadmill lift and bucket pumps, which are still in service in many parts of the world for irrigating purposes. In the more progressive parts of the world, the enormous demands for pumpage and the constantly increasing variety of materials to be handled, has caused rapid development of many kinds and types of pumps.

During the earlier stages of engineering little attention was paid to the efficiency and economy of pumps and pumping systems, but with the rise in labor and material costs it has been necessary to devise means to secure maximum output with minimum input, not only in cost of con-

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struction, but also in the costs of operation and maintenance. Water, as the most important material with which humanity deals, has occupied the attention of engineers from time immemorial. As a consequence by far the largest percentage of pumping capacity is devoted to the handling of water. The elimination of human effort in the process of pumping has resulted in the use of animals, hydraulic energy, steam, electricity and solar energy, for supplying power to the prime movers for pumping water. At the present time the application of steam to pumpage far outranks in total capacity all other forms of prime movers put together. Next in order of importance is electrical pumpage which is gradually taking a firmer hold and becoming more important.

The larger water systems, in most cases driven by steam, use as a rule reciprocating pumps driven by steam engines of the direct acting or flywheel type in sizes ranging up to 50,000,000 gals. per day or more. The more efficient classes of pumping engines are of the Corliss type, running at medium speed with steam pressurp up to 200 lbs. Such units are fairly efficient and economical but occupy much space, both horizontally and vertically, and due to their lower speed are extremely heavy and hard to handle, requiring large first cost and consequent high fixed charges.

The installation of turbine-driven centrifugal pumps, replacing the engine-driven units, has gained considerable impetus of late years and has resulted in considerable reduction in first costs and fixed charges, while the increase in economy and efficiency of properly designed units is very striking.

Following the development of the high-speed centrifugal pump in large sizes, these units have been adapted for electric motor drive, resulting in still further economies in costs as well as marked improvement in operating and maintenance conditions due to the simplicity, ease of control, efficiency, economy, reliability and safety of electric drive.

It is to be hoped that the superior advantages of electric drive will result in the elimination of steam-driven pumping units to a large extent. Such action will allow the abandonment of the unsightly, isolated steam pumping stations with which many cities are afflicted thereby automatically eliminating the haulage of coal to these stations and the smoke and fumes resulting from their operation. The most important ecomomy effected by such a step would be the centralization of the generation of power, which could be thus generated in highly economical and efficient central stations, or purchased from power companies, and transmitted to the pumping stations by duplicate underground cables.

Pumping stations housing electrically driven pumping units would be relatively small, inconspicuous and practically noiseless, with many other obvious advantages.

In the matter of auxiliaries to the main generating units of power plants, for which steam-driven, reciprocating pumps were almost entirely used, centrifugal, turbine and motor-driven pumps are now being extensively utilized. The tendency is to replace many such units by electrically driven centrifugal pumps, either of the volute or turbine type, thereby securing greater flexibility and ease of control, greater reliability and safety, higher efficiency and economy, and in many cases lower costs.

In many instances, such as in boiler feed pumps, centrifugal pumps are driven by a combination of motor and turbine, which with proper regulation, will give an almost perfect heat balance.

The immense variety of pumps used in modern industry is such that the nature of the drive depends to a large extent on local conditions, but as a rule it may be noted that the tendency is toward the elimination of reciprocating pumps, and the substitution therefor of centrifugal or rotary pumps, usually direct connected, in order to get away from reciprocating steam engines, gears, belts and chains. In other words, the greater simplicity and ease of operation of the revolving pump over the reciprocating pump has led to the use of turbine drive which in turn is being supplanted by the motor drive, thus reducing costs.

Hence we find acid pumps, air pumps, pumps for brine, deep well pumps, drainage pumps, fire and other high-pressure pumps being driven more and more by motors. Since electric drive is highly flexible, and capable of automatic control, labor costs are reduced and economies introduced which were heretofore unobtainable.

In the marine field, the reciprocating pump is fast being supplanted by the centrifugal or rotary pump, preferably driven by the electric motor, thereby avoiding the running of high-pressure steam lines all over the ship. The constantly increasing use of motor drive on ships is accelerating this tendency.

Pumps for house service, irrigation, milk and cream, mine service, sewage, even high-pressure triplex pumps, manhole pumps, vacuum, sump, dredge, paper pulp and sprinkler system pumps are all tending toward electric motor drive.

The centralization of power supply, the ease of running conductors to the pump locations, the great reductions in transmission losses, the greater flexibility, ease of control, higher economy and efficiency, all combined make the installation of electric drive a logical and beneficial step, except in special cases.

There are very few uses for a reciprocating pump which cannot be satisfactorily filled by a centrifugal or rotary, which, combined with direct-connected motor drive, will probably provide a solution for nearly all pumping problems.

PUMPING SYSTEMS, WATER, ELECTROPNEUMATIC.—Motor-driven pumping outfits for supplying rural residences, country clubs, summer resorts, etc., with water from an isolated supply. The water is pumped into a closed storage tank partially filled with air under pressure which forces the water through the distribution or supply system. The pump motor is controlled by a pressure-operated switch which is connected with the tank and which is regulated or adjusted to start and stop the motor between predetermined limits of tank pressure, thus insuring a constant water supply.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Burnett-Larsh Mfg. Co., The, 537-545 E. Monument Ave., Dayton, Ohio. "Duro."
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind. "Paul."
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y. "Autowater."
Kewanee Private Utilities Co., Kewanee, Ill. "Kewanee."
Keystone Driller Co., Beaver Falls, Pa. "Downie."
Leader Iron Works, Decatur, Ill. "Leader."
Liberty Electric Corp., Port Chester, N. Y.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Mast, Foos & Co., Springfield, Ohio. "Buckeye."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
National Utilities Corp., Belleview Pl., Milwaukee, Wis. "National."
Nordberg Mfg. Co., Milwaukee, Wis.
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."
Thompson Mfg. Co., Des Moines, Iowa. "Du Moin."
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.

PUMPS, ACID.—Usually small centrifugal, or volute or turbine type, with rotors and casings of noncorrosive, acid-resisting material. May be driven by steam, motor or belt and are usually of low head, small capacity type except in special instances. Field for use limited to chemical works, storage battery factories, sulphuric acid, water from mines, etc.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
American Well Works, The, Aurora, Ill. "American."
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Dayton-Dowd Co., Quincy, Ill.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Senaca Falls, N. Y.
Midwest Engine Co., Indianapolis, Ind.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
St. Louis Pump & Equipment Co., 722 Chestnut St., St. Louis, Mo.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Wagener Steam Pump Co., The, Canton, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, AIR, ELECTRIC, MISCELLANEOUS.—These consist of motor-driven, single or multi-stage reciprocating high-pressure type, or figure-8 rotary, low-pressure blowers, supplying air for various purposes. This class includes pump sets for air brakes, air hammers and drills; for activated sludge sewage systems; for switchboard blowing systems and general blowing service or for supplying air under pressure for all sorts of special and general purposes such as for tire pumping, general garage duty, electropneumatic water systems, etc.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dubois Iron Works, 805 N. Brady St., Du Bois, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fort Wayne Engineering & Mfg. Co., Inc., 5th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Globe Mfg. Co., Battle Creek, Mich. "Dead Easy."
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Kellogg Mfg. Co., 3 Circle St., Rochester, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane." "Pelton."
Premier Emergency Corp., 767 3rd Ave., New York, N. Y. "Premier."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."

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United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburg, Pa. (See display adv. pages 1395-1402.)
Wheeler Condenser & Engineering Co., Carteret, N. J.

PUMPS, AIR, TIRE OR GARAGE, ELECTRIC.—Usually reciprocating, single or double acting; single, duplex or triplex cylinders; single or multistage, driven by electric motor by belt, chain or direct connected; with pressure blowoff or safety valve. As a rule this type of pump discharges into a tank which acts as a reservoir. Made in both stationary and portable forms, and both types are sometimes used to supply direct pressure without reservoir.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Globe Mfg. Co., Battle Creek, Mich. "Dead Easy."
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio. "Hale."
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn. "Master."
Kellogg Mfg. Co., 3 Circle St., Rochester, N. Y.
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."
Lipman Refrigerator Car & Mfg. Co., Beloit, Wis.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Schramm & Son, Inc., Chris D., West Chester, Pa.
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio.
Utility Compressor Co., The, 355-364 Harper Ave., Detroit, Mich.

PUMPS, BOILER FEED, ELECTRIC.—The centrifugal pump is the pump most favored for boiler feed-water supply. It is economical of space, it is reliable; it supplies water without vibration; it has high speed which not only means lower cost but that the pump can be connected direct to a motor and it is simple—only one moving part.

The injector is sometimes used as a reserve and emergency source for boiler feed. The injector is cheap and compact; it has no moving parts and produces no exhaust steam to be disposed of. Its objections are that it cannot handle hot water nor maintain a continuous flow under wide variations in rate of flow and its operation is somewhat erratic. The injector is only applicable to relatively small boilers. It should be considered only a reserve form of power in any case.

Boiler feed pumps operate in dark places and for long periods of time without inspection. They are usually neglected and as they deteriorate their efficiency drops. Facilities for testing the pumps and the motors driving them are well worth while. With the present-day practice of operating boilers at two and three times the nominal rates of evaporation, special attention should be directed to installing pumps and pipes of sufficient capacity to supply the boilers with three times the normal amount of water. The auxiliaries of many plants are imposing the limitations as to rate of steam making. In the larger installations in which centrifugal pumps are used, they are duplicated as a rule or subdivided into numbers of smaller units, one or two to each set of boilers.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Boyts, Porter & Co., Connellsville, Pa. "Yough."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Champion."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Western Pump Co., Moline, Ill.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, BOILER FEED, STEAM.—May be either reciprocating or centrifugal. If reciprocating, they are driven by steam pumping units, usually direct acting reciprocating but sometimes of flywheel type in large installations. If centrifugal, they may be of volute or turbine type, in which case they are usually driven by high speed, direct-connected steam turbines. Boiler feed pumps are always designed to supply direct water pressure, usually equal at full capacity to boiler steam pressure, plus driving head, plus feed line friction losses. Nearly all of the latest installations of larger sizes are using centrifugal boiler feed pumps.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Beggs & Co., James, 36 Warren St., New York, N. Y.
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Midwest Engine Co., Indianapolis, Ind.
Warren Steam Pump Co., Warren, Mass. "Warren."
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, BRINE, ELECTRIC.—These pumps are used around artificial refrigerating plants, pickle factories, etc. Shell and impellers are made of material calculated to resist chemical action of salt. Usually of the centrifugal or rotary type either direct connected, belted or chain driven. Low to medium capacity required, pumping against total head depending upon specific conditions.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Western Pump Co., Moline, Ill.

PUMPS, CENTRIFUGAL, ELECTRIC.—Centrifugal pumps may be divided into two general classes, volute and turbine. The shape of the impeller and casing and the number of impellers or stages determine the efficiency of this pump and its adaptability. In the volute pump the casing is of spiral design forming a gradually increasing water chamber for the purpose of converting velocity head to pressure head. The turbine pump is provided with a system of diffusion vanes or expanding ducts, disposed between the periphery of the impeller and the annular casing, somewhat like the guide vanes in a reaction turbine water-wheel, so that the fluid emerges tangentially at about the velocity in the casing. Centrifugal pumps may be belt, gear, chain-driven or direct-connected to an electric motor. If properly designed they are very efficient and economical. They are made for various purposes such as pumping acid, boiler feed, brine, condenser, fire, high pressure, house, irrigating, marine, mine, dredge, sump, sewerage, milk and cream, and special and miscellaneous types.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.
Bean Spray Pump Co., San Jose, Cal.
Bucher-Smith Co., East Liverpool, Ohio.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2230-36 Wolfram St., Chicago, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Crepaco."
Crestline Mfg. Co., Crestline, Ohio. "Crestline."
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
D'Olier Centrifugal Pump & Machine Co., 400 Morris Bldg., Philadelphia, Pa.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Cameron."
Jackson Iron Works, Inc., Byron, 410 Sharon Bldg., San Francisco, Cal. "Byron Jackson."
Keystone Driller Co., Beaver Falls, Pa. "Downie."
Lawrence Pump & Engine Co., Lawrence, Mass. "Vortex."
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pelton Water Wheel Co., 19th & Harrison Sts., San Francisco, Cal.

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Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Platt Iron Works, Dayton, Ohio.
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Rumsey."
Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Taber Pump Co., Buffalo, N. Y. "Taber."
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Western Pump Co., Moline, Ill.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

PUMPS, CONDENSER CIRCULATING, ELECTRIC.—Usually of the slow or medium speed, single stage type, direct connected, gear or chain driven by electric motor, used for supplying large volumes of water to surface condensers at low head. Special priming device usually necessary. If properly designed are highly efficient, economical and reliable. Almost invariably of the volute type.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich.
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Senaco Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Vaile-Kimes Co., The, Dayton, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, CONDENSER CIRCULATING, STEAM.—Condenser circulating pumps are usually high capacity low head, direct connected, centrifugal type, and used for supplying circulating water to surface condensers. May be driven either by reciprocating steam engines or by medium speed steam turbines. Usually pump against low head, encountering only condenser tube friction losses. Often in cases when such pumps are driven by reciprocating engines, dry air pumps are reciprocating, connected in tandem with steam cylinder of pumping engine. Latest types are generally medium speed, low head, contrifugal. Vacuum priming apparatus usually required to get water over.

Manufacturers:

Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Midwest Engine Co., Indianapolis, Ind.
Vaile-Kimes Co., The, Dayton, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, DEEP WELL, ELECTRIC.—These generally consist of a multi-stage, vertical volute or turbine type, contrifugal pump driven by direct-connected electric motor, with means for lowering by chain or cable into well or shaft. Must be supplied with power leads to waterproof motor and dilscharge hose reaching to surface. Are usually of the high head, medium capacity type for raising water from comparatively great depths. Also multi-stage according to depth with series of impellers, on vertical rotating shaft, lifting water in stages. Also air lift pumps, with submerged air cylinders submergence according to depth of well, air supplied by compressor or storage tank or both.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Bean Spray Pump Co., San Jose, Cal.
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Blue Ball Machine Works, Blue Ball (Lancaster Co.), Pa. "Shirk."
Boyts, Porter & Co., Conellsville, Pa. "Yough."
Burnett-Larsh Mfg. Co., The, 537-545 E. Monument Ave., Dayton, Ohio. "Duro."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Crestline Mfg. Co., Crestline, Ohio. "Crestline."
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Evans & Co., Inc., C. H., 187 Fremont St., San Francisco, Cal. "Thomson & Evans."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Flint & Walling Mfg. Co., Kendallville, Ind. "Hoosier."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Keystone Driller Co., Beaver Falls, Pa. "Downie."
Mast, Foos & Co., Springfield, Ohio. "Buckeye."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Oil Well Supply Co., 213-215 Water St., Philadelphia, Pa. "Oilwell."
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Rumsey."
Schramm & Son, Inc., Chris. D., West Chester, Pa.
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."
Vaile-Kimes Co., The, Dayton, Ohio.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, DEEP WELL, STEAM.—Used for pumping out wells, shafts, etc., usually in confined space. Consist of single or duplex direct acting, high head reciprocating unit, arranged for lowering into shaft by chain or cable with steam feed in high-pressure steam hose, and discharge lead running to surface. Such pumps are comparatively heavy and require special tackle for lowering into or raising out of shafts or wells. Most useful in emptying flooded shafts or wells, or in keeping down water in excavations where seepage must be raised to ground or surface pumping level. Working head above ground with submerged cylinder sometimes used. Speed depends upon depth of well.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill. "American."
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Jackson Iron Works, Inc., Byron, 410 Sharon Bldg., San Francisco, Cal. "Byron Jackson."
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Vaile-Kimes Co., The, Dayton, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, DRAINAGE, ELECTRIC.—May be either of the vertical automatic, sump type, driven by direct-connected motor, controlled by float switch, small to medium capacity, used for draining cellars, basements, excavations, etc., or may be of the low to medium head, high capacity, centrifugal or screw type driven by direct-connected motor or by chain or gear, and used for draining large areas, such as reclamation projects. Made in numerous sizes, speeds, heads and capacities, but are generally reliable, efficient and economical.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Albany Pump Co., 159 Richmond St., W., Toronto, Ont., Can.
Alberger Pump & Compressor Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Canadian Fraibanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, FIRE, ELECTRIC.—For emergency or regular fire service these consist of mutli-stage centrifugal pumps, driven by direct-connected electric motors. Sometimes they are manually controlled but are generally equipped both with automatic control actuated by pressure governor and manual control. Sometimes equipped with variable-speed motors in order to vary pressure according to demand, or with variable stages to be cut in series to raise pressure when the sprinkler system operates. Reciprocating pumps are sometimes used for fire service but modern practice favors centrifugal pumps on account of higher efficiency, economy and reliability as well as ease of control. Rotary and gear pumps are also used for fire service and often are suited to the requirements

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of the load. Pumps for pneumatic sprinkler systems usually consist of triplex pump, electric motor and air compressor in one unit, either manually or automatically controlled by compressor governor. For gravity system, electric centrifugal pump is generally used, controlled by float switch. In combination systems both types are used, pumping into storage tanks from which the distributing lines are run.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Northern Fire Apparatus Co., 2422 University Ave., S. E., Minneapolis, Minn. "Northern."
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Western Pump Co., Moline, Ill.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS FOR HYDRAULIC ELEVATORS, ELECTRIC—Pumps for this service are usually either centrifugal pumps of the volute type or reciprocating pumps designed for high-pressure service. They are either direct connected to the motor or connected through gearing or chain drive.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
American Well Works, The, Aurora, Ill. "American."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

PUMPS, HOT WELL, ELECTRIC.—Usually consist of self-priming centrifugal pump, either of the volute or turbine type, packed for hot water, pumping condensate from condenser drain into hot well. Varying sizes and capacities are necessary in accordance with the size of main unit. This type of pump is generally direct connected to a suitable electric motor and in large and later installations are duplicated in order to insure continuity of service.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Boyts, Porter & Co., Connellsville, Pa "Yough."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Champion."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Union Engineering Co., The, Cuyahoga Ave. & W. 4th St., Cleveland, Ohio.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Wheeler Condenser & Engineering Co., Carteret, N. J.

PUMPS, GAS, ELECTRIC.—These motor-driven pumps are made either as single or multi-stage reciprocating high-pressure pumps or the figure-8 rotary type. They are used for pumping gas into reservoirs and through mains or for supplying gas under pressure for various sorts of special service.

Manufacturers:

Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind. (gasoline).
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, HIGH PRESSURE ELECTRIC.—This class of equipment includes both centrifugal, rotary and reciprocating pumps of many kinds and types such as boiler feed, deep well, fire, hydraulic elevator pumps, house, marine, mine, etc. Descriptions of each of these types are found in the accompanying classifications and it may be said in general that high-pressure pumps must be selected to suit the particular kind of service for which each is adapted. This leads to their use for many special classes of service.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio. "Hercules."
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Dayton-Dowd Co., Quincy, Ill.
Elmes Engineering Works, Charles F., 230 N. Morgan St., Chicago, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pensylvania."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

PUMPS, HOUSE, ELECTRIC.—Electric house pumps are of the centrifugal, rotary and reciprocating types, driven by electric motors, either direct connected or driven by gears, chains or belts. Depending on the height and size of building, which determines the required head and capacity, each pump must be selected to suit the requirements of the particular service. Often such pumps are equipped with automatic control actuated by pressure governors or float switches and supply water to gravity tanks on roofs or pneumatic tanks to insure continuous water supply.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Albany Pump Co., 159 Richmond St., W., Toronto, Ont., Can.
American Well Works, The, Aurora, Ill. "American."
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.
Blue Ball Machine Works, Blue Ball (Lancaster Co.), Pa. "Shirk."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Crestline Mfg. Co., Crestline, Ohio. "Cremco."
Dayton Pump & Mfg. Co., The, Webster St., Dayton, Ohio. "Dayton."
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Delco-Light Co., Dayton, Ohio. "Delco-Light."
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Elmes Engineering Works, Charles F., 230 N. Morgan St., Chicago, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Flint & Walling Mfg. Co., Kendallville, Ind. "Hoosier."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Lawrence Pump & Engine Co., Lawrence, Mass. "Vortex."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Mast, Foos & Co., Springfield, Ohio. "Buckeye."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Rider-Ericsson Engine Co., Walden, N. Y. "Reeco."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Xlnt."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J. "A. E.," "B. E." N. A. O."
Vaile-Kimes Co., The, Dayton, Ohio.
Viking Pump Co., The, Cedar Falls, Iowa. "Viking."
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

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PUMPS IRRIGATING, ELECTRIC.—Pumps of this class are usually of the centrifugal or screw type driven by electric motors, either direct connected or by chains, gears or belts. This class of pump generally is required to handle large quantities of water at low head, and hence may be designed so as to be very efficient, economical and reliable, but the first cost is high as a rule, due to slow speed and large size.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Bean Spray Pump Co., San Jose, Cal.
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
Dayton-Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roberts Co., George J., Dayton, Ohio.
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Western Pump Co., Moline, Ill.

PUMPS, MANHOLE.—Where manholes must be pumped out before work can proceed it is desirable that a pump of ample capacity be provided so that time may not be wasted by a waiting gang. A power-driven pump is therefore found to be desirable in large systems, but hand-operated pumps are sufficient for systems requiring the use of a pump infrequently. A gasoline engine is usually found most practical as a source of power.

Manufacturers:

Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Goulds Mfg. Co., The, Seneca Falls, N. Y.
King Bros., 439 E. Water St., Syracuse, N. Y. "Barber."
National Marine Lamp Co., The, Forestville, Conn.
Union Steam Pump Co., Battle Creek, Mich.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, MARINE, ELECTRIC.—A number of electric pumps are used for marine service. The rapid increase in the use of electricity for driving all auxiliaries, together with the use of oil-burning engines which eliminate steam has led to the application of electric motors to nearly all classes of pumps. Naval vessels have usually more electrical auxiliaries than merchant vessels and motor-driven pumps are used for different purposes, such as fire main, sanitary, fresh water, flushing, bilge, secondary drainage and engine and turbine auxiliaries, including condenser circulating hot-well, vacuum and oil circualting pumps. Centrifugal pumps are used chiefly for motor drive.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Bawden Machine Co., Ltd., 163-175 Sterling Road, Toronto, Ont., Can.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Pennsylvania Pump & Compressor Co., Easton, Pa.
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.

PUMPS, MILK AND CREAM, ELECTRIC.—Consist of centrifugal pumping units, usually driven by direct-connected electric motors. As a rule such pumps are of low head, small or medium capacity. Casings and rotors must be of special non-corrosive material and care is taken in design to prevent oils and greases from lubricating system entering material under pumpage. Used in many installations in dairies, creameries, ice cream plants, etc. Rotary and gear pumps are often used for milk and cream, the requirements of the service necessitating absolutely sanitary design, easy access for cleaning and quick dismantling and assembling. Inside surfaces are always fully machined and pits eliminated.

Manufacturers:

Burrell & Co., Inc., D. H., Little Falls, N. Y. "Simplex."
Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill. "Fort Atkinson, "Viking," "Crepaco."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.

PUMPS, MINE, ELECTRIC.—Motor-driven centrifugal, rotary and gear pumps are used for various kinds of mine service including drainage and seepage, water supply, fire, etc. Such pumps vary from the single stage low capacity pump, to the multi-stage, high capacity, high head type. Deep well pumps are used in mines for emptying flooded shafts, and many special and miscellaneous types are necessary. Mine pumps are usually required to be acid resisting.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio.
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Boyts, Porter & Co., Connellsville, Pa. "Yough."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cherry Tree Machine Co., Cherry Tree, Pa. "Brownie."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fairmont Mining Machinery Co., 10th St. & Belt Line, Fairmont, W. Va. "Fairmont."
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Jackson Iron Works, Inc., Byron, 410 Sharon Bldg., San Francisco, Cal. "Byron Jackson."
Manistee Iron Works Co., Maistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
McGowan Co., The John H., Cincinnati, Ohio.
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Western Pump Co., Moline, Ill.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUMPS, MISCELLANEOUS, ELECTRIC.—Many pumps are made for services other than those listed above, some of which are given here. Modern sump pumps are usually self-contained, the sump tank, housing, pump and motor being in one unit. Best practice indicates a vertical, medium to high speed, centrifugal pump driven by a vertical electric motor mounted above and controlled by a float switch, either of the direct or relay type. Such units with 3-phase motors are efficient, reliable and economical, but if the load conditions are such as to keep the motor under starting curent much of the time, a single-phase motor should never be used. Such pumps should be carefully watched to avoid flooding. Another interesting application of an electric pump is to dredge work. They are usually of the medium speed, low head high-capacity type, driven by direct-connected electric motors or by gears or chains. Such pumps generally pump only against line loss in discharge pipe, but must be designed with large clearances between rotor and casing in order to handle small boulders, clay, sand, etc. As dredge pumps are nearly always installed below water line, they are in most cases self-priming, but in some instances, vacuum or pressure priming apparatus is necessary. Pumps are also used for many other industrial purposes one of which is for paper pulp. These pumps usually consist of centrifugal pumps with high clearances between impellor and casing and are driven by direct-connected electric motors, or by belt, chain or gears. Sometimes reciprocating pumps are used with large valves and parts so as to handle liquid paper pulp. As a rule such pumps have fairly high head due to friction losses and triplex pumps are usually correct for this service.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Blackmer Rotary Pump Co., Petoskey, Mich. (Rotary.) "Blackmermaid."
Burleigh, Morrison & Gowing, 80 Boylston St., Boston, Mass. "Washer-pump."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Foster Pump Works, Inc., 40 Bridge St., Brooklyn, N. Y.
Guarantee Liquid Measure Co., Rochester Pa.
Liberty Bread Slicer, Inc., 108 Platt St., Rochester, N. Y. "Liberty."
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."
Lobee Pump & Machinery Co., 111-119 Dearborn St., Buffalo, N. Y. (Circulating and bilge.)
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Taber Pump Co., Buffalo, N. Y. "Taber." (Rotary for heavy-duty service.)
Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

PUMPS, MISCELLANEOUS. STEAM, RECIPROCATING.—Reciprocating or piston type steam pumps are used for numerous purposes. Many of the electric pumps described above may be operated by steam engines also. In addition, they are used for pumping air or gas and for various liquids other than water. In power plants in addition to their use for boiler feed purposes they are used as hot well pumps, oil pumps, condenser circulating pumps, etc., and for fire, house, mine and other water systems.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill. "American."
Blakeslee Mfg. Co., 235 Chestnut St., DuQuoin, Ill.
Boyts, Porter & Co., Connellsville, Pa. "Yough."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Cameron Steam Pump Works, A. S., 11 Broadway, New York, N. Y.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind. "Durable."
Dubois Iron Works, 805 N. Brady St., Du Bois, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Leitelt Iron Works, 315 Mill Ave., Grand Rapids, Mich.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
National Transit Pump & Machine Co., Oil City, Pa. "Transit."
Nordberg Mfg. Co., Milwaukee, Wis.
Platt Iron Works, Dayton, Ohio.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Wagener Steam Pump Co., The, Canton, Ohio.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
Wood & Co., R. D., Wood Bldg., Philadelphia, Pa.

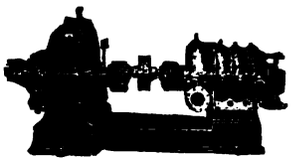
PUMPS, MISCELLANEOUS, STEAM TURBINE.—Steam turbine pumps are used in some of the larger pumping systems for various purposes. They give a very compact form of pump and may be used for either gas or liquid. A very efficient form of vacuum pump is equipped with turbine drive. Owing to the simplicity and absence of valves, these pumps operate at a high speed and with very little attention. The increase in energy that is obtained with the higher speed may be used with liquids either to increase the pressure head or the velocity head.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill. "American."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Evans & Co., Inc., C. H., 187 Fremont St., San Francisco, Cal. "Thomson & Evans."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Frederick Iron & Steel Co., Frederick, Md.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Cameron."
Kerr Turbine Co., Wellsville, N. Y. "Economy."
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

TERRY STEAM TURBINE CO., THE, Hartford, Conn. Suitable for all classes



Terry Steam Turbine Pump

of electric power plant pumping, including boiler feed, condenser auxiliaries and general service.—Adv.

Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Warren Steam Pump Co., Warren, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PUMPS, OIL, ELECTRIC. — Motor-driven oil pumps are used in oil-burning power plants or wherever oil is used for fuel to supply the oil at a uniform pressure to the burners. They are also used to circulate lubricating oil for turbine, generator or other machine lubrication where oil is supplied constantly under pressure; also to circulate oil in transformers, feeder regulators, etc. Both piston type and rotary pumps are used for these purposes and motor drive is employed on a large percentage of the pumps, generally driving through reduction gearing in the case of piston pumps. Duplex or triplex piston type pumps are usually employed for the higher pressures, as they give a steadier pressure to the oil than single piston pumps. The rotary pump has the advantage that it is continuous in its action.

A single motor is generally employed with the pumps, its character depending on the service available, but more than one pump may be driven by the motor. Some pumps are arranged on a separate base and may be connected to an individual motor, and others have from two to six separate rotary pumps driven through gearing by a single motor. These pumps may be used in any combination, either to supply separate burners or operating in parallel for one supply. Their operation is controlled by means of a clutch.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Albany Pump Co., 159 Richmond St., W., Toronto, Ont., Can.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackmermaid."
Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Century Pump Co., The, 715-719 6th Ave., Brooklyn, N. Y. "Century."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill.
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Schramm & Son, Inc., Chris D., West Chester, Pa.
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Viking Pump Co., The, Cedar Falls, Iowa. "Viking."
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.
Western Pump Co., Moline, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PUMPS, SEWAGE, ELECTRIC.—Sewage pumps are subject to many variations in type and size due to the specific requirements of the service. For local sewage a sump type, vertical direct-connected, motor-driven pump is generally used, controlled by float switch, either of the direct or relay type, owing to the intermittent character of the load. For general sewage pumping where the load is reasonably steady, larger centrifugal or screw type pumps are used either direct-connected or driven by gears, chains or belts. Such installations are often of very large size, requiring housing and regular crews for operation and maintenance.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, The, Aurora, Ill. "American."
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio. "Odofor," "Anti-Splash."
Blackmer Rotary Pump Co., Petoskey, Mich. "Blackermaid."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Lawrence Pump & Engine Co., Lawrence, Mass. "Vortex."
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Midwest Engine Co., Indianapolis, Ind.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Rumsey."
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

PUMPS, TRIPLEX, ELECTRIC.—Often used for local water supply in large buildings, consisting of triplex, reciprocating, single or double acting pumps driven by chain or gears from electric motors. Also used as ammonia or gas compressors, and to supply high pressure air. Triplex pumps are sometimes used for fire service with automatic controllers, either of the direct or relay type, actuated by pressure governors or float switches. Except for special cases, reciprocating pumps are gradually being supplanted by centrifugal pumps, either of the volute or turbine type.

Manufacturers:

Boyts, Porter & Co., Connellsville, Pa. "Tough."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Marion Rotary Pump Co., Hardwick Vt. "Marmo."
Platt Iron Works, Dayton, Ohio.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Rumsey."
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

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PUMPS, VACUUM, ELECTRIC.—Electric vacuum pumps are used on high-vacuum condensing equipment in power plants, or for other vacuum systems, such as vacuum steam-heating systems, etc. For very high vacuums a pump resembling a turbine in construction and operation is often used. This draws the air into a diffusing chamber in which a small impeller rotates and hurls water. The hurled water and air are forced from the diffusing chamber into a casing having a number of channels. The water acts as a seal which compresses the air and continually forces it outward in the channels into an annular casing from which it is discharged. These pumps are adapted to direct motor connection as they operate at a high speed.

There are many other forms of pumps for this purpose, most of them using the principle of the water seal. This is also applied to piston pumps which give very satisfactory service for this purpose. For exhausting incandescent lamp bulbs, X-ray tubes, mercury-vapor lamps and rectifiers, vacuum or electron tubes, etc., mercury-seal pumps are extensively used.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Albany Pump Co., 159 Richmond St., W., Toronto, Ont., Can.
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Beach-Russ Co., 220 Broadway, New York, N. Y. "Beach-Russ."
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Brunner Mfg. Co., Broad & Gilbert Sts., Utica, N. Y.
Buffalo Foundry & Machine Co., 1541 Fillmore Ave., Buffalo, N. Y. "Buflovak."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Burrell & Co., Inc., D. H., Little Falls, N. Y.
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Dean Bros. Steam Pump Works, 323 W 10th St., Indianapolis, Ind.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill. "Gardner-Rix."
GENERAL ELECTRIC CO., Schenectady, N. Y. Langmuir condensation pump for obtaining very high vacua. Has no moving parts. Vacuum is formed by condensation of mercury vapor. Pump is characterized by its extreme speed—3000 to 4000 c. c. per second. With this pump and proper backing up pump, vacua higher than 10^{-3} bars have been produced. Complete outfits can be furnished consisting of a condensation pump and auxiliary motor driven oil pump assembled on a common base. This two-stage rotary oil pump was developed primarily as a rough or backing-up pump to be used with the Langmuir condensation pump and can be supplied with or without the latter, with motor drive or with pulley for belt drive. Pump displacement is 7 cu. in. per revolution; pump speed 325 r. p. m., and a pressure of .001 mm of mercury can be obtained. See adv. pages 1203-1223.—Adv.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Hubbard's Sons, Norman, 265-267 Water St., Brooklyn, N. Y. "Packard."
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. "Cameron."
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill. "Eclipse."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y.
Stokes Machine Co., F. J., 17th & Cambria Sts., Philadelphia, Pa.
Utility Compressor Co., The 355-364 Harper Ave., Detroit, Mich.
Weinman Pump Mfg. Co., The, 270-280 Spruce St., Columbus, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Lehigh & Sedgley Aves., Philadelphia, Pa. "Radojet," "Rotrex," "Mullan," "C. H. Wheeler."
York Electric & Machine Co., 30 N. Penn St., York, Pa.

PUMPS, WATER SYSTEM, ELECTRIC.—Electric water system pumps for general water supply are usually of the medium to high head, direct-connected motor-driven type, with capacity depending upon the size and characteristics of the specific load. Local water system pumps in the smaller sizes often pump into pneumatic or gravity tanks and are controlled by pressure governors or float switches. General water supply systems often require complete plants housing pumping units and auxiliary apparatus. Such pumps are many times equipped wtih special priming systems. In case of electropneumatic water systems, a source of air supply for compression tank must be available.

Manufacturers:

Advance Pump & Compressor Co., Battle Creek, Mich. "Advance."
Albany Pump Co., 159 Richmond St., W., Toronto, Ont., Can.
Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.
Barnes Mfg. Co., The, N. Main St., Mansfield, Ohio. "Hercules."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Boyts, Porter & Co., Connellsville, Pa. "Yough."
Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. "Moody."
Dayton Pump & Mfg. Co., The, Webster St., Dayton, Ohio. "Dayton."
Dean Bros. Steam Pump Works, 323 W. 10th St., Indianapolis, Ind.
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
DeLaval Steam Turbine Co., Nottingham Way, Trenton, N. J.
Economy Pumping Machinery Co., 122-124 N. Curtis St., Chicago, Ill. "Economy."
Elmes Engineering Works, Charles F., 230 N. Morgan St., Chicago, Ill.
Erie Pump & Engine Works, 139 Glenwood Ave., Medina, N. Y. "Erie."
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Flint & Walling Mfg. Co., Kendallville, Ind. "Hoosier."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind. "Paul."
Gardner Governor Co., The, 1 Williamson St., Quincy, Ill.
Goulds Mfg. Co., The, Seneca Falls, N. Y.
Humphryes Mfg. Co., The, Mansfield, Ohio.
Manistee Iron Works Co., Manistee, Mich. "Roturbo."
Marion Rotary Pump Co., Hardwick, Vt. "Marmo."
Mast, Foos & Co., Springfield, Ohio. "Buckeye."
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
Midwest Engine Co., Indianapolis, Ind.
Pennsylvania Pump & Compressor Co., Easton, Pa. "Pennsylvania."
Roberts Co., The George J., 251 E. 2nd St., Dayton, Ohio. "Gem."
Roots Co., The P. H. & F. M., Connersville, Ind. "Roots."
Roper Corp., George D., Trahern Pump Division, Rockford, Ill. "Trahern."
Rumsey Pump Co., Ltd., Seneca Falls, N. Y. "Atlantic."
Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio. "Standard."
Twinvolute Pump & Mfg. Co., Inc., 216 High St., Newark, N. J.
Valle-Kimes Co., The, Dayton, Ohio.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

PUNCHES AND SHEARS, MOTOR-DRIVEN.—These are large powerful machines, the ordinary types being similar in action to a punch press. They are largely used in quantity work, the dies used being capable of punching several holes with each stroke. Motor drive through reducing gears is generally used. Shears of many sizes and types are used for cutting sheet metal of various kinds, ranging from heavy sheet boiler plate to thin sheets used for fixtures, transformer cores, etc.

Manufacturers:

Covington Machine Co., Covington, Va.
Excelsior Tool & Machine Co., East St. Louis, Ill. "Excelsior."
Long & Allstatter Co., The, High & 4th Sts., Hamilton, Ohio.
Robinson Mfg. Co., J. M., 3282 Spring Grove Ave., Cincinnati, Ohio.
Rock River Machine Co., N. Main St., Janesville, Wis.
Royersford Foundry & Machine Co., Inc., West Royersford, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Union Mfg. Co., New Britain, Conn.

PUNCHES, BENCH AND PORTABLE.—These punches are useful for cutting or punching such material as metal raceways, copper and brass strip and sheet mica disks, etc. The cutting or punching tool is set in jaws mounted on a board or metal plate for convenience in mounting on a bench or pedestal. The jaws are provided with a long handle to give sufficient leverage to cut small pieces of all but the hardest metals.

Manufacturers:

Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill. "Nail-It-Punch."
Rock River Machine Co., N. Main St., Janesville, Wis.

PUNCHINGS, ARMATURE.—See Armature punchings.

PURE CARBON CO.—Wellsville, N. Y. Manufacturer of carbon brushes for motors and generators and carbon specialties. Business established 1910. President, J. L. Moore; vice-president, H. W. Breckenridge; secretary and general manager, H. B. Eynon; treasurer, W. J. Richardson; sales manager, W. L. Cassell. Sales representatives, Ross Mechanical Supply Co., Pittsburgh, Pa.; McCarthy Bros. & Ford, Buffalo, N. Y.; H. C. Roberts Electrical Supply Co., Philadelphia, Pa.

PURE OIL CO.—Columbus, Ohio. Producer of lubricating oils and greases. S. M. Coen, general manager. Main office, Columbus, Ohio. Refineries, Marcus Hook, Pa.; Warren, Pa.; Cabin Creek Jct., W. Va.; Ardmore, Okla.; Cushing, Okla.; Heath, Ohio. Branch office, Philadelphia, Pa.

PURE OIL CO.—Minneapolis, Minn. Manufacturer of lubricating oils and greases. President and treasurer, L. B. Hancock; vice-presidents, John Hancock, R. H. Heard; secretary, E. E. Durrin. Main office, 1306 S. 1st St., Minneapolis, Minn. Branch offices, Excelsior, Mound, Buffalo, Kimball, Minn.; Ladysmith, Barron, Wis.; Devils Lake, Minot, N. D.; Idaho Falls, Idaho; Miles City, Rosebud, Bozeman, Norris, Lewistown, Portage, Great Falls, Roy, Mont.; Spokane, Wash.; Regina, LaFleche, Sask., Can.

PURITAN.—Trade name for varnished cloth manufactured by the American Mica Co., Newton Lower Falls, Mass.

PURITAN.—Trade name for lamp frosting compound manufactured by C. E. Franche & Co., 440 Orleans St., Chicago, Ill.

PURITAN.—Trade name for ignition switches manufactured by Frank W. Morse, 291 Congress St., Boston, Mass.

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PURITAN.—Trade name for lubricating oil manufactured by the Pure Oil Co., 1306 S. 1st St., Minneapolis, Minn.

PUSH BUTTON ELEVATORS.—See Elevators, electric, automatic or push button.

PUSH-BUTTON FITTINGS.—This class includes all parts of push buttons, such as bases, covers, caps, contact springs, wire terminals, the button proper, special escutcheon plates, caps, pads for the desk top, extension contacts, etc. The base and cap parts are often made of wood, although metal is also much used; occasionally molded insulation is used for these parts.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts. Hamilton, Ont., Can.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Lesser Bros. & Kurz, Inc., 58 Spring St., New York, N. Y.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1320.)
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

PUSH BUTTON SOCKETS.—See Sockets, push button.

PUSH BUTTON STATIONS.—See Stations, remote motor control (push button type, etc.)

PUSH BUTTON SWITCHES.—See Switches, push button, flush and surface.

PUSH BUTTONS, AUTOMOBILE-HORN.—Small contact making devices designed to close automobile horn circuits usually consisting of a round button of insulating material pivoted at the center and carrying a metal contact designed to complete the circuit with a ring of metal mounted on the insulating base. The button is designed for mounting in any convenient location, such as on a steering wheel or column, or side door, and may be operated by touching it from any angle.

Manufacturers:

American Electric Co., 6401 S. State St. Chicago, Ill.
Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Tip Top push buttons respond to a touch at any point on the upper surface of the button. They are made in styles to fit any convenient place on the automobile. The one shown here is attached to the spark lever.—Adv.



Tip Top Push Button

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
FITZGERALD MFG. CO., The, Torrington, Conn. "Clero."
GARFIELD MFG. CO., Garfield, N. J.
Handy Products Co., Erie Bldg., Cleveland, Ohio. "Handy."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
KLAXON CO., Newark, N. J.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Morse, Frank W., 289 Congress St., Boston, Mass. "Workrite."
Motor Specialties Co., Waltham, Mass.
Russell Electric Co., Danbury, Conn.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa.
Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

PUSH BUTTONS, CLAMPING, DESK OR TABLE.—Circuit-closing push buttons for buzzers or other signals, mounted on a horseshoe shaped spring adapted for clamping over the edge of a desk or table in a convenient location for the user, and connected to the circuit by a flexible cord. They are commonly employed in offices in connection with signals to call a stenographer, messenger boy or similar purpose, in a dining room to summon a waiter or maid, etc.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Schwarze Electric Co., E. Church St., Adrian, Mich.

PUSH BUTTONS, DESK, FLUSH AND SURFACE.—The flush type is a circuit-closing push button of small size mounted in a metal casing which may be sunk in the woodwork of desks or tables with the upper edges flush with the surface. Wire binding terminals are provided at the lower end for connection to concealed wiring. The desk surface types have the button and contacts mounted in a small wooden or metal case, usually fastened to the desk top or with a weighted bottom to give them stability. Connections are made for a flexible cord which enters the side of the case.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnel."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass. "Pushrite," "Workrite."
EDWARDS & CO., INC., New York, N. Y. The Directory push is for service in banks and fine offices. Attractive compact and rugged; has self-cleaning contacts; heavy phosphor bronze springs. Name cards can be inserted without dismantling block. May be used as a paperweight; is beautifully finished to harmonize with equipment of any high grade office. Also made for flush mounting. Supplied with any desired number of buttons.—Adv.



Directory Push Button

Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Machen Electric Mfg. Co., 4639-43 E. Thompson St. Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. "Altman." (See display adv. page 1310.)
Morse, Frank W., 289 Congress St., Boston, Mass. "Workrite."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Standard Transformer Co., The, Dana Ave., Warren, Ohio.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

PUSH BUTTONS, ELECTRIC RAILWAY CAR BATTERY AND HIGH VOLTAGE.—The elements of the buzzer or signal system which are used by passengers in signaling motorman of desire to alight from the car. They are mounted conveniently on the posts of the car and consist of an insulating button which when pushed completes the circuit through suitable contacts from the source of current through the buzzer. Such buttons are of two general types, battery and high voltage. The former type is designed for use with a dry or other battery as the source of current, while the latter is arranged to be used in circuits employing current at the trolley voltage. Obviously the latter must be carefully designed and installed so that there is no chance of shock to the passengers.

PUSH BUTTONS, ELEVATOR.—These circuit-closing devices are designed particularly for elevator signal systems and consist of single or double push buttons located at the various floors. If used in connection with an annunciator in the car, the buttons are connected through flexible cable with the annunciator; if the latter has separate "up" and "down" drops or lamps, there are two corresponding buttons on each floor, otherwise only one is needed. Where single lamp signals are used in each of a bank of cars there is usually a pair of buttons on each floor controlling the "up and "down" trips in each shaft, which govern the lamp in the first approaching car. The buttons are commonly mounted on an ornamental escutcheon plate bearing appropriate designations and finished to conform to the rest of the elevator enclosure.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Push Button Switches for elevator service are manufactured either in the flush type or the surface type. In the latter type the buttons are mounted in a depression on the case so as to prevent accidental operation. The flush type is designed to be mounted in a standard punched outlet box. A one or two-button switch fits in a single box, a three or four-button switch in a double box. As in the surface type, the buttons are mounted in a depression to guard against accidental operation. See display adv. pages 1225-1230.—Adv.



Bulletin 10335 Surface Type

EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Elevator Signal Co., 116 West St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

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Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Russell Electric Co., Danbury, Conn.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
WATERBURY BUTTON CO, 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

PUSH BUTTONS, FLOOR AND EXTENSION.—A form of contact device, intended to be inserted in the floor under a table, desk or other location where a foot operated push button is desired for signaling to other rooms. Also made with an extension attachment in the form of a cap carrying contact pins to be inserted in a receptacle in the floor device, for connecting flexible conducting cord with a table-clamp push button or other circuit-closing device. The buttons of the usual type have a rod attached to the button which when the button is pressed closes the circuit between two spring contacts. Instead of the button two flat plates which make contact in a similar manner may be used. This type is sometimes called a floor tread.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
KLAXON CO., Newark, N. J.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
WATERBURY BUTTON CO., 835 S Main St., Waterbury, Conn. (See display adv. page 1328.)

PUSH BUTTONS, HIGH-VOLTAGE.—Contact-making push buttons having special insulation for and extra clearances and spacings between the current- carrying parts, and provided with special nonarcing contact points, such as of tungsten or platinum, which are arranged to give a wiping or scraping action for self-cleaning. The springs are often of phosphor bronze and give a very rapid break. These buttons are sometimes used on 110 and 220-volt circuits for signaling with bells or gongs in series with lamps or resistors. Both open-circuit and closed-circuit buttons are made, the later breaking the circuit to actuate a relay.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description under Push buttons, marine.—Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., The, 125 Amory Sts., Boston, Mass.
KLAXON CO., Newark, N. J.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Russell Electric Co., Danbury, Conn.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

PUSH BUTTONS, MARINE AND WATER-TIGHT.—Push buttons in which the operating or contacting mechanism is enclosed in a moistureproof case. These buttons are designed for use in damp locations, such as on shipboard, in refrigerating rooms, docks, laundries, etc.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco. The boxes of Benjamin marine water-tight



Marine Push Button

push buttons are made in cast iron or brass and tapped for conduit. A gasket of raw-hide covers the box opening and is held by the box face or cap. The button is operated by pressure, thru a hole in the cover, on the exposed part of the raw-hide. Buttons are made for voltages up to 250. These buttons are also made in non-water tight types.—Adv.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., The, 125 Amory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

PUSH BUTTONS, PENDENT.—These usually consist of a single button enclosed in a neat casing of wood or composition insulating material with flexible cord passing through the upper end and the button protruding from the lower end. The casing is often of pear shape and may hang from the cord, whence the name pendent button. Frequently the cord is made long enough so that the button may be held in the hand, this being a favored arrangement for a lecturer to enable him to signal to the operator of a projecting lantern used in illustrating the lecture.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
HOLTZER-CABOT ELECTRIC CO., The, 125 Amory St., Boston, Mass.
Siemon Hard Rubber Corp., The, State Sts., Bridgeport, Conn.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

PUSH BUTTONS RETURN-CALL.—Push button mechanisms mounted near a buzzer, bell or other signal and connected in the circuit in such a manner that a return signal may be given from a remote point at which a similar device is located. The device contains a contact spring which at all times makes contact with one of two contact points so that there is always a current path through the device. This allows the use of a three-wire circuit for a return-call system where four wires would ordinarily be required.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
HOLTZER- CABOT ELECTRIC CO., THE, 125 Armory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Siemon Hard Rubber Corp., The, State Sts., Bridgeport, Conn.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W 42nd St, New York, N. Y. "U S E M."
Wadsworth Novelty Mfg. Co., Wadsworth, Ohio. "Akron."

PUSH BUTTONS, WALL AND MISCELLANEOUS.—This class covers the most numerous of push buttons. They are permanently mounted on walls and other surfaces (usually by screws) and are often circular with a central contact point above which is a short spiral shaped mating contact spring. The material, shape and finish of the base and cover varies considerably. Wood is commonly used for these parts, although spun or stamped or cast metal (usually brass) are very much used, the metal case being insulated by a fiber lining. Cast and stamped covers often have an ornamental relief design. In house and apartment building entrances push buttons usually are put directly below the letter box and their casing forms part of the single plate that covers the button, box and speaking-tube outlet. For lamp locations the cases are often made up of insulated material and include a rubber gasket to exclude moisture.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (program selector). (See display adv. pages 1262-1265.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Corbin Division, P. & F., of American Hardware Corp., New Britain, Conn. "Corbin."
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
EDWARDS & CO., INC., New York, N. Y. Push buttons for every purpose. Illustration shows Dixie, Jr. This high grade push has nonturnable centers, and scraping contacts, fully insulated. The button below is No. 85, for high voltage. Quick-break; phosphor-bronze contact springs; shell of solid brass with condensite insulation and rubber center.



Dixie Jr.



No. 85 Push Button

For 110 or 220 volts; open or closed circuit. Sturdiness and careful construction are evident in the full line, which includes types for every requirement.—Adv.
Elevator Signal Co., 116 West St., New York, N. Y.
Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

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Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Morse, Frank W., 289 Congress St., Boston, Mass.
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Schwarze Electric Co., E. Church St., Adrian, Mich.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."
Wadsworth Novelty Mfg. Co., Wadsworth, Ohio. "Akron."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

PUSH DOWN.—Trade name for electric blasting apparatus manufactured by the Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

PUSH OUT SPRINGS.—See Springs, door opener.

PUSH SWITCHES.—See Switches, push.

PUSHERS, UNDERGROUND PIPE AND DUCT.—These are devices used when installing a single pipe or duct for a short distance and it is desirable to avoid digging up the ground or tunneling under a sidewalk or driveway. Pushers operate in response to mechanical pressure supplied by a jack screw to steadily force a length of pipe through the earth for this short distance. They have been used in running services to customers, laterals being run out from the main conduit line and pushed through the short space from the main to the building. They have also been used in installing street lighting circuits of the series type where a single duct line is installed. In these cases they are used to push the pipe or duct under a paved alley or small cross street, in cases where the main conduit is installed just inside of the curb.

Manufacturers:

Easy Mfg. Co., The, David City, Neb. "Easy."
Marion Machine, Foundry & Supply Co., Marion, Ind.

PUSHES, AUTOMOBILE FOOT.—A special form of push-button switch intended for use especially in automobile-starter circuits. It consists essentially of a foot-operated plunger under spring control which completes a circuit, when pressed, between two metal contact members.

Manufacturers:

Ansonia Electrical Co., The, Ansonia, Conn. "Ansonia."
Liberty Electric Corp., Port Chester, N. Y.

PUSHLOCK.—Trade name for locking sockets manufactured by the E. H. Freeman Electric Co., 808 E. State St., Trenton, N. J.

PUSHRITE.—Trade name for surface push buttons manufactured by the S. H. Couch Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

PUSHWELL.—Trade name for automobile push buttons manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

PYKE MOTOR & YACHT CO., LTD.—374 Notre Dame St., W., Montreal, Que., Can. Manufacturer of farm lighting and power plants.

PYLE-NATIONAL CO., THE.—Chicago, Ill. Manufacturer of railway car lighting equipment, exhaust fans, marine lighting fixtures, headlights, searchlights, lighting reflectors and units, switches, voltammeters, etc. Business established 1897. President, R.C. Vilas; vice-president, William Miller; vice-president and general manager, J. Will Johnson; secretary and treasurer, H. E. Withington. Main office, 1334 N. Kostner Ave., Chicago, Ill. Branch office, 30 Church St., New York, N. Y.

PYOD.—Trade name for thermocouples manufactured by the Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

PYOTT CO. GEORGE W.—North Ave. & Noble St., Chicago, Ill. Manufacturer of power transmission appliances. President, G. W. Pyott; vice-president, F. P. Frey; sales manager, Theodore Hegelman.

PYRAMID.—Trade name for carbon and graphite brushes manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

PYRAMID.—Trade name for slate for electrical purposes manufactured by the Structural Slate Co., Pen Argyl, Pa.

PYRENE MFG. CO.—New York, N. Y. Manufacturer of fire extinguishers. President, W. Bauer; vice-president, E. J. Waring; secretary and treasurer, A. C. Clapp; general sales manager, G. P. Rogers. Main Office 17 E. 49th St., New York, N. Y. Branch offices, 24 Nassau St., Atlanta, Ga., 1712 Grand Ave., Kansas City, Mo.; 327 W. Jackson Blvd., Chicago, Ill.; 527 Mission St., San Francisco, Cal.

PYROCIDE.—Trade name for fire extinguishers manufactured by the Western Fire Appliance Co., 703 Market St., San Francisco, Cal.

PYROGRAPH.—Trade name for oxy-acetylene cutting machines manufactured by the Davis-Bournonville Co., Jersey City, N. J.

PYROID.—Trade name for compress asbestos sheet packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

PYROLECTRIC INSTRUMENT CO.—636 E. State St., Trenton, N. J. Manufacturer of electrical precision instruments. Business established 1916. President, W. C. Harter; secretary-treasurer, Harry L. Saums.

PYROMETER TUBES.—Pyrometer tubes are generally made of porcelain or special fire clay and are used as a protection to the thermocouple element. They are flanged at the outside, the flange being flush with the wall or surface in which the thermocouple is to be set. They usually have an outside diameter of about 3 inches, with a bore of 1 to 1¼ ins. They vary in length depending upon the installation, standard lengths being 18, 27 and 39 ins.

Manufacturers:

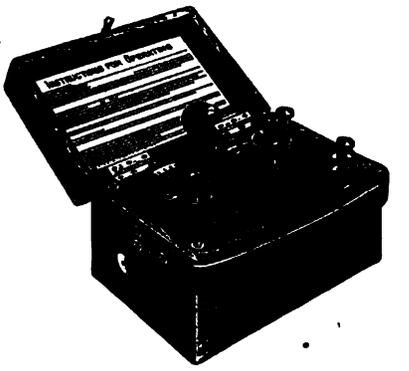
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Frink Pyrometer Co., The, Lancaster, Pa.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.

PYROMETERS, ELECTRIC, INDICATING.—A pyrometer is an instrument for the measurement of high temperatures beyond the range of the ordinary mercury thermometer. Electric pyrometers have come into extensive use for determining temperatures of furnaces, ovens, kilns, heat-treating outfits, etc. They are very accurate. The leading types are the thermocouple, the resistance pyrometer, the radiation pyrometer and the optical pyrometer. The thermocouple type is composed of a junction of two metallic wires of different metals, with the junction placed at the point whose temperature is to be measured. If the two free ends are at the ordinary outside temperature, there will be a measureable electromotive force existing between them, due to the fact that the junction is at a different temperature from the free ends. This phenomenon is called thermoelectricity, and various instruments can be used to measure this electromotive force accurately and thus determine accurately the temperature of the hot junction, that of the free ends being known. The instrument must be calibrated by reference to known temperatures. The Le Chatelier thermoelectric pyrometer uses one wire of pure platinum and the other of platinum-iridium alloy (10% iridium). The so-called "base-metal" thermocouples use cheaper metals and alloys of various kinds to replace the platinum and iridium.

In the resistance type the operation is based on the change of electrical resistance of a platinum wire with change of temperature. The resistance of the wire is measured at the unknown temperature by means of a Wheatstone bridge, and its resistance cold being already known, as well as its temperature coefficient of resistance, the temperature can readily be determined. The optical and radiation types are described and listed under a separate classification below.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Cleveland Instrument Co., The, 6523 Euclid Ave., Cleveland, Ohio.
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Foxboro Co., Inc., The, Foxboro, Mass.
Frink Pyrometer Co., The, Lancaster, Pa.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "I-Rite."
Hanovia Chemical & Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Indicating pyrometers operating on the potentiometer principle, which is the most accurate for measuring the small volt-



Indicating Pyrometer

ages or thermocouples. The clear open scale (14 in. long) permits a sensitivity of ¼% of the range with a guaranteed



Temperature Indicator

accuracy of ½% of the range. Instruments contain either automatic or hand operated cold junction compensator. The portable type is contained in a wood box and the wall type in a cast brass casing. Scale may be calibrated in millivolts, or in degrees for any type of thermocouple. Minimum range, 10 millivolts.—Adv.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J. "Northrup."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Stupakoff Laboratories, The, 6617-6627 Hamilton Ave., Pittsburgh, Pa. "Stupakoff."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."

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THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y. "Monopivot."
Zaubitz, August, 95-97 Cliff St., New York, N. Y.

PYROMETERS, ELECTRIC, OPTICAL AND RADIATION TYPE.—These are devices for measuring high temperatures. In the optical pyrometer the temperature of any given body is determined by comparing the light given out by the hot body with light from a standard source whose temperature is known. In the radiation type the temperature of the hot body is determined from measurements taken of the intensity of the heat radiations given out by the hot body. These pyrometers are of special value in determining the temperatures of furnaces without introducing the pyrometer tube therein.

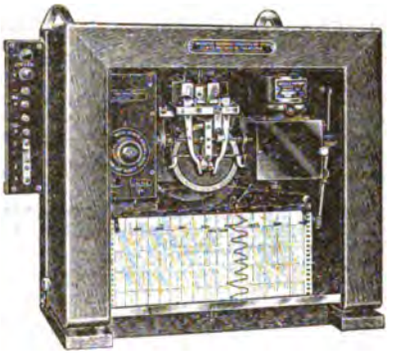
Manufacturers:

LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. The optical pyrometer is used for measuring temperatures in such work as: The open hearth furnace, furnace tapping, ingot teeming, billets and forgings in the open, reheating furnaces, steel being rolled, heat treating and high speed steel furnaces, brick and cement kilns, and coke ovens. It is very convenient to use the optical pyrometer for checking thermocouples in service by sighting on the end of the thermocouple protecting tube, also for exploring furnace temperatures or for investigational work. It measures temperatures from a dull red (about 1,200 deg. F.) up to the highest known temperatures.—Adv.
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.

PYROMETERS, ELECTRIC, RECORDING AND CURVE DRAWING.—Many of the pyrometers made under the types listed above for indicating pyrometers may be made to record the temperature measurements continuously. The resistance, radiation and thermoelectric types may be easily so arranged. They have been made for use as laboratory instruments for accurate temperature investigations and also for commercial use in various industries. The simplest application is to obtain the time-temperature curve. This record is especially valuable as a continuous record of the temperatures of a furnace or kiln during a prolonged run. Sometimes records are kept to detect recalescence points in steel which appear as flexures or indentations on the plot when the furnace is uniformly heated or cooled. Other curves, such as the inverse-rate curve, are sometimes obtained in metallography. This is obtained by noting the time intervals necessary to cool or heat the specimen by equal decrements or increments of temperature.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Cleveland Instrument Co., The, 6523 Euclid Ave., Cleveland, Ohio.
Defender Automatic Regulator Co., St. Louis, Mo. "Defender"
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
Foxboro, Co., Inc., The, Foxboro, Mass.
Frink Pyrometer Co., The, Lancaster, Pa.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "I-Rite."
Hanovia Chemical Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. The Automatic Recording Pyrometer, operating on the principle of the potentiometer, is a rugged machine which stands up under the severe conditions encountered in the industries. An adequate power supply to operate the recording mechanism is obtained from a small electric motor. The calibration of the instrument is not dependent upon any delicate mechanism, or the constancy of spring tensions, or the friction of pivots. The galvanometer, serves merely as a current detector, and supplies no energy to the recording system. By using the poteniometer principle all errors due to the resistance or changing resistance of the thermocouple and lead wires are eliminated; also the cold junction temperature is compensated automatically, electrically, and accurately, without any accessory apparatus. The chart on which the record appears is rectilinear, 10 in. wide, and moves forward at the rate of 3 in. per hour. The scale may be calibrated in millivolts or in degress for any type of thermocouple. The minimum range is 10 millivolts. The accuracy is guaranteed to ½% of the range. Any number of temperatures from 1 to 16 may be recorded on one chart. The potentiometer recorder is well adapted to signalling or controlling. The same electric motor that operates the recorder operates the signalling or controlling mechanism.—Adv.



Automatic Recording Pyrometer

Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Stupakoff Laboratories, The, 6617-6627 Hamilton Ave., Pittsburgh, Pa. "Stupakoff."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y. "LeChatelier," "Tapalog."

PYROPLAX.—Trade name for molded insulation manufactured by the Cutler-Hammer Mfg. Co., Milwaukee, Wis.

PYROTIP.—Trade name for electric lead burners manufactured by the General Electric Co., Schenectady, N. Y.

PYROTITE.—Trade name for plug fuses manufactured by the Bryant Electric Co., Bridgeport, Conn.

PYROXYLIN.—Trade name for metal enamels and lacquers manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

Q

Q.—A symbol for quantity of electricity, the unit of which is the coulomb or ampere-hour. The form q is sometimes used as a symbol for electrostatic charge.

Q & C.—Trade name for cord adjuster manufactured by the American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del.

Q & C.—Trade name for railway specialties manufactured by the Q & C Co., 90 West St., New York, N. Y.

Q & C CO., THE.—New York, N. Y. Manufacturer of electric snow melters and other electric railway specialties. Business established (about) 1890. President and sales manager, C. F. Quincy; vice-president, E. M. Smith; secretary, treasurer and general manager, F. F. Kister. Main office, 90 West St., New York, N. Y. Branch offices, Peoples Gas Bldg., Chicago, Ill.; Railway Exchange Bldg., St. Louis, Mo.

QUAD.—Trade name for receptacles manufactured by the General Electric Co., Schenectady, N. Y.

QUAD TELEGRAPH SETS.—See Telegraph sets, amateur and miscellaneous.

QUADRANT ELECTROMETER.—A form of sensitive electrometer consisting essentially of two pairs of metallic quadrants, above which a needle, consisting of a thin plate of aluminum, swings. This electrometer is sometimes made sufficiently sensitive to measure 0.001 volt, but it is a very delicate laboratory instrument. Also see Electrometers.

QUADRANT ELECTROSCOPE.—A device consisting of a wooden support or stand carrying a graduated quadrant or half circle, in the center of which is attached an indicator consisting of a straw terminating in a pith ball. It is used to indicate the presence and condition of a charge on any conductor. When the conductor is electrified the pith ball is repelled from the upright and flies out at an angle indicated on the graduated quadrant.

QUADRATURE.—If the angle of lag or lead between an alternating current and voltage or between two sets of current waves is 90° or a quarter of a cycle, the waves are said to be in quadrature with each other.

QUADRATURE COMPONENT.—See Reactive component.

QUADRIGA MFG. & SPECIALTY CO.—213 W. Grand Ave., Chicago, Ill. Manufacturer of stampings and washers. President, A. D. Thibodeau; vice-president and treasurer, W. Dangle; secretary, O. Seig.

QUADRUPLEX.—Trade name for electric grinder manufactured by the F. W. Cochrane Mfg. Co., 5829 S. Vermont Ave., Los Angeles, Cal.

QUADRUPLEX TELEGRAPHY.—A system of telegraphy in which four messages may be transmitted simultaneously over the same wire, two in each direction. See Telegraphy, land line, technical and commercial progress in.

QUAKER CITY RUBBER CO.—Philidelphia, Pa. Manufacturer of mechanical rubber goods. Main office, 629 Market St., Philadelphia, Pa. Factory, Wissinoming, Pa. Branch offices, 182 W. Lake St., Chicago, Ill.; 211 Wood St., Pittsburgh, Pa.; 53 Murray St., New York, N. Y.

QUALITI-LITE.—Trade name for lighting fixtures and portable electric lamps manufactured by the Morreau Co., 1303-1307 Oregon Ave., N. E., Cleveland, Ohio.

QUALITY.—Trade name for floor lamps and lamp shades manufactured by Kaplan, Inc., 1243 S. Wabash Ave., Chicago, Ill.

QUALITY.—Trade name for hacksaws manufactured by the Napier Saw Works, Inc., Springfield, Mass.

QUALITY ELECTRICAL PRODUCTS CO.—907 E. 15th St., Kansas City, Mo. Manufacturer of armature and battery

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testers and magnet-charging coils. President, Butler J. Haskins; vice-president, R. Finkelstein; secretary and treasurer, Carl Studna; sales manager, B. G. Olson.

QUALITY PRODUCTS.—Trade name for armature and cadmium testers and magnetizers manufactured by the Quality Electrical Products Co., 907 E. 15th St., Kansas City, Mo.

QUANTITY, ELECTRICAL.—The amount of electricity present in any electric charge or passed through a circuit during any time interval by an electric current. The practical unit is the coulomb. C. G. S. units are the abcoulomb and statcoulomb.

QUARTER PHASE OR TWO PHASE.—This is a term characterizing either a generator or circuit. A quarter-phase generator is one in which there are developed two electromotive forces differing in phase by one-quarter of a period. On a clock diagram these e. m. f.'s are represented by two vectors differing in phase by 90 degrees. A quarter-phase circuit is a combination of two circuits energized by two quarter-phase e. m. f.'s. Quarter-phase circuits may have 3 or 4 wires. They are fast becoming obsolete and being replaced by three-phase circuits.

QUARTZ.—Quartz is silicon dioxide, usually found in the form of colorless transparent hexagonal crystals, although it is sometimes colored. It has a resistivity of 10^{11} to 10^{17} ohm-cm. and a high dielectric strength and is therefore useful as an insulator in certain forms. Quartz fibers may be drawn extremely small, and they are sometimes used for suspensions in delicate electrical instruments.

QUARTZ GLASS FOR LAMPS, VACUUM TUBES, ETC.—Quartz glass is sometimes used for the manufacture of mercury vapor or the so-called quartz lamps. Quartz glass is capable of standing a much higher temperature than ordinary glass. This higher temperature permits the mercury vapor lamps to be operated at a much higher potential per unit of length and the result is a light source of much better color. Vacuum tubes used in the Moore tube lamp and Geissler tubes are also made of quartz glass.

Manufacturer:

Hanovia Chemical & Mfg. Co., Chestnut St. & New Jersey Railroad Ave., Newark, N. J.

QUARTZ LAMPS.—See Lamps, mercury vapor.

QUASI-ARC WELDTRODE CO., INC.—Atlantic Ave. & Warwick St., Brooklyn, N. Y. Manufacturer of electric welding apparatus. Business established 1917. President and general manager, D. C. Alexander, Jr.; vice-president, E. L. King; secretary, Walter Moffat; treasurer, Fred W. Gordon.

QUEEN.—Trade name for electric washing machines manufactured by the Knoll Mfg. Co., Reading, Pa.

QUEEN BEE.—Trade name for babbitt metal for electrical purposes manufactured by the Thomas F. Lukens Metal Co.. 238 N. 4th St., Philadelphia, Pa.

QUEEN-GRAY CO.—64-70 W. Johnson St., Germantown, Philadelphia, Pa. Manufacturer of electrical and other scientific instruments. Business established 1853. President, John G. Gray.

QUEEN OF THE KITCHEN.—Trade name for motor-driven household dishwashing machine made by the Conover Mfg. Co., 565 W. Van Buren St., Chicago, Ill.

QUEENS.—Trade name for electric bath cabinets manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

QUEENS QUALITY.—Trade name for lighting fixtures manufactured by the McPhilben Lighting Fixture Co., Inc., Queens, N. Y.

QUENCHED GAP.—See Spark gaps, radio.

QUEZAL ART GLASS & DECORATING CO.—Brooklyn, N. Y. Manufacturer of illuminating glassware.

QUICK ACTION IGNITION CO.—South Bend, Ind. Manufacturer of gas engine ignition apparatus, switches and spark coils. President, Eugene H. Miller; vice-president, Charles L. Zigler; secretary and treasurer, Otto M. Knoblock.

QUICK CATCH.—Trade name for sockets and switches manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

QUICK-LITE.—Trade name for electric lanterns manufactured by the Kwick-Lite Electric Corp., 360 Kearney St., San Francisco, Cal.

QUICK SAMSON.—Trade name for wire grips manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

QUICKER YET.—Trade name for electric washing machines manufactured by the Globe Mfg. Co., Perry, Iowa.

QUICKSTRIP.—Trade name for armored cable manufactured by the Pratt-Chuck Co., Frankfort, N. Y.

QUICTITE.—Trade name for automatic drill chucks manufactured by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y.

QUIGLEY FURNACE SPECIALTIES CO.—26 Cortlandt St., New York, N. Y. Manufacturer of refractories for furnace linings, powdered coal equipment, etc. President, W. S. Quigley; vice-president, H. A. Kimber; secretary, J. H. McPadden; treasurer, L. E. Turk. Branch offices, New York, N. Y.; Chicago, Ill.; Buffalo, N. Y.; Pittsburgh, Pa.; Philadephia, Pa.; Providence, R. I.; Cleveland, Ohio; Denver, Colo.

QUINCY.—Trade name for electric door openers and electric elevator safety devices manufactured by the Quincy Elevator Gate Co., Quincy, Ill.

QUINCY ELEVATOR GATE CO.—Quincy, Ill. Manufacturer of motor-operated door openers and electric elevator safety devices. President, John E. W. Fogal; vice-president and manager, A. E. Zoller; secretary, Marx Alexander; treasurer, D. Ed Miller. Main office and factory, Quincy, Ill. Branch offices, 4139 W. Kinzie St., Chicago, Ill.; 313 Lincoln Bldg., Detroit, Mich.

R

R.—The letter R is a symbol for resistance, expressed in terms of the unit "ohm." In mathematical and electrical equations the form r is used as the symbol for radius. The Greek letter rho (ρ) is also used as a symbol for resistivity, the unit of which is the ohm-centimeter.

R & H.—Trade name for lighting reflectors manufactured by the Reflector & Hardware Specialty Mfg. Co., 2235 S. Western Ave., Chicago, Ill.

RACEWAY, HYDRAULIC.—See Headrace.

RACEWAYS OR MOLDINGS, METAL, FITTINGS FOR.—A large variety of fittings are provided for use with metal moldings or raceways. They consist of various elbows, crosses and tees for making turns and taps in the raceways where no splices are made in the wires, and junction and corner boxes with covers for splicing the wires. Couplings and adapters to couple together two lengths of raceway or to change from metal raceway to wooden raceway, or to armored cable or rigid conduit are also provided. Outlet boxes are supplied, designed for mounting receptacles, rosettes or switches of various kinds. In addition there are special base members, covers and adapters, specially adapted to fit over and suitably conceal the ends of the raceways and to permit the mounting of surface snap switches, wall receptacles, rosettes, etc.

Manufacturers:

American Wiremold Co., 81-85 Woodbine St., Hartford, Conn.

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Pagrip."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

RACEWAYS OR MOLDINGS, METAL, FOR SURFACE WIRING.—Continuous metal enclosures or raceways for the conductors of branch lighting or similar circuits. They are used largely in making extensions as in offices, where it is desired to install additional lights or provide an outlet for some appliance, and where a conduit installation would be difficult to make or would be unsightly. The raceways usually consist of two pieces of metal, a base and a cover, permanently or removably assembled, forming a shallow metal-enclosed passageway for wiring, which, by use of special fittings, can be connected to the standard conduit installation and run along corners, around windows and by other inconspicuous routes to the desired location. Most types permit the cover to be removed during the installation, and snapped on again. The finish is galvanized or of a neutral tint, and may be readily refinished to match the walls.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn. "Wiremold."

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Pagrip."

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National" metal molding, "the standard for surface wiring," is a small, flat section of Sherardized steel designed for carrying and enclosing electric wires installed on walls, ceilings or other surfaces. It does away with unsightly surface wires, providing, instead, a neat, inconspicuous and absolutely safe installation. It can be painted any color and made to match the finish or woodwork of practically any room; its Sherardized surface prevents rust and mechanical injury. There is a complete line of "National" fittings and devices for use in connection with metal-molding—everything for completing the job. See display adv. pages 1302-4.—Adv.

RACEWAYS OR MOLDINGS, WOOD, FITTINGS FOR.—Fittings for use with wooden raceways or moldings consist of connection blocks and covers for use at junctions, crosses, tees, etc., where splices or connections are made in the wires. There are also a series of couplings for joining together two sections of raceway or for joining sections of wooden raceway to metal raceway, rigid conduit, armored cable or open wiring. Junction and outlet boxes are also made to permit making splices and taps and for mounting receptacles, switches, etc. Adapters or special base members which facilitate mounting of wall receptacles, snap switches, etc., are also used.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.

Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

RACEWAYS OR MOLDINGS, WOOD, FOR SURFACE WIRING.—Wire enclosures in the form of a continuous molding of wood having a slotted base member to re-

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ceive the conductors and a thin wood capping to cover the slots. Intended for surface mounting in dry locations. The molding is usually furnished with from two to four grooves. This form of molding was the first enclosure used for interior wiring and was formerly used quite generally, but has now been excluded from many districts, especially the large cities.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Mitchell Moulding Co., 15th St. & Circle Ave., Forest Park, Ill. "Wire Grip."
Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

RACINE.—Trade name for motors, electric fans, grinders, vibrators, etc., manufactured by the Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill.

RACINE ELECTRIC CO.—Bridge & Ontario Sts., Racine, Wis. Manufacturer of fractional horsepower motors, electric hair cutters, vibrators, etc. Business established 1912. President, H. Van Bree; vice-president, Mrs. H. Van Bree; secretary, treasurer and general manager, J. H. Peterson.

RACINE IRON & WIRE WORKS.—Racine, Wis. Manufacturer of nonlocking lamp guards. President and treasurer, G. L. Buck; vice-president, W. A. Talcott; secretary and sales manager, O. L. Manchester.

RACINE PHONOGRAPH CO., INC.—Racine, Wis. Manufacturer of electrically operated phonographs.

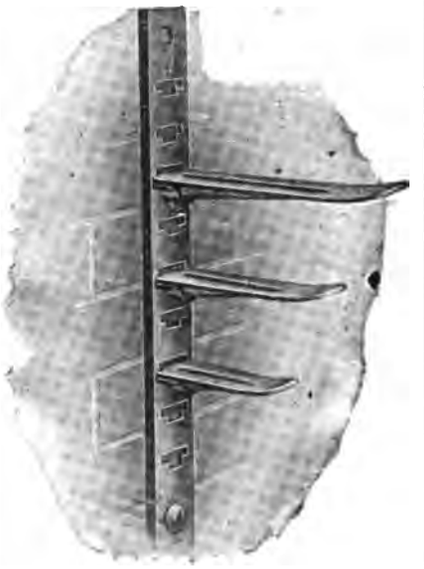
RACINE STEEL CASTINGS CO.—Racine, Wis. Manufacturer of electric steel castings. President, Judson F. Stone; secretary and treasurer, C. D. Anderson.

RACINE UNIVERSAL MOTOR CO.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of motors, electric hair cutters, vibrators, buffers, grinders, etc. Business established 1915. President and treasurer, W. J. Kerler; vice-president, E. E. McKim; secretary, D. P. Scott. Factories, Racine, Wis.; Chicago, Ill.

RACKS AND HOOKS, CABLE.—In passing through manholes, cables are supported on side walls by racks. These are made in various forms, the better types including a vertical galvanized iron support on the wall, from which detachable brackets or hooks are hung. The brackets are added as cables are installed from time to time. In some forms a porcelain insulator is used to prevent an electrical connection from the cable sheath to the grounded bracket. This construction is also used sometimes for running low-tension cables along a wall, as in the basement of a generating station or substation.

Manufacturers:

Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.
Brooklyn Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Efficiency Electric Co., The, East Palestine, Ohio. "Efficiency."
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., Pittsburgh, Pa. Peirce Presteel cable racks and hooks for manhole and interior cable work are made of open hearth steel and are hot galvanized. The rack sections are made of 1½ by ⅝ by ⅛-in. channels and can be made in any desired length. They should be fastened to the manhole walls with ½ by 4-in. Peirce expansion bolts. The hooks are pressed from open hearth steel plates and have a smooth well rounded top surface 1½ in. wide, which will not injure the sheath of the cable. They are made in three lengths, i.e., 4, 7½ and 10 ins. long. These racks and



Peirce Presteel Cable Racks and Hooks

hooks are used as a standard by the Bell Telephone companies. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Canadian agents.)—Adv.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Liberty Electric Corp., Port Chester, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

RACKS, ARMATURE.—See Armature racks.

RACKS, BATTERY.—See Holders, battery.

RACKS, INSULATED.—These racks are used for supporting wires or cables. The rack consists of a two-piece metal fitting formed to hold a row of porcelain or glass split insulators. The wire is laid over the insulators on the base and then the top together with the other half of the split insulators clamped to the base by bolts through the ends of the top and base. The rack may be made entirely of iron or with an iron base and brass top.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Liberty Electric Corp., Port Chester, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.

RACKS OR HOLDERS FOR DRAWINGS AND BLUEPRINTS.—The large number of blueprints, tracings, pen and ink drawings and maps which must be frequently consulted in large manufacturing plants, central stations, telephone and electric railway companies, etc., makes it very desirable that they be fitted in a rack or cabinet from which they may be conveniently removed and examined. The racks provided are sometimes arranged in a cabinet, the drawings being suspended on wooden sticks which hold the drawings flat and in place in their rack of the cabinet. A flat table top, on which the drawings may be placed while being examined, is often included as a part of the cabinet. This method also reduces wear and tear of the drawings as well as making it difficult to lose or misplace them. For blueprints of plans and elevations of buildings, machinery, etc., the racks are sometimes made to receive cylindrical containers, each cylinder or tube containing a complete set of prints. This plan has the objection of rolling the drawings, which causes more wear if they are referred to frequently and makes it less convenient to refer to them. Cabinets with drawers or portfolios for keeping drawings flat are also used, especially for tracings. They must be neatly fitted in dustproof drawers with cover boards or portfolios to keep the drawings from crumpling when the filled drawer is pushed back. Other racks and filing schemes have also been used and many others tried out and discarded.

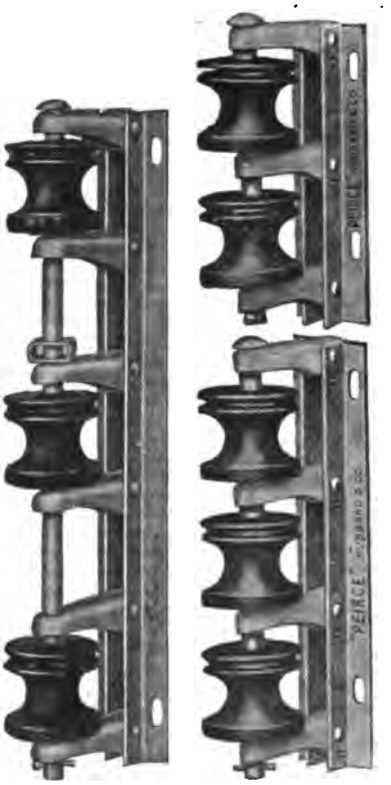
Manufacturers:

American Drafting Furniture Co., Inc., 103 Mill St., Rochester, N. Y.
Economy Drawing Table & Mfg. Co., S. Center St., Adrian, Mich. "Economy."
Lyon Metallic Mfg. Co., Aurora, Ill.
National Co., Cambridge, 39, Boston, Mass. "Presto Holder."
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill. "Up-Rite."

RACKS, SECONDARY, POLE LINE.—Secondary distribution mains are sometimes carried on vertical racks on the side of a pole instead of on crossarms. The appearance is neat and the arrangement substantial. The racks are of galvanized steel, with special spool-form insulators for the wires, the insulators being usually furnished by the manufacturer of the rack. Service connections are supported from the line rack on one side of the pole and from a separate service rack on the other side. Where many services are taken from one pole the climbing space is interfered with to some extent.

Manufacturers:

HUBBARD & CO., Pittsburgh, Pa. Peirce secondary racks are made of Presteel, hot galvanized, and are used for carrying secondary circuits vertically. They are very strong and will accommodate any size of conductor up



Peirce Secondary Racks

to 1,000,000 circular mils. Vertical racks are rapidly becoming a standard for secondary circuits. See Hubbard's catalog, Section 6, for complete listing and description of these fixtures. (Slater & Hubbard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.

When writing to manufacturers please mention the
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Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Liberty Electric Corp., Port Chester, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. "Hendee." (See display adv. page 1278.)
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.

RACKS, TELEPHONE.—A framework in a telephone office to hold telephone apparatus, such as the relay rack, repeating coil rack, terminal rack, etc.

RACKS, TELEPHONE DISTRIBUTING.—See Frames, distributing, telephone.

RADAX.—Trade name for ball bearings manufactured by the New Departure Mfg. Co., Bristol, Conn.

RADD.—Trade name for spark plugs manufactured by the Leich Electric Co., Genoa, Ill.

RADIAGRAPH.—Trade name for oxy-acetylene cutting and welding outfits manufactured by the Davis-Bournonville Co., Jersey City, N. J.

RADI-ALL CO., THE.—Ironton, Ohio. Manufacturer of electric air heaters. Business established 1920. President and sales manager, R. W. Blanton; vice-president, I. P. Blanton; secretary and general manager, John S. Roney; treasurer, E. B. Allen. Main office, Ironton, Ohio. Factories, Middletown, Ohio, and Ironton, Ohio. Branch office and warehouse, Middletown, Ohio.

RADIALS IN TRANSMISSION SYSTEMS.—A line running directly from a generating station to a substation without intermediate loops is termed a radial line. Where tie lines between substations form a ring or a network, the term is a convenient one to distinguish the direct lines from tie lines.

RADIAN.—The scientific unit employed in measuring angles. It is the angle at the center of a circle that embraces an arc of circumference equal to the length of the radius of the circle. There are therefore 2π radians about the center of a circle or 2π radians = 360°. Therefore, one radian = 57.3°.

RADIANT.—Trade name for lighting fixtures manufactured by the Radiant Lighting Fixture Co., Inc., 33 Bleecker St., New York, N. Y.

RADIANT.—Trade name for lighting and power plants made by the Radiant Mfg. Co., Water & Perry Sts., Sandusky, Ohio.

RADIANT ENERGY.—This is energy given off by a body and propagated by electromagnetic waves in the ether. Light, heat waves and the waves used in radio (wireless) communication are illustrations. Such waves have the power to pass through free space, whereas sound waves and other mechanical waves require a material medium for transmission. The term radiation is also applied to positively and negatively charged particles projected with high speed, such as the cathode rays, or the alpha and beta rays from radioactive substances. (See Radioactivity.)

RADIANT LIGHTING FIXTURE CO., INC.—33 Bleecker St., New York, N. Y. Manufacturer of lighting fixtures.

RADIANT MFG. CO., THE.—Water & Perry Sts., Sandusky, Ohio. Manufacturer of lighting and power plants. Business established 1919. President and general manager, J. W. Wellington; vice-president, secretary and treasurer, H. S. Hill; sales manager, A. H. Ambrose.

RADIATION.—The act or process of radiating or emitting rays of heat or light or electromagnetic waves. Radiation of heat from various bodies, either electrical or mechanical, unless designed expressly for that purpose, is usually a power loss, and provision is generally made to prevent the radiation as far as possible. Radiation of light is usually desired and is always accompanied with some heat radiation also. Radiation of electromagnetic waves is what makes radio communication possible.

RADIATION LOSSES IN FURNACES.—In electric or electrolytic furnaces, the proportion of the energy of the current used which is lost by radiation from the outer surface of the furnace and its appendages. Numerous electrodes projecting from the furnace may, for instance, carry large amounts of heat out of the furnace which are lost by radiation from the outer surfaces of the same. All such radiation surfaces should preferably be smooth rather than rough, and white rather than black, in order to diminish radiation losses. White aluminum paint is a cheap means of reducing radiation losses.

RADIATOR BULBS.—See Bulbs for luminous radiators.

RADIATOR HEATERS.—See Heaters, electric, automobile.

RADIATOR, TRANSFORMER.—A tube or nest of tubes extending outside of the tank from top to bottom of a large transformer. It offers a circulation path for the transformer oil with increased radiating surface for cooling. In some cases these tubes are corrugated lengthwise in order to still further increase the surface exposed to the air.

RADIATORS, ELECTRIC.—See Heaters, electric, air or space, or radiators.

RADIO.—Trade name for luminous enamel manufactured by American Luminous Products Co., Huntington Park, Cal.

RADIO.—Trade name for electric bakers or hot packs manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

RADIO AMPLIFIERS.—See Amplifiers, radio.

RADIO ANTENNA SUPPORTS.—See Antenna supports, steel pole; Antenna supports, wood pole or mast; Towers, reinforced concrete, radio, power transmission, etc.; Towers, steel, radio antenna.

RADIO BUZZERS.—See Buzzers, electric, radio.

RADIO CHANGERS (WAVE LENGTH).—See Changers, wave length (radio).

RADIO COHERERS.—See Coherers and decoherers, radio.

RADIO COILS.—See Coils, induction, radio.

RADIO COMMUNICATION, DEVELOPMENT AND STATUS OF.—Radio communication is the science and art of communication by means of electromagnetic waves or radiation, which are identical with light except in wave length. The wave lengths in common use lie between 50 and 16,000 meters (frequencies between 3,000,000 and 18,000 cycles per second, as the velocity of propagation is the same as that of light, approximately 3×10^8 meters or 186,000 miles per second.)

Radio communication systems require: (1) the production of alternating electrical energy in the frequency range given above at a transmitting station; (2) the radiation of this energy into space in the form of electromagnetic waves; (3) the absorption of a portion of this electromagnetic energy at the receiving stations and its transformation into some form of energy capable of affecting some one of the human senses. The power consumed in a transmitting station varies from a few watts to 1000 kilowatts depending on the distance of communication and the transmission conditions. The power received at the receiving station is of the order of a few millionths of a watt.

The name "wireless telegraphy," later shortened to "wireless," was first applied to this means of communication to emphasize the uniqueness of communication without connecting wires. Modern writers, however, are making use of the term "radio communication" as a broad term including all types of communication making use of electromagnetic radiations of the wave lengths cited above. The term "space telegraphy and telephony" is also in common use today.

Radio communication was predicted by Clerk Maxwell in 1865. Researches made by Henry, Hertz and many others laid foundations for further developments. Transmission of messages over a distance of 1½ miles was accomplished by Guglielmo Marconi in Italy in 1895 and considerable credit for the development of commercial radio telegraphy is due him. Since then great advances have been made in the individual efforts of many workers.

Perhaps the most noteworthy single achievement is the development of the three-electrode electron or vacuum tube and its adaptation to the radio field. This instrument was first built by Lee de Forest and patented by him in June, 1907. Its development, coupled with that of circuits and apparatus for its use, by many experimenters has done more than any other one thing to advance the art of radio communication.

After his early work Marconi transferred his activities to England, where in 1896 he took out his first patent. In 1897 a company was formed to acquire his patents in all countries, except Italy. At that time the range of communication was about 12 miles. In 1899 it had been extended to about 85 miles, in 1902 to 1000 miles, and in 1907 stations at Clifden, Ireland, and Glace Bay, Nova Scotia, were opened for transatlantic service.

Early transmitting circuits were very simple, consisting of an elevated antenna with a coil and spark gap in series with it. A transformer or spark coil was used to charge the aerial. The broad wave radiated by such a set, however, made necessary some modification and the well known coupled circuit system was developed (see Radio telegraph transmitting apparatus).

Early receiving apparatus made use of the coherer; this gave way to the crystal detector, which in turn is being rapidly replaced by the electron tube. (See these separate headings.)

The development of the radio telephone was necessarily delayed until the development of continuous-wave transmitting apparatus. In 1907 Poulsen established radiophone communication over a distance of 170 miles using an arc for generating the high frequency. The great problem in the development of the radio telephone has been the control of large amounts of high-frequency power by the minute amount of energy in the human voice. This control is called modulation. In early arc radiophone sets modulation was accomplished by using several microphones at once and connecting them in series or parallel directly into one of the oscillating circuits.

The development of the electron tube amplifier has simplified greatly the problem of modulation in radio telephony. The Western Electric Co. has also made use of electron tubes as generators of the high-frequency oscillation. In 1916 this company carried on a series of radiophone tests from the Arlington station using a battery of over 500 power tubes for amplifying the high frequency which had been generated and modulated by smaller tubes. Speech was transmitted as far as Hawaii, a distance of over 5000 miles.

The War's Developments. During the recent war some long-distance radiophone communication was done by the New Brunswick station using a bank of electron tubes and a magnetic amplifier to modulate the energy from an Alexanderson alternator.

The recent European war brought about extensive developments in the field of radio communication. Airplanes were equipped with low-power transmitting and receiving equipment in order that they might keep in constant communication with base stations. The best airplane sets contained electron-tube high-frequency generators and could be used for either telegraphy or telephony. One type of airplane antenna consists of a long wire which is let out from the fusilage. The body of the airplane acts as a counterpoise.

The radiophone was also used to some extent for intercommunication between vessels of the Navy when in convoy. Sensitive transmitters and loud-speaking receiving equipment make it possible for the commander of one ship to speak with the commander of another without either of them leaving his post on the bridge.

Radio communication was also extensively used for short distances upon the battlefields, particularly where wire connection had been broken. One very successful type of trench set developed near the close of the war made use of a loop antenna energized by a specially constructed buzzer. A second important use of radio apparatus upon the battlefield was to determine the location of enemy radio outfits by directional loop receiving apparatus. The changes in location of enemy transmitting stations often gave valuable information as to the movement of enemy troops. Directional receiving apparatus was also used by airplanes in navigating without the aid of visible landmarks.

In all the radio development which took place during the war the electron tube played a very important part, and much of the advancement in the science which has been made is due to this versatile instrument.

Fields for Radio Communication. The most developed practical phase of radio communication is undoubtedly that dealing with communication with ships. In this

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one field alone the importance of the radio telegraph cannot be overestimated. Before its advent, ships leaving port were completely isolated and thousands of ships have been lost without a trace of what befell them, whereas they are now never out of communication range of at least one land station. Thousands of passengers and crew have been rescued through aid summoned by the famous "S. O. S." radio call.

According to the laws of the United States, it is unlawful for any steamer licensed to carry fifty or more persons to leave any port of the United States unless equipped with efficient apparatus for radio communication, in good order, capable of transmitting and receiving messages over a distance of 100 miles. An operator must be on duty at all times while the ship is being navigated.

At present commercial ship sending apparatus is almost entirely confined to damped-wave transmitting equipment of from 1 to 5 kw. operating on 600 and 300-meter wave lengths.

Another increasingly important field for the radio telegraph is transoceanic and transcontinental communication. This service requires much higher powered apparatus, which is almost invariably of the undamped-wave type. Present practice is to locate a sending and a receiving station from 10 to 60 miles apart. The operator is located at the receiving station and controls the transmitting-station key by a land wire. He is, therefore, able to listen to other transmitting stations on the other side of the ocean at the same time that he is operating his own transmitting apparatus. This makes possible duplex operation and permits a much greater amount of traffic to be carried on. At present, communication is carried on at a rate of from 15 to 35 words a minute, but improvements under development will soon increase this speed to over 100 words per minute.

The high-powered Navy stations on the eastern and western coasts send out time signals and weather reports at stated hours. The Annapolis and Arlington stations send time signals at 12 o'clock noon, and at 10 p. m., 75th meridian time, which are followed by weather reports. After the evening weather report, the press news for the day is transmitted for the benefit of all ships at sea. The list of stations giving this service and their schedules may be obtained from the Superintendent of Public Documents, Washington, D. C.

Future Prospects. The future field for radio communication will undoubtedly be large. While it will never replace wire communication for short distances, it will undoubtedly be used to supplement wire service for long distances, thereby cutting down the enormous original cost and upkeep of miles of wire line.

A possible field for radio communication which as yet is practically undeveloped is the dissemination of market quotations. The broadcasting nature of such service makes radio communication eminently fitted for such work.

RADIO COMMUNICATION INTERFERENCE.—Interference to radio communication is of two general types, interference due to atmospheric disturbances and that due to stations operating simultaneously on the same wave length.

Atmospheric disturbances, or "static," as they are more commonly called, are the most serious limiting factor in all radio communication. Static manifests itself by clicks and noises in the receivers, which interfere with the incoming signals. Static disturbances are more pronounced in summer than in winter, more pronounced in the daytime than at night, more troublesome in the tropics than in the temperate zones, and limit the communication range over land to a greater extent than over water. Other atmospheric electrical disturbances, such as northern lights, also interfere with radio communication. Various devices and circuits have been produced for its elimination but as yet they have been only partially successful.

To prevent interference between stations operating on the same wave length, various classes of service are assigned various wave-length bands. Interference between sending stations operating on nearly the same wave length may be avoided by using sharply tuned circuits at the receiving station. Damped-wave stations cover a wider band of wave lengths than those sending undamped waves, and consequently cause more interference. The use of directive receiving and transmitting antennas also helps to prevent interference.

RADIO COMPASSES.—See Compasses, radio.

RADIO CONDENSERS.—See Condensers, static, radio.

RADIO CORP. OF AMERICA.—New York, N. Y. Manufacturer of radio apparatus. Business established 1899. President, Edward J. Nally; secretary, Charles J. Ross; treasurer, George S. DeSousa; general manager, David Sarnoff. Main office, 233 Broadway, New York, N. Y. Branch offices, Boston, Mass.; New Orleans, La.; Seattle, Wash.; Philadelphia, Pa.; Galveston, Tex.; Portland, Ore.; Baltimore, Md.; San Francisco, Cal.; Norfolk, Va.; Cleveland, Ohio; Savannah, Ga.; Chicago, Ill.; Port Arthur, Tex.; San Pedro, Cal.

RADIO DETECTORS.—See Detectors, radio.

RADIO ELECTRIC CO., THE.—Pittsburgh, Pa. Manufacturer of radio equipment. Business established 1919. President, J. O. Olsen; secretary and treasurer, M. V. Mansfield. Main office, 3807 5th Ave., Pittsburgh, Pa. Branch office and warehouse, 609 Orchard Ave., Avalon, Pa.

RADIO ELECTRON TUBES.—See Electron tubes.

RADIO GENERATORS (HIGH-FREQUENCY).—See Generators, high-frequency, radio.

RADIO KEYS.—See Keys, radio.

RADIO RECEIVERS.—See Receivers, radio.

RADIO RECTIFIERS.—See Rectifiers, radio.

RADIO RELAYS.—See Relays, radio.

RADIO RESONATORS.—See Resonators, radio.

RADIO SERVICE & MFG. CO.—454 Merrick St., Lynbrook, L. I., N. Y. Manufacturer of radio equipment and electrical novelties. Business established 1919. General manager, Harold Hymans.

RADIO LAWS AND REGULATIONS OF THE UNITED STATES.—This valuable compilation is published by the Government Printing Office and may be obtained from the Superintendent of Public Documents, Washington, D. C., for $0.15 a copy.

RADIO SETS OR OUTFITS, COMPLETE, AMATEUR AND EXPERIMENTAL.—These equipments or sets are rather small, compact arrangements of apparatus for the transmission and reception of radio messages. Not all amateur sets are equipped for transmission, but consist merely of the tuning equipment (variable condenser or inductance, or both), the detector and receivers. When they are made for transmission also, the equipment is much more complete, including some means of generating the high-frequency current, usually an oscillation transformer or coupler and a small power transformer. These equipments are limited in the power that may be used. For experimental purposes they may be very simple or if the equipment is used in a school or radio club it may be very complete.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
AudioTron Mfg. Co., 35 Montgomery St., San Francisco, Cal. "Cunningham."
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
Cutting & Washington Radio Corp., 6 W. 48th St., New York, N. Y.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Center, N. Y.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Gilbert."
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal. "Remler."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio." Manufacturer of radio apparatus. The list of "Grebe" apparatus includes receiving equipment for all wave lengths from 150 to 20,000 meters and various combination of audion control units, such as detector units, two stage audio-frequency amplifier units, detector and single stage, and detector and two stage amplifiers. The Grebe Type CR-3 regenerative receiver combined with the Grebe Type RORD detector and two stage amplifier unit represents the ideal equipment for the amateur or experimenter who desires to "listen-in" on wave-lengths from 150 to 680 meters. The Grebe Type CR-5 receiver with the Grebe Type RORK two stage amplifier is an unequaled intermediate wave length combination—with this outfit it is possible to receive over a wave length range of 150 to 3000 meters. For those who desire an absolutely complete receiving station, the combination of the Grebe Type CR-6 with the Type CR-7 receivers will give the utmost satisfaction. These two receivers cover the entire used wave length range of all wireless transmitting stations, i. e., 150 to 20,000 meters. The CR-6 includes a two stage audio frequency amplifier unit which is available throughout the entire wave length range covered by the CR-6 and CR-7 receivers. All Grebe apparatus is built in the finest quartered oak cabinets, and the best obtainable material and workmanship is used throughout, and complete instructions, blueprints and calibration curves are furnished with each instrument. Grebe radio will be found in the laboratories and stations of many of the largest colleges and Grebe apparatus is "standard" with the vast army of amateur radio enthusiasts in this country.—Adv.
International X-Ray Corp., 326 Broadway, New York, N. Y.
K. & G. Wireless Supply Co., 152 Chambers St., New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
KLAUS RADIO CO., Eureka, Ill.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y. "Meraco."
Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Parkin Mfg. Co., San Rafael, Cal.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Electric Co., The, 3807 5th Ave., Pittsburgh, Pa.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
Radioland Co., 209 Alsop St., Jamaica, N. Y. (Radio telephone.) "Sterns."
Simon, Emil J., 217 Broadway, New York, N. Y.
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich. "Wilcox."
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

RADIO SETS OR OUTFITS, COMPLETE, COMMERCIAL AND MARINE.—Commercial and marine radio stations are sometimes made very powerful and the equipments therein are very extensive and complete. While these are not called sets or outfits, because of their extensiveness, the manufacturers listed here are in position to supply the various individual apparatus required. In addition there are some smaller complete outfits used on the smaller vessels and in the smaller commercial stations. The apparatus contained in such outfits is varied, depending upon the location of the station, the volume of business expected and the distance over which communication is desired. For a

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more complete discussion of the apparatus see Radio telegraph transmitting apparatus; Radio telephone transmitting apparatus; Radio telegraph and telephone receiving apparatus.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Cutting & Washington Radio Corp., 6 W. 48th St., New York, N. Y.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Center, N. Y.
Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal. "G. D."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio." (See descriptive advertisement under Radio sets or outfits complete, amateur and experimental.)
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y.
ROBBINS & MYERS CO., THE, Lagonda Ave. & Leah St., Springfield, Ohio.
Simon, Emil J., 217 Broadway, New York, N. Y.
Tecla Co., Inc., Detroit, Mich.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

RADIO SETS OR OUTFITS, COMPLETE, MILITARY, NAVAL AND AIRPLANE.—These sets or outfits as a rule are very compact and light outfits for transmission of messages over comparatively short distances. The military and airplane sets are often contained in a single box or cabinet, having a small panel in the front or top, on which are the operating handles for the variable resistances, inductances and condensers, jacks for plugging in the receivers, and various switches and indicating instruments. These sets are for portable use. Larger and more powerful and complete outfits are also used in military service. These are sometimes mounted on automobile bodies or small handcarts. Some large permanent military stations contain apparatus resembling that found in the commercial stations, but that is not included in this classification.

Naval sets or outfits resemble those used for military service in many of the smaller destroyers, submarines, etc. The main difference is that in these vessels they are installed permanently, and the necessity for lightness and compactness is not so dominant. Some naval equipments are also very large and powerful and are capable of transmitting over great distances. This is nearly always special apparaus made to meet the particular specifications.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Cutting & Washington Radio Corp., 6 W. 48th St., New York, N. Y.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Center, N. Y.
Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio." (See descriptive advertisement under Radio sets or outfits complete, amateur and experimental.)
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Meyberg Co., Leo J., 428 Market St., San Francisco, Cal.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Radio Corp. of America, 233 Broadway, New York, N. Y.
Simon, Emil J., 217 Broadway, New York, N. Y.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

RADIO SPARK COILS.—See Spark coils, radio.

RADIO SPARK GAPS.—See Spark gaps, radio.

RADIO STATIONS, HIGH-POWER.—A partial list of high-powered stations showing geographic location of station, also type and power where known, is given below: Annapolis, Md., arc, 500 kw.; Arlington, Va., spark and arc, 100 kw.; Balboa, C. Z., arc, 100 kw.; Bordeaux, France, arc, 1000 kw.; Carnarvon, Wales; Cavite, P. I., arc, 350 kw.; Cordova, Alaska, arc, 30 kw.; Funibashi, Japan, arc; Lyons, France, arc and alternator, 250 kw.; Mexico City, Mexico, damped; Nantes, France, arc; Nauen, Germany, alternator, 150 kw.; New Brunswick, N. J., alternator, 200 kw.; Pearl Harbor, Hawaii, arc, 100 kw.; Rome, Italy, arc, 300 kw.; San Diego, Cal., tuned spark, 300 kw.; Sayville, L. I., arc; Stavangen, Norway, 40 kw.; Tuckerton, N. J., arc.

RADIO TELEGRAPH AND TELEPHONE RECEIVING APPARATUS.—Apparatus for the reception of radio signals falls into two distinct classes, that for receiving undamped waves and that for receiving damped waves. The apparatus for receiving radio telephone speech may be identical with that used for damped waves.

For receiving damped waves, the energy from the transmitting station is absorbed by an antenna which is tuned to the incoming wave length by a condenser, an inductance, or both. The incoming waves set up electrical oscillations in the tuned antenna which are applied to a detector directly or by the aid of a second circuit. The energy, after rectification by the detector, is used to actuate a telephone receiver diaphragm or some recording device. The incoming energy may be amplified before or after rectification, or both.

Undamped-wave receiving apparatus contains, in addition to the above mentioned parts, a means for breaking up the undamped energy in the receiving antenna into audio-frequency groups, there being no audio or spark frequency in the transmitted wave. The most common method of doing this is to combine with the incoming oscillations energy from a local oscillator of such frequency that the beats produced by the interference of the two frequencies will, when rectified, be audible in the receivers. This method is commonly known as heterodyne reception.

RADIO TELEGRAPH TRANSMITTING APPARATUS.—This may be divided into two classes, damped and undamped wave apparatus.

Damped-wave transmitting apparatus produces and radiates high-frequency electrical energy by the aid of the discharge of a condenser through an inductance, the resistance of the circuit being less than what is known as the critical value. In a standard damped set circuit a-c. energy is transformed to a voltage of approximately 20,000 to charge a condenser. When the voltage across the condenser becomes sufficient to break down the resistance of the gap, the condenser discharges through the gap and inductance. The energy is then absorbed by the aerial circuit, this circuit being tuned to the radio frequency produced.

In low-power sets the transformer is replaced by a spark coil with vibrator and d-c. supply. The key is usually placed in the low-voltage circuit of the transformer or spark coil. (For descriptions of individual pieces of apparatus see separate headings.)

Commercial ship sets generally use 500-cycle current at 110 volts supplied by a special generator. The gap is usually of the rotary or quenched type (See spark gaps radio) and the power ranges from ½ to 10 kw. Amateur land sets are usually 1 kw. or less with 60-cycle supply and use a rotary gap. Commercial land sets range as high as 100 kw. Higher power damped sets have been built but proved unfeasible. The U. S. Navy damped set at Arlington, Va., used for sending time signals and weather reports, is a 100-kw. damped set using 500-cycle primary supply and a rotary synchronous gap. It radiates a 2500-meter wave.

Undamped-wave or continuous-wave radio telegraph transmitting apparatus produces and radiates high-frequency electrical energy of constant amplitude. This type of energy is commonly produced by one of three classes of apparatus: arc generator, high-frequency alternator, or electron tube oscillator. Practically all high-power transmitting equipment is of the undamped-wave type. Until recently arc equipment has been the more universally used, but some of the best communication records have been made by alternator equipment in the United States and Germany.

RADIO TELEGRAPHY.—A system of communication by means of electromagnetic signals transmitted or radiated through space as electromagnetic waves. It was originally called wireless telegraphy because it uses no line wires. See Radio Communication, development and status of.

RADIO TELEPHONE TRANSMITTING APPARATUS.—This apparatus consists of a method for generating high-frequency undamped waves and a means for varying the amplitude of this energy to correspond with the modulations of the voice. The most common method of generating high frequency for the radio telephone is by a high-power electron tube oscillator. Modulation of high frequency produced by this method may be accomplished by varying either the grid voltage or plate voltage of the oscillator tube. If the plate voltage is varied, a second electron tube, called the modulator, is connected in parallel with the oscillator, the plate voltage of both tubes being supplied by a common source through a high inductance. If the speech frequency is applied to the grid of the modulator, the current taken by the modulator will cause a variation of the voltage applied to the oscillator as well and consequently the amplitude of the radio-frequency output will vary to correspond. One advantage of this type of modulation over the grid-voltage variation method is the fact that complete modulation gives a variation in output current of from zero to that of the unmodulated value, while the grid-voltage variation method allows for a variation of from zero to that of the unmodulated value only. This is due to the fact that the variations in the current taken by the modulator tube cause the voltage across the choking inductance to either add to or subtract from the voltage of the generator in such a way that the total current taken by the two tubes is constant. An additional advantage is due to the fact that the output current of an oscillating electron tube varies directly with the plate voltage over a large range. Therefore, a plate-voltage variation method of modulation gives very little distortion.

Some notable radio telephone work has been done using an Alexanderson alternator as a source of high frequency coupled

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to a magnetic amplifier circuit. Speech applied to the magnetic amplifier changes the tuning of the circuit and consequently the amount of energy absorbed from the antenna.

RADIO TELEPHONY.—A system of telephony in which the transmission of articulate speech through distance is accomplished by means of electromagnetic waves. This system was formerly called wireless telephony. See Radio communication, development and status of.

RADIO 30.—Trade name for commercial lighting unit manufactured by the General Gas Light Co., Kalamazoo, Mich.

RADIO TRANSFORMERS.—See Transformers, radio.

RADIO TRANSMITERS.—See Transmitters, radio.

RADIO TUNERS.—See Tuners, radio.

RADIO-VITANT.—Trade name for electrotherapeutic apparatus manufactured by the Burdick Cabinet Co., Milton, Wis.

RADIOACTIVITY.—Becquerel discovered in 1896 that uranium and its compounds give off radiation different from light. This radiation is invisible, acts on a photographic plate, and penetrates considerable thickness of paper and other materials, including metals. In addition to uranium, thorium, polonium, actinium and radium have been found to be radioactive.

Rutherford has shown that there are three types of radiation or rays, which he called the alpha rays, the beta rays and the gamma rays. In the case of polonium, alpha rays only are emitted. Alpha rays are found to be positively charged particles having a mass about four times that of a hydrogen atom. This is almost identical with the mass of an atom of helium. Beta rays are charged negatively, have a mass about 1/1800 of the mass of a hydrogen atom and are emitted with a velocity almost as great as that of light. Gamma rays are ether pulsations similar to X-rays but even more penetrating. When traveling perpendicular to a magnetic or an electric field, alpha rays are deflected in one direction and beta rays in the opposite direction, while gamma rays are not deflected at all. All three types of radiation act on a photographic plate and ionize gases, but in different degrees.

A common test, for radioactivity is to place the substance in a gold-leaf electroscope which is charged. If radiation is emitted, the air in the electroscope becomes conducting and the gold leaf falls as it loses its charge. The rate of fall of the gold leaf is a measure of the radioactivity of the sample tested.

Radioactive substances undergo transformations which alter their properties, including their atomic weight. Some of these transformations are very rapid but others are slow. Radium is believed to change into radio lead, but it requires more than 1700 years for the change to be half completed. M. Curie observed that radium continually gives off heat as a result of energy being liberated during the emission of radiation.

RADIODUCTOR.—Trade name for heating element manufactured by the H. G. Weeks Mfg. Co., Hamilton, Ohio.

RADIOGRAPHY.—A name sometimes given to the art of making X-ray photographs or radiographs, usually of an opaque object.

RADIOLAND. CO.—209 Alsop St., Jamaica, N. Y. Manufacturer of radio apparatus. Business established 1920. President, treasurer and general manager, Morton W. Sterns; vice-president and secretary, Carl A. Baas. Factory, Bronx, N. Y.

RADIOLITE.—Trade name for lighting fixtures manufactured by the National Electric Fixture Co., 17 S. Clinton St., Chicago, Ill.

RADIOPHONE.—A frequently used contraction of radio telephone.

RADIOPHONE.—Trade name for radio telephones manufactured by the De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y., and Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

RADIOPTICAN.—Trade name for post card projectors manufactured by the H. C. White Co., North Bennington, Vt.

RADIOSCOPE.—Trade name for stereopticons and projectors manufactured by A. T. Thompson & Co., 15 Tremont Pl., Boston, Mass.

RADIOSCOPES, ELECTRIC.—A device used to examine patients by means of X-rays for medical and dental diagnosis. It consists of an X-ray tube, with a fluorescent screen and is operated from a high-frequency source of supply. Other names given to this apparatus are roentgenoscope or fluoroscope. Also see X-ray fluoroscope.

RADIOSCOPY.—The art of making examinations of part of the human body, by the use of the X-ray in connection with a fluorescent screen without employing photography.

RADIOTRONS.—Trade name for vacuum tubes for radio detection and amplification manufactured by the Radio Corp. of America, 233 Broadway, New York, N. Y.

RADIUM.—Radium is a heavy, strongly radioactive element discovered by M. and Mme. Curie in 1898. Its atomic weight is 226. It was originally obtained from pitchblende from Austria. Recently the chief source of supply has been the mineral carnotite found in Colorado. Radium occurs in very small quantities, only a few milligrams being obtained by the chemical treatment of a ton of the best ore. It is consequently very expensive. Radium bromide, or some other compound of radium, is generally used instead of the pure element. The principal uses are for scientific investigations and for therapeutic purposes. The radiations from radium act on living tissues in a manner similar to X-rays and are found to have valuable curative properties in certain diseases. Also see Radioactivity.

RADIUM.—Trade name for storage batteries manufactured by the Milwaukee Auto Specialty Mfg. Co., Inc., 711 Chestnut St., Milwaukee, Wis.

RADIUM LTD., U. S. A.—2 W. 45th St., New York, N. Y. Manufacturer of electrometers, electroscopes and luminous compounds. Business established 1914. President, Rich Kay; secretary, A. G. E. Hanke; general manager, Henry H. Singer.

RADIUM LUMINOUS MATERIAL CORP.—58 Pine St., New York, N. Y. Manufacturer of luminous switch buttons, plates, compounds, etc. Business established 1915. President, Dr. S. A. Sochocky; vice-president, W. Redmond Cross; secretary, Thomas R. Strong; treasurer, Arthur Roeder; sales manager, C. H. Dimick. Factory, Orange, N. J.

RADOJET.—Trade name for electric vacuum pumps manufactured by the C. H. Wheeler Mfg. Co., Lehigh & Sedgley Aves., Philadelphia, Pa.

RAGOTZKY, C. A.—2252 N. 21st St., Philadelphia, Pa. Manufacturer of angle insulators.

RAHMANN & CO., GEORGE.—31 Spruce St., New York, N. Y. Manufacturers of leather belting and belt dressing. Business established 1895. Partnership, George Rahmann and Arthur H. Rahmann.

RAIL BOND PROTECTORS.—See Protectors, rail bond.

RAIL BOND TESTERS.—See Testers, rail bond.

RAIL BONDING TOOLS.—See Bonding tools.

RAIL BONDS.—See Bonds, rail.

RAIL JOINT CO., THE.—61 Broadway, New York, N. Y. Manufacturer of rail joints.

RAIL JOINTS (INSULATING).—See Joints, rail.

RAIL WELDERS.—See Welders, electric rail.

RAIL WELDING & BONDING CO.—Cleveland, Ohio. Manufacturer of electric rail welding and bonding apparatus. Business established 1916. President, Edward R. Alexander; vice-president, George A. Kirkendale; treasurer and general manager, W. E. Traster. Main office, 2400 Woodland Ave., Cleveland, Ohio. Branch offices, 504 Fisher Bldg., Chicago, Ill.; 30 Church St., New York, N. Y. Sales representatives, Charles N. Wood Co., 14 Federal St., Boston, Mass.; W. L. Rose Equipment Co., LaSalle Bldg., St. Louis, Mo.; A. A. Wigmore, Pacific Electric Bldg., Los Angeles, Cal.; Lincoln Electric Co. of Canada, 136 John St., Toronto, Ont., Can.; Burton R. Stare Co., 325 Yesler Way, Seattle, Wash.

RAILROAD SUPPLY CO., THE.—Chicago, Ill. Manufacturer of highway crossing signals, signal supplies and accessories for railroads. Business established 1889. President and treasurer, E. H. Bell; vice-president, H. M. Buck; secretary, Paul W. Kohnen. Main office, 203 S. Dearborn St., Chicago, Ill. Branch offices, 30 Church St., New York, N. Y.; Pioneer Bldg., St. Paul, Minn.; Equitable Bldg., Denver, Colo., 305 Frisco Bldg., St. Louis, Mo.; Crocker Bldg., San Francisco, Cal.

RAILROAD TRAIN DISPATCHING BY TELEPHONE.—See Dispatching of railroad trains by telephone.

RAILS, CONDUCTOR OR "THIRD."—In some electric railway work, as in tunnel, subway, elevated and heavy traffic lines, instead of using an overhead contact wire, an insulated steel bar is installed usually on the outer ends of especially long ties which are spaced about 10 ft. apart. These conductor bars are termed "conductor" or "third" rails and may be of any convenient shape or section. In some cases they are of the same section as the ordinary running rails and in others special sections are used and in some cases special steel of high conductivity is employed. Third rails are mounted either upright (overrunning) or inverted (underrunning).

Manufacturer:

Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.

RAILS, RUNNING OR TRACK.—The rails in a track which act as the support and guide of the passing wheels. Used to designate these particular rails from all other rails used in track construction, such as the so-called "third rail" from which electric power is taken, or the extra rails known as "guard rails" that are used at special work as a safety device and not to carry the actual wheel load. On interurban electric railways standard types of T-rails are used in open stretches. On electric street railways T-rails are frequently used on unpaved streets, but on paved streets grooved girder rails are now mostly used.

Manufacturers:

Algoma Steel Corp., Ltd., Sault Ste Marie., Ont., Can.
American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Easton Car & Construction Co., Easton, Pa.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

RAILWAY ALARMS (CROSSING).—See Alarms, railway and highway crossing.

RAILWAY & INDUSTRIAL ENGINEERING CO.—Greensburg, Pa. Manufacturer of transmission protective and switching equipment. Business established 1910. President and general manager, B. W. Kerr; vice-president and secretary, H. H. Rudd; vice-president, C. G. Koppitz; treasurer, K. S. Nevin. Main office and factory, Greensburg, Pa. Branch offices, Pittsburgh, Pa.; 53 W. Jackson Blvd., Chicago, Ill.; 2 Rector St., New York, N. Y.

RAILWAY CONTROLLERS.—See Control systems.

RAILWAY ELECTRIC MFG. CO.—250-2 W. Water St., Milwaukee, Wis Manufacturer of selective train dispatching equipment. Business established 1910. Secretary and treasurer, Hugo J. Von Rohr; office manager, Elias Arnold.

RAILWAY IMPROVEMENT CO.—61 Broadway, New York, N. Y. Manufacturer of motormen's power economy recorders.

RAILWAY MOTORS.—See Motors, railway.

RAILWAY ROLLER BEARING CO.—Syracuse, N. Y. Manufacturer of roller bearings for railway and industrial purposes. President, Willard C. Lipe; vice-president, Herman Casler; treasurer, Raymond H. Carhart; manager, Parker A. Stacy.

RAILWAY SIGNALING SYSTEMS.—See Signaling systems, railway block and interlocking.

RAILWAY STORAGE BATTERY CAR CO.—New York, N. Y. Manufacturer of storage battery railway cars. President, Samuel C. Steinhardt; vice-president, William Goodman; secretary, Ernest C. Rollins; treasurer and general manger, Lee Klopman. Main office, 50 Broad St., New York, N. Y. Branch office, 910 Farmers & Merchants Bank Bldg., Stockton, Cal.

RAILWAY SUPPLIES, ELECTRIC.—See specific articles desired.

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RAILWAY SUPPLY & CURTAIN CO.—614-618 S. Canal St., Chicago, Ill. Manufacturer of electric car curtains and other fittings.

RAILWAY TELEPHONE MFG. CO.—9 S. Clinton St., Chicago, Ill. Manufacturer of telephone train dispatching systems.

RAILWAY TELEPHONY.—This comprises telephone train dispatching, telephone service for company's business locally and between centers, and emergency telephones. Another form known as railway composite is the addition of a telephone set to a telegraph line (single wire) for emergency telephoning. The noise is great, but it can be worked if necessary. Signaling is done by means of a "howler." Also see Telephone and Telegraph composite systems.

RAILWAY TRACK-WORK CO.—3132 E. Thompson St., Philadelphia, Pa. Manufacturer of railway track grinders, bonding tools, etc. Business established 1910. President, William D. Gherky; vice-president, A. M. Nordine; secretary and treasurer, William B. Goodall.

RAILWAY TRAIN DISPATCHING SYSTEMS.—See Train dispatching systems, telephone.

RAILWAY UTILITY CO.—151 W. 22nd St., Chicago, Ill. Manufacturer of electric railway heat regulators and car ventilators. President and treasurer, E. J. Magerstadt; vice-president and secretary, W. J. Pine.

RAILWAYS, ELECTRIC, DEVELOPMENT OF.—The development of electric railways in America dates back to the experiments of Thomas Davenport, of Vermont, who operated a toy motor on a small railway in 1834. From this time on numerous experiments were conducted until 1880 when Thomas A. Edison built a small experimental railway at his Menlo Park laboratory.

Between 1880 and 1890 a great many experimenters were active along this line. In 1881 Frank J. Sprague conducted experiments with a motor with two armature circuits, using plug connections by which series-parallel combinations could be used. This experiment later developed into series-multiple control commonly used on all motor cars. In 1883 Leo Daft constructed an electric locomotive which ran on the Saratoga & Mont McGregor Ry. where it pulled a full-sized car. In August, 1885, Daft began his work on the Hampden branch of the Baltimore Union Passenger Ry. One of the early electric railways was in Mansfield, Ohio, which was built by the Daft Electric Trolley Systems Co. and the trial runs made as early as Aug. 8, 1887. The current was carried by positive and negative overhead wires and a four-wheeled trolley collector was used. From this device flexible leads brought the current down to the car and two additional wires, one attached to the front end of the car and the other to the rear, towed the collector along and prevented it from running ahead or behind the car as it stopped or started.

In May, 1887, the Sprague Electric Railway & Motor Co., which had previously been formed by Frank J. Sprague, secured the contract to build and equip the Richmond Union Passenger Ry., of Richmond, Va. This installation, because of its size and importance, is usually credited with being the first electric street railway built in this country. This contract called for 12 miles of track, a 375-hp. power plant and 40 cars with two motors each, together with all appurtenances. Among the features of this installation was the employment of an overhead trolley wire with an underrunning trolley making contact and from which the present type of underrunning trolley has been developed. The road was completed so that trial runs were made in November, 1887, but owing to difficulties that had to be overcome the line was not put into regular operation until Feb. 2, 1888. The contract price was $110,000 and the Sprague company claimed to have lost about $75,000 on the contract, but the operation of this road brought out many difficulties that could not be foreseen and which were gradually overcome so that, while not of immediate financial gain, it was a big step ahead in electric railway operation and ushered in the era of street-railway construction which swept over the country in the next few years. The ten-year period from 1888 to 1898 is often referred to as the period of electrification of city horse and cable-car lines and the next ten-year period, from 1898 to 1908, as the period of interurban railway development.

Among the early types of construction, the third-rail scheme of conducting current to the motor-driven cars instead of the trolley wires was tried out. This method employs an auxiliary rail which is usually mounted between or alongside the running rails a short distance from them and insulated from the ground by various forms of insulation. Various forms of rail and methods of support have been considered. The earliest of which there is record was an experiment by Stephen D. Field in 1879 and the Baltimore Union Passenger Ry, built by Daft in 1885 employed this method of supplying current to the cars. The underrunning type adopted by the New York Central R. R. has probably been the most largely used. This construction employed a bullhead rail, i. e., a rail having a double head and rolled of a soft steel giving fairly high conductivity—a ratio of about one-sixth the conductivity to about one-tenth or one-eleventh that of copper. The method of supporting the third rail consists of a pair of porcelain blocks which engage the head of the rail and the blocks are in turn supported by means of a forged yoke-bolt which attaches to the bracket casting. This leaves the under surface of the rail unobstructed for the current-collecting shoe. The rail is protected from accidental contact by various forms of guards, the formed fiber type being quite common. In this latter type the formed fiber is sprung over the upper head of the rail, thus enclosing the top and sides of the rail and leaving the lower surface exposed.

The development of storage-battery cars has been interesting, as a self-contained unit, without necessity of third rail or overhead wire, possesses considerable advantage. Experiments were made as early as 1880 to 1883 both in Europe and this country and storage-battery cars were tried out in New York City between 1887 and 1888. These early experiments did not prove successful owing to the weight of the batteries, the difficulty of recharging and to the objectionable fumes in the cars. In recent years improvements in batteries have largely romoved these objections so that storage-battery cars are now being used for certain classes of work successfully.

Chas. L. Henry, first president of the American Electric Railway Association, is often referred to as the father of the interurban electric railway of this country. He built the Anderson-Alexandria interurban which began operation in 1898 and was the start of the Union Traction Co. of Indiana, although the line from Akron to Cleveland, Ohio, was in operation a short time earlier. Mr. Henry is credited with first applying the name "interurban" to this class of railway and has been a pioneer in this field. He later built the first single-phase railway in this country—the Indianapolis & Cincinnati Traction Co., which opened a line from Indianapolis to Rushville in December, 1904. This road used catenary overhead construction in which the trolley wire was suspended from a messenger wire and was kept practically horizontal, i. e., without sag, by spacing the supporting hangers close together (10 ft.) and making them of such length as to compensate for the sag in the supporting messenger wire. The trolley wire carried 3300 volts and the catenary system permitted greater ease in insulating for this voltage than would have been possible with ordinary direct suspension. This was accomplished by means of large flat porcelain insulators which were mounted on the end of the pole brackets over which the messenger wire passed. A bow type trolley was used to collect the current, this being also the first application of that type of current collector in this country and a form which has been largely superseded by the pantograph type now commonly used on high-speed interurban and steam-road electrifications.

Multiple-unit control was a big forward step in electric railway operation permitting two or more motor cars to operate in trains. This development was the result of Mr. Sprague's experiments in which two cars were successfully operated on the tracks of the General Electric Co. (which had absorbed the Sprague Electric Co.) in July, 1897. In November of that year, a five-car train was tried out on the Chicago Southside Elevated and by February, 1898, the entire system of 120 cars was so equipped and in regular operation. Multiple-unit train operation has since become quite general on elevated and subway lines and electrified suburban lines of steam railroads, 8, 10 or 12 cars being quite common.

The first electric railway voltages were usually 500. This voltage was gradually raised until 750 was reached which was considered the highest practical direct current. The advocates of alternating current considered 750 volts to be too low to be practical and that the economies of high-voltage alternating current on the trolleys would cause its adoption. After the Indianapolis-Cincinnati line was built with its 3300-volt trolley, other lines were built with still higher voltages. The New York, New Haven & Hartford, which originally consisted of a d-c. third-rail installation at 500 volts, went to 11,000 volts alternating current and adopted very heavy bridge catenary construction. It was on this line that the triangular catenary was used, two messenger wires being employed to support each trolley wire, and the hangers were of rigid triangular form. The result was a very rigid overhead which gave excessive wear on the trolley wire. To overcome this defect a steel contact wire was installed about two inches under the copper wire, from which it was suspended by means of clips spaced midway between the regular triangular hangers. This gave a greater flexibility to the overhead and improved the operating condition, but on later construction the triangular catenary has been abandoned in favor of more simple and flexible construction.

One of the main objections to the a-c. system has been the weight of the cars and equipment necessary to transform and control the high-voltage alternating current which is brought directly into the cars. This objection has been sufficient to hamper its more extensive use and high-voltage direct current has been a later development. The Indianapolis-Louisville Traction Co., built in 1906, was the first to use 1200-volt direct current on the trolley. This road was built by James Bryan, of Pittsburgh, who also laid out the Pittsburgh, Harmony, Butler & New Castle line using this same type of construction. The plans and specifications for this latter road were really prepared first, but the Indianapolis-Louisville line was first built and operated and carries the distinction of being the first road to use this popular form of construction, which has been further developed until the Chicago, Milwaukee & St. Paul Ry. adopted it with a d-c. trolley voltage of 3000 for its extensive trunk-line electrification in the Rocky Mountain divisions.

It is largely due to the electrification of the old horse-car lines and to the clean, rapid transit which resulted that the American cities underwent such a marked development within the last three decades. Previous to rapid transit such large cities as New York and Chicago were merely groups of congested small towns in close proximity, but with rapid transit, it became possible for one to live in upper Manhattan and to conduct business 15 or 20 miles away in lower New York without difficulty. The same development was experienced in all large cities throughout the country, permitting the development of beautiful suburban residence districts which would otherwise have been impossible. The electric railway not only showed its ability to withstand competition from other forms of tramway transportation but supplanted practically all other forms, developing sparsely settled outlying districts and at the same time carrying heavy loads of taxation and other expenses.

The injustice of some of these heavy financial burdens are apparent when one considers such heavy expenses as paving between the tracks which the electric railway does not itself use but which has been a big help to its only rival—the "jitney" bus. Snow fighting is also a big expense which has been borne by the electric railways but which is to the advantage of all other forms of vehicles without expense. It has been the private automobile picking up its miscellaneous load at each corner in the spirit of good-fellowship and the jitney bus, operating usually without financial obligations or liabilities for accidents, without developing outlying territory but merely taking the cream of the short-haul business, without paving or snow-fighting expense or other heavy taxation and operating only during favorable weather and peak loads that has recently put the electric railways in such an unsatisfactory financial condition.

The American city has developed through the reliability of the electric railway and

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must support it in a way that is attractive to new capital so that necessary extensions and improvements can be made, either by making fares such as to bring adequate return, by lightening such expenses as taxation, paving, sprinkling, etc., or equalizing the burden by imposing a proper share on other forms of transportation benefiting thereby in an equitable manner. The electric railways are capable of competing with all other forms of transportation if put on a proper and just basis, but cannot stand the present high operating expenses and give their patrons the comforts they desire unless protected from improper competition.

The electric railways are vital to the American city and should be properly supported that they may continue to furnish adequate service and to develop properly for the ultimate good of the communities served.

RAILWAYS, ELECTRIC, MINIATURE AND TOY.—Systems with light portable sectional track and locomotives using a small universal type series motor for propulsion and obtaining current from dry batteries or the house lighting circuit through a small toy transformer. Various kinds of trailer cars are used to make up trains. A very popular toy; also used in store window displays, where they serve as a very effective means of attracting both young and old. Switches, crossovers, signals, stations, tunnels, bridges, etc., are furnished with many of the more elaborate outfits.

Manufacturers:

Easton Car & Construction Co., Easton, Pa.
Ives Mfg. Co., The, Bridgeport, Conn.
Lionel Corp., The, 48-52 E. 21st St., New York, N. Y. "Lionel."
Voltamp Electric Mfg. Co., 407-409 N. Paca St., Baltimore, Md. "Voltamp."

RAILWAYS, ELECTRIC, OVERHEAD CONSTRUCTION OF.—See Overhead line construction of electric railways.

RAILWAYS, ELECTRIC, STATISTICS OF.—Beginning with the early electric railways in 1887, there was a very rapid growth until about 1907. The earlier part of this period covered electrification of the major portion of the city roads, while the building of interurban lines came in the later period. This was quite the natural line of development as the city roads were in operation with horse cars or cable cars and served the more congested districts. Operation was already established and electrification was in the nature of an improvement. The interurban railways were mostly new projects requiring complete financing and construction. The enthusiasm of capital to enter this field was responsible for a great deal of promotion that was really not justified. Many roads were built entirely as speculation and paralleled existing steam or other electric roads or traversed sparsely settled territory where travel was too light to support the projects.

It was about the time of the financial depression of 1907 that many of these roads reached a point where their unprofitable financial condition became generally apparent and financial people began to look to other fields for investments. So many electric roads were forced to go into the hands of receivers or to reduce or pass dividends or interest on their bonds that the situation reflected discredit to the entire industry and the roads that were in better position financially due to location and management had difficulty in raising the necessary funds for their growth and improvement.

The following data show the approximate growth of street and electric railways in the United States from 1890 to date.

Date	Number of oper'g companies	Capitalization (millions)	Number of employees
1890	770	$ 350	71,000
1895	780	1,350	75,000
1900	810	2,100	123,000
1905	880	3,400	180,000
1910	970	4,300	261,000
1915	960	4,730	296,000
1920	830	5,680	315,000

Date	Mileage of single track	Number of passenger cars	Millions of passengers carried
1890	8,100	32,000	2,000
1895	15,000	45,000	2,800
1900	20,000	57,000	4,000
1905	30,000	68,000	6,200
1910	38,000	72,000	8,800
1915	43,000	78,000	10,700
1920	48,000	87,000	12,400

Note. Data taken from curves based on Bureau of Census figures of 1890, 1902, 1907, 1912, 1917 and recent figures from the technical press.

The capitalization given above is not to be taken as the cash expenditure for construction, as this is impossible to ascertain. Many of the early roads were built as a speculation and later sold. In many cases construction companies were organized to handle the building of new roads and extensions, while in other cases mergers and consolidations have added to the confusion in this respect so that the figures are relative only when compared to cost of construction. It is interesting to note that the capitalization for electric lines per mile has increased until the present figure exceeds the similar figure for steam roads. Although the electric roads avoid some expenses for roadway that are figured for steam roads, the electric roads do carry other heavier expenses not required in steam road construction. There are the power houses and substations, the overhead conductor system or third rail, the feeder circuits and bonding of return circuits, the paving in city streets, and, in some of the large cities, the expensive elevated and subway construction.

The above data include all roads other than steam roads. In 1890 about 84% of the track mileage was not electrically operated. In 1902 this percentage had decreased to 3%, in 1907 to 1%, and since then to about 0.3%. In 1890 the railways other than steam roads were distinctly street railways, being confined largely to the cities. With the rapid growth of the electric railway not only were these urban lines electrified but large extensions and new lines, mostly interurban, were constructed. Thus it may be seen from the table that with the introduction of the electric railway track mileage almost doubled in the five years from 1890 to 1895 and from 1890 to 1920 has increased almost 600%. The most striking comparison showing the rapid growth followed by the slowing up of the industry, is given by a comparison of the percentage of increase of miles of single track between census periods as follows:

	Percentage of Increase
1890-1902	177.9%
1902-1907	52.3%
1907-1912	19.4%
1912-1917	9.2%

(Data taken from census figures of 1890, 1902, 1907, 1912, 1917.)

With the first enthusiasm of electric railway construction the natural result of overbuilding also tended to reflect on the financial status, but with the slowing up that has followed communities have caught up with the development until now many outlying lines are earning fair returns on the investments.

The high costs of operating have been a tremendous burden, but the original idea that five cents represented a street-car ride has given way as it did earlier with the five-cent loaf of bread or the five-cent quart of milk. The improved fare condition is tending to put the roads on a better basis and this condition is further helped by the dropping out of "jitney" competition in most cases. In some cases the city governments have restricted jitneys to certain streets, forced them to pay license fees and assume certain obligations which together with the deterioration of their machines and the heavy operating expenses has largely eliminated them from street-railway competition.

Many of the electric railways operate light and power companies in connection with their railway lines and attempts to separate the revenue from these respective sources are sometimes difficult. However, the Bureau of the Census does make this separation in its reports and its figures may be of interest. In 1907 the revenue from railway operations is given as $400.896.000; in 1912, 535,996,000, and in 1917 650.150.000, representing an increase in revenue from 1907 to 1917 of 62.2%. Due to the many changes in rates and other conditions no attempt can be made to estimate the corresponding figures for 1920.

There is every indication that the electric railways of the country are entering a sounder, more generally stable and satisfactory, financial period than they ever before enjoyed, free from the "high-financing" abuses of the early days and with better returns than they have enjoyed for the last few years.

RAILWAYS, ELECTRIC, TRACK CONSTRUCTION OF.—See Track work, tangent, for electric railways; also Track work, special, for electric railways.

RAILWAYS, INDUSTRIAL, POWER HOUSE, ETC.—These railways are narrow-gage, the car equipment being commonly small scoop, dump, or platform cars. Locomotives or other haulage systems may be used or, particularly where the loads are light, the cars may be pushed or pulled by one or two men. They are used in factories, contracting operations, foundries, in power plants for handling coal and ashes, warehouses, docks, etc., in fact wherever a reasonable quantity of material must be handled over the same route, that is, where a fixed route is practical. Though most of these roads employ standard type cars, many types of cars are made for special purposes, such as tank cars, special cars for heat-treating and baking ovens, etc.

Manufacturers:

Atlas Car & Mfg. Co., Cleveland, Ohio.
Easton Car & Construction Co., Easton, Pa.
Indianapolis Switch & Frog Co., Springfield, Ohio.
Koppel Industrial Car & Equipment Co., Koppel, Pa.
LINK-BELT CO., 329 W. 39th St., Chicago, Ill.
Turl Iron & Car Co., Inc., The, 50 Broad St., New York, N. Y.

RAINAUD CO., THE H. E.—Meriden, Conn. Manufacturer of portable electric lamps. Business established 1913. President, H. E. Rainaud; vice-president, L. B. Rainaud; secretary, M. A. Lyman; treasurer and sales manager, H. A. Lyman. Main office, Meriden, Conn. Branch office, 139 5th Ave., New York, N. Y. Sales representatives, Lyman Sales Service, 141 E. 4th St., Cincinnati, Ohio; Ira A. Jones Co., 17 N. Wabash Ave., Chicago, Ill.

RAINBOW.—Trade name for electric flashing signs manufactured by the Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.

RAINBOW.—Trade name for electric washing machines manufactured by the Bernard E. Finucane Co., 296 Franklin St., Rochester, N. Y.

RAJAH.—Trade name for spark plugs and automobile terminals made by the Rajah Auto-Supply Co., Bloomfield, N. J.

RAJAH AUTO-SUPPLY CO.—Bloomfield, N. J. Manufacturer of spark plugs and automobile terminals. President and treasurer, David B. Mills; secretary, W. D. Washburn; general manager, H. R. Bunten.

RALCO.—Trade name for receptacles manufactured by the Central Electric Co., 316 S. Wells St., Chicago, Ill.

RALUMINUM.—Trade name for high-tensile alloy of aluminum manufactured by the Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

RAMAPO IRON WORKS.—Hillburn, N. Y. Manufacturers of railroad track equipment. President, William W. Snow; vice-presidents, James B. Strong, J. Edgar Davidson, Elmer J. Snow; secretary, R. J. Davidson, Jr. Main office, Hillburn, N. Y. Factories, Hillburn, N. Y., and Niagara Falls, N. Y. Branch offices, 200 Devonshire St., Boston, Mass.; 30 Church St., New York, N. Y.; Niagara Falls, N. Y.

RAMEY MFG. CO.—Columbus, Ohio. Manufacturer of electric yacuum cleaners.

RANDALL, FRANK E.—248 Ash St., Waltham, Mass. Manufacturer of micrometer gages. Business established 1896.

RANDALL CO., A. L.—180 N. Wabash Ave., Chicago, Ill. Manufacturer of portable electric lamps, shades, bases and fountains. President and treasurer, A. L. Randall; vice-president, H. A. Banske; secretary and general manager, Frank M. Johnson; sales manager, E. G. Galavan.

RANDALL GRAPHITE PRODUCTS CORP.—711-721 Fulton St., Chicago, Ill. Manufacturer of graphite sheet lubricator and bronze and cast iron bushings. President, W. P. Thatcher; treasurer and general manager, R. H. Whitely.

RANDALL SIGN CO.—Eau Claire, Wis. Manufacturer of electric signs. Business established 1881. Copartnership, Adin A. Randall and Everett H. Randall. Factories, Eau Claire and Chippewa Falls, Wis. Branch office, Chippewa Falls, Wis.

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RANDALLIZED.—Trade name for electric signs manufactured by the Randall Sign Co., Eau Claire, Wis.

R. AND I. E.—Trade name for transmission protective and switching equipment manufactured by the Railway & Industrial Engineering Co., Greensburg, Pa.

R & M.—Trade name for electric motors, generators and fans manufactured by the Robbins & Myers Co., Lagonda Ave. & Leah St., Springfield, Ohio.

RANDLE MACHINERY CO.—Powers St. & C. H. & D. R. R., Cincinnati, Ohio. Manufacturer of power plant injectors and ejectors. Secretary and treasurer, W. E. Randle.

RANDOLPH-CLOWES CO., THE.—Waterbury, Conn. Manufacturer of brass and copper rods, sheets and tubing. Business established 1830. President, Frank Miller; vice-president, Ralph H. Smith; secretary and general manager, H. I. Farnum. Main office and factory, Waterbury, Conn. Branch office, 253 Broadway, New York, N. Y.

RANGES, ELECTRIC, DOMESTIC OR HOUSEHOLD.—The household range usually comprises a number of electrically heated disks or hot plates, called "burners," mounted flush with the main cooking surface, and one or more heat-conserving ovens also provided with electric heating elements, all of which are controlled by suitable indicating switches giving several degrees of heat. The relative arrangement of parts may be varied so as to furnish types having elevated ovens, extra broilers, and special attachments for controlling clock-operated switches in the various circuits, auxiliary water heaters, etc. By means of the clock-operated switches and thermostatic controls the operation of these ranges may be made semiautomatic or full automatic. By these arrangements food may be placed in the ovens and the cooking started at a predetermined hour by the clock switches. Thermostatic control regulates the degree of heat. The ovens are built on the fireless-cooker principle so that once the proper degree of heat is reached the heaters may be manually or automatically turned off and the heat maintained in the oven without further consumption of energy, making a decided saving in the cost of operation of the ovens.

The convenience of these automatic features, the excellence of the cooked foods, the reduction in shrinkage of meats and waste of foods, and the cleanliness and ease of operation have brought these ranges into popularity and the growth of their use has been rapid. According to figures given out by the Society for Electrical Development in 1917, 3600 communities had a special cooking rate in effect, and in 1921, 6000 communities out of a possible 13,733 communities. It would appear from this growing tendency on the part of central stations to encourage their use that they will become one of the most important of central-station loads in residence districts.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St, New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric ranges, ovens and appliances. There are in all seven different types and sizes of Hotpoint-Hughes ranges. Some have three and four hot plates while one design has six. The prominent features of these ranges are the roomy oven and warming closet, shelf, damper and thermometer. The thermometer is of a new and improved type. Its construction makes it possible to place the thermostat in the side of the oven which brings the dial on the side splasher. This affords a more accurate record of the oven temperature. The ranges come equipped with either sheathed wire or open coil units, regulated by three-heat snap switches. The range illustrated, R67, covers a floor space 26¼ ins.x52 ins., has a cooking surface 24⅛ ins.x26 ins., built 32½ ins. from floor. The oven is 18 in.x18 ins.x14 ins. and the warming closet 22½ ins.x22½ ins.x12 ins. Space



"Hotpoint-Hughes" Electric Range

between units 12¾ ins. Height over all 57¼ ins. Weight 450 lbs. In either plain or nickel finish. See display adv. pages 1292-3.—Adv.

ESTATE STOVE CO., THE, Hamilton, Ohio. Builders since 1845 of high-grade stoves and ranges. "Estate" electric ranges are made in a complete assortment of styles and sizes. Exclusive features: quick-detachable oven and surface units of Estate iron-clad construction; mercury thermometer in oven door; copyrighted cooking chart; all-castiron construction. (Catalog with complete information, including wiring diagrams, sent on request.)—Adv.

Globe Stove & Range Co., The, Kokomo, Ind. "Globe."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Moffats, Ltd., Denison Ave., Weston, Ont., Can. "Electra." "Moffat."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Rathbone Sard Electric Co., Inc., Albany, N. Y. "Acorn."

Rutenber Electric Co., Marion, Ind. "Rutenber."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

S.-P. Stove Co., Johnson Creek, Wis.

Standard Electric Stove Co., The, 1718-1720 N. 12th St., Toledo, Ohio. "Standard."

Walker & Pratt Mfg. Co., 31 Union St., Boston, Mass. "Crawford."

Weeks Mfg. Co., H. G., Hamilton, Ohio. "Cookerette."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RANGES, ELECTRIC, HOTEL, RESTAURANT AND INSTITUTION.—These are large capacity ranges in which a number of heating elements of either the open-coil or concealed-element type provide an extended heating surface and in which baking ovens having electrically operated heating units are incorporated. Each heating unit is controlled by suitable switches so connected that any desired degree of heat is obtained. The general external appearance of the electric range is similar to the coal range, but due to the smaller space required for heating elements it is smaller. This economy of space is one of its advantages in such locations as hotels where space is very valuable. Among its other important advantages are the entire elimination of fuel and ash-handling equipment, no excessive heat in the kitchen and the absence of the dirt and noise incident to firing. Their exact control and uniformity of heat gives them advantages from a cooking standpoint as well.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes," "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y. (Steamship.)

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint-Hughes ranges and ovens. The frame of the range shown is of heavy angle iron,



"Hotpoint-Hughes" Electric Range

welded at the corners. Top of steel, reinforced. Its remarkably rigid mounting will easily support 1000 lbs. without warping. Guard rail protects front of range. Heating elements are of sheathed wire type. Oven has upper and lower burners of 2 and 4-kw. maximum capacity. Each hot plate separately controlled by independent three heat switch. Range is 31 ins. high, 39 ins. deep and 48 ins. long. Heating surface 24x36 ins. Oven 18x21½x26½ ins. Oven has 2-in. flue. Further information upon application. See also Ovens and display adv. pages 1292-3.—Adv.

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Moffats, Ltd., Denison Ave., Weston, Ont., Can. "Electra." "Moffat."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Walker & Pratt Mfg. Co., 31-35 Union St., Boston, Mass. "Crawford."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

RANIVILLE CO., F.—Grand Rapids, Mich. Manufacturer of leather belting and belt dressing. Business established 1874. Secretary and treasurer, W. F. Powers; general manager, F. F. Raniville; sales manager, A. J. Sparks. Main office and factory, 241-247 Pearl St., Grand Rapids, Mich. Branch offices and warehouses, 6 Church St., New York, N. Y.; 170 Summer St., Boston, Mass.; 208 N. Wabash Ave., Chicago, Ill.

RANSOM & RANDOLPH CO., THE.—Toledo, Ohio. Manufacturers of mica slitting machines. Business established 1872. President, T. G. Crandel; vice-president, R. E. Munn; secretary and treasurer, M. H. McFellin. Main office, 518 Jefferson Ave., Toledo, Ohio. Branch offices, Ross Bldg., Cleveland, Ohio; Wheeler Bldg., Columbus, Ohio; David Whitney Bldg., Detroit, Mich.; Gilbert Bldg., Grand Rapids, Mich.; Metropolitan Bldg., Akron, Ohio; Smith Bldg., Flint, Mich.

RAPID ADDRESSING MACHINE CO.—New York, N. Y. Manufacturer of motor-driven addressing machines. President, E. D. Belknap. Main office, 46 W. 23rd St., New York, N. Y. Branch office, 1600 S. State St., Chicago, Ill.

RAPID ELECTRIC.—Trade name for electric washing machines manufactured by the Fortier Electric Mfg. Co., Tulsa, Okla.

RAPID FIRE.—Trade name for auger bits and drills manufactured by the Diamond Expansion Bolt Co., 90 West St., New York, N. Y.

RAPID FIRE.—Trade name for electric horn manufactured by the Russell Electric Co., Danbury, Conn.

RAPID TOOL & MACHINE CO., LTD.—174 St. Joseph St., Lachine, Que., Can. Manufacturer of die stocks and gasoline engines. Business established 1915. President and general manager, D. Harrington; vice-president, J. J. Steele; secretary and treasurer, P. W. Ogden. Main office, 174 St. Joseph St., Lachine, Que. Factories, Lachine and Iberville, Que. Branch office, Iberville, Que.

RATES FOR ELECTRIC SERVICE.—The determination of the proper rates for service to be charged by a corporation giving central-station electric light and power service is an important subject. Many schemes have been proposed and adopted in various sections of the coun-

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try. Rates for service should be such that the corporation giving the service should receive sufficient revenue to pay operating expenses, interest, insurance, taxes, depreciation, and a fair profit on the enterprise.

To determine the rates two general theories have been used as a basis. The "value of service" theory is that the rate of charge should be based on the value to the consumer of the service rendered. This theory has undoubtedly had much to do with the making of central-station rates in the past, but present tendencies are to abandon this theory in favor of the other. Public sentiment and public service commissions are in favor of the change, because, according to the theory, where only one central station supplies a locality and it is in the nature of a monopoly, the value of the service may be considerably in excess of the necessary rates to pay all expenses and yield a fair profit, and excessive profits would be made from the consumers in this case.

The "cost of service" theory of rate making is the one now generally used by the various public service commissions. This theory is that all rates should be proportioned among the various classes of consumers according to the cost of serving them. The term cost is in this case assumed to include all operating and fixed charges and a reasonable profit.

The numerous accepted forms of electric rates may be divided into two main classes, meter rates and demand rates. Each of these classes are subdivided into several different types of rates, as follows:

Meter Rates. The term "meter rate" is applicable to any method of charge for electric service based solely upon quantity of electricity used. The quantity is usually expressed in kilowatt-hours and is measured by an integrating watt-hour meter.

Straight Line Meter Rates. The term "straight line" (or merely straight) indicates that the price charged per unit is constant regardless of the number of units (kilowatt-hours) used. The straight line meter rate is the simplest of all meter rates.

Step Meter Rate. The term "step" indicates that a certain specified price per unit is charged for the entire consumption per month or other customary period, the rate depending on the particular step within which the total consumption falls. The step meter rate has, in the past, been popular owing to the fact that each bill is calculated at a single rate, and it has therefore simplified matters for both the sales and billing departments.

Block Meter Rate. The term "block" indicates that a certain specified price per unit is charged for all or any part of a block of such units, and reduced prices per unit are charged for all or any part of succeeding blocks of such units, each such reduced price per unit applying only to a particular block or portion thereof. The block meter rate provides certain blocks which correspond in general averages to rates of the demand type. The general simplicity of the rate and the ease with which it is understood by customers are the reasons for its adoption by many companies, especially for retail lighting.

Demand Rates. The term "demand rate" applies to any method of charge for electric service which is based upon, or is a function of the use, or size, of the customer's installation or maximum demand during a given period of time. The demand is preferably expressed in kilowatts or horsepower.

Flat Demand Rate. The term "flat demand rate" applies to a charge for electric service based upon the customer's installation of energy-consuming devices. This is usually so much per watt or kilowatt, per month or per year. Sometimes this type of rate is nominally so much per customer per year, or per month, for each of the various classes of customers, but estimated demand and quantity of energy likely to be used, play an important part in the determination of the class. Such a rate may be modified by the "block" or "step" method. Several years ago it was believed that the flat demand rate should not be used, but recently this type of rate has again come into use for small residence customers. Where used it is customary to employ some current-limiting device to prevent exceeding the estimated or contracted for demand.

Wright Demand Rate. The term "Wright demand rate" applies to that method of charge in which a maximum price per unit is charged for a certain amount of energy, and one or more reduced prices per unit are charged for the balance, on the block principle, in accordance with a schedule based upon the use of the maximum demand. This method of charge was first proposed by Arthur Wright in 1896.

Hopkinson Demand Rate. The term "Hopkinson demand rate" applies to that method of charge which consists of a demand charge, a sum based upon the demand, either estimated or measured, or the connected load, plus an energy charge, a sum based upon the quantity of energy used. This method of charge was proposed by Dr. John Hopkinson in 1892. It is also known as the "two-charge" rate.

Block Hopkinson Demand Rate. Either the demand charge or the energy charge, or both, in a Hopkinson demand rate, may be of the block form.

Doherty or Three-Charge Rate. The term "Doherty rate" or "three-charge rate" is applicable to that method of charging which consists of a customer charge, a charge per customer or per meter; plus a demand charge, a sum based upon the demand, either estimated or measured, or the connected load, plus an energy charge, a sum based upon the quantity of energy used. This rate may be expressed in either the block or the step form. This method of charge was proposed by Henry L. Doherty in 1900.

RATHBONE SARD ELECTRIC CO., INC.—Albany, N. Y. Manufacturer of electric ranges. President, R. E. Sard; vice-president and secretary, A. M. Blanchard; treasurer, E. H. Vaughn. Main office, Albany, N. Y. Factories, Albany, N. Y., and Aurora, Ill. Branch offices, 1325 S. Michigan Ave., Chicago, Ill.; Philadelphia, Pa.; Detroit, Mich.; Los Angeles, Cal.; San Francisco, Cal., and Seattle, Wash.

RATHENAU FURNACE.—An electric furnace for the production of ferro-alloys, in which one electrode is in the hearth of the furnace.

RATING OF ELECTRICAL MACHINES.—The output which is marked on the name plate of the machine and which is based on the load that the machine can carry continuously, or for a stated period, without exceeding a temperature rise which, added to a standard ambient temperature, will not exceed a safe temperature for the insulation. The standard ambient temperature is 40° C. for air and 25° C. for water.

Rating is usually expressed in kilowatts at the terminals for d-c. generators, kilovolt-amperes at the terminals for a-c. generators and transformers, and horsepower at the shaft for motors.

Ratings are classified as (1) continuous ratings, the outputs which a machine can give continuously; (2) short-time ratings, the outputs which they can give for alternate short-time periods of work and rest; and (3) nominal ratings, the outputs which they can give under certain specified conditions which do not represent practical working conditions but are specified for the purpose of establishing a rating.

RATIO ARMS.—The proportionate arms of a Wheatstone bridge whose ratios are known. These are also referred to as the bridge arms.

RATIO MARGIN.—In a nonpolar telegraph system, the ratio of the current flowing through a receiving instrument when operated to that flowing when not operated.

RATIO OF TRANSFORMATION.—This is the ratio of primary to secondary turns in a transformer. It is thus the ratio of primary to secondary no-load voltages and approximately the ratio of full-load voltages and also the ratio of secondary to primary currents. Sometimes this ratio, as given, is compensated for losses and thus is the ratio of full-load voltages or the inverse ratio of full-load currents.

RATTAN MFG. CO., THE.—552 State St., New Haven, Conn. Manufacturer of portable lamps, conduit and fixture fittings. Business established 1863. President and treasurer, George E. Dann; vice-president and secretary, Paul N. Dann. Sales representative, Hatheway & Knott., Inc., 117 West St., New York, N. Y.

RAUCH & LANG, INC.—Chicopee Falls, Mass. Manufacturer of electric pleasure vehicles. Business established 1905. Factories, Chicopee Falls, Willimansett, Mass. President, P. A. Frank; vice-president and sales manager, H. H. Doering; vice-president, Nathaniel Platt; secretary and treasurer, M. R. Leathers; general manager, R. W. Stanley. Factories, Chicopee Falls, Willimansett, Mass.

RAVEN.—Trade name for insulated wire manufactured by the New York Insulated Wire Co., 114 Liberty St., New York, N. Y.

RAWHIDE GEARS AND PINIONS.—See Gears and pinions, leather and rawhide.

RAWHIDE MALLETS.—See Mallets, lead and rawhide, electricians'.

RAWHIDE PULLEYS.—See Pulleys, leather or rawhide.

RAWSON & EVANS CO.—710-712 Washington Blvd., Chicago, Ill. Manufacturer of electric signs.

RAWSON ELECTRICAL INSTRUMENT CO.—4 Norfolk St., Cambridge, Mass. Manufacturer of ammeters, voltmeters, wattmeters and other electrical instruments. President, H. E. Rawson; vice-president, Arthur P. Teele; secretary, Ralph C. Watrous; treasurer and general manager, Arthur J. Lush.

RAY.—One of the lines of light which appear to radiate from a luminous body or bright object. It is one of the threads or smallest separable portions of a beam or pencil of light or, in general, of any other form of radiant energy.

RAY.—Trade name for adjustable light bracket and desk lamp manufactured by the Cleveland Phon-Arm Co., 1265 W. 2nd St., Cleveland, Ohio.

RAY BATTERY CO.—Huron St., North, Ypsilanti, Mich. Manufacturer of storage and wet batteries. Business established 1920. President and general manager, Roy R. Fisher; vice-president, Thomas H. Lavier; secretary, Max H. Finkelston; treasurer, Herman Fisher; sales manager, D. B. Jacobs.

RAY-O-DAY.—Trade name for semi-indirect lighting fixtures manufactured by Egan & Egan, 21 E. 40th St., New York, N. Y.

RAY-O-LITE.—Trade name for flashlights and flashlight batteries manufactured by the French Battery & Carbon Co., Madison, Wis.

RAY-O-SPARK.—Trade name for dry batteries manufactured by the French Battery & Carbon Co., Madison, Wis.

RAYDEX MFG CO.—Brackenridge, Pa. Manufacturer of automobile spotlights. President, H. E. Sheldon; vice-president, W. F. Detwiler; secretary, James O. Carr; treasurer, R. D. Campbell.

RAYLAX.—Trade name for aluminum melting and soldering flux manufactured by the Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

RAYMO.—Trade name for commercial lighting units manufactured by the Moran & Hastings Mfg. Co., 16-18 W. Washington St., Chicago, Ill.

RAYMOND BROS. IMPACT PULVERIZER CO.—1819 N. Branch St., Chicago, Ill. Manufacturer of pulverized coal equipment. President, L. E. Raymond; vice-president and general manager, C. M. Lauritzen; secretary, F. C. Spring.

RAYMOND CO., THE.—Saugatuck, Conn. Manufacturer of electric laundry machinery. Business established 1908. Main office and factory, Saugatuck, Conn. Branch office, 228 Bank of Italy Bldg., San Jose, Cal.

RAYO.—Trade name for resistance wire and ribbon manufactured by the Electrical Alloy Co., Morristown, N. J.

RAYVAC.—Trade name for electric vacuum cleaners manufactured by the Ramey Mfg. Co., Columbus, Ohio.

R-C-O-C.—Trade name for remote control oil switches manufactured by the South Bend Current Control Co., South Bend, Ind.

REACTANCE, ARMATURE LEAKAGE.—The inductive reactance due to magnetic lines of force set up by the current in the armature conductors of synchronous generators and motors. These lines of force produce, as the armature current alternates, an e. m. f. of self-induction which combines with the e. m. f. generated by rotation to give a resultant e. m. f. that is less than that generated by rotation when the current lags behind this e. m. f. and greater when it leads. The armature leakage reactance is thus an important factor in the voltage regulation of synchronous generators, and it is also the principal factor in limiting the initial rush of current upon the short-circuiting of

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such machines. For good voltage regulation, low reactance is desired; but for safe short-circuit currents a higher value may be wanted. In high-speed alternators of large capacity the leakage reactance is frequently so small that additional reactance is placed in the circuit external to the machines in order to limit the short-circuit current to a safe value.

Inductive reactance, such as the armature leakage reactance, is a necessary factor in the stable operation of a-c. generators in parallel and of synchronous motors.

REACTANCE COILS.—See Coils, reactance; also Reactors.

REACTANCE SOCKETS.—See Sockets, series street lighting.

REACTANCE, SYNCHRONOUS.—The combined effect, expressed in ohms, of the armature reaction and the armature leakage reactance of synchronous machines. Since the effect of both of these factors varies in approximately the same way with the magnitude and phase of the armature current, and since they are more easily measured through their combined effect than separately, it is frequently convenient to treat them as one factor. For example, the voltage generated in an alternator may be assumed to be the vector sum of (1) the terminal voltage, (2) the voltage required to force the current through the armature resistance, and (3) the voltage to overcome the synchronous reactance. The second is taken in phase with the current and third, 90° ahead of the current. Thus the effect of the synchronous reactance is that of the armature leakage reactance and the armature reaction added in phase.

The voltage regulation of a-c. generators is largely dependent on the magnitude of the synchronous reactance, as the armature resistance has a relatively small effect. Also the final steady value of current produced in a short-circuit of an alternator depends mainly on the relative value of the synchronous reactance.

REACTION, HEATS OF.—A summation of the heat absorbed and evolved in a chemical reaction. For any given chemical reaction it is the sum of the heats of formation of the products, diminished by the sum of the heats of formation of the reacting bodies. The first sum is the heat evolved if the products were formed from their elements, the second sum is the heat necessary to resolve the reacting bodies into their elements; the difference is the net heat evolved or absorbed in the reaction and may be either positive or negative. Example: $H_2O+C=CO+H_2$; the heat of formation of CO being 29.160, and of H_2O (as steam) 58.060, the difference is 28.900 calories, which is the heat absorbed when 18 grams of H_2O as steam, is decomposed by 12 grams of solid C, forming 28 grams of CO and 2 grams of hydrogen gases.

REACTION TURBINE.—A type of steam turbine in which most of the work done by the steam is by reaction. See Turbines, steam.

REACTION WATER WHEEL.—A type of water wheel, or more correctly hydraulic turbine, in which most of the work is done by reaction. See Turbines, water or hydraulic.

REACTIVE-FACTOR.—The ratio of the reactive component of the current or voltage of a circuit to the total current or voltage is called the reactive-factor. It is the sine of the angular phase difference or angle of lead or lag between current and e. m. f.

REACTIVE OR QUADRATURE COMPONENT.—The reactive component of an alternating current is that component which is one-quarter of a period out of phase with the e. m. f. producing it; it is often said to be in quadrature with the e. m. f., hence this is also called the quadrature component. In angular measure, the phase difference is 90 degrees. Similarly the reactive component of the e. m. f. across a circuit is that component which is in quadrature with the current. Reactive components were often formerly but erroneously called "wattless" components.

REACTIVE VOLT-AMPERES.—The product of the reactive component of the voltage and total current, or the product of the total voltage and reactive component of the current is called the reactive volt-amperes of the circuit; it equals $EI \sin \theta$, where θ is the phase difference or angle of lead or lag.

REACTO.—Trade name for electric factory horns manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

REACTOR.—A coil, winding or conductor, heretofore commonly known as a reactance coil or choke coil, possessing inductance, the reactance of which is used for the operation, protection or control of a circuit or circuits.

REACTORS, POWER-LIMITING.—In systems having a generating station capacity of 50,000 kv-a. and upward, the amount of power available in case of a short-circuit on a line in or near the station is so great that it is found desirable to provide reactors to limit the flow of power. These consist of long windings of heavy copper cable in the form of layers. They are wound on open frames to provide cooling and have no iron in the magnetic circuit. The successive layers are insulated from each other by wooden, porcelain, or molded compound cleats. Because of the severe mechanical stresses between turns that are present under trouble conditions, they are very ruggedly constructed and braced, and in some cases they are mounted in a concrete framework.

A 5% reactor limits the short-circuit current to 20 times full-load current, whereas at ordinary transmission voltages it may reach 100 times full load or more if not limited by a reactor. Reactors are preferably placed in outgoing lines, since most troubles originate outside the station and the flow of power is much less than if the reactor were placed in the generator circuit.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio.

GENERAL ELECTRIC CO., Schenectady, N. Y. Application of reactors should be made only after thorough study of entire system in question. The use of series reactance in a circuit provides reflecting points for high-voltage disturbances, and in addition the reactances themselves may give rise to serious resonant conditions depending upon the constants of the circuit. This Company has developed a resistor-reactor which is designed to eliminate these dangerous conditions and act as protection, not to the reactor itself, but to the other apparatus in the circuit. It can be applied to all classes of service where it is desired to control short circuits or limit the current, as in generator-leads, busbars, tie and feeder circuits, etc. Constructed of bare copper cable in concrete supports specially cured and the ingredients of which are carefully selected. (Bulletin 45300.) See adv. pages 1203-1228.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REACTORS, RADIO.—Radio reactors, as their name implies, are used to provide reactance to insert in a radio oscillating circuit. They consist of specially wound and insulated inductance coils, usually in large sizes. They are usually wound in spiral form on an open framework or nonmagnetic core. The resistance is kept quite small.

Manufacturer:

Simon, Emil J., 217 Broadway, New York, N. Y.

READE MFG. CO.—135 Hoboken St., Jersey City, N. J. Manufacturer of soldering fluid, salts and paste.

READEANA.—Trade name for soldering paste manufactured by the Reade Mfg. Co., 135 Hoboken St., Jersey City, N. J.

READINA.—Trade name for soldering solution manufactured by the Reade Mfg. Co., 135 Hoboken St., Jersey City, N. J.

READING.—Trade name for electric cranes and hoists manufactured by the Reading Chain & Block Corp., 2140 Adams St., Reading, Pa.

READING BRASS WORKS, INC.—104 Court St., Reading, Pa. Manufacturer of fixture fittings and parts, brass castings, etc. President, E. R. Wicklein; vice-president, George S. K. Morris; secretary and treasurer, A. R. Wicklein. Branch office, 601 3rd Ave., New York, N. Y.

READING CHAIN & BLOCK CORP.—Reading, Pa. Manufacturer of electric cranes and hoists. Business established 1904. President, Frank H. Howard; secretary, Ira J. J. Reber; treasurer and general manager, Fred A. Howard. Main office, 2140 Adams St., Reading, Pa. Branch office, 93 Grand St., New York, N. Y.

READING CHANDELIER WORKS, THE.—503 Penn St., Reading, Pa. Manufacturers of lighting fixtures. Business established 1905. John J. Witman, sole owner.

READING IRON CO.—Reading, Pa. Manufacturer of high-pressure pipes, boiler tubes, etc. President, L. E. Thomas; vice-presidents, J. M. Callen, W. W. Williams; secretary, George W. Delany; treasurer, H. N. Yost; sales manager, E. J. Mishler. Main office and factory, Reading, Pa.; Branch offices, New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Chicago, Ill.; Pittsburgh, Pa.; Houston, Tex.; Los Angeles, Cal.

READRITE.—Trade name for battery ammeters, voltmeters, voltammeters and testers manufactured by the Readrite Meter Works, Bluffton, Ohio.

READRITE METER WORKS.—139 N. Main St., Bluffton, Ohio. Manufacturers of battery ammeters, voltmeters, voltammeters and testers. Business established 1904. President, W. E. Siller; vice-president, H. O. Frederick; secretary and sales manager, R. L. Triplett.

READY-TO-SHIP.—Trade name for panelboards manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

READYTOUSE.—Trade name for sheet steel cabinets manufactured by James F. Burns, 713-715 Cherry St., Philadelphia, Pa.

READY-2-INSTALL.—Trade name for lighting fixtures manufactured by the Reflector & Illuminating Co., 565 W. Washington St., Chicago, Ill.

REAL.—Trade name for heating device plug manufactured by T. C. Smith & Co., 1531 Cherry St., Philadelphia, Pa.

REALFLEX.—Trade name for armored cord and cable manufactured by the Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio.

REALIVE.—Trade name for storage batteries manufactured by the Cole Storage Battery Co., 2437 Indiana Ave., Chicago, Ill.

REAMERS, ARMORED CONDUIT.—Compact machines for facing the ends of the armor of flexible steel conduit prior to assembling with terminal fittings, such as couplings, clamps, etc.

Manufacturers:

Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.

REAMERS, ELECTRICIANS' HAND POWER.—Hand-operated tools used by electricians in reaming the ends of rigid conduit. This is necessary to remove the burr or sharp inner edge of the conduit. The reamer is usually a tapered cutter for use in a hand brace.

Manufacturers:

American Tap & Die Co., Greenfield, Mass.

Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.

Butterfield & Co. Division, Union Twist Drill Co., Derby Line, Vt.

Card Mfg. Co., S. W., Mansfield, Mass.

Carpenter Tap & Die Co., The J. M., Pawtucket, R. I.

Cleveland Twist Drill Co., E. 49th St. & Lakeside Ave., Cleveland, Ohio. "Paradox." "Peerless."

Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.

Detroit Twist Drill Co., Fort St., West, at 14th St., Detroit, Mich.

Deuse, J. S. Chester, Conn.

Fastfeed Drill & Tool Corp., Toledo, Ohio. "Fastfeed."

Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.

Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Mayhew."

Morse Twist Drill & Machine Co., New Bedford, Mass.

Mueller Mfg. Co., H., Decatur, Ill.

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Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Pratt & Whitney Co., 111 Broadway, New York, N. Y.
Saunders Sons, D., Yonkers, N. Y.
Scott-Spencer Automatic Tool Co., Inc., 2683-2689 Madison Rd., Cincinnati, Ohio.
Union Twist Drill Co., Athol, Mass.
Walworth Mfg. Co., Boston, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."
Winter Bros. Co., Wrentham, Mass.

REAMERS, MOTOR-DRIVEN.—Pipe and conduit reaming tools, driven by electric power. They may be used in the contractor's shop, or even on the job with portable electric motors, where large conduits, or considerable quantities of smaller sizes require reaming. Motor-driven reamers, of proper style, are also extensively used in steel structural work to line up irregular holes for bolts or rivets.

Manufacturers:

Butterfield & Co. Division, Union Twist Drill Co., Derby Line, Vt.
Chicago Pneumatic Tool Co. 6 E. 44th St., New York, N. Y.
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Standard Electric Tool Co., Cincinnati, Ohio.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Van Dorn Electric Tool Co., 2978 Woodhill Rd., Cleveland, Ohio.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

REBSAMEN & ALMEROTH.—2324 Elston Ave., Chicago, Ill. Manufacturers of motor-driven refrigerating and ice making machinery. Partnership, J. Rebsamen and G. Almeroth.

R. E. C.—Trade name for electric cups manufactured by the Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn.

RECALL.—The act or process of calling the telephone operator in on a connection after it has been established and the subscribers have been talking. It is done by moving the hook slowly down and up. If the circuits are arranged so that moving the hook down once and up again causes the answering lamp on the cord to flash periodically, it is called "automatic recall."

RECEIVER EAR CUSHION, TELEPHONE.—A soft device, usually of spongy rubber, made to fit over the ear cap of a receiver to prevent fatigue and to aid in shutting out room noises. For other details and manufacturers, see Cushions, ear, telephone receiver.

RECEIVERS, RADIO.—Telephone receivers used in radio receiving equipment. Two small receivers mounted on a head band are generally used for this purpose. Their construction is identical with other head type telephone receivers, except that they are usually wound to a resistance of from 1000 to 5000 ohms.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y. "Amrad."
American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."
Baldwin, Nathaniel, 3474 S. 23rd St., East, Salt Lake City, Utah
Brandes, Inc., C., 32 Union Sq., New York, N. Y. "Transatlantic," "Navy," "Superior."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Chicago Radio Laboratory, Ravenswood & Schreiber Aves., Chicago, Ill. "Paragon."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Doolittle Co., F. M., 817 Chapel St., New Haven, Conn. "Amplifone."
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Armory St., Boston, Mass. "Universal," "National."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clarke Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Radio Corp. of America, 233 Broadway, New York, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

RECEIVERS, TELEPHONE, COMBINED TRANSMITTERS AND.—Combined transmitters and receivers are used for some classes of portable telephones and also for desk and wall telephones, especially for interior and intercommunicating systems. They consist of a short handle, usually of rectangular or oval shaped brass tubing, with a watchcase type receiver mounted at one end and a transmitter at the other end.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Couch Co., Inc., S. H. Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
HOLTZER-CABOT ELECTRIC CO., The, 125 Armory St., Boston, Mass.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
KLAXON CO., Newark, N. J.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

RECEIVERS, TELEPHONE, HEAD TYPE.—The head type receiver is sometimes spoken of as a watchcase receiver or operator's receiver, as it is mostly used by operators. It is in the form of a short cylinder with two small coils inside. The outer cylinder is generally fastened to a spring steel headband which passes over the head and holds the receiver to the ear.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Electric Co., 6401 S. State St., Chicago, Ill.
American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Erlichman, Inc., Robert I., Widener Bldg., Philadelphia, Pa. ("Hear-Clear" adapter for standard receiver).
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., The, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass.
Stanley & Patterson, 34 Huber St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

RECEIVERS, TELEPHONE, LOUD SPEAKING.—A telephone receiver fitted with a horn and capable of being heard at a considerable distance. It is often called a reproducer. The receiver generally has a lower resistance and requires a larger current to operate it than an ordinary receiver. Also see Announcers, telephonic.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Baldwin, Nathaniel, 3474 S. 23rd St., East Salt Lake City, Utah.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Globe Phone Mfg. Co., Reading, Mass.
KLAXON CO., Newark, N. J.
Magnavox Co., The, 2701-2765 E. 14th St., Oakland, Cal.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Stanley & Patterson, 34 Huber St., New York, N. Y. "DeVeau."
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

RECEIVERS, TELEPHONE, STANDARD.—This is the part of a telephone set which changes talking current into sound waves. Essentially it is an electromagnet with an iron diaphragm whose center is near the poles of the magnet. Alternating current flowing through the coil sets the diaphragm into vibration. A shell protects the parts, an ear cap makes it easy to fit the ear and to keep out noise. The standard receiver known as a hand receiver is tubular, flared out at the earcap end. The resistance is from 50 to 90 ohms. There are two types of receivers, polar type and nonpolar. The polar type is a receiver which has a permanent steel magnet. It is used in both local battery and in common-battery systems. It is usually bipolar, with two soft iron pole pieces, each surrounded by a coil of insulated wire. The nonpolar type is a telephone receiver which has no permanent steel magnet. The direct current flowing in the line gives it the necessary polarization. It is used only in common-battery systems. It is also called direct-current receiver and series receiver, the latter because it is used directly in series with the transmitter.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Couch Co., Inc., S. H., Arlington & Quantum Sts., Norfolk Downs, Quincy, Mass.
Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Theraphone."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Solid."
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

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RECEIVING SET, RADIO.—See Radio telegraph and telephone receiving apparatus.

RECEPTACLE.—A receptacle is a device which serves to receive and retain something placed therein. In electrical practice a receptacle is a rigidly mounted device that serves to receive a connection for and to complete an electrical circuit. Receptacles are used very extensively to receive lamps, and attachment or connecting plugs for numerous appliances and industrial apparatus. Sockets may be, and often are, used for the same purpose and because of this fact and the similarity of construction of sockets and receptacles, the two are often confused. The distinction between the two is as follows. A receptacle is made with a base, cap or body that permits it to be mounted securely on a wall or other flat surface or in a conduit or outlet box, or on a switchboard or other permanent and rigid object. Sockets are made with a cap having a threaded hole by which they may be mounted on a fixture or, if the hole is fitted with a bushing, may be suspended from a drop cord or connected to an extension cord.

Receptacles are made with several kinds of bodies and bases, to adapt them to the varied services, and the different methods of wiring. They are made in forms to readily adapt themselves to conduit, raceway or wooden molding, cleat and other open wiring systems. They are also made in special forms for such particular services as battery charging portable motors and other motor-driven machinery, welding, marine systems, water-tight and vaporproof service, etc.

The standardization of receptacles has not progressed as rapidly as it has with some other electrical apparatus, like sockets. Receptacles for attachment plugs or lamps for the lower rated appliances up to 660 watts, have been standardized when provided with the Edison medium-base screw-shell contacts. However, the prong types of contact are much more convenient for use with attachment plugs for appliances. Several types of such contacts have been introduced by different manufacturers and it was not until within the last few years that standardization of these contacts has been effected to some extent by part of these manufacturers. These receptacles are adapted to baseboard and wall mounting, some for floor mounting, others for signs, switchboards, etc. Unfortunately many of these are referred to as wall sockets or baseboard plugs, etc., instead of adhering to the accepted distinction between plugs, sockets and receptacles.

RECEPTACLE BODIES, SHELLS AND OTHER PARTS.—Certain types of receptacles for surface mounting employ an interchangeable body, which by the use of different forms of bases adapts the receptacle for several methods of mounting, as for plain surface, cleat, angle, wood molding or raceway, etc. Three types of bodies usually suffice for this purpose, the keyless, key and pull chain types. These bodies are made of porcelain with Edison medium screw shell and include the key or pull switching in the two latter types. In many cases these bodies are identically the same as for lamp sockets, but in the latter different types of caps are used, while with receptacles different types of bases are employed in place of caps. With these receptacle bodies may also be used interchangeably, several types of metal shells. Porcelain and other weatherproof receptacles are also made interchangeable in certain types. For flush mounting in suitable outlet boxes the receptacles are arranged to fit the standard size boxes and may have several types of flush plates mounted thereon.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. (base) "Mesco."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless E-Z Wire."
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Thomas & Sons., The R., East Liverpool, Ohio. "Thomas."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, BASEBOARD AND WALL.—Fittings consisting of a body portion, generally of porcelain, in which are mounted two sets of contact-making springs protected by a cap of molded material having two slots or recesses through which the prongs of an attachment-plug cap may pass to make connection. Frequently medium-base Edison screw-shell contacts are mounted in the receptacle body, but the tendency is towards the general use of the other type. They are intended for flush mounting in walls or baseboards to receive attachment plugs for portable, lamps, electric phonographs, vacuum cleaners, fans, and other appliances. Duplex receptacles are also available; these are listed separately below. The receptacles are provided with terminal screws to which the line wires are atached and with two mounting lugs, by means of which they are secured to the switch box and on which the protecting face plate is mounted.

Receptacles of this type are very widely used in homes, offices, hotels, etc., for the attachment of all kinds of electrical appliances. Such receptacles are much more suited for connection of appliances than are lighting fixture sockets and for several years farsighted electrical interests have encouraged their widespread installation in dwellings as convenience outlets. Provision of such outlets has been followed by greatly increased use of appliancs in almost every instance. The recent movement to standardize receptacle contacts will doubtless aid still greater use of electrical devices.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Safety flush receptacles with Edison screw bases. Contacts dead until attachment plug is screwed into base. Also flush receptacles slotted for tandem or parallel blade attachment plug caps. Self adjusting to perfect alinement on plaster surface when outlet box is out of line. Supplied for all types of service in any commercial voltages. —Adv.



Safety Flush Receptacle

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Won-Dor," "D. D.," "Chapman," "Junior," "Perkins."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The arrangement of outlet contact slots employed in the C-H 7710 line of "Standard" Receptacles conforms to the standard adopted by the leading electrical manufacturers. It provides that interchangeability which is very desirable in the factory or home where electrically operated devices equipped with various attaching caps are many times connected to receptacles furnished by several different manufacturers. Receptacles are rated at 10 amperes, 250 volts. Receptacles for use with standard conduit fittings, as well as for metal molding and concealed cleat work, are furnished.—Adv.



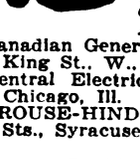
C-H 7710 Receptacle with C-H 7646 Plate

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. Manhattan."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Shurlok."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless E-Z-Wire."
Russell & Stoll Co., 17-27 Vandewater St., Ney York, N. Y.
SEARS, HENRY D., 345 Boylston St., Boston, Mass.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, BATTERY-CHARGING.—Special heavy-duty receptacles enclosing contact members mounted on insulating bases designed to fit the contact members of removable plugs. The contact members are almost always of the concentric type, as they have to be polarized. One terminal consists of a spring sleeve in the center of the receptacle and the other terminal is an outer sleeve, also with spring action. They are nearly always of special construction and are almost invariably mounted in cast iron protecting boxes. The receptacles are used principally in garages and railroad yards. For garage service they are sometimes made with a swivel mounting so that if any excessive strain is put on the cord the receptacle will aline itself with the pull and the plug will be pulled out; this is a safety feature of special value in case the vehicle is started up without disconnecting the charging plug. Railroad yard mounting requires a special waterproof construction and the receptacles are also mounted under a protective hood in some cases.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Two and three pole, 15, 30 amp. receptacles with molded composition base mounted in watertight outlet box, for use with two and three pole watertight attaching plug as shown. A well constructed device for outdoor charging service.—Adv.



Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."

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GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RECEPTACLES, CANDELABRA AND MINIATURE.—These receptacles are designed to be attached to flat surfaces. They consist generally of a porcelain base having screw shells of nominal ½-inch diameter for the candelabra size and ⅜-inch for the miniature size mounted therein. They are generally used for decorative work or small signs and are used almost entirely with lamps and very rarely with an attachment plug.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011½ Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

RECEPTACLES, CEILING OR WALL FIXTURE.—Ceiling receptacles are arranged with a flat back for mounting on a ceiling or round outlet box. They consist of a porcelain base containing a screw shell and sometimes a key or pull-chain switch mechanism. The whole base is enclosed in a brass or other metal shell giving the appearance of a canopy. They are used for holding a lamp and reflector right at the ceiling without using any other fixture.

Another type of receptacle for ceiling or wall mounting is arranged for supporting and connecting any lighting fixture so that it may be attached or removed as easily as any prong-type attachment plug is from an ordinary wall receptacle. Such receptacles are intended to permit removal of the fixtures during decoration, also to permit changing the fixtures about or replacing them easily with other types or designs to produce a different lighting effect; they are also of special value in apartment buildings where many of the tenants may want to provide their own fixtures to suit individual tastes. While such receptacles have not been used to any great extent as yet, their use has recently been energetically advocated and it is thought that if fixture hanging and removal may be easily accomplished by this means their use will increase rapidly. One type of receptacle has an inconspicuous flush face plate with two parallel slots into which an ordinary attachment-plug cap or the special fixture-supporting plug may be inserted. The latter forms part of the fixture, being secured to it where the canopy ordinarily covers the fixture stud, hickey and soldered wiring connections. The weight of the fixture is safely borne by specially shaped locking prongs.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago, Ill. Economy Receptacles and Plugs for "Elexits" are wiring and fixture supporting devices, marking a radical but welcome improvement in the practice of wiring and demountably attaching lighting fixtures to ceiling or walls, and their use makes possible a utilization of the idea to "Hang a Fixture Like a Picture." They are standardized "electric exits" or outlets designed permanently to cover any standard outlet box and to receive either ceiling or wall Economy Plugs for Elexits or the standardized attachment plugs, as found on most electrical appliances. The advantage of being able to make a lighting fixture as portable as any other electric appliance is obvious. Ceiling and wall fixtures may be removed during cleaning and redecorating periods, or when rearrangement requires a change of the lighting scheme. Attaching or detaching the fixture is exactly the same process used in attaching or detaching the standard attachment plug of an electrical appliance. The old conventional canopy used for covering unsightly wiring connections is unnecessary and where a fixture is out of order and removed, the face plate of the Economy Receptacle for Elexits furnishes an inconspicuous circular or rectangular flush receptacle. The general use of Economy Receptacles and Plugs for Elexits allows architects, fixture manufacturers and dealers, lighting engineers and users great latitude in providing flexible lighting systems; permits electrical contractors to completely finish the electrical wiring before fixtures are attached and offers fixture manufacturers and dealers increased opportunities for immediate and future sales. See display adv. page 1289.—Adv.
Electric Outlet Co., Inc., 119 W. 40th St., New York, N. Y. "Elexits."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

RECEPTACLES CLEAT.—Cleat receptacles are almost always mounted on bases of porcelain ⅛ inch or more in thickness and having screw terminals mounted on the upper surface and suitable holes for fastening the receptacle by screws through the base. They are used in open cleat wiring and the thickness of the receptacle base and the spacing of the terminals corresponds to those dimensions for the cleats so that the wiring is always straight and uniformly spaced. They are always made to mount on a flat surface, and are used with lamps in places where exposed wiring is permissible, or for attaching portable tools or other appliances, as in a factory.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., St. Louis, Mo. A full line of receptacles and rosettes, flush and cleat, standard styles, porcelain mounted.—Adv.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant." "Junior."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "Cem Co."
CRESCENT ELECTRIC CO., Mountain Grove, Mo. "Acme."
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Kirkman Engineering Corp., 484-490 Broome St., New York, N. Y. "K-E."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P & S."
Paulding, Inc., J. I., New Bedford, Mass.
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, CONDUIT BOX.—Conduit-box receptacles generally have medium-base Edison screw shells mounted in a porcelain base. The base is provided with connections for the line wires. The receptacles are made with or without switch mechanisms, which are either of the pull chain or key type. They are made in two general types, one to be mounted on or in standard conduit box covers and the other in which they form the cover of the box. The latter type are almost always provided with a brass protecting shell and have mounting screw holes so spaced that they may be mounted on 3¼ or 4-in. conduit boxes. There are several forms made for mounting on or in the cover of the box. Some of these are provided with mounting screw holes and wire passages so spaced that they may be mounted on special covers for this purpose. Others are arranged to pass through the cover and be fastened to it from the inside. These have screw terminals for connecting to the circuit wires and only a portion of the receptacle extends on the outside of the cover.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Key and keyless receptacles with porcelain or molded base to mount in Benjamin water-tight and weatherproof marine outlet boxes, also types to fit standard outlet box covers.—Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Pancake."
Connecticut Electric Mfg. Co., Connecticut & Florence Aves., Bridgeport, Conn. "Cem Co."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, DECORATIVE.—Decorative receptacles are used to outline buildings, towers and other structures and to provide convenient means of producing other decorative lighting effects outdoors or indoors. They are made in the medium, candelabra and miniature types. The medium-base receptacles are most common and are usually mounted in bases of porcelain, although molded composition is also used sometimes to make the receptacles waterproof. The receptacles are often furnished ready-wired, that is, the leads are connected and soldered in place and then the whole receptacle is sealed with insulating compound. Such receptacles are furnished in strings, spaced any desired distance from 4 ins. up.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

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BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Machen Electric Mfg. Co., 4639 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.

RECEPTACLES, DIRT AND DUST-PROOF.—Attachment-plug receptacles mounted in enclosures having hinged covers or doors to exclude foreign matter when the attachment plug is not inserted in the receptacle. The receptacles are often of special construction and may not receive standard attachment plugs. One common form has two small doors that open and close again after the receptacle is inserted. Another type has a door that is held flush with the plate when the receptacle is not in place, and automatically recedes when the plug is inserted. These are all especially applicable to baseboard mounting where there is likely to be much dust raised in sweeping and cleaning, or in other places that are commonly subjected to dust. The door or lid serves also as a safety feature to prevent short-circuit or shock when the receptacle is not in use.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, DUPLEX WALL.—These receptacles are of the same general design as flush baseboard and wall receptacles, but provide for connecting two attachment plugs to the same receptacle body. By carefully designing the latter a compact construction is secured so that the duplex receptacle fits into the same standard outlet box as a single receptacle. The two sets of receptacle contacts are superposed. This duplex type is of special value in wiring finished buildings as two outlets can be obtained at but little over the cost of one.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis. C-H 7720 is a double-outlet receptacle which fits the same



C-H 7720
Receptacle with C-H 7722 Plate

standard outlet box as do single outlet receptacles. C-H Duplex Receptacles afford twice the utility at less than half the cost of two single receptacles installed. See display adv. pages 1225-1230.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hubbell, Inc., Harvey, Bridgeport, Conn.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

RECEPTACLES, FLOOR.—Floor receptacles are generally mounted in special waterproof floor outlet boxes. They are of special construction, consisting of a porcelain body with recessed and concealed terminal screws for connecting to the supply circuit. They are designed for flush installation in a floor and are mounted on an adjustable mounting strap in the floor box. The water-tight boxes generally have a metal cover that has to be removed before the attachment-plug cap and flexible cord may be inserted, although some are arranged for insertion through the cover. They are used in many temporary connections for extension lamps, fans, office appliances, etc.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Campbell."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES FOR TRAILER AND TRAIN JUMPERS.—Metal-protected weatherproof receptacles installed on the ends of cars and arranged to receive the terminal plugs of jumper cables that connect the lighting, heater and control circuit of the cars in a train. The car receptacle usually contains the male parts of the connectors, there being a contact prong for each wire to be connected; the jumper plug usually contains the female parts consisting of split spring receiving sockets for the corresponding prongs. All contacts are carefully insulated. The number of contacts depends on the character of the jumper. For trailers receiving lighting and heating current from the motor car, there may be only two contacts as a minimum; if the trailer is also equipped with a master controller, the jumper also contains a group of control circuit wires. In multiple-unit trains in which each car has its own trolley or third-rail collector, the jumper contains only the master control circuits.

RECEPTACLES, HEATER, INDICATING OR PILOT LAMP.—Combination receptacles having recessed or concealed contacts designed to accommodate screw-shell attachment plugs, or standard prong-type plug caps for heating devices. They are also provided with a lamp socket usually of the candelabra type for a small indicating or pilot lamp which is connected to the load side of the receptacle so that the lamp remains illuminated when the receptacle is in use. The lamp is usually placed behind a red-colored bull's eye to attract attention to the fact that the current is still on. This type is made to fit into a single two or three-gang switch box, as it has the receptacle and lamp, and sometimes also a control switch, all covered by the one face plate. These combinations are also made on a porcelain base for open or exposed conduit wiring and have the same apparatus mounted on a single plate or cover.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill. "Unilets."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, MARINE.—Marine receptacles are usually of special water-tight construction and are generally made of a highly glazed porcelain base which has mounted in it a standard Edison screw shell. The receptacles are usually made in two parts, the base and cap. The base is mounted in a water-tight conduit box and the cap is separated from it by a sealing plate or gasket and attached to it by screws which also complete the electrical connection. They are generally made to receive a lamp, but there are many applications where attachment plugs are used with the receptacles, such as in engine and boiler rooms where inspection and trouble lamps are often connected by a cord and plug. These receptacles are used not alone on shipboard, but also in laundries, refrigerating rooms, packing houses and other damp locations.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See Receptacles, conduit box. —Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conneaut."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36th E. Larned St., Detroit, Mich. "S-M."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

RECEPTACLES, MOTOR AND OTHER HEAVY-DUTY.—Receptacles for heavy-duty attachment plugs provided with current-carrying parts of liberal size to handle the currents used in motor, welding or other circuits when in excess of 10 amperes. As the receptacles are designed for work chiefly in railroad shops and industrial plants, they are of rugged construction to withstand rough handling. They generally consist of strong porcelain blocks with heavy brass or phosphor-bronze contacts, the whole protected by a cast iron or other metal case. Several types of openings are used in the receptacles, as they are adaptable to ordinary d-c. service, polarized connections, and single, two and three-phase circuits. In general, rectangular openings with the contacts on opposite sides are used and this principle is also used for the special forms. These receptacles are used for

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relatively heavy portable tools, welding circuits, special portable heaters, etc.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Two and three pole, polarized and non-polarized, 15 and 30 amp. receptacles mounted in watertight outlet boxes for making watertight connection with two and three pole heavy duty plugs. See Receptacles battery charging.—Adv.



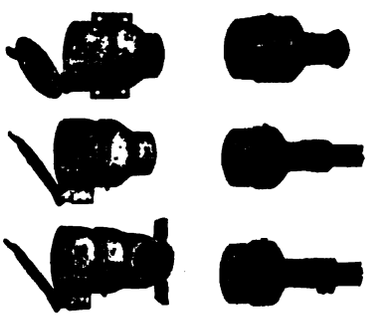
Bryant Electric Co., The, 1521 State St., Bridgeport, Conn. "Bryant."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Central Electric Co., 316 S. Wells St., Chicago, Ill. "Raico."

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."

DELTA-STAR ELECTRIC CO., 2433-2459 Fulton St., Chicago, Ill. The Unit Type plugs and receptacles made by this company are intended to meet conditions too severe for the conventional type. The various elements of plugs and receptacles are held in place by simply screwing together the heavy metal sections. All parts are interchangeable and easily accessible. Made for d-c., single, two and three phase a-c., capacity 100 amperes at 600 volts. Especially fitted for use with coal handling machinery on docks, in yards, heavy duty service in mills, railroad shops, pumping stations, mines, etc. All two and four-pole plugs and receptacles are polarized to prevent reversal of connections. All three-pole plugs and receptacles for use on direct current are polarized. When plug is removed from receptacle, a strong spring closes cover of receptacle. Upper left cut shows Type JI receptacle, arranged for bolting to a flat surface; center left shows Type JK receptacle, for mounting directly on conduit; lower left shows Type JL receptacle, for mounting on flat surface, but with outlet at side. Upper right is Type JW plug, with insulating handle, enclosing conductor; center right is type JS plug, for soldering on flexible conduit; lower right shows Type JC plug, for clamping on flexible armored cable. The four-conductor plug and receptacle may be used for grounding the frame of a 3-wire motor by connecting the fourth contact of the receptacle to a permanent ground, and the fourth pole of the plug to the motor frame. All styles are made for two, three or four conductors. Metal parts are hot galvanized in accordance with N. E. L. A. standards.—Adv.



Delta-Star Unit Type Plugs and Receptacles

Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

GLEASON & CO., J. L., 241 Franklin St., Boston, Mass.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.

Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Campbell."

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

RECEPTACLES, POLARITY.—Receptacles for attachment plugs in which the slots for the entrance of the prongs carried by the plug caps are arranged at right angles to each other or in some equivalent unsymmetrical arrangement to prevent the entrance of the plug in more than one definite position. Heavy-duty receptacles are also made in the polarized form. Instead of having a rectangular opening, one side is arched or beveled and the plug made to correspond so that it can be inserted in one position only.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Two and three pole polar-receptacles, 30 amps., mounted in cast iron or brass water-tight outlet boxes. —Adv.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Hubbell, Inc., Harvey, Bridgeport, Conn.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.

Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

RECEPTACLES, RACEWAY OR MOLDING.—Receptacles intended to receive attachment plugs or lamps and designed with specially formed bases, generally of porcelain, intended for use with surface wiring raceways or moldings. The bases are provided with recesses or grooves which are designed so that the base member of the molding will run through the receptacle, forming a subbase, and the capping will stop just inside of the receptacle. They are generally arranged to receive standard prong-type attachment plugs as they are more nearly dustproof, although standard medium-base screw shells are also used.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. See display adv. pages 1302-1304.)

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, S I G N.—Sign receptacles are made with medium-base screw shells of the keyless type mounted in porcelain bodies sometimes having a beaded edge. They are designed to be mounted in openings in the faces of sheet-metal signs and have open or concealed wire terminals located on the inner end of the receptacle body. Generally little more than the edge of the receptacle extends through the sign, and they are arranged to fasten to the sign with screws or to be mounted in a conduit box. Often the leads to the receptacles are soldered and sealed in place by the manufacturer, thus giving a weatherproof receptacle.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. "Benco." (See display adv. pages 1231-1234.)

Best Electric Corp., 476 Broadway, New York, N. Y.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Ruby."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn.

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."

Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Manufacturers' Distributing Co., 30 Church St., New York, N. Y.

Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.

Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)

Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Tulip," "P. & S."

SEARS, HENRY D., 80 Boylston St., Boston, Mass.

SOLAR ELECTRIC CO., 124 W. Lake St., Chicago, Ill. "Baby."

Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.

Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, STAGE (FLOOR AND WALL POCKETS).—Outlet fittings in metal enclosures designed for mounting in floors or walls of theater stages and provided with contact springs intended for use particularly with heavy-duty attachment plugs for spotlights, temporary border lights, cluster or bunch lights, or other theatrical equipment requiring temporary connections. They are of very rugged construction and are always contained in an iron box with door or cover. Very often, where very heavy currents are to be carried, the box is lined with slate on which all the current-carrying parts are mounted. These receptacles are commonly called stage floor or stage wall pockets.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Chase-Shawmut Co., The, Newburyport, Mass. "Cushing."

Display Stage Lighting Co., 314 W. 44th St., New York, N. Y.

Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.

Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

Pennefather, James S., 358 W. 43rd St., New York, N. Y.

Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "Patterson."

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Campbell."

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, SWITCHBOARD, VOLTMETER, PILOT LAMP, ETC.—Receptacles of special form designed particularly for mounting on switchboards some-

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times with concealed rear-connected contact springs, to accommodate removable plugs of corresponding forms, with internal connections to complete circuits to indicating instruments, etc. Pilot-lamp receptacles are generally made with candelabra screw shells of keyless type with terminal studs for back connections on switchboards. For voltmeters and synchroscopes the receptacles frequently have four or more sleeve contacts and the plug has corresponding contact prongs bridged in pairs. Two of the contacts connect to the machine or line-circuit terminals, while the other two connect to the buses for a voltmeter mounted on a swinging end panel or bracket of the board. By plugging in on the proper receptacle this voltmeter will read the voltage of any machine or line circuit.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RECEPTACLES, VAPORPROOF AND WATER-TIGHT.—Receptacles with bases of nonabsorptive material such as molded compound or glazed porcelain having sealed-in leads and designed for mounting on conduit-box covers with gasketed outer globes to prevent entrance of corrosive vapors or moisture. They are used in such locations as storage-battery rooms, tanneries, refrigerating rooms, on shipboard, in dry-cleaning establishments or wherever gases or vapors of a corrosive or explosive nature are present. The receptacles are almost always completely enclosed and special precautions are taken to reduce the liability of a spark or flash being formed in places where explosive conditions prevail. They are generally made to receive medium-base lamps, but are also used with attachment plugs in special cases.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "A. B. C."
Arnessen Electric Co., 109 Broad St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234).
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conlon."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
Electric Appliance Co., 701-709 W. Jackson Blvd., Chicago, Ill. "Watight."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, WEATHERPROOF.—Weatherproof receptacles, to receive a medium-base lamp or attachment plug, consist of a base made of nonabsorbent porcelain or other insulating material, and not having switch or key mechanism in connection with it. The lead-in wires are permanently attached and sealed in with insulating compound. They are designed for direct connection to a supply circuit and have the leads either coming out of the side or the bottom of the receptacle. Both the open type, for mounting on a flat surface with screws, and those for mounting on a conduit box to form the box cover are made in the weatherproof type. They are intended for use outdoors or in places where there is considerable moisture.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See Receptacles, conduit box.—Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Ralco."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Conduletto."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Russell & Stoll Co., 17-27 Vandewater St., New York, N. Y.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

RECEPTACLES, WELDING.—See Receptacles, motor or other heavy-duty

RECO.—Trade name for motors, sign flashers, kitchen units and reflectors manufactured by the Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill.

RECORD-FLASHER.—Trade name for phonograph lights manufactured by the Standard Accessory Corp., 355-357 E. Water St., Milwaukee, Wis.

RECORDER, SIPHON.—A receiving instrument used in submarine cable working systems by means of which received signals are marked on a moving band of paper tape. An incoming positive impulse causes the inking siphon to make a mark on one side of the center line while an incoming negative impulse causes a mark to be made on the opposite side of the center line.

RECORDER, TELEGRAPH.—In telegraph systems recorders are used to record automatically the message as it is received. This does not refer to the apparatus giving a printed message record but to those giving the record in code. Also see Telegraph systems, printing. One form of recorder known as a chemical recorder is used at the receiving end of a telegraph line using a chemical automatic telegraph system. This consists essentially of a strip of sensitized paper moving over a cylinder, and a steel needle which decomposes the chemical solution with which the paper is treated. This action is one of electrolysis.

RECORDERS, COMBUSTION AND CO_2.—These recorders furnish a reliable means of obtaining automatically a permanent record of the percentage of CO_2 in the flue gas, a record of importance in obtaining the highest combustion efficiency in a boiler plant. The principle employed by most of these devices is to separate the CO_2 from the other flue gases and measure the difference in volume before and after separation, recording the percent change in volume. The instruments include devices, generally bell float and tank arrangements for separating the sample volume of gas to be tested and repeating the process at definite intervals, usually every three minutes, and they are so arranged that the gases remain at uniform temperature throughout the process to eliminate error due to changing temperature. A continuous flow of water furnishes the motive force in these instruments.

Another type of instrument which obtains a continuous record operates on a slightly different principle. In this device the flue gas passes continuously through an orifice, then through a chamber in which the CO_2 is extracted from the gas, and finally through a second orifice. This extraction of CO_2 produces a reduction in volume and a corresponding reduction in the pressure of the gas. This change in pressure is transmitted to a recording gage. The records of all these recorders are registered on a paper roll or dial operated by a clock mechanism.

Though the CO_2 content is not the absolute index of combustion efficiency, it is commonly taken as the index in commercial practice because of the ease with which it may be obtained. The theoretical percentage of CO_2 for complete combustion of carbon is about 21%. However, for ordinary fuels burned in a boiler furnace this cannot be obtained, from 15 to 16% being the most that can be expected under the very best conditions, with an average range of 10 to 14% for general practice. If the content is less than 12% it shows that an excess of air has been supplied.

Manufacturers:

Chadburn Ship Telegraph Co. of America, Inc., Troy, N. Y. "W. R." (Exclusive distributor, Yarnall-Waring Co., Philadelphia, Pa.)
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Foxboro Co., Inc., The, Foxboro, Mass.
Hays Corp., The Joseph W., Michigan City, Ind. "Hays."
Mono Corp. of America, 25 W. Broadway, New York, N. Y.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Republic Flow Meters Co., 2240 Diversey Blvd., Chicago, Ill.
Uehling Instrument Co., Paterson, N. J.
Yarnall-Waring Co., Mermaid Ave., Chestnut Hill, Philadelphia, Pa. "Yarway."

RECORDERS, METER READING.—An attachment designed to fit over an ordinary residence watt-hour meter and to record the reading of the meter on a card by turning a thumb screw.

Manufacturer:

Economy Appliance Co., The, 517 Marsh-Place Bldg., Waterloo, Iowa. "Mutton's."

RECORDERS, POWER ECONOMY, ELECTRIC RAILWAY.—Instruments or meters for use on electric railway cars or locomotives which record on dials the power consumption, the time power is on the motors, or print on tape the amount of time power is on the motors, or the amounting of coasting. None of these devices in themselves save power, but merely record the power consumption or some element of the operating cycle which is related to the power consumption. Through the installation of such devices on one car of a train, a locomotive, or on every motor car where such cars are operated singly, the power consumption or some related element is made available. It is thus possible to determine the most efficient motorman as well as the most

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wasteful, and to establish standards, based on the most economical use of power for the performance of the various operating schedules. All motormen can then be encouraged to approximate as closely as possible the standard performance as determined by test and calculation. In this manner important savings in power for traction purposes are made possible. The saving in power consumption through the use of such devices on electric railway systems is dependent, of course, on the operating conditions obtaining, tests indicating that it will range from about 10% to 20% or more.

It is also found that in connection with the saving in power consumption, there are concurrent savings in brake-shoe and wheel wear which are substantial in amount. In connection with the use of any type of power-economy device, a department to keep the individual records, assist in establishing standards, make the required adjustments, and retain the interest of the motormen, is necessary if the maximum results are to be secured and maintained.

Three principal types are in use: (a) the watt-hour meter, (b) the "power on" clock, (c) the "coasting" clock. The watt-hour meter records the actual power consumption in kilowatt-hours. The "power on" clock records the time power is on the motor. The "coasting" clock records the time of coasting, i. e., that interval of time between shut-off of power and application of brakes. Some types of these devices are installed where the motorman can see the dials and after he is familiar with the instrument, can tell relatively how he is operating his car or train as regards the economical use of power. Other types are installed in convenient locations on the car or locomotive and integrate and print on a tape at any desired time or place through the insertion and turning of a suitable key, the element of the operating cycle which they are designed to measure.

A late addition to the watt-hour type of recorder, which is supplied if desired, consists of three resetable dials, A, B and C, suitably geared to the main recording gear train, which, based on past experience, indicate when a car should be brought in for (a) inspection of brakes, (b) oiling of motors, and (c) general inspection. Each of these dials is provided with a stationary indicator or pointer which can be set by some one in authority and is then locked in place. When the moving pointer on a dial reaches the set indicator, the car should be borught in for inspection or work indicated by that particular dial. This feature of the watt-hour meter saves considerable clerical work required in the ordinary procedure to follow up cars and the mileage or work they do so that inspections, oilings and overhauling will be taken care of at the proper time.

Manufacturer:

Railway Improvement Co., 61 Broadway, New York, N. Y. "Rico."

RECORDERS, PRESSURE.—Gages which make a permanent record on a chart of the air or steam pressure. They are very useful in power plants, giving a record of the furnace regulation and indicating whether an excess of coal is burned by alternately running up the pressure and then allowing it to drop down low again.

Manufacturer:

Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."

RECORDERS, PRODUCTION, ELECTRICALLY OPERATED.—Production recorders, electrically operated, are made in several forms for the various types of products they may be used on and to conform to the production systems that have been installed in the factories. For machine operations they generally operate in the form of a speed or revolution counter. Timing machines, which are often operated from a master clock, giving a synchronous record for all machines, usually form a part of the recorder. In some processes tickets are inserted in the production recorder when the job is started. This stamps the time of starting. When the job is completed the number of pieces or parts produced and the elapsed time are also recorded on the ticket.

Manufacturers:

Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind. See Instruments, electrical, curve drawing, graphic recording or printing, miscel. —Adv.
Foxboro Co., Inc., The, Foxboro, Mass.
International Time Recording Co., 50 Broad St., New York, N. Y. "International."
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.

RECORDERS, SPEED.—These are mechanical recording devices that are attached to motor-driven or other power-driven machinery of various kinds to record the rotative speed at certain definite intervals. They are sometimes in the nature of a tachometer, having a printing mechanism attached so that the indication may be recorded upon a strip of paper at definite intervals.

Manufacturer:

Sohm Electric Co., 841-49 Blue Island Ave,. Chicago, Ill.

RECORDERS, TIME, ELECTRIC, MISCELLANEOUS.—These are a special form of electric clock which is not used primarily to indicate time but to record the time when a certain operation occurs, etc. They may be made with a clock dial or arranged with a special recording chart in place of the dial. Special forms of these time recording instruments are used for making records of switching operations, synchronizing and other operating details in power plants, etc. They may include relays to actuate the recording mechanism at the moments when the time records are to be made.

Manufacturers:

Automatic Time Stamp Co., The, 160 Congress St., Boston, Mass. "Duragraph."
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Foxboro Co., Inc., The, Foxboro, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. The Warren Master Clock for central station service. See "Clocks, Electric," for description. Also Oscillograph, which see for description.—Adv.
Gishoit Machine Co., 1241 E. Washington Ave., Madison, Wis.
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
International Time Recording Co., 50 Broad St., New York, N. Y. "International."
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Nachod Signal Co., Inc., 4771-4777 Louisville Ave., Louisville, Ky.
Precision Instrument Co., 21 Halsey St., Newark, N. J.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.
Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

RECORDERS, VACUUM.—Vacuum gages which make a permanent record on a chart of the amount of the vacuum. They are used in power plants and are of importance in connection with condenser operation, where it is advisable to keep a definite record of the vacuum. They operate in a manner similar to the pressure recorders, giving a graphic record on either a circular disk chart or on a continuous roll.

Manufacturer:

Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."

RECORDING & COMPUTING MACHINES CO., THE.—Dayton, Ohio. Manufacturer of ignition instruments, magnetos, generators and small motors. President and general manager, Will I. Ohmer; secretary, Henry N. Riehle; treasurer, Howard Linkert; sales manager, Robert F. Ohmer. Main office, 1 Essex Ave., Dayton, Ohio. Factories, Dayton, Ohio. Branch office, Dayton Fare Recorder Co., Dayton, Ohio.

RECORDING DEVICES CO., THE.—Dayton, Ohio. Manufacturer of die castings, dies for molded insulation, screw machine products, metal stampings, etc. President, F. M. Sayre; vice-president and general manager, H. G. Defendorf; secretary and treasurer, E. F. Brown. Main office, 5th & Norwood Sts., Dayton, Ohio. Branch offices, New York, N. Y.; Philadelphia, Pa.; Chicago, Ill.; Detroit, Mich.

RECORDING INSTRUMENTS, GRAPHIC, OR CURVE DRAWING.—See Ammeters, recording or curve drawing; Voltmeters, recording or curve drawing; Wattmeters, recording or curve drawing; also Instruments, electrical, curve drawing or graphic recording, miscel.

RECORDING METERS, WATT-HOUR INTEGRATING.—See Meters, watt-hour.

RECTIFIER.—A rectifier is a device which rectifies alternating current, that is, reverses every other half wave so that the current will be made to flow continually in one direction. There are two general types, the commutator or switching type and the valve type.

In the former a rotating commutator or vibrating switch is operated synchronously with the alternating current and is so connected that the current in the d-c. system always flows in the same direction. For satisfactory operation these types require absence of "hunting" and commutation at the exact instant of zero current, otherwise sparking will result.

In the valve type, use is made of electric valves, that is, of devices that will permit the flow of current in one direction, but not in the opposite direction. These valves are of several distinct types. Two valves are generally used. One end of each valve is connected to an end of a transformer secondary or balancing coil, while the other ends are joined together and connected to one terminal of the d-c. load. The other terminal of this load is connected to the middle of the transformer or balancing coil. This current can flow through only one-half of the transformer during each half wave, but will be continually flowing in one direction through the d-c. circuit.

Rectifiers are used only for circuits having relatively small power rating, the rectified circuits of the largest power rating being those for series magnetite arc lamps. Apart from this application, rectifiers are generally used for charging storage batteries from a-c. circuits, for electrical precipitation circuits, motion-picture service, small d-c. magnets, occasionally for electrolytic experimental work, etc. For heavy currents and large power service synchronous converters or motor-generators are used instead of rectifiers.

RECTIFIERS, BATTERY-CHARGING SERVICE.—Where only alternating current is available, battery charging may be accomplished by using a rectifier. In general this applies only to charging at one time a rather small number of batteries, each having cells of small or medium size, because where a large number of batteries are charged, such as in a garage where a fleet of electric vehicles is kept, a synchronous converter or motor-generator is generally used to obtain higher efficiency. The number of batteries to be charged at one time and their size largely determines the type of rectifier to use. Where one or more batteries of the same type and current rating can be connected in series to give a counter e. m. f. of from 70 to about 90 volts at beginning of charge and where the charging current normally is between 10 and 50 amperes, the mercury-arc rectifier is generally used on 110 to 220-volt a-c. circuits. It has the disadvantage that it is less efficient at lower voltages and smaller number of cells than the ionized-gas and certain mechanical types of rectifiers. The ionized-gas type is frequently used for charging ignition, lighting and starting batteries for gasoline automobiles, one or a few batteries of the same type and rating in series being charged efficiently by this means. Vibrating rectifiers are used for only very small batteries, such as for ignition or light signaling service. Electrolytic rectifiers are sometimes used for charging one or a few individual small cells. These three latter types require relatively little skilled attention, but are limited to low current ratings.

All types of rectifiers that do not receive constant attention are generally arranged so that the current is automatically decreased as the charge progresses, and they are often provided with a time switch or ampere-hour meter cutoff so that the charge is automatically stopped at a predetermined time or after a definite amount of recharge.

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Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
American Battery Co., 1134 Fulton St., Chicago, Ill. "American."
BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Electric Products Co., The, Cleveland, Ohio. "Wotton."
Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
GENERAL ELECTRIC CO., Schenectady, N. Y. Standard Mercury Arc Rectifier Battery Charging Sets for charging automobile, signal or telephone batteries made in standard sizes of 10, 30 and 50 amp. capacity, and in d-c. voltages ranging from 10 to 100 volts when operated at 110 volts alternating current, and from 20 to 175 when operated from 220 volts. Suitable for circuits of 60 cycles or more. Special rectifiers can be furnished for higher d-c. voltages than the foregoing in capacities up to 50 amp. or for operation on 25, 30 or 40 cycles. (Bulletin 43950.) See adv. pages 1203-1223.—Adv.



Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Leich Electric Co., Genoa, Ill.
Liberty Electric Corp., Port Chester, N. Y.
Main Electric Co., Cleveland, Ohio.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Ross Engineering Co., J. J. 1006 E. Larned St., Detroit, Mich. "Ross."
Stahl Rectifier Co., 1401-5 W. Jackson Blvd., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO. 1529-33 Columbus Ave., Boston, Mass.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RECTIFIERS, COMMUTATING TYPE.—In this type a commutator and a pair of slip rings are mounted on the shaft of a synchronous motor. Pairs of brushes bearing on the slip rings and commutators form the terminals for the a-c. and d-c. circuits. There are sometimes as many segments in the commutator as poles in the motor, although to reduce sparking some have a large number of smaller segments jumpered together, giving as many sections as there are poles in the motor with some dead segments between sections. Absence of hunting in the motor is essential to satisfactory operation. These rectifiers are used largely for storage-battery charging in private garages and service stations. Special forms of this rectifier are used for rectifying small currents for measurement on a galvanometer, also for rectifying high-voltage current for use in smoke and dust precipitation in stacks.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
Liberty Electric Corp., Port Chester, N. Y.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Ross Engineering Co., J. J., 1006 E. Larned St., Detroit, Mich.
Stahl Rectifier Co., 1401-5 W. Jackson Blvd., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

RECTIFIERS, ELECTROLYTIC TYPE.—These are of the electric valve type and depend upon the fact that when a cell is made up with an aluminum plate and one of lead or carbon in a bath of ammonium phosphate, sodium borate or certain other solutions, a current may be made to pass freely into the aluminum plate; however, when it reverses and starts to pass outward, a layer of highly insulating oxide is formed which stops the flow. In this way the "valve action" is effected. In these rectifiers two aluminum plates are generally used with one lead or carbon plate between them. Thus the two valves are obtained for the arrangement described above under "rectifiers". This rectifier is simple and inexpensive, but of low efficiency, generally below 60%. On account of the large resistance loss, the temperature of the cell tends to become excessive, so that it is generally suitable only for light or intermittent loads. They are used principally for electrotherapeutic work or where an inexpensive rectifier is required for only occasional direct-current service, such as in a laboratory.

Manufacturers:

American Battery Co., 1134 Fulton St., Chicago, Ill. "Ab-rec."
Atlantic Clock Co., 45 India St., Boston, Mass.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
New Era Radio Sales Co., Elmira, N. Y. "Universal."

RECTIFIERS, HIGH-VOLTAGE.—High-voltage rectification may be accomplished by means of a special form of vacuum or electron tube called the Kenotron. These tubes are furnished in standard sizes, rated from 100,000 to 10 000 volts on the d-c. side. The current capacity is 100 to 250 milliamperes direct current. One of the principal uses of this high voltage rectified current is in electrical precipitation by the Cottrell process. The principle upon which this rectifier depends for its operation is the fact that a highly evacuated chamber containing two metal electrodes, one of which is incandescent and the other relatively cold, possesses a unilateral conductivity, so that current passes through the tube only when the heated electrode is negative. It thus may be used to rectify alternating currents like other types of electric valve. The amount of current which can be rectified by this tube increases rapidly with the temperature of the heated electrode, but remains constant as long as the temperature of the latter is maintained constant. The heated electrode or cathode consists of a spiral tungsten filament supported in a metal frame. The anode is of sheet molybdenum in the shape of a cylinder mounted on metal supports. Both elements are assembled in a glass bulb which is exhausted by special means.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. "Kenotron," a product of the G-E Research Laboratories. Supplied in four standard sizes: 100,000 volt, 100 milliampere; 20,000 volt, 100 milliampere; 10,000 volt, 100 milliampere, and 100,000 volt, 250 milliampere. See adv. pages 1203-1223.—Adv.

RECTIFIERS, IONIZED GAS (OR TUNGAR) TYPE.—This rectifier is of the electric valve type. Within a glass bulb is included a short tungsten wire which is kept at a white heat like the filament of a Mazda lamp. Opposite it and about ¼ in. away is a comparatively cool disk of tungsten. The bulb is filled with an inert gas, such as argon. Due to the ionization which takes place at the surface of the heated wire, a stream of electrons passes from the heated wire to the plate. If the plate on the one side and the heated wire on the other are made electrodes and subjected to an alternating e. m. f., a current will flow from the plate to the filament, but not in the opposite direction. In this way an electric valve is produced, which may be used in the double-valve rectifier, as described under Rectifier. It is also used in small sizes as a single-valve rectifier, placed directly in the circuit and cutting out alternate waves. This rectifier is self-starting and has no moving parts. This type is largely made in the smaller sizes and is used for charging automobile storage batteries of 6 or 12 volts, such as are used for ignition, lighting and starting service on gasoline cars.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Tungar" Battery Chargers. A popular charging device for garage or service station use. It is simple in construction, light in weight, and self-starting, and requires no expert attendance. Its first cost and operating expense are very low. The smaller sizes operate from any lamp socket on alternating current. There is a size for almost every purpose, but if the largest size is not sufficient, additional units may be added. The sizes made are: 6- and 12-amp., 75 volts; 5-amp., 30 volts; and 5- and 2-amp. at 7.5 volts. The small sizes are made portable and are often used to charge a battery without removing it from the car. The "Tungar" Battery Charger is applicable also to railway signal battery charging, laboratory, factory, and other uses. The efficiency of the 6-amp., 75-volt size is about 75% at full load. Fully described in Bulletin Y-1457. See adv. pages 1203-1223.—Adv.



G-E Rectifiers

Liberty Electric Corp., Port Chester, N. Y.
RECTIFIERS, MERCURY-ARC TYPE.—This rectifier is of the electric valve type. It depends upon the action of a short arc in mercury vapor and with mercury and iron or graphite as electrodes. Here the current will pass from the iron to the mercury but not in the reverse direction. For single-phase rectifiers the two valves needed for the arrangement described under Rectifiers are provided by using a bulb-shaped glass receptacle with a pool of mercury for the common terminal attached to the direct-current load, and two iron electrodes which are connected to the ends of the transformer secondary. To carry the arc over the instants when the current would otherwise fall to zero, inductance is placed in the circuit. This is not required on a three-phase rectifier. A second mercury electrode is provided close to the main pool for starting the arc. By rocking the bulb the mercury in the two pools is momentarily brought together and then separated, producing an arc, which then spreads to one or the other of the iron terminals. Between these the positive end of the arc alternates, while its negative end remains at the mercury pool. The air is extracted from the bulb so that it will contain nothing but mercury. To prevent too high a temperature, the bulb is enlarged so as to form a condensing chamber, which is much larger than the space needed to enclose the electrodes.

The losses depend upon the current but not upon the voltage of the system to be rectified, so that for higher voltages the efficiency of the rectifier is increased. In the high voltages it is often used to supply direct current for series arc lighting systems with magnetite lamps. These rectifiers are also used widely for storage-battery charging, picture projection and other d-c. supply of medium current values.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COOPER HEWITT ELECTRIC CO., 95 River St., Hoboken, N. J. "Cooper Hewitt."
GENERAL ELECTRIC CO., Schenectady, N. Y. A combined-unit mercury arc set for operation of series or luminous arc lamps, consisting of a constant-current transformer, d-c. reactance, tube tank, exciting transformer, static discharger and pilot lamp mounted on a common base. The outfit is, therefore, complete in itself with the exception of the switchboard panel. This compact construction reduces to a minimum the space required, makes all parts readily accessible and, with all wiring done at the factory, the customer needs to connect only the two primary and the two secondary leads. The standard sets are made in 25, 50 and 75-light sizes for 2200 volts, 25 and 60-cycle primary and the 4, 5 and 6.6-amp. secondaries. If necessary, outfits can be built for

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operation on any frequency between 25 and 133 cycles and 13,200 volts primary. (Bulletin 43900.) See adv. pages 1203-1223.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RECTIFIERS, MOTION-PICTURE SERVICE.—Rectifiers are sometimes used for motion-picture service as the d-c. arc is much steadier and brighter than the a-c. arc. In many of the larger theaters motor-generator sets or small synchronous converters are used. The mercury-arc type of rectifier is probably the most widely used for this service in the smaller theaters, as the mechanical and other types of rectifiers have not given as satisfactory results because of insufficient current capacity.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. A special line of mercury arc rectifiers for moving picture machine arc lamps. Also the G-E "Compensarc" in motor generator and transformer types. See adv. pages 1203-1223.—Adv.

Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."

Liberty Electric Corp., Port Chester, N. Y.

Ross Engineering Co., J. J., 1006 E. Larned St., Detroit, Mich. "Ross."

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

RECTIFIERS, RADIO.—See Detectors, radio.

RECTIFIERS, VIBRATING OR ELECTROMECHANICAL TYPE.—These are of the switching type. There is an a-c. electromagnet with a flat spring polarized armature, which is timed to vibrate approximately in unison with the frequency of the current. During half of each wave, or in the case of battery charging so long as the alternating e. m. f. is in excess of the battery voltage, this armature is pulled over toward the magnet and holds closed the circuit through which the rectified current is to flow. During the remainder of the cycle the armature is released and repelled and the circuit remains open. In this form only half of the wave is rectified; by using two such switches in an arrangement similar to the double-valve device described under Rectifiers, the whole wave can be rectified. Another form uses a double switch with two opposing magnets and two opposite contacts. In this case the vibrating armature is held against one contact during half of the period, or less in the case of battery charging and against the opposite contact during the other half. This rectifier is also connected like the double-valve type, each contact corresponding to a valve.

This type of rectifier is used quite widely in the small sizes for such services as charging one or a small number of storage cells, such as three-cell ignition batteries.

Manufacturers:

Clapp-Eastham Co., 139 Main St., Cambridge, Mass. "Cambridge."

Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.

France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."

Leich Electric Co., Genoa, Ill.

Liberty Electric Corp., Port Chester, N. Y.

Main Electric Co., Cleveland, Ohio.

Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."

RED BAND.—Trade name for induction motors manufactured by the Howell Electric Motors Co., Howell, Mich.

RED CORE.—Trade name for wire manufactured by the General Electric Co., Schenectady, N. Y.

RED CORE.—Trade name for rubber-covered wire manufactured by the Habirshaw Electric Cable Co., Point St., Yonkers, N. Y

RED CROSS.—Trade name for commutator lubricating compounds manufactured by Hart & Co., 124 N. Main St., Fostoria, Ohio.

RED DEVIL.—Trade name for linemen's and electricians' tools and appliances manufactured by the Smith & Hemenway Co., Inc., Irvington, N. J.

RED DEVIL.—Trade name for lamp coloring compound made by the Technical Color & Chemical Works, 382 Hudson St., New York, N. Y.

RED E.—Trade name for buffing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

RED-HOT.—Trade name for gasoline and kerosene torches and fire pots manufactured by the Ashton Mfg. Co., 184 Emmet St., Newark, N. J.

RED LINE.—Trade name for chain hoists manufactured by the Clinton E. Hobbs Co., 30-35 Pearl St., Boston, Mass.

RED LINE.—Trade name for mica tubing manufactured by the Liberty Mica Co., 79 Sudbury St., Boston, Mass.

RED SEAL.—Trade name for gasoline engines manufactured by the Continental Motors Corp., 2951 Jefferson Ave., E., Detroit, Mich.

RED SEAL.—Trade name for dry batteries manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

RED SEAL.—Trade name for storage batteries manufactured by the Wolke Lead Batteries Co., 918-923 E. Main St., Louisville, Ky.

RED SPOT.—Trade name for chain suspensions for high-candlepower commercial lighting units manufactured by the F. W. Wakefield Brass Co., Vermilion, Ohio.

RED TOP.—Trade name for guy anchors manufactured by the Universal Cable Grip Co., Skaneateles, N. Y.

RED TYE.—Trade name for mailing bags manufactured by the Milwaukee Bag Co., 216 S. Water St., Milwaukee, Wis.

RED WING.—Trade name for packing manufactured by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

REDDY.—Trade name for electric toasters and grills manufactured by the Curtainless Shower Co., Inc., 507-5th Ave., New York, N. Y.

REDFIELD-KING.—2448 Washington Ave., Ogden, Utah. Manufacturers of electric signs. Business established 1917. President, F. W. Redfield; secretary and general manager, William G. King; treasurer, Carl Redfield.

REDMANOL CHEMICAL PRODUCTS CO.—636-678 W. 22nd St., Chicago, Ill. Manufacturer of electrical insulating materials. President, L. V. Redman; vice-president, A. D. Berlizheimer; secretary, A. J. Weith; treasurer, Adolph Karpen.

REDMON, EDGAR & REDMON.—218 S. 1st St., W., Cedar Rapids, Iowa. Manufacturers of electric dishwashers, vegetable parers and other kitchen equipment.

REDTOP ELECTRIC CO., INC.—8 W. 19th St., New York, N. Y. Manufacturer of electric cooking and heating devices. Business established 1916. President, C. W. Coleman; vice-president, C. C. Fries; secretary and treasurer, M. R. McKeon; general manager, Albert Fries.

REDUCERS, CONDUIT.—Threaded fittings in the form of collars intended to be used with conduit fittings in reducing threaded holes to accommodate conduit of smaller pipe size. Also see Adapters, conduit bushing.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

NATIONAL METAL MOLDING CO., Fulton Bdg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md.

STEEL CITY ELECTRIC CO., 1221 Columbus Av., Pittsburgh, Pa. "Ovalduct."

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T & B" Male Reducer (left) for securing conduit in an outlet of the next smaller size, is bushed. Three sizes, reducing ¾ to ½ in.; 1 to ¾ in.; 1¼ to 1 in. "T &



"T. & B." Male Reducer



"T. & B." Conduit Enlarger

B" Conduit Enlarger (right) is also bushed. Secures conduit in an outlet of the next larger size. Four sizes, enlarging from ½ to ¾ in.; ¾ to 1 in.; 1 to 1¼ in.; 1¼ to 1½ in.—Adv.

REDUCERS, CONNECTOR.—A connector, either solderless or otherwise, for joining together two different sizes of wire or cable. The solderless type is especially useful in connecting solid round buses on switchboards to feeder circuits. The term is also loosely used to cover pipe or conduit couplings for joining two sizes of pipe.

Manufacturers:

CROUSE-HINDS CO., Wolf and 7th North St., Syracuse, N. Y. "Condulet."

Frankel Connector Co., Inc., Hudson and Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)

NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)

Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REDUCERS, SOCKET.—See Adapters, reducers or extensions, socket.

REDUCING AGENTS.—Chemical reagents which tend to reduce metallic compounds to metal, by taking away their acid constituent; or stated another way, reagents with strong affinity for acid elements. Example: Metallic sodium will reduce most metallic chlorides to metal, combining with their chlorine to form sodium chloride and leaving the metal free:

$$Al Cl_3 + 3 Na = Al + 3 Na Cl.$$

Carbon will reduce most metallic oxides:

$$Fe_2O_3 + 3C = 2 Fe + 3 CO.$$

Zinc will reduce ferric salts to ferrous by taking away part of the acid element:

$$2 FeCl_3 + Zn = 2 FeCl_2 + ZnCl_2.$$

REDUCTION, CATHODIC.—The use of a material which it is desired to reduce to metal as a cathode. The action of the electrolyzing current is to decompose it and leave the metal base of the material, if the cation set free from the electrolyte is strong enough to perform the reduction. Example: Lead sulphide, PbS, used as cathode in solution of sulphuric acid; the hydrogen which the current tends to liberate combines with the S, forming H_2S gas which escapes, and leaving the Pb in place of the PbS. (Salom process). PbS can also be floated on melted Pb under an electrolyte of melted NaCl; on passing current the Na combines with the S, leaving the Pb, which unites with the melted Pb cathode.

REDUCTION, ELECTROLYTIC.—The placing of a substance to be reduced in the catholyte, or liquid in contact with the cathode, of an electrolytic cell, whereby it is subjected to the reducing action of the cathode. Commonly used for reducing cyanic compounds, which may be mixed with or dissolved in a suitable acid, alkaline or neutral catholyte; often used as a cheap substitute for such expensive reducing agents as sodium, zinc, etc. The catholyte may be a solution of an acid, like sulphuric, an alkali, like caustic soda, or a neutral salt, like sodium chloride.

REE-NU-IT ELECTRIC MFG. CO.—958 Acushnet Ave., New Bedford, Mass. Manufacturer of renewable plug fuses. Business established 1919. President and sales manager, Joseph E. Grenache; secretary, treasurer and general manager, Walter O. Smith.

REECO.—Trade name for electric pumps and internal combustion engines manufactured by the Rider-Ericsson Engine Co., Walden, N. Y.

REECO.—Trade name for farm lighting and power plants manufactured by the Rural Electric Equipment Co., Canton, Pa.

REED & PRINCE MFG. CO.—Worcester, Mass. Manufacturer of screws, nuts, bolts, rivets, etc. President, Edgar Reed; vice-president and general manager, E. Howard Reed; secretary, Chester T. Reed; treasurer, Alden Reed. Main office and factory, Worcester, Mass. Branch office, 190 N. State St., Chicago, Ill.

REED-PRENTICE CO.—Boston, Mass. Manufacturer of motor-driven surface grinders. Main office, 53 Franklin St., Boston, Mass. Factories, Hyde Park and Worcester, Mass. Branch offices, New York, N. Y.; Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Indianapolis, Ind.; Worcester, Mass.

REED SMALL TOOL WORKS.—23 Cherry St., Worcester, Mass. Manufacturer of micrometer gages. President, E. Howard Reed; secretary and general manager, Donald D. Simonds; treasurer, Edward E. Lothrop.

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REEDICON LIGHT CO., THE.—7 E. Grant St., Minneapolis, Minn. Manufacturer of electric lighting fixtures. Business established 1919. President R. C. Plant; general manager, R. D. Barnard.

REEDY CO., H. J.—Cincinnati, Ohio. Manufacturer of electric elevators. President, Charles Reedy; secretary and treasurer, Howard Ayers.

REELITE.—Trade name for extension portable lamps manufactured by the Anderson Electric & Equipment Co., 154-160 Whiting St., Chicago, Ill.

REELS, AUTOMATIC EXTENSION (FOR LAMPS).—Devices consisting of a casing containing a spring operated reel, on which is wound a quantity of flexible lamp cord, with a lamp at the end. It is mounted on the ceiling or at some convenient, out-of-the-way place and operates like a window shade roller, allowing the lamp to be carried out a considerable distance for use. When not in use the cord is rewound by the spring, thus keeping it out of danger from rough usage and also out of the way. The same arrangement has been applied to the automobile spotlight, allowing the lamp and reflector to be detached from its support and used as a trouble lamp. A reel and spring inside the mounting take care of the cord.

Manufacturers:

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.

CINCINNATI SPECIALTY MFG. CO., INC., Cincinnati, Ohio. The "Autex" reel for portable lamp service in factories, garages, machine shops, etc., also extensively used for portable drills, grinders and other equipment. The "Autex" takes the light exactly to point where needed and eliminates the bad practice of dragging cords over floors; consequently, it saves cords, lamps, fuses, guards and materially reduces the fire risks that result from broken insulation and short circuits. It has been approved by the Underwriters' Laboratories, the Factory Mutual Laboratories and the Hydro-Electric Power Commission. Under a test applied by the Underwriters' its insulations and connections withstood an a-c. potential of 1,250 volts—only 110 to 220 being required for lamp service. The "Autex" is easily operated; simply grasp lamp and walk in any direction from reel to the desired distance, when a slow, backward motion causes the automatic lock to catch and hold cord. A slight pull then unlocks the catch and releases cord, which is automatically rewound as operator returns to reel. The actual size is 9¼ ins. in diameter by 2 ins. wide. Each "Autex" reel has a swivel-joint head and is equipped with 25 ft. of reinforced cord, socket, handle and lamp guard (less globe), complete for installing. The device is fully warranted against mechanical and electrical imperfections and with proper usage and care should last indefinitely.—Adv.



"Autex" Reel

International X-Ray Corp., 326 Broadway, New York, N. Y.

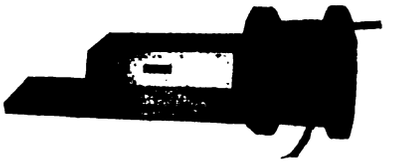
REELS, CABLE.—These are usually made of wood in the form of a large diameter drawn with the circular heads enlarged to form protecting flanges. The flange diameter may reach 8 ft. in the case of reels for large lead-covered cables. The weight of a reel of such cable may be several tons, depending on its size, consequently all cable reels are substantially built of heavy lumber, with the flanged heads made double ply of crossed boards. A hole in the center permits inserting a shaft or pipe when the reel is placed on a jack for reeling the cable on or off. In spite of their massive construction these reels are rather short-lived because of the hard service they get in shipment and use. Therefore, steel reels have been tried out to a limited extent. They consist of a steel drum with flanged heads of heavy boiler plate having the rim flanged outward. For submarine cable the reels are of much more massive construction and are usually specially made to suit the particular cable to be used.

Manufacturers:

American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa. "American."

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

GLEASON & CO., J. L., 241 Franklin Street, Boston, Mass. Gleason continuous contact reel for portable electrically driven machinery, 600-volts or less.



Gleason Continuous Contact Reel

2, 2 or 4 pole. Special boxes, receptacles and plugs. Special high grade cables. Basic patents in U. S. and Canada.—Adv.

Western Electric Co., Inc., 195 Broadway New York, N. Y.

REELS, PAYOUT AND TAKEUP.—Payout and takeup reels are used in line construction for telephone, telegraph, power distribution and transmission systems. They consist of a frame or reel arranged to hold a coil of wire which is placed around some centrally located guide pins. The payout reel has a vertical shaft on which it is free to rotate and the shaft is either mounted on a portable framework or barrow, which may in turn be mounted on a wagon or cart or carried. As the cart is moved the reel rotates and pays out the wire at a uniform rate. Some reels are made double, that is, two reels are mounted on the same shaft, one above the other in a double-deck arrangement.

Takeup reels are for taking up wire that has been used. They generally have a vertical reel with a horizontal shaft and arranged with a crank handle at each end so that two men may turn the reel. Guides are provided at each side of the reel and the set on one side is removable so that after the reel is filled the coil may be removed.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.

Dicke Tool Co., The, Downers Grove, Ill.

HERBST, PAUL W., Chicago, Ill. We specialize in pay-out and take-up reels—light or heavy—for electric light, telephone and telegraph work. Save time and labor in handling wire. (See display adv. page 1258.)—Adv.

JOSLYN MFG. & SUPPLY CO., 133 W. Washington St., Chicago, Ill.

Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.

Minneapolis Electric & Construction Co., Minneapolis, Minn.

OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)

Waldman, John J., 64 Murray St., New York, N. Y.

REELS, WIRE, MISCELLANEOUS.—Large reels are usually made from wood, bolted together, and of a strength depending on the service required. Small reels, more frequently called spools, may be turned from wood, made from tin or from sheet fiber. They are usually provided with a hole through the center for mounting on a spindle. Both the material and the design depends largely on the use to be made of the reel. See also Spools for cord and wire.

Manufacturers:

American Insulating Machinery Co., Fairhill and Huntingdon Sts., Philadelphia, Pa. "American."

American Pulley Co., The, 4200 Wissahickon Ave., Philadelphia, Pa. "American."

Betz Co., Frank S., Hoffman St., Hammond, Ind.

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Segur."

Mountain Lumber & Supply Co., Mount Union, Pa. (Wood.)

Nilson Machine Co., The A. H., 1525 Railroad Ave., Bridgeport, Conn.

Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."

REELS, WIRE MEASURING.—See Wire measuring reels and outfits.

RE-ENTRANT.—Having the quality of re-entering, applied to closed-coil armature windings used in d-c. machines. The degree of re-entrancy is equal to the number of independent windings separately closed on themselves. The number of circuits through the armature winding is determined by the kind of winding (lap or wave), number of poles, its multiplicity and degree of re-entrancy; for example, a four-pole duplex doubly re-entrant lap winding and a four-pole duplex singly re-entrant lap winding, have the same number of circuits, eight. In the first case, there are two independent windings; in the second case one.

REEVES.—Trade name for motor-driven air compressors and gas engines manufactured by the Hope Forge & Machine Co., Mount Vernon, Ohio.

REEVES & CO., INC., PAUL S.—1415-25 Catharine St., Philadelphia, Pa. Manufacturer of castings. Business established 1868. President, Leo Mac Farland; treasurer, P. L. Balentine; secretary and general manager, Edward J. Decker.

REEVES BROS. CO.—338 Rush St., Alliance, Ohio. Manufacturer of penstocks, smoke stacks, tanks and other steel plate construction. President and general manager, A. G. Reeves; secretary, H. L. Wathour; treasurer and purchasing agent, A. A. Reeves; sales manager, A. O. Miller.

REEVES CO., THE.—3110 S. Carrollton Ave., New Orleans, La. Manufacturer of protective paints and wood preservatives. Business established 1911. Assistant secretary, N. E. Kerth; sales manager, Locke H. Trigg.

REFILLABLE FUSES.—See Fuses, cartridge, renewable; Fuses, plug, renewable.

REFINING OF COPPER.—See Copper.

RE-FLECT-A-LITE.—Trade name for electric advertising devices manufactured by the Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.

REFLECTION.—The change of direction experienced by a light ray, heat ray or other radiant energy, when it strikes a surface and is sent back or reflected. This principle is very widely used in changing the direction of light rays by means of what are called reflectors.

REFLECTO-CAP DIFFUSER.—Trade name for metal diffusing reflector manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

REFLECTOCRAFT.—Trade name for lighting reflectors manufactured by Nelson Weeks, 214 State St., Brooklyn, N. Y.

REFLECTOLYTE.—Trade name for lighting fixtures made by the Reflectolyte Co., 914 Pine St., St. Louis, Mo.

REFLECTOLYTE CO., THE.—914 Pine St., St. Louis, Mo. Manufacturer of electric lighting fixtures and reflectors. President, Frank Adam; vice-president, secretary and general manager, H. C. Adam; treasurer, G. W. Johnson.

REFLECTOR & HARDWARE SPECIALTY MFG. CO.—2235 S. Western Ave., Chicago, Ill. Manufacturer of lighting reflectors. President and general manager, Joseph Taussig; vice-president, F. Grossman; secretary, F. Froehlich.

REFLECTOR & ILLUMINATING CO.—565 W. Washington St., Chicago, Ill. Manufacturer of lighting fixtures and lighting specialties. Business established 1911. President and general manager, James C. Herron; vice-president and treasurer, Robert H. Davidson; secretary, R. Hammond; sales manager, C. C. Veneman.

REFLECTOR AND LAMP MANUFACTURERS' STANDARD.—A standard line of porcelain-enameled steel reflectors known as the "Reflector and Lamp Manufacturers' Standard", from which the designation RLM is derived. It was evolved by the principal manufacturers of metal reflectors and the illuminating engineers of the principal tungsten-lamp manufacturers, after a thor-

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ough study of the reflector requirements for industrial lighting. The first type standardized is the RLM dome, which is intended to meet average industrial plant needs. This new dome is designed to virtually combine the advantages of the older dome and bowl types. The angle of cutoff is somewhat lower than in the old form of dome and this gives the required added protection from direct glare without appreciably sacrificing the effectiveness of the illumination. The RLM standard specifications cover not only the shape of the reflector, but the quality of its material and of its enameled finish. All manufacturers making RLM reflectors must subject their product to periodic tests by the Electrical Testing Laboratories, New York City, and carry the label of the Laboratories.

REFLECTOR HOLDERS.—See Holders, shade, globe and reflector.

REFLECTOR-SOCKET. — Trade name for one-piece industrial lighting fixture manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

REFLECTOR SOCKETS.—See Sockets, reflector.

REFLECTORS, GLASS, MIRRORED.—Reflectors of glass with a mirrored coating (usually of silver) on the back. The mirror coating must be such as to successfully withstand the heat of the lamp, otherwise such reflecting material soon blackens or peels off of the glass surface. The kind of protective paint applied over the mirror surface on the back of the glass is therefore of great importance. Mirrored reflectors are used in many forms and adapted to many purposes, the principal uses being as follows: Indirect lighting, show-window lighting, flood lighting, searchlights and stage lighting; they are also used to some extent for direct lighting in industrial plants and in large rooms, such as gymnasiums, large offices, etc. On account of the rather unfinished appearance of the back of the mirror, they are usually provided with ornamental casings in locations where finished appearance is necessary; such casing also serves to protect the glass from breakage. For outdoor use they must also be provided with weatherproof casings.

Mirrored glass is the most efficient kind of reflector of the opaque type, but to secure the highest efficiency with this material it should be shaped to a smooth and continuous curved form that gives the light distribution desired. This usually requires a one-piece reflector of special form, in some cases parabolic. As such a reflector is somewhat expensive in large sizes, large reflectors are quite commonly made sectional, consisting of numerous small pieces of plane or slightly curved mirrors fitted together to approximate the shape of the ideal smooth curved surface; this reduces the cost at the sacrifice of some efficiency.

Manufacturers:

American Reflector & Lighting Co., 100-104 S. Jefferson St., Chicago, Ill. "Paragon."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" mirror-glass reflectors, noted



Jove

for their efficiency in directing and controlling light. Made of one-piece, tough, blown glass, having especially designed corrugations which break up and diffuse the light rays, eliminating streaks and unevenness. The silver-plated reflecting surface is protected by a special green backing that prevents cracking, peeling or blistering. The inside of the reflector is fire-glazed; this prevents dust adhering and makes cleaning easy. Other types supplied for every form of com-



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mercial, industrial, residence and special lighting service. The upper cut shows typical X-Ray show window lighting reflector—lower shows typical form of unit for indirect lighting. See adv. page 1405.—Adv.

Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.
Pittsburgh Reflector & Illuminating Co., Inc., 3rd and Ross Aves., Pittsburgh, Pa.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y. "Sunray."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Weeks, Nelson, 214 State St., Brooklyn, N. Y.
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."
Wheeler Reflector Co., 156 Pearl St., Boston, Mass.

REFLECTORS, GLASS, OPAL. — Reflectors of various forms made of opal glass are extensively used over lamps for commercial and other lighting where it is desired to reflect a large portion of the light downward and yet get a part of the light to pass through the reflector to the ceiling to make the room and the reflector more pleasing in appearance. The most common form of opal reflector is the bowl shape, although a considerable number of patented fixtures now employ an opal reflector nearly flat in shape above the lamp, with an opal bowl or reflector below the lamp for diffusing purposes and to reflect part of the light back to the flat reflector.

Manufacturers:

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Collins-Wagner Mfg. Co., 122 W. 43rd St. New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
Gilbert Electric Shade Co., 101 Warren St., New York, N. Y. "Superba."
Gill Glass Co., Inc., Amber and Venango Sts., Philadelphia, Pa. "Luxual."
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Regent." (See display adv. pages 1266-1269.)
Jefferson Glass Co., The, Follansbee, W. Va
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Northwood Co., H., 36th and Wetzel Sts., Wheeling, W. Va. "Luna."
Opalux Mfg. Co., The, 200 Fifth Ave., New York, N. Y. "Opalux."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Berylite."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

REFLECTORS, GLASS, PRISMATIC.—Glass reflectors having their outer surfaces formed in the shape of totally reflecting 90-degree prisms. Crystal or clear glass is generally used although occasionally a satin finish is put on the outside of the reflector. When clear glass is used, such prismatic reflectors act very much like mirrored reflectors of the same shape, as a large percentage of the light is totally reflected from the prisms. However, a small portion of the light passes through the rounded surfaces at the tops and bottoms of the prism ridges, and this makes the reflector more pleasing in appearance than if opaque. In the cheaper makes of these reflectors the prisms are only rough approximations of the correct prismatic form and the glass used absorbs more light than clear glass. Prismatic glass reflectors are used mostly for direct lighting of offices, store interiors and show windows. Allowing some light to pass through the reflector, they do not give so sharp a cutoff as opaque reflectors and also avoid the dark appearance of ceilings and walls that is evident when practically all the light is directed downward.

Manufacturers:

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
Gilbert Electric Shade Co., 101 Warren St., New York, N. Y. "Gilbert."
Gill Glass Co., Inc., Amber & Venango Sts., Philadelphia, Pa. "Luxual", "Nova."
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa.
HOLOPHANE GLASS CO., INC., The, 340 Madison Ave., New York, N. Y.
Jefferson Glass Co., The, Follansbee, W. Va.
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

REFLECTORS, HAND LAMP AND FLASHLIGHT.—Reflectors for these lamps are usually of polished pressed steel or aluminum. The hand lamp types usually fasten to the socket and are formed in approximately parabolic or spherical shapes. The flashlight and hand lantern types are generally parabolic, so constructed that when fastened in position on the lamp socket the lamp will be approximately in focus and the rays of the lamp more or less concentrated to give a strong beam of light. Another type of reflector commonly used on trouble lamps consists of a curved metal plate, polished or plated to give a reflecting surface, which is placed on one side of the lamp. This type intensifies the light in one direction at the same time cutting off the glare from the lamp in the other. This form sometimes employs a flat plate slightly curved or the plate may be formed to approximate the shape of the bulb, called a half-shade form.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Diamond Electric Specialties Corp., 101 S. Orange Ave., Newark, N. J.
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
National Marine Lamp Co., The, Forestville, Conn.
Novo Mfg. Co., Inc., 424 W. 33rd St., New York, N. Y. "Novo."

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Central Electric Co., 316 S. Wells St., Chicago, Ill. "Maxolites."
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Dunlap Co., John, Carnegie, Pa. "J-D."
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
First National Lighting Corp., 2030 E. 22nd St., Cleveland, Ohio.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y. The Holophane "Reflector-refractor" is a high-efficiency, semi-enclosing unit. No. 2110, illustrated, is 7¼ ins. in diameter and 4⅞ ins. in height. It takes a 75-watt lamp and 2¼ in. Type O holder. No. 2120 is similar to the above with the exception that it is 9½ ins in diameter and 6¼ ins. in height, and is designed for 100 and 150-watt lamps, with 3¼ in. Form O holders. Nos. 2130 and 2140 are similar to the first two, respectively, except that they are two-piece units, the two halves held together by die-cast clamps. These two numbers are, respectively, 12¼ ins. and 14¼ ins. in diameter and 8¼ and 9⅝ ins. in height, and have 4-in. heels. No. 2130 is for 200-watt lamps and No. 2140 is for 300-500-watt lamps.—Adv.


No. 2110

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Regent." (See display adv. pages 1266-1269.)
Jefferson Glass Co., The, Follansbee, W. Va.
K. H. Sign Mfg. Co., 819 Locust St., Pittsburgh Pa.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. The Brascolite arrangement of bowl and reflector directs all emitted light to the working plane with a minimum absorption and insures uniform distribution, making these fixtures particularly desirable for store and office use. The drop in efficiency is less in Brascolites than with direct reflectors and other semi-indirect units or indirect units, tests showing only a 3% drop in the Brascolite. See display advertisement pages 1276-7 for other Brascolite products.—Adv.


The Brascolite

Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Reflectors, showcase and show-window, also fixtures, lighting, store, exterior and interior, and adv. page 1405.—Adv.
Opalux Mfg. Co., The, 200 Fifth Ave., New York, N. Y. "Opalux."
Perfeclite Mfg. Co., 119 Main St., Seattle, Wash.
Pittsburgh Reflector & Illuminating Co., Inc., 3rd and Ross Aves., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
REFLECTOLYTE CO., 914 Pine St., St. Louis, Mo.
Robinson & Co., T. L., 105 W. Monroe St., Chicago, Ill.
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y.

REFLECTORS, PROJECTING LAMP, PROJECTOR AND SEARCHLIGHT.—This class of work calls for a reflector that will give a concentrated beam of light that will carry quite a distance. Parabolic reflectors are generally used. For the projecting lamps they are often made of steel either pressed into shape or spun over accurate steel forms. These are then nickel or silver-plated and highly polished. Some of the larger units, especially for searchlight service, are made of glass mirrors, sometimes a large number of pieces being put together to give an approximate parabola. This has a decided advantage in that it is not affected by the atmosphere. The pieces are carefully ground to the proper shape. The lamp is always placed so that the filament or arc will be near the focal point. Usually slight adjustments of the lamp position are provided for as this permits materially changing the angle of spread of the beam of light. Most reflectors for this service are protected by an outside casing of sheet steel or cast iron.

For searchlight reflectors a parabola having a comparatively long focus gives most satisfactory results. This gives a very narrow spread of light, that is, a very concentrated beam. Also see Projectors, floodlight; also Searchlights.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Imperial."
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
Faries Mfg. Co., Decator, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Matisse Corp. C. & A., 116th St. and East River, New York, N. Y.
National Marine Lamp Co., The, Forestville, Conn.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" mirror-glass reflectors, designed for all classes of projecting lamps, projectors and searchlights. Made of the finest quality of one-piece, tough, clear glass with a silver reflecting surface and a specially processed, high-temperature backing. See adv. page 1405.—Adv.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Pittsburgh Reflector & Illuminating Co., Inc., 3rd and Ross Aves., Pittsburgh, Pa.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd. Vermilion, Ohio.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REFLECTORS, ROUNDHOUSE, YARD AND DOCK.—These reflectors are made very strong, weatherproof and, for use where corrosive gases make it necessary, vaporproof as well. There are two common types: one, similar to the ordinary industrial lighting fixture, is commonly used for dock and railroad and other yard lighting; the other, similar to a headlight in form, is particularly adapted for use in steam-locomotive roundhouses and is generally designed for wall mounting. All these reflectors are very carefully protected against corrosion, most commonly by special porcelain enamel.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Maxolites."

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CROUSE-HINDS CO., Wolf and 7th North Sts., Syracuse, N. Y. "Imperial."
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
Faries Mfg. Co., Decatur, Ill.
Hommel & Co., Ludwig, 530-534 Fernando St., Pittsburgh, Pa. "Hommel-Lite."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Ivanhoe." (See display adv. pages 1266-1269.)
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
National Screw & Tack Co., The., AB Products Division, Cleveland, Ohio.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Reflectors, projecting lamp, projector and searchlight; also adv. page 1405.—Adv.
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sol-Lux." (See display adv. pages 1395-1402.)

REFLECTORS, SHOWCASE AND SHOW-WINDOW.—These reflectors for show-window lighting are usually of glass, mirror, opal or prismatic. As this form of lighting requires intense illumination over a limited area, the reflectors are usually so constructed that they distribute the light within the window only, throwing none onto the sidewalk or into the store. They are made in many forms to conform with the various depths and heights of show windows. For producing special lighting effects other forms of reflectors, spot lights, etc., are sometimes employed. Showcase reflectors are of two general types. One of these is essentially a metal trough in which are placed tubular lamps, the trough being concealed from view in the corner between the top and front side of the case. The other type is commonly of mirrored glass similar in form to the show-window reflectors of this material, but much smaller so that the reflector may be concealed in the corners of the case.

Manufacturers:

American Reflector & Lighting Co., 100-104 S. Jefferson St., Chicago, Ill. "Aralco."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description under Fixtures, lighting, window and show case.—Adv.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Maxolites."
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
Faries Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y. No. 922 reflector, illustrated, has an annular, prismatic, refracting plate placed over part of the bottom of the reflector which screens the lamp filament from view. This type is used in all types of deep windows and keeps the glare out of the spectators' eyes. A small portion of the light is transmitted through the valence. Takes 100 and 150-watt lamps, with Form H holder.—Adv.


No. 922

Jefferson Glass Co., The, Follansbee, W. Va.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."

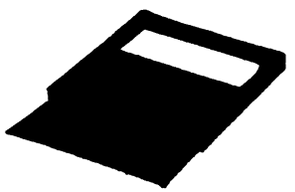
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LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" silver-plated glass reflectors are especially designed for efficient showcase and show-window lighting. The "X-Ray" is a durable, permanent, brilliant reflector, made of one-piece,



"Scoopette"

tough, blown glass, each type having scientifically designed corrugations which break up and diffuse the light rays, and eliminate streaks and uneveness. For show-window lighting the X-Ray reflectors known as "Jove," "Jupiter," "Scoop" and "Hood" are standard equipment wherever electric lighting is used. These four styles cover every window lighting requirement. The "Color-Ray" is a practical



"Color-Ray"

method of producing color light in show windows. The unit fits on either Jove or Jupiter reflector, and consists of frame and slides of colored gelatine. The X-Ray Scoopette is a miniature X-Ray show-window reflector for showcases. Scoopette is 4 by 3⅞ by 4⅝ inches over all, and uses 15 or 25-watt, G-18½ standard base lamp. See adv. page 1405—Adv.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Pittsburgh Reflector & Illuminating Co., Inc., 3rd & Ross Aves., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd. St., New York, N. Y.
Reflector & Hardware Specialty Mfg. Co., 2235 S. Western Ave., Chicago, Ill. "R & H."
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill.
Straight Filament Lamp Co., 21 W. 37th St., New York, N. Y.
Sunlight Reflector Co. 226 Pacific St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Weeks, Nelson, 214 State St., Brooklyn, N. Y. "Reflectocraft."
Western Reflector Co. 1221 W. Madison St., Chicago, Ill. "Western."
WHITING CO., INC., H. S., 104 E. 41st St., New York, N. Y.

REFLECTORS, SIGN AND BULLETIN.—These reflectors are generally used for illuminating painted signboards, wall signs, bulletins, etc. Angle type reflectors are generally employed. They are either suspended from brackets extending out from the sign or building or may be mounted on conduit-box receptacles at the ends of short conduits extending forward from the top of the sign. Sometimes trough-shaped or special box reflectors are used. Steel reflectors with either porcelain enamel or painted reflecting surfaces are employed. They are usually made waterproof and used with weatherproof sockets or receptacles.

Manufacturers:

A & W Electric Sign Co., The, Cleveland, Ohio.
A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benjamin elliptical angle reflector is an ideal fixture for sign or bulletin board lighting. The superiority of this design lies in the fact that it distributes light to the sides in such a manner as to increase the illumination between the units and thereby gives an even light distribution to the entire surface of the sign.—Adv.



Elliptical Angle Reflector

Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See adv. page 1308.)
Faries Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Imperial Brass Mfg. Co., The, 1200 W. Harrison St., Chicago, Ill. "Imperial."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Ivanhoe." (See display adv. pages 1266-1269.)
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray" floodlight projectors may be used for many classes of sign and bulletin lighting. See Projectors, floodlight. See adv. page 1405.—Adv.
Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. "Reco."
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

REFLECTORS, SPECIAL AND MISCELLANEOUS.—Under this classification are included the wide variety of reflectors of very limited application. Among these are various mirrored glass reflectors used in instruments, such as dental and surgical instruments and scientific instruments, microscopes, galvanometers, oscillographs, etc. These reflectors usually are employed to catch a beam of light and direct or focus it over a limited area. Those used in dental and surgical instruments are more commonly for illuminating small areas upon which the dentist or surgeon is working, those used in scientific instruments in connection with a reading or measuring device. They are generally in the form of a concave lens with a mirror backing. Other reflectors are used on a wide variety of lamps of special application, the reflector being designed to fit the lamp.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Clancy, J. R., 1000 W. Belden Ave., Syracuse, N. Y. (Orchestra.)
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See display adv. page 1308.)
Faries Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn N. Y.
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
LIGHTOLIER CO., 569 Broadway, New York, N. Y.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. This company has developed many new and efficient units for lighting without ceiling fixtures and lighting from sources concealed in various ways by the use of X-Ray reflectors. A large staff of engineers and artists is maintained to execute any special device desired. See adv. page 1405.—Adv.
Novelty Lamp & Shade Co., 2490 E. 22nd St., Cleveland, Ohio. (billiard)
Plaut & Co., L., 434 E. 23rd St. New York, N. Y.
REFLECTOLYTE CO., THE, 914 Pine St., St. Louis, Mo.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

REFLECTORS, STAGE - LIGHTING.—Reflectors used for stage lighting are made in a variety of forms. For stage spotlights there are used parabolic reflectors which are in general of the same type as for projecting lamps or flood-light projectors. General illumination of a certain area is often provided by using a box-type metallic reflector arranged as a drop or mounted in the wings. Border lights and foot lights usually have trough-shaped reflectors that are made in a number of shapes; most of them, however, are long sheet steel troughs painted white on the inside. They are made in a number of styles, some containing a double row of lamps and others giving special angles of spread, depending upon the depth of the stage, height of drops, etc. Bunch lights or clusters often have a large circular or dome-shaped reflector set on edge back of the lamps.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ERIKSON ELECTRIC CO., L. 6 Portland St., Boston, Mass. (See adv. page 1308.)
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. (See display adv. pages 1266-1269.)
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See Borders, stage, Bunches, stage, Clusters, stage, Footlights, stage, Strips, stage; also adv. page 1405.—Adv.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
REFLECTOR & ILLUMINATING CO., 565 W. Washington St., Chicago, Ill.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.

REFLECTORS, STEEL, PORCELAIN-ENAMELED.—Reflectors in which the reflecting surface is a white enamel, similar to opal glass in composition. This is fused onto the surface of the shaped steel at high temperatures, or "fired", so that the finished surface will stand rough usage and be sufficiently smooth so it can be cleansed to bring it back to its original whiteness. Such enamel is usually called "porcelain enamel", although it is more nearly a fused glass. The value of such a reflecting surface depends much on the number and kind of enamel coatings used. The

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"R. L. M." standard reflector is a white enameled steel reflector designed for general use in industrial plants, R. L. M. standing for Reflector and Lamp Manufacturers' standard. All the principal manufacturers of white enameled steel reflectors make this type, which is maintained at a certain standard of excellence by inspections and tests by the Electrical Testing Laboratories, New York, N. Y.

Enameled steel reflectors are widely used for industrial lighting, both interior and exterior, especially where there is exposure to smoke, corrosive gases or fumes, excessive moisture or other destructive agencies that would ruin paint or other protective coverings and probably damage the steel itself, at any rate spoiling the reflecting surface in a short time. Even where the service is not so severe, the enameled surface is much more durable and more readily cleaned than an aluminized, painted or bare polished metal surface.

Manufacturers:

A-A Electric Mfg. Co., 303 Center St., Bridgeport, Conn. "A-A."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. See description under Reflectors, industrial lighting, miscel.—Adv.
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Duplexalite."
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Maxolite."
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Dunlap Co., John, Carnegie, Pa. "J-D."
Duplex Lighting Works of General Electric Co., 6 W. 45th St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
General Porcelain Enameling & Mfg. Co., 4554 W. Congress St., Chicago, Ill.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill. "Nitrolite."
Hommel & Co., Ludwig, 530-534 Fernando St., Pittsburgh, Pa. "Hommel-Lite."
Hubbell, Inc., Harvey, Bridgeport, Conn.
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, O. (See Reflectors, industrial lighting, miscel. Also display advertising pages 1266-1269.—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave. St. Louis, Mo. (See display adv. pages 1276-1277.)
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio. "ABolite."
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Porcelain Enameling & Mfg. Co., 1263 Bellevue St. Detroit, Mich.
REFLECTOLYTE CO., 914 Pine St., St. Louis, Mo.
Strong Mfg. Co., Sebring, Ohio.
Vitreous Enameling Co., 6800 Grant Ave., Cleveland, Ohio. "Vitre-Lite."
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WHEELER REFLECTOR CO., 156 Pearl St., Boston, Mass. "Para-Steel."

REFLECTORS, STREET-LIGHTING.—Reflectors for street-lighting units are almost always made of pressed steel and are either finished with a weather-resisting baked paint enamel or porcelain enamel. Numerous types of reflectors are in use, depending on many conditions, such as character of the street, spacing of the units, type and size of lamp used, distribution desired, etc. For very wide spacing of units, such as on suburban streets or country roads, an inverted cone type of reflector is sometimes used. This is mounted in such a manner that nearly all light from the lamp emitted above the horizontal is redirected and thrown quite a distance horizontally. Where the units are closer together shallow dome reflectors are often used, sometimes with prismatic glass refractors or diffusing globes enclosing the lamp. Some of the more important types of reflectors used are: flat radial reflectors, flat radial wave reflectors, radial bowl reflectors, concentric dome reflectors, etc.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa. "Diamond."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Matisse Corp., C. & A., 116th St. and East River, New York, N. Y.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Piper Co., Ltd., The Hiram L., 75 St. Remi St., Montreal, Que., Can.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Sol-Lux." (See display adv. pages 1395-1402.)

REFLECTORS, TIN, ALUMINUM AND OTHER METAL.—These reflectors are usually made in the smaller sizes for fastening to medium-base brass shell sockets. They are made in most of the principal shapes: Bowl, parabolic, flat, shallow and deep cone, pear-shape half reflectors, etc. In many cases they are made of tin for cheapness, while others are made for decorative purposes, such as special spun or thin cast brass reflectors. Aluminum reflectors are sometimes used for their lightness and because the interior may be highly polished to give a good reflecting surface without the use of paint, enamel or plating. For use on surgical or dental instruments, silver or nickel-silver reflectors are sometimes used; for these see Reflectors, special.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Central Electric Co., 316 S. Wells St., Chicago, Ill. "Maxolites."
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See adv. page 1308.)
Faries Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Hubbell, Inc., Harvey, Bridgeport, Conn.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa.
Kosmolite Mfg. Corp., 5-7 E. 16th St., New York, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

REFLECTORS, TROUGH, FOR PICTURES.—These reflectors are used for illuminating a picture and are consequently constructed in trough form which when used with tubular lamps gives a large evenly illuminated surface as the light source; this reduces specular reflection upon the surface of the painting. They are made of glass or of metal and are mounted within a shadow box or clamped to the picture frame. As the types which clamp to the picture frame are exposed to view they are generally made more or less ornamental. Though they have seldom been so used, they may be used in connection with a color screen to produce a daylight color quality to bring out the colors of the painting as they were painted by the artist.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Reflectors for tubular lamps for all conditions where long narrow (or strip) lighting is required.—Adv.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
ERIKSON ELECTRIC CO., L., 6 Portland St., Boston, Mass. (See adv. page 1308.)
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Frink."
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Klemm & Co., 132 N. 5th St., Philadelphia, Pa.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill. "Oamco."
Pittsburgh Reflector & Illuminating Co., Inc., 3rd and Ross Aves., Pittsburgh, Pa.
Straight Filament Lamp Co., 21 W. 37th St., New York, N. Y.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y.
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

REFLEX IGNITION CO.—3068-3086 W. 106th St., Cleveland, Ohio. Manufacturer of spark plugs. President and treasurer, C. W. Fenner; secretary, J. A. Fenner; sales manager, W. R. Vick.

REFRACTION.—The change in direction or deflection from a straight line suffered by a ray of light, heat, sound or other radiant energy in passing obliquely from one medium into another in which its velocity is different, as from air into water or into glass. Refraction of light is made use of in lenses and prisms.

REFRACTORIES FOR FURNACE LININGS, ETC.—Where high temperatures are developed regularly or continuously, as in furnaces under steam boilers, or in the various forms of electric furnaces used in the reduction or remelting of metals, some high heat-resisting material is required to prevent the destruction of the outer walls of the furnace, and in some processes to assist in the chemical treatment of the contents. These furnace linings are usually built up of bricks made from the proper material, and need to be replaced or repaired at stated periods, depending upon the severity of the service. Because of their ability to withstand high temperatures, these lining materials are called refractories. Under steam boilers the lining regularly consists of some form of fire brick, molded from fire clay. As this material shrinks considerably when heated, the clay is usually fired thoroughly then ground up and remixed with just enough additional clay to bind it together, then molded into the desired form and refired. There are several grades of fire brick made, suitable to different types of furnaces.

In metallurgical processes, especially with electric furnaces, the requirements for refractories depend upon (1) the product of the furnace, (2) whether basic or acid process, (3) the type of furnace, (4) whether furnace is operated continuously or intermittently.

The raw materials include: Basic—magnesite, dolomite, zirkite, alundum, carborundum, bauxite; neutral—chromite, zircon, carbon, fire clay; acid—silica.

Basic bricks are usually made from magnesite or bauxite which has poor mechanical strength but great resistance to heat. Magnesia is a form of calcined magnesite, a mineral 90% to 96% carbonate of magnesia which is a product of Styria and Greece. It is very resistant to slag and limestone but very sensitive to silica. It is laid in a thin mortar of powdered magnesia and tar.

Neutral fire bricks are usually of chromite, mixed with fire clay or bauxite. They are practically infusible and are used in basic open-hearth steel furnaces as a neu-

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tral course between fire clay and magnesia brick.

Silica bricks are made from practically pure silica and about 1/50 of their weight of lime. Another form, known as ganister bricks are intermediate between fire clay and silica bricks. They are made like silica but without the lime binder. Silica bricks are acid in their reaction and are very largely used in the construction of roofs of furnaces.

None of the materials now in use possess the qualities of a perfect refractory and a choice must be made according to the particular needs, bearing in mind the fact that in the presence of basic influences, basic materials should be used, and in the presence of acid influences, acid materials.

Manufacturers:

Bernitz Furnace Appliance Co., 15 State St., Boston, Mass.
Bird-Archer Co., The, 90 West St., New York, N. Y. "Hot-Stuff."
Canadian Aloxite Co., The, Niagara Falls, Ont., Can.
Carborundum Co., The, Niagara Falls, N. Y.
Electrical Refractories Co., The, East Palestine, Ohio.
Exolon Co., Blasdell, N. Y., "Carbolon Refractory."
General Ceramics Co., 50 Church St., New York, N. Y.
Gravert, Inc., William J., 246 Jackson Ave., Long Island City, N. Y.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
King Refractories Co., Inc., 1709 Niagara St., Buffalo, N. Y. "Flame."
Norton Co., Worcester, Mass.
Olive Hill Refractories Co., The, Ashland, Ky.
Pacific Clay Products Co., American Bank Bldg., Los Angeles, Cal.
Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y. "Hytemplite," "Carbosand."

REFRACTORS, LIGHTING. — Lighting refractors are special glass accessories used on incandescent and arc lamps to direct the light where it is most needed, thus giving a very broad distribution. By means of refractors, which have been used largely for street-lighting purposes, it is possible to double the normal candlepower of the lamp in directions near the horizontal, thus increasing the illumination intensity midway between units. They also serve to reduce the intrinsic brilliancy of the complete light source. Refractors are made in two pieces, one of which is made with horizontal prisms and the other with vertical prisms. The two pieces are nested together with the prisms on the inner adjacent surfaces and cemented or sealed together to exclude dust and dirt, the exposed surfaces being smooth. Three types of refractors are used, one being dome-shaped, another globe-shaped, and the third in the form of a band. The dome and band are generally used with enclosing globes or lanterns, but the globe shape may be used separately without further enclosure. They all serve to redirect the light given off that would be directed upwards or above the horizontal and distribute it below the horizontal where it is most needed. In the case of the globe type, the light ordinarily directed downward in zones below and near the lamp is also redirected and spread out to give a much wider distribution than is otherwise obtained.

Manufacturer:

HOLOPHANE GLASS CO., INC., THE, 340 Madison Ave., New York, N. Y.

REFRIGERATING AND ICE-MAKING MACHINES, MOTOR-DRIVEN HEAVY DUTY.—Artificial ice plants are required not only to supply the great public demand for ice in cities and for transportation purposes, but for refrigeration in cold-storage houses and in the factories for numerous classes of products, where a temperature continuously below that of the normal atmosphere is required. These plants, whether for ice-making or for cooling, operate on the same general principle, that of compressing some gas, usually ammonia, to a liquid form, carrying away the heat so generated, then conveying the cold compressed gas to the compartment to be cooled, where it is allowed to expand and, in doing so, to take up heat from its surroundings. The principal machine of the plant is the compressor, which is usually motor-driven. Various pumps are also required. D-c. motors, because of the ease with which their speed can be controlled, are most suitable, but a-c. motors are often more efficient, and by various methods may be properly controlled. Where the requirements for refrigeration vary greatly through the year, it is advisable to have the plant divided into units, as many of which may be operated as desired. Ammonia compressors are rated on a basis of 15 lbs. suction pressure and 185 lbs. condensing pressure, with cooling water 70° F. (21° C.). Under these conditions machines making over five tons of ice per 24 hours require about 1.5 hp. per ton; those making from one to five tons require 1.5 to 2 hp.

Ice-making plants are of two classes, those using distilled water and those using raw or natural water. There are also two principal methods, the can system and the plate system. The distilled-water plants use the can system, the other, either the can or plate system. The equipment and power requirements are approximately the same for all of these, except that the plate system requires 15% to 20% more compressor capacity. The "central-freeze" system has the advantage of producing pure ice from natural water. Ordinarily the block frozen in the can has a spot of white ice at the center, containing the impurities that were in the water. In this system the water is agitated by an air jet which helps to drive the impurities to the center. When all is frozen except a small volume at the center, this is drawn off and replaced by distilled water, which, when frozen, gives a clear, solid block of ice.

Manufacturers:

Allman Gas Engine Co., 461 Canal St., New York, N. Y. "Champion."
Armstrong Machinery Co., 3201-3219 E. Riverside Ave., Spokane, Wash. "Alaskan", "Siberian", "Icelander", "Spokane."
Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill. "Automatic Evercold."
Automatic Refrigerating Machinery Co., The, 618 Capitol Ave., Hartford, Conn. "Automatic."
Born Co., H. A., 326 River St., Chicago, Ill.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "CP."
Cyclops Iron Works, 837-847 Folsom St., San Francisco, Cal.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y. "Audiffren-Singrun."
Kroeschell Bros. Co., 440 W. Erie St., Chicago, Ill.
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."
Lipman Refrigerator Car & Mfg. Co., Beloit, Wis.
McClellan Refrigerating Co., Roosevelt Rd. and Washtenaw Ave., Chicago, Ill. "McClellan."
Narco Co., The, Wapakoneta, Ohio. "Narco."
Niebling & Co., F. W., 406 Elm St., Cincinnati, Ohio.
Peerless Ice Machine Co., The, 503 S. Jefferson St., Chicago, Ill. "Peerless."
Rebsamen & Almeroth, 2324 Elston Ave., Chicago, Ill.
Refrigo Corp., 18th St. and Forest Home Ave., Milwaukee, Wis.
Ruemmeli-Dawley Mfg. Co., The, 3911 Chouteau Ave., St. Louis, Mo.
Sanitary Refrigerating Machinery Co., Milwaukee, Wis.
Stevens, Will P., 1632-34 Long Beach Ave., Los Angeles, Cal.
Technical Products Co., Inc., 501 5th Ave., New York, N. Y.
Toledo Coldmaker Co., 1690 Fernwood Ave., Toledo, Ohio. "Toledo."
Triumph Ice Machine Co., The, 3058 South St., Cincinnati, Ohio. "Triumph."
Vilter Mfg. Co., The, Milwaukee, Wis. "Vilter."
Vogt Machine Co., Henry, Louisville, Ky.
York-Allen Ice Machine Co., Omaha, Neb.
York-California Construction Co., 832 Folsom St., San Francisco, Cal.
York Mfg. Co., York, Pa.

REFRIGERATORS, ELECTRIC, HOUSEHOLD.—This apparatus consists usually of a motor-driven compressor with a circulatory system containing sulphur dioxide or carbon dioxide or other heat-absorbing medium, together with suitable radiating coils for the disposal of the heat generated in compression, and expansion coils placed in the cooling chamber of the household refrigerators for the absorption of heat. Suitable means in the form of thermostatic switches or equivalent are provided to control the operating motor and maintain the refrigerator temperature within predetermined limits.

These refrigerators are entirely self-contained and self-cooled; they eliminate all need for ice supply because, if a few ice cubes are desired for placing into drinking water, they can be frozen in the refrigerator, in some types at least. Electric refrigerators are especially adapted for large households, in which cases the combined investment and operating charges are less than the cost of ice by the old system. Their cleanliness and high sanitary features are additional and important advantages.

Manufacturers:

Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill. "Automatic Evercold."
Balsa Refrigerator Corp., 50 E. 42nd St., New York, N. Y. "Frigidor."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis.
Clothel Refrigerating Co., 61 Broadway, New York, N. Y. "Clothel."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Electrical Refrigerating Co., Inc., The, 130 E. 15th St., New York, N. Y. "Williams."
Frigidaire Corp., The, 2135 Scotten Ave., Detroit, Mich. "Frigidaire."
Glacier Machine Mfg. Co., 55-57 E. Lake St., Chicago, Ill. "Glacier."
Isko Co., The, 2525 Clybourn Ave., Chicago, Ill.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Kelvinator Corp., 2051 Fort St., W., Detroit, Mich. "Kelvinator."
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."
McClellan Refrigerating Co., Roosevelt Rd. and Washtenaw Ave., Chicago, Ill. "McClellan."
Narco Co., The, Wapakoneta, Ohio. "Narco."
Refrigo Corp., 18th St. and Forest Home Ave., Milwaukee, Wis.
Spalt & Sons, Inc., George, 904 Broadway, Albany, N. Y. "Powrkold."
Toledo Coldmaker Co., 1690 Fernwood Ave., Toledo, Ohio. "Toledo."
Toronto Laundry Machine Co., Toronto, Ont., Can.
Utility Compressor Co., The, 355-364 Harper Ave., Detroit, Mich. "Utility."
Wolf, Fred W., 802 Diversey Parkway, Chicago, Ill.

REFRIGERATORS, ELECTRIC, RESTAURANT, HOTEL, STORE, ETC.—Motor-driven compressors connected with pipe coils located in the cooling chambers of large refrigerators and containing a compressible circulating heat-absorbing medium, such as sulphur dioxide, carbon dioxide or ammonia. Suitable means are provided for automatically controlling the compressor motor by a thermostatic switch operated by the changes in temperature between predetermined limits. The smaller plants usually employ sulphur dioxide as the refrigerant, because it is more easily controlled and less injurious or dangerous if it should escape from the pipes, but plants of larger size, such as are required for hotels, large meat markets, etc., sometimes use ammonia, which is the most used cooling medium for commercial refrigerating and ice-manufacturing plants. These self-contained refrigerator sets are found to be economical in comparison with the cost of icing refrigerators. They are highly sanitary and practically automatic in operation.

Manufacturers:

Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill. "Automatic Evercold."
Automatic Refrigerating Machinery Co., The, 618 Capitol Ave., Hartford, Conn. "Automatic."
Born Co., H. A., 326 River St., Chicago, Ill.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Clothel Refrigerating Co., 61 Broadway, New York, N. Y. "Clothel."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill.
Cyclops Iron Works, 837-847 Folsom St., San Francisco, Cal.
Isko Co., The, 2525 Clybourn Ave., Chicago, Ill.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Lipman Refrigerating Works, 53 W. Jackson Blvd., Chicago, Ill. "Lipman."

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McClellan Refrigerating Co., Roosevelt Rd. and Washtenaw Ave., Chicago, Ill. "McClellan."
Narco Co., The, Wapakoneta, Ohio. "Narco."
Niebling & Co., F. W., 406 Elm St., Cincinnati, Ohio.
Peerless Ice Machine Co., The, 503 S. Jefferson St., Chicago, Ill. "Peerless."
Refrigo Corp., 18th St. and Forest Home Ave., Milwaukee, Wis.
Spalt & Sons, Inc., George, 904 Broadway, Albany, N. Y. "Powrkold."
Toledo Coldmaker Co., 1690 Fernwood Ave., Toledo, Ohio. "Toledo."

REFRIGO.—Trade name for automatic household refrigerating machine made by the Refrigo Corp., 835 Caswell Block, Milwaukee, Wis.

REFRIGO CORP.—835 Caswell Block, Milwaukee, Wis. Manufacturer of automatic refrigerating machines. Business established 1920. President, Archie Tegtmeyer; vice-president, Joseph Ellmauer; secretary and general manager, Otto L. Lundgren; treasurer, Theodore Dammann.

REGAL.—Trade name for gaskets manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

REGAL GASOLINE ENGINE CO.—Coldwater, Mich. Manufacturer of farm lighting plants and marine engines. President, A. E. Robinson; vice-president, H. D. Robinson; secretary and treasurer, P. H. Robinson.

REGALITE.—Trade name for farm lighting plant manufactured by the Regal Gasoline Engine Co., Coldwater, Mich.

REGENERATION.—The recouping or replacing of an element which has been removed, so as to restore the original combination. Example: In electrolyzing a metallic solution and depositing metal on the cathode, we regenerate the metallic salt by using an anode of the same metal as is being deposited (plating processes).

REGENT.—Trade name for sheet packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

REGENT.—Trade name for illuminating glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

REGINA.—Trade name for electric vacuum cleaners and electrically operated musical instruments and orchestrions, manufactured by the Regina Co., 47 W. 34th St., New York, N. Y.

REGINA CO., THE.—New York, N. Y. Manufacturer of electric vacuum cleaners, motor-driven printing presses and copying machines and electrically operated musical instruments. Business established 1892. President, F. J. Gubelman; vice-president, James Shaw; secretary and treasurer, L. T. Gibson; sales manager, Joseph Blumberg. Main office, 47 W. 34th St., New York, N. Y. Factory, Rahway, N. J. Branch office, 209 S. State St., Chicago, Ill.

REGISTERS, CASH, ELECTRICALLY OPERATED.—These cash registers for use in stores, etc., are equipped with small lamps located adjacent to the indicator and in the larger forms with a small electric motor operating the registering and printing mechanism, the circuits of which are controlled by a manually operated starting button and an automatic circuit-opening switch. Some of the larger types have adding machine devices incorporated in the register which keep separate totals for each person using the machine, check the number of times each key is punched and record various other data, making a machine of very exacting requirements for the motor and mechanical mechanisms. The lamp device is used to call attention to the amount registered in the machine. A bell is sometimes substituted for this lamp.

Manufacturer:

National Cash Register Co., The, Main and K Sts., Dayton, Ohio. "National."

REGISTERS, FARE, ELECTRIC RAILWAY CAR.—Portable or fixed devices used to record the number or the amount, or both, of the fares received for transportation by conductors of cars or trains. Of two principal types, counting and printing. The simplest types of fare registers are counters and show the number of separate fares registered, both on trip dials and on total dials. Trip dials are usually arranged to be set back to zero to show fares registered on "out" and "in" trips, an indicator showing words "Out" or "In" being displayed according to the direction in which the car is proceeding. The counting or operating mechanism of such types of registers is enclosed in a metal case to protect from tampering, and is operated and a registration effected by the conductor pulling a cord or stepping on a foot pedal located at his position and connected to the register through suitable rods, bell cranks and levers, as frequently in the "prepay" design of cars.

The portable type of register is carried by the conductor in one hand and is held by him to all passengers as they offer fare. Passengers insert the coin into a slot in the mechanism and it is passed through the register which counts and indicates on suitable dials. The coin is then available to the conductor for change. The breast type portable register formerly used by conductors is now seldom employed. Fixed types of registers are also designed to register both cash fares and transfers, although many companies use separate registers for cash and transfers. The printing type of fare register records, indicates and prints on a sheet the amount of fare if paid in cash and shows "ticket," "pass," etc., if such is offered by the passenger. Such types of registers are used on suburban or interurban systems where fares are proportional to distance traveled. The setting for the different cash fares, ticket, pass, etc., is effected by a rod extending along the upper part of the car and connected to the registering and printing mechanism of the register. Dials are fixed at convenient locations on this rod and pointers attached to the rod, and can be set by conductor to the desired cash fare, or at word "ticket," "pass," etc. Registration is accomplished by pulling on a cord carried along the setting rod and attached to the operating lever of the register machine. Station registers used for elevated and subway systems are usually simple counting registers.

A feature of all fare registers is a gong or bell which rings with each registration. This has its moral effect in securing a registration of every fare, as well as indicating to passengers or to interested parties, such as checkers, inspectors, etc., that registration is being made. Also see Boxes, fare.

Manufacturers:

International Register Co., The, 15 S. Throop St., Chicago, Ill.
Ohmer Fare Register Co., Dayton, Ohio.
Rooke Automatic Register Co., Providence, R. I. "Rooke."
St. Louis Cash Register Co., 2213 Lucas Ave., St. Louis, Mo.
Woodman Mfg. & Supply Co., R., 82 Sudbury St., Boston, Mass.

REGISTERS, FIRE-ALARM BOX NUMBER.—Telegraph registers comprising an electromagnetically controlled spring or electrically operated mechanism which feeds a continuous tape through a printing mechanism. When a call is sent in the register indicates by dots and dashes or other characters printed or punched on the tape, the number or location of the fire-alarm box from which the call is sent. These registers are also used in certain burglar alarm and watchmen's report systems.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "F. P. & Co."
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
Hays, Corp., The Joseph W., Michigan City, Ind. "Hays."

REGISTERS, HAND TALLY.—See Counters, pole and tally.

REGISTERS, TAPE.—A device used in telegraphy for recording calls or messages automatically. It usually consists of an electromagnet with a pivoted armature lever, which presses a moving tape against an inked wheel for the duration of the signal.

REGISTERS, TELEPHONE.—See Meters, telephone, call counting; Meters, telephone, long distance call measuring.

REGULATING SOCKETS.—See Sockets, dimming or regulating.

REGULATION.—The change in value of some characteristic quantity of a machine, such as the speed or the terminal voltage occurring between any two loads. It is very commonly expressed as a percentage of that value of the quantity taken as normal and should be determined at a constant temperature of those parts that affect the regulation, a temperature of 75° C. being considered standard.

Regulation requires special definitions for particular cases.

The regulation of d-c. generators is the mean of the two changes in voltage between rated load and no load observed upon gradually reducing the load from rated value to zero and from zero to rated value.

For constant-potential a-c. generators, regulation is the change in voltage between a specified load at a specified power-factor and no load expressed as a percentage of rated-load voltage.

For constant-current machines, either d-c. or a-c., regulation is the maximum difference from the rated-load current occurring between rated load and the minimum load for which the machine is designed, expressed as a percentage of rated-load value.

For constant-speed d-c. or a-c. motors regulation is change in speed between rated load and no load as a percentage of no-load speed.

For converters, dynamotors, frequency changers and motor-generators, regulation is the percentage change of rated-load value in the voltage of the output side between rated load and no load.

For a generating set, such as a prime mover driving a generator, the regulation of the generator includes the changes in voltage due to changes in load on the generator and those due to changes in speed of the prime mover. The speed regulation of the prime mover is determined under constant steam pressure, head, etc., conditions which would also be observed in finding the voltage regulation of the generating set.

REGULATION, FEEDER VOLTAGE.—The requirements of lighting service necessitate good regulation of the pressure delivered throughout a distributing system. In d-c. networks the feeders are often segregated on buses operating at different voltages, thus giving approximately the same pressure at the end of long feeders as on short ones. Pressure wires from feeder ends to the station indicate conditions to the operator. The network is self-regulating to some extent, since current tends to flow toward a low-pressure area from all directions thus helping to support the overloaded area.

In a-c. distributing systems the feeders may be equipped with potential regulators, thus avoiding the necessity of operating several buses at different pressures. The pressure at feeder ends may be indicated by line-drop compensators which are used in most large systems. With this device and a relay of suitable design the regulator may be automatically controlled with changing loads on the feeder. It is customary to adopt a standard voltage and to attempt to keep the range of pressure for lighting within 5% of the standard.

REGULATION, TRANSFORMER.—The difference between no-load and rated-load secondary voltages divided by rated-load secondary voltage, and expressed as a percentage. This is for a load of unity power-factor or any other specified power-factor. The primary voltage is assumed constant at such a value as will give secondary rated voltage at rated output.

REGULATOR.—Trade name for electric irons manufactured by the Reimers Mfg. Co., 513 W. 50th St., New York, N. Y.

REGULATORS, BOILER-FURNACE DRAFT.—Furnace or combustion regulators aim to automatically control the ratio of air to fuel and the supply of fuel to the furnace in synchronism with the flow of steam (with mechanical stokers).

Only when the right amount of air is supplied to the fuel is the resulting combustion of maximum efficiency. The supply of air to the fire is controlled by the position of the damper in the boiler breeching or stack and the position of the ash-pit door, the fire doors, etc. As the rate of combustion changes as the flow of steam varies, and as the condition of the fuel bed changes from minute to minute due to holes forming, clinker building up, etc., an excess or a deficiency of air may occur and combustion efficiency suffers.

If combustion efficiency, hence fuel economy, is to be stable during these ever-changing conditions, every change must be met by a change in the air supply, which means in the position of the stack damper. It is impossible for a fireman to modify the air supply every time modification is required because he has other things to do than to adjust the stack damper every minute and several times a minute. Moreover, he cannot tell what is needed because of the time lag before he can find out what has happened. By that time another condition has developed. These reasons explain why furnace or combustion regulators are widely used. They overcome human limitations.

Combustion regulators operate according to the pressure in the furnace chamber, en-

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deavoring to maintain a certain predetermined condition regardless of the thickness or condition of the fuel bed. Usually these regulators control the stack damper and also the mechanical blower. Often they also control the stoker speed, so that as the demand for steam increases, the blower and stoker speed up in proportion while the damper opens in synchronism.

The automatic furnace regulators, if properly adjusted, will ordinarily save at least 10% of the fuel and in some cases 25% and 30%. They increase boiler capacity very materially; they permit the use of inferior fuel than when the combustion was adjusted by hand; they result in closer steam pressure regulation; less wear and tear on boilers and grates and so lower maintenance costs. Some of these benefits are chargeable in part to the mechanical blower that usually accompanies the regulator, of course; but it is difficult to segregate the respective credits.

Manufacturers:

Automatic Fuel Saving Co., 1061 Bulletin Bldg., Philadelphia, Pa. "Gray."
Burrows Mfg. Co., York, Pa. "Burrows."
Carrick Engineering Co., 538 S. Clark St., Chicago, Ill. (Combined with fuel control)
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Engineer Co., The, 17 Battery Pl., New York, N. Y.
Hagan Corp., The, 401 Peoples Bank Bldg., Pittsburgh, Pa. "Hagan."
National Regulator Co., The, 208-12 S. Jefferson St., Chicago, Ill. "Metaphram", "A-Jacks."
Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y. "Standard P. & S."
Powers Regulator Co., The, 989 Architects Bldg., New York, N. Y. "Powers."
Ruggles-Klingemann Mfg. Co., 15 Foster Court, North Salem, Mass. "R-K."
Spencer Regulator Co., Salem, Mass. "Spencer."
Watts Regulator Co., 252 Lowell St., Lawrence, Mass. "Lawrence."

REGULATORS, COMPRESSOR. — See Controller regulators.

REGULATORS, CONSTANT CURRENT. —Constant-current regulators are intended for the same purpose as constant-current transformers, i. e., to maintain a current that will vary but slightly under various load conditions. The regulator usually consists of an air-cooled adjustable reactance, comprising a winding on an open magnetic circuit which is so counterbalanced that a change in the load reactance will cause the coil to adjust itself with respect to the core, so that the current value will be unchanged. Constant-current regulators are not used as extensively as the constant-current transformers, as many inspection departments require the use of an additional transformer for insulation purposes. In places where it is not required that the receiving circuit be insulated from the source of supply they may be used to advantage for series lighting circuits as their efficiencies are generally between 90 and 95% at full load.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y. "Arca."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Packard Electric Co., Warren, Ohio. "A. W."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REGULATORS, ELECTRIC, ORGAN.— See Governors, electric organ.

REGULATORS, ELECTRIC, ROOM AND OTHER TEMPERATURE. — Temperature regulators are used extensively in houses, schools, hotels, etc., for maintaining uniform temperatures. They consist of a thermostat, located in one of the rooms having an average temperature, which is equipped with a set of contacts. When the temperature reaches the desired degree one set of contacts is closed, which in one type completes the circuit through an electric motor or solenoid in the basement. The motor operates to close the furnace draft and open the check damper. Then when the temperature falls to the lower value, the other contacts close and cause the motor to open the draft and close the check damper. Sometimes the motor is a spring motor and the thermostat merely controls the starting and stopping. An alarm-clock arrangement may be added, which enables any low temperature to be maintained during the night and the alarm dial turns on the heat in the morning at any desired time.

Modifications of the electric temperature regulators above described may be applied to temperature control for both heat and refrigeration in industrial processes. These modified types are usually particularly adapted to some particular installation though they do not vary in principle of operation. Among these applications are their use in connection with water heaters, soldering machines refrigerators, laboratory apparatus such as ovens, incubators, furnaces, and numerous industrial processes where close control of temperature is essential. Though temperature control is their primary purpose, their use is of importance even where this close control is not necessary because of the fuel economy obtained by such control. Also see Thermostats for electric car heaters.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
American Thermostat Co., 226 Jelliff Ave., Newark, N. J. "Marvel."
Andrews Heating Co., 2529 University Ave., S. E., Minneapolis, Minn.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Bishop & Babcock Co., The 1200 E. 55th St., Cleveland, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass. "Ceaco."
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane Ltd., 1820 St. Patrick St., Montreal, Que., Can.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.
Electrical Automatic Appliance Co., The, 1749-51 Arapahoe St., Denver, Colo.
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Foxboro Co., Inc., The, Foxboro, Mass.
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Honeywell Heating Specialties Co., Wabash, Ind.
Illinois Engineering Co., Racine Ave., and 21st St., Chicago, Ill. "Eclipse."
Jewell Mfg. Co., Auburn, N. Y. "Jewell."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Minneapolis Heat Regulator Co., 2747 4th Ave., South, Minneapolis, Minn. "Minneapolis."
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Sarco Co., Inc., 229 Broadway, New York, N. Y. "Sarco."
Sieben Merchandising Co., 614 Gumbel Bldg., Kansas City, Mo. "Sieben."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."

REGULATORS, FEEDER-VOLTAGE.— In a-c. systems the transformer-booster principle can be used to add to or subtract from the bus pressure to give the desired pressure at the end of a feeder. There are three types of transformers used, depending upon (a) the use of taps in the secondary, (b) changing the relative position of the coils, (c) changing the position of the core relative to the coils.

The first and older type is called a step-type or dial-type regulator, because the voltage can be adjusted only by steps by means of a dial switch. To keep the steps small, the taps must be numerous. They are connected to segments or blocks arranged in dial form, and an arm or slide connected to the circuit travels over these. To prevent short-circuiting a portion of the transformer secondary, a split contact with resistance between the two parts is necessary, or a system of auxiliary blocks, connected by resistance to the main blocks, may be used.

The second type is known as the induction type regulator. Here the primary coil is divided up, and placed in slots on the inside of a magnetic ring, similar to the stator of an induction motor. The secondary is similarly placed on the outside of another ring like a rotor and may be turned through an angle of 180 degrees. This ring is turned by hand or by a small motor, and the position of its slots, relatively to these of the stator, determines the secondary voltage and its direction. This pressure is either added to or subtracted from the bus pressure. In the case of the polyphase regulating transformer, the windings are practically identical with those of a wound-rotor induction motor. This type has largely superseded the dial type because of the smoothness of the steps and the absence of sliding contacts. When equipped with motor-control, contact-making relays and line-drop compensators, the regulators are automatic, requiring only periodic inspection by the operator.

The third type also has the outer ring, upon which both coils are located, and the amount of flux through the secondary, as well as its direction, is determined by the position of a revolved inner core.

While the regulating transformer may be used to produce a range of voltage from zero to a maximum as in some testing transformers, it is most frequently used for raising or lowering the voltage of a circuit by a relatively small per cent. In this case, the primary of the regulating transformer is connected across the circuit, while the secondary is connected in series with it, thus adding to, or subtracting from the voltage of the system. In larger sizes these regulators are also used to control the pressure delivered to a synchronous converter and sometimes to control the bus pressure of a large industrial consumer. These are often called potential regulators. A pole-line type induction regulator is also available which automatically controls the pressure on an exceptionally long branch. Also see Regulation, feeder voltage.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y. "Arca."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E feeder voltage regulators are designed for the control of single-phase or polyphase circuits of any standard voltage, frequency or current capacity. Supplied for hand or motor (remote) control. Motor operated regulators made automatic by addition of certain auxiliaries. Adapted for outdoor use by addition of covers to protect auxiliary apparatus. A panel may be furnished for auxiliaries, making installation a compact unit. This Company has developed also regulators suitable for pole mounting at or near center of load. This type can be used advantageously for regulating voltage of a feeder taken from a transmission or power system and supplying a small village or community. (Bulletin 45450.) Other G-E service in electric power transmission and distribution is portrayed on page 1205.—Adv.



WESTINGHOUSE ELECTRIC MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REGULATORS, FURNACE. — Electric furnace operation requires a close regulation of the heat produced and therefore of the energy supplied. This is obtained in arc furnaces by adjusting the position of the electrodes, either by hand or automatically. This is accomplished in single-phase furnaces having one electrode, the crucible forming the other, by having a magnetic winding controlling the position of the electrode depending on the current flowing through the furnace. In arc furnaces of the Heroult type, especially three-phase large-capacity furnaces where the electrodes are immersed in the molten metal, the regulation is very important and cannot be very satisfactorily done by hand. It is

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often accomplished by placing a contact-making voltmeter relay across each electrode so that unbalances in the load over certain values will be overcome by the action of a motor-operated regulating device for each electrode which controls its position. The relays and other control apparatus of such furnace regulators are usually mounted on a panel somewhat removed from the furnace so that the delicate equipment will be protected from the heat of the furnace.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y. "Arca."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. All electrical equipment needed in connection with electric arc furnaces of any type. Described in Bulletin 48710A. The motors to control the electrodes are totally enclosed for 230 volts, direct current, and provided with self-lubricating bearings to meet the severe requirements of automatic control. They are shunt wound to obtain the benefits of dynamic braking. Tilting motors, either a-c. or d-c. are provided with a reversible control and solenoid brake to hold the furnace in any position desired. These are totally enclosed for installing where it is impossible to provide an isolated motor compartment. The primary control panels, automatic and auxiliary electrode regulating panels, together with instruments for the measurement of power are made to the highest standards. The arrangement of equipment on the panels is standardized, and varies only to suit individual requirements. Motor-generator sets can be furnished where direct current is not available. See adv. pages 1203-1223.—Adv.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Volta Mfg. Co., Ltd., Welland, Ont., Can. "Volta."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wing Mfg. Co., L. J. 352 W. 13th St., New York, N. Y.

REGULATORS, GENERATOR FIELD.—In order to maintain practically constant voltage on large generators where the load fluctuates widely, or to have them automatically compound to take care of the feeder drop, field regulators are used. They may be either non-automatic or automatic. The first type is common in small installation and merely consists of a hand-controlled field rheostat. Automatic regulation is secured by two methods, by adjusting the field resistance by means of motors or solenoids controlled by a relay and by alternately short-circuiting and inserting resistance in the main field circuit or that of the exciter. The latter method, which gives very close regulation, is used in the Tirrill regulator, or automatic generator voltage regulator as it is sometimes called.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See display adv. pages 1225-1230.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Regulators designed to control a-c. or d-c. stations having a capacity as high as 200,000 kw. Intended for switchboard use, but certain types can be mounted on pedestals. They provide a steady voltage, which makes possible the use of more economical lamps, fewer lamp renewals, saving in energy, and fewer switchboard attendants. A comparatively new voltage regulator has been designed for the control of d-c. generators, 35 kw. and above, for lighting and mixed power and lighting service. The voltage is held constant by a coil which controls contacts operating in the field of a small motor. The motor armature generates a counter e. m. f. opposing the field of the generator being controlled, the amount depending on the action of the regulator contacts. (Bulletin 45450-A.) See adv. pages 1203-1223.—Adv.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "UEMCO."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

REGULATORS, HEADLIGHT.—See Controls, automobile headlight.

REGULATORS, IMPEDANCE. — Impedance regulators are used in connection with a-c. testing apparatus and in the primary circuit of testing transformers to regulate the voltage. One form consists of a single stationary coil with an adjustable laminated iron core operated by a hand-wheel and rack, or other convenient means. The coil is connected in series in the circuit and the regulation given by moving the core in or out. The magnetic circuit is changed by the motion of the core and this either increases or decreases the total reluctance of the path and thus decreases or increases the impedance of the circuit. As the impedance increases the voltage drop in the regulator constitutes a larger part of the total voltage.

Manufacturers:

Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hanson & Van Winkle, Newark, N. J.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Standard Electric Machinery Co., Baltimore, Md., "Standard-Baltimore."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."

REGULATORS, INDUCTION TYPE.—See Regulators, feeder voltage.

REGULATORS, LAMP.—See Dimmers, lamp socket; also Compensators, projecting arc lamp; Compensators, incandescent lamp.

REGULATORS, MOTOR SPEED.—See Controllers, speed regulating.

REGULATORS, POTENTIAL.—See Regulators, feeder voltage.

REGULATORS, PULP-GRINDER LOAD.—The pulp-grinder load regulator consists of a torque motor, series transformer and a piston type balance throttle valve, assembled with the necessary globe valves and pipe fittings. The equipment is installed in the main water line to the grinder. The function of this regulator is to maintain a constant predetermined load on the grinder motor, thus assuring maximum production for a given power consumption. In cases where power is purchased on a maximum-demand basis the regulator is of considerable additional value, because by preventing peak loads it makes it possible for the purchaser to avoid being penalized for excessive demands. Briefly, the operation is as follows: The balanced valve in the main pressure pipe is connected to the torque motor through a lever mechanism. The weight of the valve is balanced by the counterweight and the movement of the rotor determines the position of the valve and the water pressure on grinder pockets. The torque of the motor is directly proportional to the current flow in the windings of the main grinder motor and for any change in current in the grinder-motor circuit there will be a simultaneous and proportional change in torque in the regulator motor. The torque exerted by the regulator motor is balanced by an adjustable weight. It is possible, therefore, to vary the load to be held by simply adding or removing a part of these weights. When the grinder-motor load increases, the torque of the regulator motor increases and the valve is closed enough to hold the motor load at the predetermined value. When part of the load is thrown off, the torque of the regulator motor decreases and the counterweight causes the motor to move so that the valve is opened the proper amount to hold the load at its normal value.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. Regulators of simple construction, making expert attention unnecessary. Many installations have been made and are giving entire satisfaction. See adv. pages 1203-1223.—Adv.
Hagan Corp., The, 401 Peoples Bank Bldg., Pittsburgh, Pa. "Hagan."
Mason Regulator Co., 1190 Adams St., Dorchester Center, Boston, Mass.

REGULATORS, PUMP.—See Governors, compressor or pressure pump.

REGULATORS, STEAM PRESSURE.—These are regulators to be installed on a boiler furnace and regulate the draft or stoker speed so that, a practically constant steam pressure is obtained. With hand regulation when the steam pressure drops, the fireman usually opens the damper and sets the stoker at maximum speed. In a very short time the pressure is too high and the fireman then closes or nearly closes the damper. This operation is usually repeated quite often and results in an enormous loss of coal. The pressure regulators to overcome this fault operate in response to slight changes in the steam pressure to open or close the damper and in some cases to vary the speed of the stoker engines. Diaphragms are operated by the varying pressure in some types and in others an orifice is installed in the steam header and a nozzle installed there is connected from this point to the regulator, to effect the proper changes on small pressure variations. Also see Regulators, boiler furnace draft.

Manufacturers:

American Galco, Inc., Grand Central Palace, New York, N. Y. "Arca."
Bacon Vulcanizer Mfg. Co., 4065 Hollis St., Oakland, Cal.
Bishop & Babcock Co., The, 1200 E. 55th St., Cleveland, Ohio.
Chicago Automatic Switch Co., 2336 Wolfram St., Chicago, Ill.
Chicago Engineer Supply Co., 68 W. Lake St., Chicago, Ill.
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Davis Regulator Co., G. M., 420 Milwaukee Ave., Chicago, Ill. "Davis."
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Fisher Governor Co., The, Marshalltown, Iowa.
Foster Engineering Co., 109-117 Monroe St., Newark, N. J.
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hagan Corp., The, 401 Peoples Bank Bldg., Pittsburgh, Pa. "Hagan."
Illinois Engineering Co., Racine Ave. and 21st St., Chicago, Ill. "Eclipse."
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Mason Regulator Co., 1190 Adams St., Dorchester Center, Boston, Mass.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Mueller Mfg. Co., H., Decatur, Ill.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Squires Co., The C. E., E. 40th St. and Kelley Ave., Cleveland, Ohio.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Union Water Meter Co., 33 Hermon St., Worcester, Mass. "Union."
Watson & McDaniel Co., 150 N. 7th St., Philadelphia, Pa.
Watts Regulator Co., 252 Lowell St., Lawrence, Mass. "Lawrence."
Wing Mfg. Co., L. J., 352 W. 13th St., New York, N. Y.

REGULATORS, TESTING TRANSFORMER.—Regulators for controlling testing transformer voltages are made in several forms. One type is the impedance regulator described above. Nearly all types operate by varying or regulating the primary voltage of the transformer. It is essential that the secondary voltage be increased or decreased in small amounts and some regulators give several hundred steps from zero voltage to full voltage. One method, the step-by-step control, uses a drum controller, either hand or motor-operated, in conjunction with a transformer having several primary taps. Induction regulators similar to those used for feeder regulation are also employed and they give a very smooth voltage varia-

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tion. A combination of the step-by-step and induction principle is also used with good results by mounting a drum controller to operate with a relatively small capacity induction regulator. Motor-generator sets, in which the generator voltage may be controlled over a very wide range are also used to regulate the primary voltage.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. The standard method for controlling voltage of testing transformers is the Induction Regulator. For large sizes specially designed induction regulators similar to those used for feeder regulation are recommended. For small sets requiring not over 2 kv-a. a small miniature, air-cooled regulator has been developed suitable also for many laboratory purposes. Motor generator sets with specially wound sine wave generators, are also available for controlling large sets. See adv. pages 1203-1223.—Adv.

STATES CO., THE, 71 Francis Ave., Hartford, Conn. This manufacturer's



Induction Regulators

induction regulators are designed particularly for maintaining definite values of current or voltage during tests or comparisons of alternating current electrical instruments. Also applicable to any conditions requiring accurate current or voltage adjustments.—Adv.

REID INSTRUMENT CO., INC., J. E.—408 N. 12th St., Philadelphia, Pa. Manufacturer of electrically heated surgical instruments, dental control boards and switchboards, X-ray outfits, etc. Business established 1916. President, J. Ernest Reid; treasurer, Louis B. Storg.

REILLY.—Trade name for power plant evaporators manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

REILLY MULTISCREEN.—Trade name for water filters manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

REIMERS MFG. CO.—513 W. 50th St., New York, N. Y. Manufacturer of electric irons and heating elements.

REINFORCED CORD.—See Cord, flexible, reinforced.

REINFORCING SLEEVES, POLE.—All wooden poles will eventually decay at the ground and become so weakened that unless some reinforcement is provided the pole must be replaced. This reinforcing is commonly provided by a sleeve of concrete or steel. The concrete reinforcing is poured into a mold about the base of the pole after it has been chopped clean of all decayed wood and reinforcing bars fastened above and below the decayed section. Expanded metal, wrapped around the reinforcing bars, is generally provided as additional reinforcement to the sleeve. Metal sleeves which fit snugly over the pole, extending above and below the decayed portion, are sometimes employed.

Manufacturers:

Eggers Pole & Supply Co., 610 Paulsen Bldg., Spokane, Wash. (Harding process.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S".
Lanz & Sons, Mathew, Pittsburgh, Pa.

REITER, G. C.—Canton, Ohio. Manufacturer of electric bells and gongs and sheet metal stampings.

RE-LART.—Trade name for portable lamps and lamp shades manufactured by the Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill.

RELAY BOXES FOR SIGNALING SYSTEMS.—These boxes are used for housing signaling equipment, commonly in railroad work. The boxes are generally cast iron, wood-lined and provided with gaskets to make them weatherproof. The box is usually divided into separate compartments for the interlocking or neutral relays, for the battery box and for a terminal board on which may be mounted terminal blocks, lightning arresters, etc., and provided with clamps or other fittings for mounting on a pole or short pipe post.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
Hall Switch & Signal Co., Garwood, N. J.
KLAXON CO., Newark, N. J.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

RELAY CONTACTS.—See Points, contact and sparking.

RELAYS.—A relay is a device by means of which contacts in one circuit are operated by a change in conditions in the same or other circuits. Relays are used for a large number of purposes. In some cases the relay operates on a very feeble impulse or a change in a very small current, but the contacts control a circuit in which a strong current flows. This amplifying action until recent years was the most frequent and common use of relays, large numbers being used in the telegraph, telephone and signaling fields. In nearly all of these cases a weak current sent over a comparatively long line actuated the relay and controlled apparatus in another circuit that required more power to operate it than was transmitted over the line. Recently the use of relays for protective purposes in power work, i. e., the generation, transmission and distribution of electrical energy, has increased to the extent that there are now many types of relays used for a variety of purposes of protective devices. Both uses of relays are very important.

On the large and complicated power systems that are rapidly becoming more common, relays are used for many purposes and often form one of the most important links in the power chain, functioning at the proper time when certain conditions obtain, or when certain operations have been completed. Failure on the part of a relay to function properly will often cause damage to valuable apparatus, or an annoying interruption in the service. Relays used in this manner operate in conjunction with circuit breakers or oil switches. The operating mechanisms of large circuit breakers and oil switches are controlled by the relays which close circuits to the operating solenoid or motor. Relays may be arranged to operate the switch on overload, on reversal of flow of power, on low voltage or overvoltage, on reversal of phases or phase failure, or to protect a circuit, machine or apparatus from harm due to almost any kind of abnormal conditions. The closing of the relay circuit may be effected instantaneously, or in a definite time such as one second, or in a time interval inversely proportional to the amount of overload. The currents and potentials used with relays in high-potential or large-capacity circuits are derived from current and potential transformers, thus permitting the installation of the equipment on low-tension switchboards.

In general, relays may be divided into two classes, with respect to the kind of circuit upon which they are to be used, viz., alternating and direct current. These two classes may in turn be divided into current relays and potential relays, depending upon which is to govern the action, the current strength or the potential difference between two points. A further subdivision gives the classifications of primary and secondary relays; logically, the next division is with respect to the particular result that is to be obtained, or the condition which will cause the device to operate. It is this division that has been carried out under questions of safety and reliability in operation and of economy in manufacture.

At first glance, perhaps, these two features seem to be widely different, but when considered from various angles it is seen that they are so closely related that they can hardly be separated, for if the device is to be used with large currents it will certainly be more economical to operate the relay from the secondaries of current transformers than it would be to use sufficient copper for it to have the necessary current-carrying capacity. With potential relays the difficulty of proper insulation presents itself and this alone is sufficient to warrant the use of secondary relays, without further consideration. One should not, however, lose sight of the safety features that obtain with the use of low potential on such devices as are mounted in places where accidental contact is possible. Another reason for the use of secondary relays is the fact that in the majority of installations there are usually a considerable number of instruments or meters that, being low-voltage devices, make necessary the use of instrument transformers, and it is a very easy matter to provide for the relays in the secondary circuits of these transformers. Mention should be made of the reduction in spare parts that this practice makes possible.

The selection of the proper relay for a given service depends on a number of important factors, each of which should be carefully considered in making the decision as to which particular type will be used. The most common types of relays are the solenoid or plunger type, having a plunger acting against spring tension, and the meter type, which operates on the principle of an induction meter. The adjustment for operating conditions is made by varying the plunger position in the first type and by adjusting the strength of a spring which opposes the rotative action in the meter type. The time adjustment is made by means of dashpots containing oil or by a bellows arrangement to resist the motion. Definite-time-limit relays are obtained usually by the addition of clockwork.

An application of this type is in power transmission and distribution systems where several substations or large users are connected in tandem or on a ring and it is desirable that a fault which may develop at the far end of the line shall not interrupt the service to the stations nearer the source of supply. This is accomplished by the use of definite-time relays set to operate under short-circuit after a fixed time interval. Thus the relay at the point of supply may be set to open in two seconds, the first one out in 1.5 seconds, the next one at one second and the last one at 0.5 second. The relays on the other side of the ring (in case of a ring) are set likewise.

The usual setting for relays is the inverse-time-limit, in which case the response is much quicker for heavy currents than for small currents. This makes possible the use of relays where slight variations will not affect the relay unless sustained but the response to short-circuits will be almost instantaneous. The successful interconnection of transmission lines is made possible only by the protection afforded by relays which may be arranged to open at each end any section which may develop a fault without opening other sections which are not involved in the trouble.

RELAYS, A-C., DIFFERENTIAL.—Differential a-c. relays generally consist of a double-coil differentially wound solenoid with a plunger which acts against the pull of a helical spring or gravity and carries a contact that either opens or closes a control circuit when the net or differential current in the two windings reaches a predetermined value. These relays are used for circuits which require protection against conditions where the relative value or direction of current in two related circuits should not be changed. Another type of differential relay consists of a single coil which is energized by the differential current flowing in the interconnected secondaries of current transformers, the primaries of which are placed in corresponding phases. This type of relay finds its application in the protection of generators or power transformers against internal short-circuit. When used for the protection of power transformers one winding of the relay is sometimes connected in the primary circuit and the other in the secondary circuit by means of current transformers, a special type of autotransformer being connected between the relay and the secondaries of the current transformers.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A-C., OVERLOAD.—Overload relays are widely used on transmission lines for individual outgoing feeders and distribution feeders and also for motor and generator protection. Overload relays for a-c. circuits are often of the meter type operating like an induction meter. The setting of the relay or the rotation of the disk is controlled by damping magnets as

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in a watt-hour meter, or by a spiral spring. The disk carries a contact that closes the circuit when the current value is sufficient to make it meet the adjustable stationary contact, which makes possible a time adjustment.

A common type of overload relay is the so-called plunger type which consists of a solenoid ordinarily energized from the secondary of a current transformer and may have either circuit-opening or circuit-closing contacts. Where direct current is available for tripping purposes, the circuit-closing relays have proven more satisfactory. When alternating current is used for tripping the plunger type of relay with circuit-opening contacts, or the induction type of relay with reactors is used. When tripping reactors are employed the relay is of the circuit-closing type, the contacts of which close the circuit through the trip coils, thereby shunting the tripping reactors and causing the trip coils to operate.

The time interval generally varies inversely with the overload, that is, the larger the current flow the quicker the action of the relay. When used for the protection of machinery the relay is set to open at a certain percentage of full load, such as 150%. With power transmission lines the protection desired is usually against short-circuit or ground and the relays are set to operate at 200% load or more; it is usually desired that the line will not be opened under fluctuations of load and the higher setting is found to give more reliable service.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal. "Merco."
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont. Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO. THE, Milwaukee, Wis. C-H Inverse-Time-Limit Overload Relay, Bulletin 10175, provides protection for single and polyphase induction motors. It may be used with any type of automatic controller which has a magnetic main-line contactor and with any type of manual controller which affords low-voltage protection. The inverse-time-limit feature, whereby the rapidity of operation



Bulletin 10175

varies inversely with the amount of overload, is obtained by retarding the action of the plungers by oil dashpots. C-H Bulletin 10175 does not trip on the high initial inrush of current incident to starting an induction motor nor on a momentary overload. It will not, however, permit an overload which would do harm to be maintained. See display adv. pages 1225-1230.—Adv.
Cutler Electrical & Mfg. Co. 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
KLAXON CO., Newark, N. J.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Motor Protector Mfg. Co., 47 Kearney St., San Francisco, Cal.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp. 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A-C., OVERVOLTAGE.—Overvoltage relays are constructed on both the plunger or solenoid, and the induction principle. They consist essentially of a moving element which may be adjusted to close a set of contacts when the voltage increases any amount over normal. The principal use of these relays is for the protection of distribution systems where the relays are connected across the feeders and lines, and operate an alarm to let the operator know that the voltage is excessive; such excess voltage is likely to hasten burnout of incandescent lamps.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A-C., REVERSE-PHASE AND PHASE-FAILURE.—If one of the phases on a polyphase a-c. system becomes reversed the direction of rotation of all the motors on the line is reversed. This is sometimes a very serious matter, so reverse-phase relays are generally used with controllers of elevators, cranes, machine tools and other motors to protect against this condition and open the circuit when it occurs. When one phase to a polyphase induction motor fails, the motor will continue to run as an open-delta or as a single-phase machine, but the current in the remaining phases will be excessive if the motor is loaded. An induction motor will not start if one phase is open, and will be burned out if connected to the line for a short time.

One type of reverse-phase relay consists of two or more current or potential coils, mounted on the same vertical axis and so connected that with normal phase rotation the plunger will tend to move in a definite direction. In case of phase reversal the plunger will tend to move in the opposite direction, causing the relay to function.

Some relays are on the market which provide both phase failure and reversal protection. In one type a small polyphase torque motor is used, which operates against a spring. When the phases are in the correct relation, the torque of the motor is sufficient to overcome the spring and close a pilot contact. If one phase fails or becomes reversed, the pilot contact is broken, which prevents operation of the controller, usually by opening the coil circuit of the main magnetic contactor. In another type of relay a mechanism similar to a wattmeter is used in place of the torque motor.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Automatic Switch Co., 2336 Wolfram St., Chicago, Ill.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Phase-Failure



Bulletin 10080

Relay, Bulletin 10080, protects polyphase induction motors against burnouts because of phase failure, protects machinery and life when the line phases become accidentally reversed, and stops the motors when voltage becomes abnormally low. The relay must be used with a controller provided with a main magnetic contactor. See display adv. pages 1225-1230.—Adv.
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Elevator Supplies Co., 1515 Willow Ave., Hoboken, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commerical Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A. C., REVERSE-POWER.—Where two or more transmission lines are connected to the same bus at each end, a short circuit in one line draws power from the far end of the line after the circuit breaker has opened at the supply end. In order to have the line opened at the far end a reverse-power relay is provided at that point which will operate only when the direction of flow of power has been reversed. One common form of reverse-power relay has a wattmeter element with a set of contacts that remain open as long as power does not flow in a reverse direction, but close and operate a circuit-breaker trip when this does occur. These relays are also sometimes called directional relays or reverse-energy relays.

Manufacturers:

Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A-C., UNDERLOAD.—Underload relays for a-c. circuits are usually made similarly to the overload relays and operate on the principle of an induction ammeter, or are of the plunger type and consist of a solenoid having a current coil. The contacts are either circuit-opening or circuit-closing, depending on local conditions. The moving element carries a contact designed to close or open a circuit when the current falls below a predetermined value. They are used principally for the disconnection of motors, in cases where it is desirable to stop the motor when its load is removed and it is running idle.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, A-C., UNDERVOLTAGE.—A-c. undervoltage relays usually operate on the plunger principle or on the principle of an induction type voltmeter, and are connected directly across the line for

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voltages up to 300 volts, and through potential transformers for higher voltages. They are used principally with circuit breakers for motor protection and operate when the voltage fails. to prevent burning out of the motor if the power came back on the line when the motor had slowed down or stopped and was without adequate restarting protection. They are also used on transmission lines and feeders in distribution systems, to notify an attendant when the line voltage falls below a certain value or fails entirely.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, BELL ALARM.—These are auxiliary relays used chiefly in power plants and substations to ring an electric bell or gong notifying the attendant that some abnormal condition exists, such as a circuit breaker opened, excessive or low voltage on the bus, a generator or converter fallen out of step, high or low water level at a water-power dam, a hot bearing on some machine, and numerous other troubles that should receive immediate attention. As a rule, such relays are quite simple, including means for closing the gong circuit when certain contacts are closed (or sometimes opened) by the abnormal condition that requires sounding the alarm. These relays are usually provided with a hand reset device, thus making it necessary for the operator to reset the relay in order to stop the ringing of the alarm. For instance, the arm of a circuit breaker on opening bridges two contacts in the relay circuit; a thermostat on a bearing closes the relay circuit when excessive bearing temperature develops, etc.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, BURGLAR ALARM.—These relays are used mostly with closed-circuit burglar-alarm systems. When any of the contact circuits is broken at a door, window or other attempted point of entry, the relay is actuated and closes the circuit of the alarm bell, sometimes also of an annunciator to indicate where the intruder tried to enter, and occasionally also the circuit to police or protective association headquarters. It may also turn on all the lights in the house by actuating a master switch. Other relays operate on closing of the circuit in special cases, or on short-circuiting part of a closed-circuit system. The simplest forms are called constant-ringing drops, see Drops, burglar alarm. In all cases ruggedness and reliability of the relay is very desirable, else it may prove to be the weak element in an otherwise dependable system. The relay should be so built that it may be installed in an inconspicuous place and one not readily accessible for attempts at tampering; preferably it should be completely enclosed.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. "Telecode." (See display adv. pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th and Exterior Sts., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Pony."
METROPOLITAN ELECTRIC PROTECTIVE CO., 233 7th Ave., New York, N. Y. "Hess," "Circle H."
Roller-Smith Co., 233 Broadway, New York, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., DIFFERENTIAL.—Differential relays have two separate coils, differentially wound, and operate a plunger or armature only when an unbalance in the two windings occurs; that is, when the differential current reaches a predetermined value. Relays of this type are used largely for telephone and telegraph work. They are also used extensively on three-wire d-c. systems, as with balancer sets, to prevent excessive voltage between either positive or negative line and neutral, as is usually caused by heavy unbalanced loads. They are especially desirable in the protection of lighting circuits. Also see Relays, telephone, and Relays, telograph.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., OVERLOAD.—Overload relays for d-c. circuits usually consist of a small solenoid of the plunger type and a pilot contact mechanism, which is operated when the plunger is attracted. The pilot contact is normally closed when used in connection with a magnetic contactor or the holding coil of a circuit breaker and normally open when used with a tripping coil. The coil of the relay is connected in the circuit to be protected. The current at which the relay trips is varied by raising or lowering the plunger or by a sliding weight. Instantaneous-trip relays operate instantly when the current for which they are set is reached. Inverse-time-element relays are retarded (by means of an oil dashpot or air device, such as a bellows), so that they will not trip on momentary overloads, unless extremely heavy, but will operate if the overload is sustained; that is, their response is inversely proportional to the percentage of overload. Overload relays are used widely for the protection of d-c. transmission lines and feeders, and for motors, generators, synchronous converters, etc.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th and Wesley Aves., Columbus, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Overload Relay No. 177 is used where overload protection with time lag or delayed action is desired. A momentary overload will not cause the relay to trip, but, if the overload is sustained for an appreciable length of time, the relay will open the controller circuit in time to prevent injury to the motor. When once the control circuits are opened they will remain so until some master controller is operated. See display adv. pages 1225-1230.—Adv.



C-H Overload Relay No. 177

Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
KLAXON CO., Newark, N. J.
Roller-Smith Co., 233 Broadway, New York, N. Y. "Imperial."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., OVERVOLTAGE.—Overvoltage relays for d-c. circuits are made in both the instrument or voltmeter type and the solenoid type, similar to the undervoltage relays. In the instrument type, the moving pointer carries a contact which meets a stationary one at any predetermined voltage and either closes a tripping circuit or an alarm circuit. The solenoid type is similar to the overload relay, except that it is connected across the line. These relays are used on circuits subject to a variation of voltage, and in some cases merely summon an attendant when the voltage increases above a certain value. Another common use is in storage-battery charging where they are used to open the circuit when the battery voltage reaches a certain value assumed to indicate fully charged condition.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Roller-Smith Co., 233 Broadway, New York, N. Y. "Imperial."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., REVERSE-CURRENT.—Reverse-current relays are used to bring about an opening of the circuit when a reversal of current occurs, and generally operate in connection with a circuit breaker. These relays may be of the plunger or of the rotating armature type and are usually circuit-closing, so that on reversal of current a circuit is closed through the tripping device, causing the opening of the circuit breaker. Some forms have a regular ammeter mechanism connected across a shunt, and when the current reverses and causes the indicating mechanism to swing in the opposite direction it closes contacts in the tripping circuit. Other forms are much simpler and consist of a sensitive coil which operates a releasing mechanism when the current through it reverses.

Reverse-current relays are much used to provide protection for battery charging, for generators operating in parallel, electrolytic processes, etc. They are also widely used for the protection of synchronous converters, which require sensitive relays to prevent running inverted, and on motor-generators and other places where energy may flow in the reverse direction into a short-circuit. In the case of battery-charging sets, these relays prevent the battery discharging back into the generator or other charging circuit when the charging voltage fails or falls below that of the battery.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

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Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th and Wesley Aves., Columbus, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Roller-Smith Co., 233 Broadway, New York, N. Y. "Imperial."
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., UNDERLOAD.—Underload relays are often of the rotating armature type and may be either circuit-opening or circuit-closing, containing, in most cases, both current and potential coils. They are also frequently of the meter type, having an ammeter movement arranged so that when the current falls to a predetermined value the relay contacts close the tripping circuit of a circuit breaker. Another form is the solenoid type, arranged so that on a minimum current the pull of a spring exceeds that of the plunger and the tripping circuit is then actuated. One of the principal uses of these relays is in storage-battery charging, when the charging current decreases to a certain value and it is desirable to interrupt the circuit before the current reverses.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Roller-Smith Co., 233 Broadway, New York, N. Y. "Imperial."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, D-C., UNDERVOLTAGE.—These relays, which are sometimes called no-voltage relays, are commonly used in connection with starters or circuit breakers for the starting and protection of motors. They usually consist of a small solenoid and plunger similar to those in an overload relay, but differ in that they are connected across the line and only operate when the voltage falls to a predetermined value, usually half of normal voltage. These relays are usually made circuit-closing. Some relays operate on the instrument principle, having a mechanism similar to a moving-coil voltmeter. When used for motor protection they prevent the excessive current that would flow if the power came back on the line after the motor had slowed down or stopped without having the starting resistance restored to the armature circuit. They are also used with feeders in distribution systems, but in this case usually sound an alarm when the voltage falls a certain percentage below its normal value.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th and Wesley Aves., Columbus, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Deagan, Inc., J. C., 1770 Berteau Ave., Chicago, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Liberty Electric Corp., Port Chester, N. Y.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.
Roller-Smith Co., 233 Broadway, New York, N. Y. "Imperial."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, DIRECTIONAL.—See Relays, a-c., reverse power; also Relays, d-c., reverse current.

RELAYS, FIELD REGULATOR.—Relays are often used with d-c. motors to maintain full field strength and thus prevent excessive armature currents during starting or on overload. The relays are essentially small solenoids with a plunger operating against spring tension. When the armature current exceeds a predetermined value the plunger pulls up and closes contacts which short-circuit the shunt-field rheostat giving full field strength until the current decreases, when the plunger drops and weakens the field. This cycle is repeated rapidly until the motor is brought to the speed determined by the rheostat setting. It thus insures a safe starting of adjustable-speed motors with the field rheostat permanently set to give the desired speed.

Relays are also used somewhat in the regulation of generator voltage. They operate to vary the field strength in these cases also. Because of the fact that these devices consist of more than the relay itself and that they operate to provide voltage regulation, they are called regulators. See Regulators, generator field.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St. and St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RELAYS, FIRE-ALARM.—Electromagnetic apparatus or instruments operated by the relatively small currents in primary fire-alarm circuits to close contacts controlling the circuits of alarm devices with more reliable sources of supply of greater energy. They are used principally on closed-circuit systems, in which the small current flowing in the line holds the relay armature in the operated position and when the alarm is sent in closes the circuits to the register apparatus and the alarm.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Relay equipment for industrial and fire alarm signals.—Adv.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
EDWARDS & CO., INC., 140th and Exterior Sts., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

RELAYS, RADIO.—Radio relays are used to intensify the currents flowing in the local receiver circuit and give a louder sound. They have also been used in automatic recording of messages, in which case a sensitive polarized relay, similar to those used on telegraph circuits, is inserted in the receiving circuit. The action of this relay opens and closes a set of contacts which operate an ordinary Morse or line telegraph recorder. The other types of relays used for giving a stronger current in the 'phones are usually modifications of the polarized relays, so constructed as to give greater sensitivity.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
DeForest. Lee, Inc., 451 3rd St., San Francisco, Cal.
DeForest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Simon, Emil J., 217 Broadway, New York, N. Y.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wireless Specialty Apparatus Co., C and Fargo Sts., Boston, Mass.

RELAYS, SPECIAL AND MISCELLANEOUS.—There are many types and forms of relays not listed above that are made to meet special conditions. Some of these are very sensitive multiple-contact or multiple-circuit relays used for the protection of generators on transmission systems. They are arranged to operate only in case of a ground or fault occurring in the generator windings, and do not respond to unbalances, overloads, underloads, or even short-circuits on the lines. Other relays called secondary or control relays are used in connection with motor operation, where control switches are used which are not capable of carrying the total motor current, but merely operate the relay switch which closes and opens the main circuits. Control relays are also frequently used for operating the closing coil circuits of electrically reclosed circuit breakers. Relays for use on high-voltage circuits, called post-type relays, are made for mounting

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indoors and have the solenoid on a long insulating post. They are arranged to close the relay contacts at the other end of the insulator, the motion being transmitted by an insulating rod attached to the plunger. Relays are often used in testing work to indicate when a certain condition of voltage or current has been reached, either actuating an alarm, a recording device or a circuit closer or breaker. In railroad and other signaling circuits relays frequently operate on battery or other feeble line currents to actuate local circuits requiring heavier currents for operating lamps, semaphores, etc.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Autocall Co., The, Shelby, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell," "C. Q. A."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hall Switch & Signal Co., Garwood, N. J.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
KLAXON CO., Newark, N. J.
Liberty Electric Corp., Port Chester, N. Y.
Nachod Signal Co., Inc., 4771-4777 Louisville Ave., Louisville, Ky.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S & C"
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

RELAYS, TELEGRAPH.—Several forms of relays are used in telegraph systems, both in the simple closed-circuit single-working systems and the more complicated duplex, quadruplex, printing and submarine-cable systems. On the simpler systems the "main line relay" is used, being connected in the line circuit and actuating the local sounders when operated. It consists merely of a double-pole electromagnet with a light armature and retractile spring, provided with suitable adjustments and local contacts. They are usually wound for 150 ohms.

Duplex and quadruplex telegraphy require the use of special relays, the different systems giving rise to the polar relay and the neutral relay. The polar relay is one which operates in response to a change in the direction of the current in a controlling circuit. It is composed of a differential magnet, so constructed that equal currents in the two windings produce neutralizing magnetic fields. The armature is a permanent magnet and when drawn to one pole or the other, due to a change in current, will remain there until the next change in direction. The neutral relay is one which operates in response to a change in the strength of the current in a controlling circuit, irrespective of the direction of the current. Differential relays not having a polarized or permanent magnet armature are also used. These relays are also used in printing telegraph systems, although these systems also use numerous other relays to effect the circuit changes for the different signal characters.

Submarine cable telegraphy makes use of several special forms of relays. Among these are the selenium relays in which a selenium cell is acted upon by beams of light reflected by a small mirror attached to the moving coil of the primary receiving instrument. Variations in the electrical resistance of the selenium cell due to the application and removal of light rays control the operation of local circuits. Another type used is known as the gold-wire relay. This is a sensitive relay invented by Muirhead and used in submarine cable signaling. The Brown drum relay is also used. In this the moving coil of the primary receiving instrument has attached to it an armature which rests on a small drum, composed of an insulating and two conducting surfaces. There are also other special forms used for this type of signaling. The Gulstad vibrating relay is another sensitive relay used in various telegraph systems. The local contact armature is kept in continuous vibration by means of a local battery. Incoming signal impulses act to hold the armature in contact with right or left stop, depending upon the polarity of the line current.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
DeForest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Liberty Electric Corp, Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Morkrum Co., 1410 Wrightwood Ave., Chicago, Ill.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

RELAYS, TELEPHONE.—There are many forms of telephone relays, all of which consist essentially of an electromagnet with an armature arranged to close or open electrical contacts. They differ from other relays in being quite compact and cheap. The contacts are usually on springs, which may have their tension adjusted, thus varying the operating characteristics. The principal types of telephone relays used are as follows:

The cutoff relay is the one which cuts the line relay from the line when the operator answers a call. It is usually operated by the sleeve circuit of the plug. It is used also in automatic telephone circuits, where it is operated by the release trunk, a wire which corresponds to the sleeve wire.

A differential relay is one which has two opposing windings. It will not operate until the current in one of them decreases, or becomes stronger, or reverses, so that both windings aid instead of oppose each other. Differential relays of all these three types are used frequently in telephony.

The line relay is a relay whose winding is normally connected to the line. Each subscriber's line on a common-battery switchboard has a line relay to operate a line lamp or to initiate the action of automatic switches. Each automatic switch usually has a line relay, in most cases actuated by the subscriber in controlling the switch.

A marginal relay is one which will not operate on a certain current, but which will pull up on a greater current.

A locking relay or lockup relay is one which, when operated, remains in an operated position until released by an outside action. A mechanically locking relay has a catch to hold the armature or the springs. An electrically locking relay has a winding and a contact; the latter closes the circuit of the winding and holds the relay energized.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benjamin Telecode relay makes it possible to hear the telephone bell, or other signal, at a great distance or above noises as in shops or factories. Connected in the circuit of the telephone or signal system it will, upon receiving the electrical impulse of the signal, close a secondary circuit consisting of a battery and electric horn or other device. This may be located at any convenient point from which it may be effectively heard.—Adv.



Benjamin Telecode Relay

Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass.
DeForest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
KLAXON CO., Newark, N. J.
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
North Electric Mfg. Co., The, Galion, Ohio.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Western Electric Co., Inc., New York.

RELAYS, TEMPERATURE.—Temperature relays are largely used to protect electrical apparatus from excessive heating. They sometimes operate with exploring coils which are immersed in the oil or imbedded in the apparatus to be protected, and hence do not open the circuit on an overload unless it is of such duration as to cause excessive heating. The principle of most of the relays is that of a Wheatstone bridge, one arm of which is the exploring coil. One winding of the relay is connected to the bridge like a galvanometer and the direction and magnitude of current in it depends upon the resistance of the exploring coil. The closing of the relay contacts is thus determined by the temperature of the apparatus at the point where the exploring coil is located, as in the windings of a large turbogenerator, in the element of a large transformer, etc.

Another type of temperature relay consists of a small tube containing a very volatile liquid. This tube is imbedded in the portion of the apparatus that is most likely to overheat. When abnormal temperatures obtain, this liquid expands and causes a distortion of a secondary member, which results in the opening or closing of a tripping circuit.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RELAYS, VOLTAGE REGULATOR.—Voltage regulating relays may be connected in a circuit to provide constant-voltage regulation, or low-voltage and high-voltage regulation. They are frequently made on the principle of a galvanometer, the moving arm being a contact arm which opens and closes a local circuit. By adjusting the contacts, the circuits may be regulated within any predetermined values. Constant voltage can be maintained within about 1 per cent with some relays of this type. These relays are sometimes called contact-making relays, although this designation broadly covers several other types. They are much used in connection with feeder voltage regulators of the induction type.

Manufacturers:

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
METROPOLITAN ELECTRIC PROTECTIVE CO., 253 7th Ave., New York, N. Y. "Hess," "Circle H."
Takamine Commercial Corp., 120 Broadway, New York, N. Y. "Olaf."

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UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

RELC EQUIPMENT CORP.—5 Beekman St., New York, N. Y. Manufacturer of automatic fire alarm systems and fire extinguishing systems. Business established 1916. President, A. F. Hancock; vice-presidents, E. M. McNally and Cogswell Bentley; secretary, treasurer and sales manager, J. H. House.

RELEASE.—To cause automatic telephone switching apparatus to break the connection. Usually caused by the subscriber hanging up his receiver. In the automatic system this automatically causes the switches to restore to normal.

RELEASE OUTFITS, ELECTRIC, FOR CLOSING FIREDOORS, ETC.—These are solenoid-operated devices designed to close fire doors, stair and elevator traps, bulkheads, tank covers, etc. They may be used in connection with fire-alarm or automatic-sprinkler system for automatic operation, or they may be controlled by the operation of a manual switch. They are usually designed for operation of devices where a pull not exceeding 50 lbs. is required. See also Damper release magnets, stage ventilating.

Manufacturers:

American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y. "Derby."
Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa. "I-T-E."

RELIABLE.—Trade name for electric vacuum cleaners manufactured by the Clements Mfg. Co., 609 Fulton St., Chicago, Ill.

RELIABLE.—Trade name for motor-driven ice cream freezers manufactured by Henry G. Lange, 162 N. May St., Chicago, Ill.

RELIABLE.—Trade name for measuring tapes manufactured by the Lufkin Rule Co., Saginaw, Mich.

RELIABLE.—Trade name for telegraph keys and sounders and floor treads manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

RELIABLE.—Trade name for lightning arresters, fuses, switchboards and other telephone equipment manufactured by the Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill.

RELIABLE.—Trade name for electric incubators manufactured by the Reliable Incubator & Brooder Co., Quincy, Ill.

RELIABLE.—Trade name for battery fillers manufactured by the Reliable Mfg. Co., Cleveland, Ohio.

RELIABLE.—Trade name for electric welders manufactured by the Reliable Tractor & Engine Co., Portsmouth, Ohio.

RELIABLE.—Trade name for motor-driven churns manufactured by the Taylor Bros. Churn & Mfg. Co., 2951 N. Market St., St. Louis, Mo.

RELIABLE ELECTRIC CO.—3145 Carroll Ave., Chicago, Ill. Manufacturer of switchboards, lightning arresters, fuses and other telephone equipment. President and treasurer, Wallace L. Cook; vice-president, Fred J. Wegg; secretary, George W. Rodorner.

RELIABLE HEER.—Trade name for portable light and power plants and gas and oil engines manufactured by the Reliable Tractor & Engine Co., Portsmouth, Ohio.

RELIABLE INCUBATOR & BROODER CO.—Quincy, Ill. Manufacturer of electric incubators and brooders. President and general manager, J. W. Myers; vice-president, E. V. Skinner; secretary and treasurer, A. E. Myers; sales manager, G. C. Mitchell.

RELIABLE MACHINE CO., THE.—1188 Main St., Bridgeport, Conn. Manufacturer of magnet wire. Business established 1909. President, Donald Noble; vice-president, James A. Marr; secretary and treasurer, Andrew B. Huntington; general manager, Nathaniel Wheeler.

RELIABLE MFG. CO., THE.—Cleveland, Ohio. Manufacturer of battery fillers. Sales representative, H. B. Shontz Co., 157 W. 54th St., New York, N. Y.

RELIANCE.—Trade name for weather-proof wires and cables manufactured by the American Steel & Wire Co., 208 S. La Salle St., Chicago, Ill.

RELIANCE.—Trade name for belting for motors and generators manufactured by the Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

RELIANCE.—Trade name for power transmission chains manufactured by the Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio.

RELIANCE.—Trade name for motor-driven saws manufactured by the Kaetker Saw Machine Co., Cincinnati, Ohio.

RELIANCE.—Trade name for pliers manufactured by the Kilborn & Bishop Co., Chapel & Lloyd Sts., New Haven, Conn.

RELIANCE.—Trade name for generators, electric buffers and rheostats manufactured by Charles F. L'Hommedieu & Sons Co., 4521 Ogden Ave., Chicago, Ill.

RELIANCE.—Trade name for electric time switches manufactured by the Reliance Automatic Lighting Co., Racine, Wis.

RELIANCE.—Trade name for d-c. and a-c. motors and d-c. generators manufactured by the Reliance Electric & Engineering Co., 1054 Ivanhoe Rd., Cleveland, Ohio.

RELIANCE.—Trade name for electrical measuring instruments manufactured by the Reliance Instrument Co., Inc., 1135 W. Van Buren St., Chicago, Ill.

RELIANCE.—Trade name for weighing machines manufactured by the Reliance Weighing Machine Division, Stearns Motor Mfg. Co., Ludington, Mich.

RELIANCE.—Trade name for hydrometers manufactured by the Storage Battery Supply Co., 239 E. 27th St., New York, N. Y.

RELIANCE AUTOMATIC LIGHTING CO.—Racine, Wis. Manufacturer of electric time switches. Benjamin F. Flegel, sole owner; F. W. Flegel, general manager.

RELIANCE ELECTRIC & ENGINEERING CO.—Cleveland, Ohio. Manufacturer of d-c. and a-c. motors and d-c. generators. President, C. L. Collens; vice-president, H. Morley Hitchcock; secretary, C. V. Putnam; treasurer, Lawrence Hitchcock. Main office and factory, 1054 Ivanhoe Rd., Cleveland, Ohio. Branch offices, 343 S. Dearborn St., Chicago, Ill.; 46 Dey St., New York, N. Y.; Pennsylvania Bldg., Philadelphia, Pa.; Arrott Bldg., Pittsburgh, Pa.; 200 Devonshire St., Boston, Mass.; 601 Temple Bldg., Detroit, Mich.; 708 Traction Bldg., Cincinnati, Ohio.

RELIANCE ELEVATOR CO.—212 W. Austin Ave., Chicago, Ill. Manufacturer of electric elevators, safety devices and controllers. Business established 1905. President, John C. A. Anderson; vice-presidents, C. E. Anderson, H. C. Anderson; secretary, A. C. G. Anderson; treasurer, C. A. Anderson; sales manager, E. H. Johnson. Sales representatives, M. M. Kidney Elevator Co., 5 Scott Pl., Pittsburgh, Pa.; Consumers Elevator Co., 618 N. 3rd St., Philadelphia, Pa.; Elevator Repair & Supply Corp., 68 Barclay St., New York, N. Y.; C. H. Reid, 1904 Olive St., St. Louis, Mo.; Kansas City Elevator Mfg. Co., 2601 Madison Ave., Kansas City, Mo.; T. J. Ellington, 404 W. 19th St., Little Rock, Ark.; R. E. Smith, 283 Union Ave., Memphis, Tenn.; C. K. Weekley, 155 Forsyth St., Atlanta, Ga.

RELIANCE GAUGE COLUMN CO., THE.—5924 Carnegie Ave., Cleveland, Ohio. Manufacturer of tank alarms, steam traps, water gages, etc.

RELIANCE INSTRUMENT CO., INC.—1135 W. Van Buren St., Chicago, Ill. Manufacturer of electrical measuring instruments.

RELIANCE LIGHTING FIXTURE CORP.—275 Canal St., New York, N. Y. Manufacturer of lighting fixtures.

RELIANCE METAL SPINNING & STAMPING CO., INC.—160 John St., Brooklyn, N. Y. Manufacturer of lighting fixtures. President and treasurer, Samuel Shapiro; secretary, Morris Berman.

RELIANCE OIL & GREASE CO., THE.—16 W. Goodale St., Columbus, Ohio. Manufacturer of lubricating oils. J. M. Backert, manager.

RELIANCE WEIGHING MACHINE DIVISION, STEARNS MOTOR MFG. CO.—Ludington, Mich. Manufacturer of weighing machines. Business established 1902. President and treasurer, J. S. Stearns; secretary and general manager, W. W. Cromley.

RELIFCO.—Trade name for electric lighting fixtures manufactured by the Reliance Lighting Fixture Corp., 275 Canal St., New York, N. Y.

RELUCTANCE.—The magnetic flux developed by a current depends upon the magnetomotive force and also upon the length, cross section, and permeability of the magnetic circuit. The factor that depends upon the length, cross-sectional area and permeability is known as the reluctance; its symbol is $\mathfrak{R}$. $\mathfrak{R} = l/(\mu A)$, where l is the length, μ the permeability and A the area. The reluctance has the same relation to a magnetic circuit that resistance has to an electric circuit. Reluctance in series or in parallel may be combined exactly as electrical resistances. The unit of reluctance is the oersted.

RELUCTIVITY.—The reciprocal of permeability, $1/\mu$. It may also be defined as the reluctance between opposite faces of a cube 1 cm. on edge.

REMANENCE.—See Residual magnetism.

REMCO.—Trade name for selective train dispatching equipment manufactured by the Railway Electric Mfg. Co., 250-2 W. Water St., Milwaukee, Wis.

REMINDO.—Trade name for combined switch and buzzer manufactured by the General Electric Co., Schenectady, N. Y.

REMLER.—Trade name for amateur radio apparatus manufactured by Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

REMOTE CONTROL SWITCHES.—See Switches, remote control.

REMOVERS, FUSE.—To insure safety to the man removing a fuse, the fuse should not be removed by hand where the voltage is high enough to be dangerous. For removal of cartridge fuses the fuse remover, a special form of insulated plier which may be manipulated with one hand, is employed. For high-tension work these removers are not used, but instead fuse tongs are employed. For these see Tongs, fuse, high-tension.

Manufacturers:

BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill.

REMPIS & GALLMEYER FOUNDRY CO.—524 Front Ave., N. W., Grand Rapids, Mich. Manufacturer of brass and aluminum castings. President, J. H. Rempis; vice-president, E. Duus; secretary and treasurer, P. J. Hake.

REMSSCO.—Trade name for lighting fixtures manufactured by the Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y.

REMY ELECTRIC CO.—Anderson, Ind. Manufacturer of automobile lighting, starting and ignition equipment. General manager, J. D. Mooney.

RE-NEW LAMP CO.—Malden, Mass. Manufacturer of renewed incandescent lamps.

RENEWALS, FUSE.—See Fuse links and renewals.

RENEWALS, WET BATTERY.—Wet-battery renewals include supplies for the various types of wet primary batteries. Such renewal outfits usually consist of zinc, carbon, copper or copper oxide electrodes, completely charged porous cups, and electrolyte compounds.

Manufacturers:

Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Edison, Inc., Thomas A., Belmont Ave., Orange, N. J.

RENEWED INCANDESCENT LAMPS.—See Lamps, incandescent, renewed.

RENFREW ELECTRIC PRODUCTS LTD.—Renfrew, Ont., Can. Manufacturer of electric household appliances. Branch offices, 29 Richmond St., W., Toronto, Ont.; 803 Lindsay Bldg., Winnipeg, Man.

RENIM SPECIALTY CO.—110 K St., Boston, Mass. Manufacturer of boxes and cabinets for electrical purposes. President and sales manager, William J. Barkley; vice-president, Charles E. Watson; treasurer, Arthur Watson; general manager, John P. Feehan.

RENMAR.—Trade name for adjustable portable lamps manufactured by Renner & Maras, Inc., 289 4th Ave., Long Island City, N. Y.

RENNER & MARAS, INC.—289 4th Ave., Long Island City, N. Y. Manufacturer of portable lamps.

RENNERFELT.—Trade name for electric furnaces made by Hamilton & Han-

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sell, Inc., Park Row Bldg., New York, N. Y.

RENOWN.—Trade name for lubricating oil manufactured by the Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill.

RENULIFE.—Trade name for high-frequency violet-ray generators manufactured by the Renulife Electric Co., Marquette Bldg., Detroit, Mich.

RENULIFE ELECTRIC CO.—Detroit, Mich. Manufacturer of high-frequency violet-ray apparatus. Business established 1917. President, J. H. Eastman; vice-president, J. Stanley Cape; secretary, treasurer and sales manager, R. J. Sherman. Main office and factory, Marquette Bldg., Detroit, Mich. Branch office and warehouse, Canadian Renulife Electric Co., Netting Bldg., Windsor, Ont., Can.

REPAIR WAGONS, TROLLEY LINE.—See Wagons, tower, electric; Wagons, tower, gasoline; Wagons, tower, horse drawn.

REPEATER SIX.—Trade name for cartridge and plug fuses manufactured by the Moss-Schury Mfg. Co., Inc., 444-446 Woodbridge St., E., Detroit, Mich.

REPEATER, TELEPHONE IMPULSE.—Used in automatic telephony. It repeats dialing impulses generated by the calling subscriber from the subscriber loop into the long trunk line connecting two offices. It secures better operation of the switches, furnishes battery current to the calling telephone (for good voice transmission), enables the use of only two wires per trunk, and performs other and minor duties.

REPEATERS, TELEGRAPH.—In telegraphy instruments embracing a receiving relay, a transmitter and a holding device, designed to repeat signals from one circuit to another. They may be used on single line, duplex or quadruplex systems. A repeater in which the receiving relay, controlled by the signals received over a line, repeats these signals into another line or lines without the interposition of other apparatus is known as a direct-point repeater. Half-set repeaters consist of one relay and one transmitter for connecting either a duplexed or a quadruplexed line with a single line. Duplex and quadruplex repeaters are quite simple, it being necessary only to place the pole-changer of the east line under control of the polar relay of the west line. The transmitter or common side of the east line is under control of the neutral relay on the west line. For working from east to west corresponding connections are used.

Manufacturer:

Jester-Cooper Co., Houston, Tex. "J. C."

REPEATERS, TELEPHONE.—Telephone voice current becomes weakened or attenuated as it travels along the line. Sometimes it cannot be heard. Then a repeater or voice relay is inserted. It has a receiving part in which the weak received current controls locally generated strong current and sends ahead a strong current which is like the received current. It may be likened to putting a receiver against a transmitter. This device alone is called an amplifier. It usually takes two amplifiers to make a complete two-way repeater for telephone lines, one for amplifying conversation from east to west (for example) and the other for amplifying the conversation from west to east. Complicated circuits have to be used to prevent the two amplifiers from "singing" with each other. The electron tube is most used as the amplifier.

Manufacturer:

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

REPLACERS, CAR.—Portable devices to assist in replacing on the track the trucks of derailed rolling stock. They are usually special castings of such shape as to form an incline from the top of ties or roadbed to the top of running rails and having suitable grooves and humps to aid the flanges of the car's wheels when the car is pulled or moved with its own power in getting back in proper position on the track.

Manufacturers:

Aldon Co., The, 3338 Ravenswood Ave., Chicago, Ill. "Aldon."
Alexander Car Replacer Mfg. Co., Mears Bldg., Scranton, Pa.
Columbia Machine Works & Malleable Iron Co., Atlantic Ave. and Chestnut St., Brooklyn, N. Y.
Q. & C. Co., The, 90 West St., New York, N. Y. "Q. & C."
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

REPLACERS, LAMP.—These devices are used for replacing lamps mounted in inaccessible places and are commonly called lamp changers. See Changers, lamp.

REPLACING JACKS.—See Jacks, car.

REPRODUCO.—Trade name for electrically operated organs made by the Operators Piano Co., 16 S. Peoria St., Chicago, Ill.

REPUBLIC CEDAR CO.—Marinette, Wis. Manufacturer of cedar poles. Business established 1913. President, J. C. Kirkpatrick; vice-president, H. S. Gilkey; secretary and treasurer, H. W. Reade; general manager, M. E. Brown.

REPUBLIC CREOSOTING CO.—Indianapolis, Ind. Producer of creosoted crossarms and cedar poles and creosote oil. Business established 1898. President, Peter C. Reilly; vice-president, Ineva T. Reilly; secretary, treasurer and general manager, A. J. Lauth; sales manager, B. S. McConnell. Main office: Merchants Bank Bldg., Indianapolis, Ind. Plants: Indianapolis, Ind.; Minneapolis, Minn.; Mobile, Ala.; Seattle, Wash.; Norfolk, Va. Branch offices, Minneapolis, Minn.; Mobile, Ala.; Norfolk, Va.; Seattle, Wash.; Chicago, Ill.; Detroit, Mich.; Buffalo, N. Y.; Boston, Mass.; Cleveland, Ohio; Philadelphia, Pa.; Toronto, Ont., Can.; Milwaukee, Wis.; Louisville, Ky.; Cincinnati, Ohio.

REPUBLIC FLOW METERS CO.—Chicago, Ill. Manufacturer of boiler-room instruments. President and general manager, James B. Cunningham; vice-president, J. M. Fitzglass; secretary and treasurer, M. P. Vore. Main office, 2240 Diversey Blvd., Chicago, Ill. Branch offices: Boston, Mass.; Denver, Colo.; Detroit, Mich.; New York, N. Y.; Pittsburgh, Pa.; Atlanta, Ga.; Minneapolis, Minn.; Philadelphia, Pa.; Toronto, Ont., Can.

REPUBLIC RUBBER CORP.—Youngstown, Ohio. Manufacturer of belting. Main office, Youngstown, Ohio. Factories: Youngstown and Canton, Ohio. Branch offices: Ivy and Harrison Sts., Atlanta, Ga.; 1732 Michigan Ave., Chicago, Ill.; 424 W. 4th St., Cincinnati, O.; 2014 Commerce St., Dallas, Texas; 1528 Grand Ave., Kansas City, Mo.; 426 Stinson Blvd., Minneapolis, Minn.; 221 W. 37th St., New York, N. Y.; 806 N. Broad St., Philadelphia, Pa.; 165 2nd St., San Francisco, Cal. H. J. Woodard, vice-president in charge of sales.

REPUBLIC STRUCTURAL IRON WORKS DIVISION OF THE CONSOLIDATED IRON-STEEL MFG. CO.—East 53rd St., Cleveland, Ohio. Manufacturer of railway catenary and signal bridges, crossarms, coal bunkers, steel poles and towers, smoke stacks, structural steel, etc. J. Lehman, secretary.

RESCO.—Trade name for electric signs manufactured by the Root Electric Sign Co., Inc., 20-30 Lock St., Lockport, N. Y.

RESERVE.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

RESIDENCE LIGHTING FIXTURES.—See Fixtures, lighting residence.

RESIDENCE PANELBOARDS.—See Panelboards, residence.

RESIDUAL MAGNETISM.—The magnetism which is retained by the core of an electromagnet or by any other magnetic body after the electrical energizing circuit or magnetizing force is removed. When a mass of iron has once been magnetized it is very difficult to remove all traces of it. If a B-H or magnetized curve be plotted for the iron with increasing and then decreasing values of H, the magnetizing force, when H is reduced to zero, the magnetism B does not reduce to zero. This magnetism that remains, usually a small amount, is known as residual magnetism. The amount or strength of this residual magnetism varies in different samples of iron. Well annealed pure iron possesses very little residual magnetism, while iron containing a large percentage of impurities, or iron that has been hardened by rolling, stamping or hammering possesses a large amount of residual magnetism. Hard steel retains such a large amount of residual magnetism that it is called a permanent magnet. The smaller amounts found in iron are of importance in the operation, especially the starting, of self-excited generators. Also see Magnetism.

RESISTAL.—Trade name for industrial goggles manufactured by Strauss & Buegeleisen, 16 Hanover Pl., Brooklyn, N. Y.

RESISTANCE.—Resistance is that property of a conductor by virtue of which the energy of the electric current is converted into heat. (See Power loss in conductors.) It may also be looked upon as a sort of frictional resistance to the flow of electricity. The resistance of a conductor depends upon the material and is directly proportional to its length and inversely proportional to its cross-sectional area. The practical unit of resistance is the ohm. The resistance of conductors may be calculated by the following formula: $R=\rho l/A$. If l is measured in feet and A in circular mils, then ρ is the circular mil-foot resistivity. If l is in centimeters, A in sq. cm., then ρ is the resistivity of a centimeter-tube.

RESISTANCE, ARMATURE, EFFECTIVE.—That value of resistance which, when multiplied into the square of the current, gives the power converted into heat in the armatures of a-c. machines. The effective resistance to alternating current is greater than the resistance to direct current on account of (1) unequal distribution of alternating current over the cross-section of conductors, particularly large ones, (2) hysteresis in adjacent iron, and (3) eddy currents in such iron or other conducting material. It depends largely upon the size and shape of the conductors, the magnitude and frequency of the current and the size and shape of the slots. In some cases it may be as much as 50 per cent greater than the resistance to direct current.

RESISTANCE BOXES.—See Boxes, resistance.

RESISTANCE COILS.—See Coils, resistance.

RESISTANCE FURNACE.—An electric furnace in which the energy of the current is converted into heat by passing through a solid or liquid resistor. The electrical energy is thus transformed into sensible heat at 100 per cent efficiency of conversion. The resistor may be a solid block, or rod or wire, or granulated solid material, or a liquid bath. The substances to be heated are either brought into proximity to the resistor, under the same roof, or are in contact with it, or mixed in with it, or they may constitute the resistor itself. This principle is widely used in laboratory furnaces, in annealing, hardening and heat-treating furnaces, in brass-melting and other nonferrous alloy furnaces, etc. Also see Resistor, electric furnace; Furnaces, electric.

RESISTANCE GRIDS.—See Grids, resistance.

RESISTANCE MATERIALS.—The more common resistance materials are carbon and graphite, in stick or powder form, and metal alloys of various compositions. Instead of buying these materials in the finished form, some manufacturers prefer to buy the material in bulk form and make it up to suit their own needs. See also Wire, resistance.

Manufacturers:

Driver-Harris Co., Harrison, N. J. "Nichrome," "Nichrome II."
Electrical Alloy Co., The, Morristown, N. J. "Karma."
Hoskins Mfg. Co., Lawton and Buchanan Sts., Detroit, Mich. "Chromel."

RESISTANCE RIBBON.—See Ribbon, resistance.

RESISTANCE RODS.—See Rods, resistance.

RESISTANCE, TEMPERATURE COEFFICIENT OF.—See Temperature coefficient of resistance.

RESISTANCE TESTING SETS.—See Testing sets, battery, bridge and galvanometer.

RESISTANCE UNITS.—See Units, resistance, standard or precision; Units, resistance, miscel.

RESISTANCE VOLTAGE.—The resistance voltage of a circuit is the product of the effective current by the resistance of the circuit; $E_r=IR$. It is also called the resistance drop, voltage drop, or copper drop. See Voltage drop, Copper drop.

RESISTANCE WIRE.—See Wire, resistance.

RESISTIVITY.—Resistivity is the resistance, either in ohms or C. G. S. units, of a conductor of unit length and unit cross-sectional area. In practical measurements the unit length is one foot and unit area is one circular mil. In scientific measurements, the unit length is the centimeter and unit area is the square centimeter. The resistivity of a conductor depends upon the material and upon its temperature. The symbol for resistivity is ρ.

RESISTOLAC.—Trade name for insulating paint manufactured by the Robertson Chemical Co., Cleveland, Ohio.

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RESISTOR.—A resistor is a device possessing the property of resistance which is used for the operation, control or protection of the circuit or circuits in which it is included.

RESISTOR, ELECTRIC FURNACE.—Any electrically conducting body used because of its electrical resistance; specifically, a conducting body of considerable electrical resistance, in an electric furnace which generates the desired heat when a heavy electric current is passed through it. In small laboratory furnaces a coil of platinum wire or of nichrome or chromel is often used as the resistor; in large furnaces a body of granular carbon is a very useful resistor, sometimes rods of graphitized carbon are used.

RESISTORS, CARBON, IRON, ETC.—A resistor is an aggregation of one or more units possessing the property of resistance used in an electric circuit for the purpose of operation, protection, or control of that circuit. (Electric Power Club definition.)

The materials most commonly used for resistors are iron, steel, nickel alloys, and carbon. Iron is used in the form of wire wound on tubes and for making cast iron grids; steel is sometimes used for making grids; (see Grids, resistance). The nickel alloys have a high specific resistance and low temperature coefficient and are used principally where high-resistance units are required. The wire is usually wound on a base of porcelain, clay or other insulating material and then covered with cement, vitreous enamel or japan for protection. Carbon is used because of the fact that its contact resistance decreases when pressure is applied.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis. (graphite).
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. Ironclad resistors, grid resistors, wound tube resistors, resistors for all types of controllers. (No carbon resistors.) See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Radio Co., 11 Windsor St., Cambridge, Mass. (for phantom antenna).
HIGH TENSION SUPPLIES CO., Wilmington, Del.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Railway & Industrial Engineering Co., Greensburg, Pa. "Koppat."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RESISTORS IN PARALLEL.—When resistors are connected so that the total current divides among them, part flowing through each resistor, they are said to be connected in parallel. The joint resistance of resistors connected in parallel is the reciprocal of the sum of the reciprocals of the individual resistances. If R is the joint resistance of R_1, R_2, R_3 connected in parallel, then $1/R=1/R_1+1/R_2+1/R_3$.

RESISTORS IN SERIES.—When resistors are connected end to end so that the current flowing through one must flow through the others, they are said to be connected in series. The joint resistance of a set of resistors connected in series is equal to the sum of their separate resistances.

RESONANCE.—Resonance in a circuit is that condition of the circuit when the inductive reactance balances the condensive reactance; see Inductive reactance and Condensive reactance. In symbols $X_1=X_c$ or $2\pi fL=1/(2\pi fC)$. In a resonant circuit with the series inductance and capacitance effects equalized the current is limited only by the resistance, but the potential across the condenser may be very high. Resonant circuits are of much importance in radio work.

RESONANT FREQUENCY.—The resonant frequency is that critical frequency in a circuit which causes resonance. It is given by the formula

$$f=1/(2\pi\sqrt{LC}),$$

where L is the inductance in henrys and C is the capacitance in farads of the circuit.

RESONATORS, RADIO. — Radio resonators or tone intensifiers are used to amplify the sound produced by the receiver. They are used somewhat in circuits where the detector current is very small. They are also used in conjunction with loud-speaking telephones. The resonator is placed over the receiver and may be tuned for the particular tone of the receiver and thus causes a further mechanical amplification than that generally produced by electrical means.

Manufacturers:

Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Cramer & Swain, 2916 N. 16th St., Omaha, Neb.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Simon, Emil J., 217 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wireless Specialty Apparatus Co., C. & Fargo Sts., Boston, Mass.

RESONATORS, TELEGRAPH.—An adjustable container box for mounting telegraph sounders in proximity to the position occupied by a telegraph operator when receiving telegrams from a wire. They are often mounted on a swinging arm so that they may be moved to a convenient position. They are used principally in large offices where several operators work simultaneously. By using the resonator the sound from any one sounder is confined and directed to one operator and does not cause disturbance or confusion among the other operators. The resonator also gives a sharper sound than is obtained from a sounder mounted on a table.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Liberty Electric Corp., Port Chester, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.
White Co., The O. C., 17 Hermon St., Worcester, Mass.

RESPIRATORS.—Respirators are worn for protection against dust, poisonous gases, acid fumes, etc. They are used extensively in coal-handling plants, electroplating, acid, chemical, paint and color plants, etc. There are two common types, one a small mask covering the mouth and nose, the other a helmet form. The former is used in less dangerous atmosphere where all that is required is a device which will separate the air inhaled from the dangerous dust or gas it may contain. This is accomplished by a sponge or paper filter within the respirator through which the air must pass before it is breathed into the lungs. The helmet form is used in connection with a small light auxiliary tank, usually worn strapped on the back or over the shoulder, containing the air or oxygen supply. This tank is connected to the mouth and nose, thereby furnishing the required air to the wearer, all other air being excluded by a helmet or mask worn on the head; the air exhaled is passed out through check valves without vitiating the air to be inhaled. These helmets are used by firemen in entering smoke and gas filled buildings; by men entering rooms where ammonia, illuminating gas, chloride or other dangerous fumes have been allowed to escape; by mine-rescue parties seeking to save victims of mine fires or explosions, etc. Modified forms of both types of respirators known as "gas-masks" were extensively used in the World War.

Manufacturers:

American-LaFrance Fire Engine Co., Elmira, N. Y. ("LaFrance" respirators.)
Munning & Co., A. P., Church St., Matawan, N. J.
Safety Equipment Service Co., The, 215-21 St. Clair Ave., N. E., Cleveland, Ohio.
Safety Fire Extinguisher Co., The, 291-93 7th Ave., New York, N. Y. "Safety."
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa. "Diamond."
Servus Rescue Equipment Co., 50 Columbia St., Newark, N. J.

RES-PRO INSULATING CO., INC.—Boston, Mass. Manufacturer of insulating materials. Exclusive distributor, L. O. Duclos, 176 Federal St., Boston, Mass.

RESTS, CABLE.—See Racks and hooks, cable.

RESUSCITATION APPARATUS.—This apparatus is a mechanical device for carrying on respiration in cases where from some cause it has been suspended, as from electric shock, asphyxia from gas, smoke, fumes or drowning. The apparatus usually consists of a hand pump operating in two cylinders, one for exhalation, the other for inhalation. The cylinders are connected by tubes to a mask which is clamped over the nose and mouth. When the pump is operated the cylinders alternately exhaust air from the lungs, and force air into the lungs, in exactly the same manner as though the patient were breathing normally, the quantity of air being regulated by valves. Though manual methods may be employed in resuscitation, they require some knowledge of the method, are very fatiguing and may fail because of the inability of the person applying them to continue for several hours, a length of time sometimes required to restore natural respiration. For these reasons mechanical resuscitators, which an untrained man or even a woman or child can operate without serious fatigue are included in the "first-aid" equipment of industrial plants, central stations, hospitals, etc.

Manufacturers:

Cleveland Breathing Machine Co., 1833 E. 13th St., Cleveland, O. "Lyon."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Life Motor."
Life Saving Devices Co., 109 N. Dearborn St., Chicago, Ill. "Lungmotor." (Exclusive distributor, Lungmotor Co., 711 Boylston St., Boston, Mass.)

RESUSCITATION FROM ELECTRIC SHOCK.—In the case of injury from electric shock immediate treatment is of primary importance, if the life of the injured person is to be saved. Consequently, employees whose work places them in danger of serious shock are trained in some method of resuscitation. The most approved is the prone pressure method as it requires the service of only one man. All methods of resuscitation induce breathing by forcing air into and out of the lungs at the normal breathing rate. In the prone pressure method this is accomplished by placing the patient prone, that is, with the face lying down, and pressing upon the small of the back, thus forcing the diaphragm upward and expelling the air from the lungs, then suddenly releasing the pressure, which results in sucking air into the lungs. The operator repeats this process about 16 times a minute, the normal breathing rate. As it is necessary that the operator work over the patient at times for as long as three hours, the process is very fatiguing even if there are several operators to relieve each other. For this reason several forms of mechanical resuscitators, which are easy to operate and can be used by inexperienced men, are manufactured. In principle they are the same as the prone pressure method, but the artificial breathing is produced by mechanically pumping air into and out of the lungs and in some cases oxygen is used instead of air. See Respirators and resuscitation apparatus.

RETARDERS, CONTROLLER.—See Controller regulators.

RETH-FLEX.—Trade name for desk and floor lamps manufactured by the Highlands Mfg. Co., Muncie, Ind.

RETH-LITE.—Trade name for semi-indirect lighting fixtures manufactured by the Highlands Mfg. Co., Muncie, Ind.

RETOUCHERS, ELECTRIC, FOR PHOTOGRAPHIC STUDIOS.—These are small hand instruments containing a retouching tool to which is imparted an oscillatory motion similar to the motion imparted by the retouching in the non-electric tool. This tool enables the operator to accomplish a more skillful and cleaner job than might be done by hand and more rapidly.

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Manufacturer:

Gilbert Supply Co., Lock Box No. 3, Independence, Iowa.

RETRIEVER.—Trade name for street car bells manufactured by the J. G. Brill Co., 62nd St. & Woodland Ave., Philadelphia, Pa.

RETRIEVERS, TROLLEY.—See Catchers and retrievers, trolley.

RETURN CIRCUIT.—That portion of an electric circuit through which the current is assumed to return to the source. This current is called the return current. If the return circuit is the ground, it is spoken of as a metallic line with ground return. In the case of alternating-current circuits the term "return circuit" is meaningless. Even for direct-current circuits the common notion that the negative side of the circuit is the return circuit is not now accepted by the latest theories of electricity. See Electron theory.

REVERSIBLE CELL. — An electrolytic cell which shows back electromotive force; one which after electrolysis has been performed shows a disposition or ability to act like a primary cell and to generate electromotive force in the opposite direction to the previously applied electrolyzing potential; it is a form of secondary cell. When acting as such a cell, the current produced reverses the electrochemical reactions produced by the electrolyzing current. A storage battery is one of the best examples. Also see Secondary battery; Batteries, storage.

REVERSIBLE REACTION.—A chemical or physical reaction which works both frontwards and backwards. Examples: Freezing of water; decomposition of calcium carbonate in a closed space,

$$CaCO_3 = CaO + CO_2.$$

For every temperature there is a critical pressure of equilibrium below which pressure the reaction goes from left to right, and above which it goes from right to left. Similarly, for every pressure there is a critical temperature of equilibrium, above which temperature the reaction goes from left to right and below which it goes from right to left. This relation of critical temperature to critical pressure is tabulated as the dissociation tension of the compound.

REVERSITE.—Trade name for circuit breakers manufactured by the Cutter Electrical & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa.

REVERSO.—Trade name for electric toasters manufactured by the Electro-Weld Co., 70 Munroe St., Lynn, Mass.

REVOLUTION COUNTERS.—See Counters, revolution or speed.

REVOLUTION INDICATORS.—See Tachometers, electric, indicating; Tachometers, electric, recording; Tachometers, vibrating, reed; Tachometers, miscellaneous.

REVOLVATOR CO.—336-352 Garfield Ave., Jersey City, N. J. Manufacturer of portable electric elevators. President and general manager, H. S. Germond, Jr.

REX.—Trade name for conduit benders manufactured by the M. B. Austin Co., 108-16 S. Desplaines St., Chicago, Ill.

REX.—Trade name for coal and ash handling machinery, power transmission chains and water intake screens manufactured by the Chain Belt Co., 736 Park St., Milwaukee, Wis.

REX.—Trade name for outlet boxes and ceiling plates manufactured by the W. H. Colgan Co., West Newton, Mass.

REX.—Trade name for electric heating appliances manufactured by Cope & Son, Ltd., 150 Hastings St., W., Vancouver, B. C., Can.

REX.—Trade name for insulating compounds manufactured by the Flintkote Co., Inc., 88 Pearl St., Boston, Mass.

REX.—Trade name for metallic engine packing manufactured by the Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J.

REX.—Trade name for x-ray tubes manufactured by Green & Bauer, Inc., 234 Pearl St., Hartford, Conn.

REX.—Trade name for conduit benders made by M. B. Skinner Co., 562 Washington Blvd., Chicago, Ill.

REX.—Trade name for bells and buzzers manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

REX-LITE.—Trade name for lighting units manufactured by L. Plaut & Co., 434 E. 23rd St., New York, N. Y.

REXFORD MFG CO.—Liberty, Mo. Manufacturer of oil filters.

REXO.—Trade name for photographic lamps, printing machines, etc., manufactured by Burke & James, 240 E. Ontario St., Chicago, Ill.

REXOLUX.—Trade name for motor-generators for motion picture projection manufactured by the Electric Products Co., Cleveland, Ohio.

REX-O-LUX.—Trade name for portable electric lamps manufactured by L. Plaut & Co., 434 E. 23rd St., New York, N. Y.

REYNOLDS ELECTRIC CO.—Chicago, Ill. Manufacturer of motors, electric sign flashers, kitchen units and lighting reflectors. Business established 1901. President, C. F. Ziegler; vice-president, O. D. Ziegler; secretary and treasurer, William L. Laib. Main office, 2650 W. Congress St., Chicago, Ill. Branch office, 1122 Broadway, New York, N. Y.

RHEOSTAT.—A resistor combined with means for varying its resistance. The resistance may be varied by having a movable contact lever slides over a number of stationary buttons or segments between which sections of the resistor are connected, by compressing a number of carbon or graphite disks or plates, by using a number of levers or knife switches for cutting in and out resistance, etc. In a water rheostat, two or more electrodes are immersed in the liquid (usually water with a sodium salt to make it conducting) and the resistance varied by changing the liquid level. Rheostats differ from resistance boxes in having larger current-carrying capacity; that of resistance boxes is usually limited to a few hundredths of an ampere.

RHEOSTAT CASINGS OR COVERS.—Rheostat covers usually serve the double purpose of supporting the resistance apparatus and protecting the operator against contact with live parts. They should be arranged to provide for ventilation of the resistor. Where the resistor is mounted back of the panel, the top and bottom of the supporting frame are usually made of wire screen or perforated metal.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Liberty Electric Corp., Port Chester, N. Y.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RHEOSTAT CONTACT-MAKING ARMS.—Rheostat arms are usually pivoted at one end, with a contact-making shoe at the other. Spring pressure is applied to the shoe, so that firm contact is made with the buttons or segments over which it slides. In some cases the arm is pivoted at the center, and contacts placed at both ends. For three-phase motor-speed regulators a three-armed lever is frequently used with the arms 120° apart.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RHEOSTAT CONTACTS, STATIONARY.—The stationary buttons or segments of rheostats are usually of brass or copper, and are made renewable whenever possible to permit replacing contacts burned by arcing. The number of contacts is determined by the number of control points required and by the arcing. The size of the contacts is determined from the current to be carried.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RHEOSTAT HANDLES AND EXTENSION OPERATING MECHANISM.—Rheostat handles in many cases consist simply of an insulating knob or handle fastened to the contact-making arm. Where a rheostat is mounted on the rear of a panel, or inside of an enclosing case, and operation from the front is desired, a separate operating lever is necessary. In some cases of distant location of the rheostat the operating lever or handwheel is mounted on the front of the panel and drives the rheostat arm by means of a sprocket and chain.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y.

RHEOSTAT PANELS.—See Panels, rheostat.

RHEOSTATS, BATTERY-CHARGING.—Storage batteries are sometimes charged from a separate generator (or motor-generator set) and the variation in charging current obtained by means of a rheostat in the generator field. They are usually, however, charged from a constant-voltage circuit and in this case a rheostat is placed in series with the battery which reduces the voltage across the battery and allows for adjustment of the charging current. An ammeter is generally inserted in the charging circuit so that the current may be adjusted to the proper value. Reverse-current relays or circuit breakers prevent discharge of the battery back through the charging circuit in case of failure of generator voltage. Automatic means for stopping the charge when the battery is full are frequently used, principally for battery locomotives and farm lighting plants. The charge is usually stopped by means of a contact-making ampere-hour meter, although voltage relays, current relays, and contact-making hydrometers have been used. Where a number of batteries are charged at one time separate panels are provided; for these see Panels, battery-charging.

Manufacturers:

Acme Electric & Mfg. Co., The, 1444 Hamilton Ave., Cleveland, Ohio. "Acme."
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y. "Whittingham."
Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.
Battery Appliance Corp., 3 E. 44th St., New York, N. Y. "G. B. C."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

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Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Battery Charging Rheostats are available for use with ignition batteries, starting and lighting automobile batteries, and for electric vehicle batteries of all kinds. (Also see Panels, Battery charging.) See display adv. pages 1225-1230.—Adv.
Electric Products Co., The, Cleveland, Ohio. "Wotton."
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hobart Bros. Co., 113 Water St., Troy, Ohio. "HB."
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. "National." (See display adv. page 1286.)
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Ross Engineering Co., J. J., 1006 E. Larned St., Detroit, Mich. "Ross."
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Ribohm."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RHEOSTATS, CARBON OR GRAPHITE, COMPRESSION TYPE.—This type of rheostat consists of a series of graphite or carbon disks or rectangular plates stacked in a suitable frame or tube with an adjusting screw so arranged that the pressure between the plates may be varied. This variation in pressure produces an inversely proportional variation in resistance of the stack. The change in pressure affects the resistance by changing the number of points of contact between adjacent disks or plates. This form of rheostat is particularly applicable in devices where a smooth, continuous variation of resistance over a limited range is desired. They are used in many control devices and for laboratory work.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Crane, Harold G., 322 Front St., Adrian, Mich. "Crane."

RHEOSTATS, DIMMING. — Rheostats intended for dimming lamps or lighting circuits, and used for other services than those specially listed under Dimmers, automobile and car headlight, lamp socket, and theater or stage, which see. They may be used for dimming or "fading out" a projecting lamp, producing gradual change of colors or other effects in special decorative lighting, in laboratory or special lamp testing, etc. In general, such rheostats resemble theater dimmers, but they may depart therefrom considerably, depending on the resistance range and current-carrying capacity required.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. See Dimmers, Theater or Stage. See display adv. pages 1225-1230.—Adv.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. "National." (See display adv. page 1286.) (stereopticon dissolving)
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm," "Ribohm."
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.

RHEOSTATS, ELECTRIC RAILWAY, CAR OR LOCOMOTIVE.—Resistors placed in the railway motor circuit to take up a portion of the line voltage or pressure so that the remaining voltage is suitable to the counter e.m.f. and speed and the torque developed by the motors. These resistors are of suitable metal, usually cast iron in grid form, and a number of grids are assembled and insulated in a frame, the whole being called a rheostat. One of the functions of the controller is to place in circuit at the proper time, rheostats or sections of them of the proper resistance, according to the speed of the car or locomotive. These rheostats or sections of them are removed from the circuit step by step, the maximum being in circuit at the instant of starting the car or locomotive from rest and the total resistance being reduced as speed is attained. The number of resistance steps is the minimum required to produce reasonably smooth acceleration. Railway and locomotive car rheostats must be of rugged design to withstand road shocks and vibration, and of sufficient capacity to carry for a reasonable time, the current required by the motors during starting. For large locomotives water rheostats are sometimes used; see Rheostats, water or liquid. Also see Grids, resistance.

RHEOSTATS, FIELD.—Field rheostats are adjustable resistors for inserting in the shunt field circuits of generators to control the voltage, or of shunt d-c. motors for speed control, or in the field circuits of synchronous motors and converters for power-factor regulation, etc. They are made in various forms, but usually for switchboard control where they may be mounted directly on the back of the board or in a separate compartment. This term does not properly include resistors inserted in the secondary (rotor) circuits of induction motors of the slip-ring or wound-rotor type. If remotely placed, as with large rheostats, the adjustment is either mechanical (by means of rods, levers and links, or sprocket chains) or electrical (through a motor-driven contact arm). Field rheostats are usually of the sliding-contact type, although the compression type is also used. The resistors are usually made up of alloy wire, but for very large generators cast iron grids are used.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J.
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Hanson & Van Winkle, Newark, N. J.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. "National." (See display adv. page 1286.)
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Ribohm," "Vitrohm."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

RHEOSTATS, METER-TESTING.—Meter-testing rheostats usually consist of a number of single-pole knife switches, each controlling a step of resistance. The load is varied by opening or closing the different knife switches. These differ from other rheostats in that they must be portable and are, therefore, provided with handles for carrying and are also made light and compact.

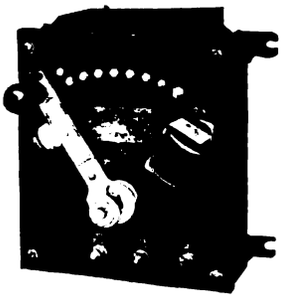
Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Jagabi" sliding contact tube rheostats. See Rheostats, special and miscel.—Adv.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Eastern Specialty Co., 3551 N. 5th St., Philadelphia, Pa.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Allen," "Stansico-Allen."
Sticht & Co., Herman H., 15 Park Row, New York, N. Y. "Standco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Ribohm."

RHEOSTATS, MOTOR-STARTING.—The commonest form of motor-starting rheostat is the simple hand starter or "starting box," which consists of a contact-making arm and a number of contact buttons or segments with resistance connected between them. As the arm is moved over the butons the motor is started and accelerated to full speed. The arm is usually held in the "full on" position by a no-voltage release device. In another form of starter, the starting lever compresses a tube of graphite disks. In the "full on" position the tube is short-circuited and the starting lever held in position by a no-voltage release device. The multiple-lever starter consists of a number of starting levers or knife switches, interlocked so that they must be closed in the proper order. Each one cuts out a step of resistance and the final lever is held by a no-voltage release device. The resistors of standard motor-starting rheostats are designed to stand one 15-second start every four minutes.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Motor Starting Rheostats are all manufactured as an integral part of a complete motor starter with operating handle and certain protective devices. C-H Bulletin 2110 is a simple starter. It is used for

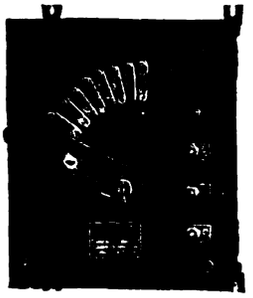


C-H Motor Starter

starting d-c. motors and provides low-voltage protection. The resistor is mounted in a substantial sheet steel frame at the rear of the panel, and is well ventilated. C-H Bulletin 2111 is similar to Bulletin 2110 except for an enclosing case and operating handle outside. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

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GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
INDUSTRIAL CONTROLLER CO., Milwaukee, Wis. Electric motor starting rheostats including open and fully enclosed types, for both d-c. and single-



Motor Starting Rheostat

phase a-c. motors. These starters are provided with under-voltage release, removable segmental contacts, heavy removable copper contact shoes, pressed steel levers, etc.—Adv.
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm," "Ribohm."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RHEOSTATS, PROJECTING LAMP.—These rheostats are used chiefly for control of projecting lamps for theaters. The ordinary forms generally circular and hand-operated, are used in gradually dissolving light from one picture to another in stereopticon machines, and for dimming lamps for focusing, etc. As they are used for control of lamps which are very sensitive to voltage variation they are provided with many steps to give a very gradual variation of resistance.

Manufacturers:

Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. "National." (See display adv. page 1286.)

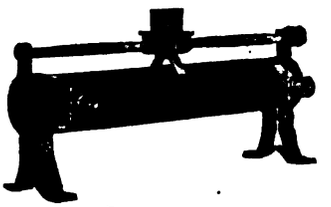
RHEOSTATS, SPECIAL AND MISCELLANEOUS.—Rheostats are often made in special forms and sizes for testing purposes. Artificial loads are produced in this way that are used in discharge tests of storage batteries and many other similar tests. Small non-inductive accurately wound rheostats having disk coils are often used in connection with instruments. The special forms used for testing include carbon or graphite plate or disk rheostats, which permit a very smooth variation of resistance by varying the pressure, thus the contact area between plates.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric rheostats are adapted for use in connection with different devices for reducing or regulating the temperature, particularly of laundry and pressing or tailor's irons. Made for devices consuming 400, 600, 800 and 1,000 watts.—Adv.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa. (blasting).
Betz Co., Frank S., Hoffman St., Hammond, Ind.
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Jagabi" sliding contact tube rheostats for meter-testing, motor control, experimental work,



"Jagabi" Tube Rheostat

control of radio apparatus, etc. Suited for any service that requires rapid regulation of electrical circuits. Resistance ratings up to 3200 ohms. Current ratings up to 25 amps.—Adv.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Ely, C. Upham, 50 Vesey St., New York, N. Y.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
General Radio Co., 11 Windsor St., Cambridge, Mass.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hayes, Carl I., Edgewood, R. I.
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
L'Hommedieu & Sons Co., Charles F., 4521 Ogden Ave., Chicago, Ill. "Reliance."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Meyrowitz, Inc., E. B., 520 5th Ave., New York, N. Y. (for physicians' diagnostic apparatus).
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Munning & Co., A. P., Church St., Matawan, N. J.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Parkin Mfg. Co., San Rafael, Cal.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sticht & Co., Herman H., 15 Park Row, New York, N. Y. "Standco."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Tresco, 1201 Kahl Bldg., Davenport, Iowa. "Perfection."
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. (for stage lamps). "Universal."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm."

RHEOSTATS, SPEED-REGULATING.—Speed-regulating rheostats for d-c. motors are either of the field-resistance (see Rheostats, field) or armature-resistance type. Speed regulators for single-phase commutator motors are similar to those used for armature control on d-c. circuits. The speed of a-c. slip-ring motors is controlled by resistance in the secondary circuit. Speed-regulating rheostats are either of the face-plate, drum, multiple-lever or carbon-pile types. With rheostats of the armature-resistance or secondary-resistance type, the speed decreases as the load increases, and they should not be used if constant speed is required. This type of rheostat is also inefficient; when the speed is reduced, energy is dissipated as heat by the resistor.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Consolidated Electric Co., Ltd., 230-232 King St., E., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.—C-H Bulletin 3110 is a simple form of C-H speed-regulating rheostat. This regulator is intended for use only in decreasing the speed of the motor below normal by means of a resistor in the armature circuit. C-H Bulletin 3130 is a multiple-switch speed regulator for use with large motors and with motors of medium size where the operating conditions are severe. C-H Bulletin 3230 is a compound speed regulator which provides low-voltage protection. Regulation is obtained by both armature and shunt field rheostats. C-H Bulletin 3235 is a multiple-switch compound speed regulator intended for use with large motors. Other speed regulators or speed-regulating rheostats are manufactured by the Cutler-Hammer Mfg. Co. for use in connection with special machines. See display adv. pages 1225-1230.—Adv.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. " E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. "National." (See display adv. page 1286.)
Schaefer Bros. Co., 1059 W. 11th St., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Uemco."
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm." "Ribohm."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RHEOSTATS, WATER OR LIQUID.—Liquid or water rheostats are used to control the current in circuits of large capacity for testing purposes or for starting and controlling large motors. They consist of sets of electrodes immersed in a tank containing water or other conducting liquid and the regulation is obtained either by raising or lowering the electrodes or by changing the level of the liquid. For testing purposes, such as testing a generator or generating station before it is put into service, the first method is largely used. A large tank is filled with acidulated or salt water or where a river or body of water is adjacent to the plant suitable electrodes are immersed in it, and the submerged depth varied or the electrodes moved together or apart to give the different loading conditions.

Rheostats of a permanent nature used in controlling large wound-rotor induction motors applied to mine hoists, haulage systems, dredges, etc., generally operate by having stationary electrodes and varying the liquid level. A motor-driven pump is provided to circulate the liquid or electrolyte, which is sometimes a solution of sodium carbonate. Motion of the controlling handle causes a wier to raise or lower and thus the liquid level is determined. Cooling coils supplied with cir-

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culating water are placed in the reservoir containing the electrolyte when the current to be regulated is very large.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. page 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RHOADS & SONS, J. E.—Philadelphia, Pa. Manufacturers of belting, straps and washers. Main office, 12 N. 3rd St., Philadelphia, Pa. Factory, Wilmington, Del. Branch offices, 102 Beekman St., New York, N. Y.; 322 W. Randolph St., Chicago, Ill.

RHODE ISLAND ELECTRIC PROTECTIVE CO.—32 Custom House St., Providence, R. I. Manufacturer of burglar alarm and fire alarm equipment. President, George H. Grant; vice-president, Dr. A. B. Briggs; secretary, treasurer and general manager, Henry A. Barker.

RHODIN CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution, using a mercury cathode and a rotating anode.

RIBBON, RESISTANCE. — Resistance materials are often made up in the form of ribbon to be used in heating elements or rheostats where large current-carrying capacity is required or where a particularly flat construction is desired. One example of the latter is in the construction of the heating elements for electric flatirons, where resistance ribbon is wound over a mica form. The size of resistance ribbon is expressed in thickness in the American Wire Gage and ranges from No. 10 to No. 40, with widths varying from ¼ in. to 1 in. for No. 10, and 1/32 in. to 1 in. for some of the smaller sizes. For the properties and materials of which resistance wire is made see Wire, resistance.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Columbia Steel Co., The, Elyria, Ohio.
Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J. "Calido," "Rayo," "Comet," "Ideal," "Lucero," "Phenix."
Hoskins Mfg. Co., Lawton & Buchanan St., Detroit, Mich. "Chromel."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

RIBBON, SOLDER.—See Solder, wire and ribbon.

RIBBON, WIRE.—Wire ribbon is made and used for special purposes, such as where an open construction is required to provide large radiating surfaces. This is sometimes applied to field windings of generators or motors, to pancake type transformer coils, and to certain types of electromagnets. It is also used in the construction of some choke coils and for loading coils on telephone circuits. Steel ribbon wire is often used, one common form being fish tape; see Tapes or wires, steel fish. The ribbon is made in widths up to one inch and in thickness up to ¼ inch. The edges are nearly always rounded. Ribbon wire used for winding electromagnets is covered with one, two or three layers of cotton or silk, similar to that used on magnet wire.

Manufacturers:

Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J.
Lanz & Sons, Mathew, Pittsburgh, Pa.
ROME WIRE CO., Rome, N. Y. Bare and tinned copper ribbon wire as manufactured by Rome Wire Company is clean, free from scale, discoloration, roughness, fins, slivers, cracks and laminations. It is rectangular in section with rounded corners. Tinned ribbon is uniformly tin coated, clean and free from lumps, spots, kinks, splints, scraped surface or corrosion. Both the bare and tinned ribbon is thoroughly annealed after the last drawing or rolling operation and will successfully withstand cold edgewise bending when proper forming tools are used around pins of ¼ in. diameter for stock up to ⅛ in. wide and ⅛ in. or less thick, up to pins of 1 in. diameter for stock ⅞ to 1 in. wide and ⅛ in. or less thick, in an arc of 180 deg. without cracking at the edges. Special ribbon can be furnished to bed around smaller pins, if required. The method of reeling Rome Wire ribbon is shown in the cut below. Conductivity of copper is not



Rome Ribbon Wire, Reeled

less than 98 per cent and the conductivity of tinned ribbon is not less than 96 per cent, 100 per cent being based on copper having a resistance of 0.1530 ohms per meter gram at 20 deg. C. For the purpose of calculating weights, cross sections, etc., the specific gravity of copper is taken as 8.89 at 20 deg. C. Rome Wire specifications provide that bare and tinned ribbon shall have an ultimate tensile strength of not more than 40,000 lbs. for strips over .010 ins. to .020 ins. thick and elongation of not less than 25 per cent in 10 ins., ranging to an ultimate tensile strength of 37,000 lbs. for strips over .050 ins. and an elongation of not less than 32 per cent in 10 ins. All bare and tinned ribbon, rectangular or square has edges with corners rounded to a quarter circle, and is furnished in continuous lengths, necessary joints being so made that the ribbon is identical in ductility and dimensions with the rest of the ribbon and has at least 95 per cent of its strength. Orders can be executed for flat or square ribbon with sharp corners on either one or both sides if desired. The standard method of reeling square wire



Rome Square Wire, Reeled

is illustrated. Variation in thickness for both bare and tinned ribbon is closely restricted and Rome Wire square and ribbon wire is accurate and quite uniform as to dimensions. For other Rome Wire products see display advertisement on page 1247.—Adv.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

RIBOHM.—Trade name for rheostats manufactured by the Ward Leonard Electric Co., Mt. Vernon, N. Y.

RIC-WIL CO., THE.—Cleveland, Ohio. Manufacturer of conduit systems for underground heating.

RICE, JOHN H.—509 Ford Bldg., Wilmington, Del. Producer of chestnut poles.

RICE & LAWLER CO.—23 Church St., Cambridge, Mass. Manufacturer of electrical heating appliances.

RICE & SARGENT.—Trade name for steam engines manufactured by the Providence Engineering Corp., 521 S. Main St., Providence, R. I.

RICHARD.—Trade name for engineers' oiler manufactured by the Ansonia Novelty Co., 285 Main St., Ansonia, Conn.

RICHARDSON BRASS CO., THE EDBRO.—318 N. Holliday St., Baltimore, Md. Manufacturer of couplings, elbows, locknuts and other brass goods. Business established 1897. President and general manager, Edro Richardson; vice-president, E. F. Richardson; secretary and treasurer, C. Herbert Clayton.

RICHARDSON-PHENIX CO., THE.—124 Reservoir Ave., Milwaukee, Wis. Manufacturer of oil filters, lubricators, gages, valves, etc. President, J. William Peterson; vice-president and general manager, L. E. Strothman; vice-president and secretary, F. L. Swanberg.

RICHMOND.—Trade name for electric bath cabinets manufactured by the Hospital Supply Co., 157 E. 23rd St., New York, N. Y.

RICKETTS.—Trade name for illuminated thresholds for elevators manufactured by the Elevator Supplies Co., Inc., 1515 Willow Ave., Hoboken, N. J.

RICO.—Trade name for motormen's power economy recorders manufactured by the Railway Improvement Co., 61 Broadway, New York, N. Y.

RIDDLE CO., THE EDWARD N.—Toledo, Ohio. Manufacturer of lighting fixtures, portable electric lamps and shades. Business established 1892. President, treasurer and general manager, Edward N. Riddle; vice-president and sales manager, J. Newton Riddle; secretary, John K. Riddle. Main office, 27 Broadway, Toledo, Ohio. Branch office, 292 5th Ave., New York, N. Y.

RIDDLES, FOUNDRY, MOTOR-DRIVEN.—Riddles are used for breaking up and sifting the sand preparatory to its use in molding. The motor-driven riddle is essentially a machine for holding a riddle and shaking it with much the same motion as is communicated by hand riddling. The machines are of two types, one for overhead suspension from a trolley, the other mounted on legs to be placed on the floor wherever it is desired. The riddle is actuated by an electric motor which, through gears, cams or other mechanical means communicates an elliptic or rocking motion, or combination of both, to the riddle. The motor and all bearing parts are enclosed in dustproof covers for protection from the dust and dirt common in the foundry. Motors of about ¼ hp. are used and may be connected into any lamp socket, no special power wiring being required for these machines.

Manufacturers:

Champion Foundry & Machine Co., 2419 14th St., Chicago, Ill. "Champion."
Great Western Mfg. Co., Box 813, Leavenworth, Kans. ("Combs" gyratory.)
Maroa Mfg. Co., Maroa, Ill. "Worsham."
Tessmer Machine & Tool Co., 285-91 Rivard St., Detroit, Mich.
Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

RIDER-ERICSSON ENGINE CO.—Walden, N. Y. Manufacturer of electric pumps and internal combustion engines. Business established 1842. President, D. C. Dominick; vice-president and treasurer, Sanford Abrams; secretary, Alpha Andrews; general manager, H. L. Shartle. Main office, Walden, N. Y. Branch offices, 20 Murray St., New York, N. Y.; 116 S. 8th St., Minneapolis, Minn.; 203 N. Liberty St., Baltimore, Md.; 564 W. Randolph St., Chicago, Ill.; 40 N. 7th St., Philadelphia, Pa.; 1536 Franklin St., Tampa, Fla.; Fidelity Mutual Bldg.; Wilson, N. C.; 9th & Cary Sts., Richmond, Va.

RIDGWAY DYNAMO & ENGINE CO.—Ridgway, Pa. Manufacturer of motor-generators, generators, steam engines and turbines, etc. Business established 1897. Main office and factory, 120 Electric Ave., Ridgway, Pa. Branch offices, New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Wilkes-Barre, Pa.; Cincinnati, Ohio; Cleveland, Ohio; Chicago, Ill.; St. Louis, Mo. Sales representatives, F. L. DeMarce, Chattanooga, Tenn.; Keiser-Geismer Engineering Co., Birmingham, Ala.; Hotchkiss Engineering Corp., Memphis, Tenn.; Electric Appliance Co., New Orleans, La.; Power Equipment Co., Little Rock, Ark.; Coast Equipment Co., San Francisco, Los Angeles, Cal., and Portland, Ore.; L. E. Pollard Co., Minneapolis, Minn; Lindrooth-Shubart Co., Denver, Colo.

RIEBER.—Trade name for X-ray equipment manufactured by the Roentgen Appliance Co., 693 Mission St., San Francisco, Cal.

RIEHLE BROS. TESTING MACHINE CO.—1424 N. 9th St., Philadelphia, Pa. Manufacturer of testing machines. President, Frederick A. Riehle; secretary, Henry R. Fiells.

RIEKER INSTRUMENT CO.—1919-21 Fairmount Ave., Philadelphia, Pa. Manufacturer of electrical and other scientific instruments. Business established 1916. President and general manager, Walter C. Rieker; vice-president and treasurer, E. G. Rieker; secretary and sales manager, M. A. McCready.

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RIESENMAN MFG. CO., LTD.—Franklin, Pa. Manufacturer of insulating and protective paints and varnishes. President, Joseph Riesenman; secretary and general manager, Joseph Riesenman, Jr.

RIGGS, DISTLER & STRINGER.—Baltimore, Md. Manufacturers of cutout boxes.

RIGHT.—Trade name for gaskets made by the Gasket Supply Co., 1729 Ludlow St., Philadelphia, Pa.

RIGHT-O-WAY.—Trade name for automobile signals manufactured by the Boesch Lamp Co., 960-62 Mission St., San Francisco, Cal.

RILEY STOKER CO., SANFORD.—Worcester, Mass. Manufacturer of automatic furnaces and underfeed stokers. President, R. Sanford Riley; vice-president, R. T. Riley; secretary and general manager, F. H. Daniels, Jr.; treasurer, Aldus C. Higgins; sales manager, William Pestell. Main office, 9 Neponset St., Worcester, Mass. Factories, Detroit, Mich. and Worcester, Mass. Branch offices, Boston, Mass.; New York, N. Y.; Buffalo, N. Y.; Chicago, Ill.; Cleveland, Ohio.; Detroit, Mich. Sales representatives, Stearns-Roger Mfg. Co., Denver, Colo.; Robinson, Cary & Sands Co., St. Paul, Minn.; F. M. Beeson Machinery Co., Kansas City, Mo.

RINEHART.—Trade name for solder and babbitt metal manufactured by the Pittsburgh White Metal Co., 3116 Penn Ave., Pittsburgh, Pa.

RING AND DELTA CONNECTIONS.—A ring connection is one in which the individual phase circuits of a polyphase system are connected end to end, thus forming a closed circuit of the various phases in series. This type of connection in a three-phase system is usually called the delta connection.

RING, CIRCUIT.—Where two lines from a station are joined together by tie lines the combination is known as a ring system. Such a system may have loops to several substations or industrial consumers, and is used in transmission and bulk supply systems chiefly. When additional radial lines are required from the source of supply to points along the ring, the system becomes a network.

RING-O-LITE.—Trade name for incandescent lamps manufactured by the V. & D. Electric Co., 335 S. Center St., Franklin, Ohio.

RING OILING.—A method of lubrication often used on electrical machinery. Rings of a much larger diameter than the shaft to be lubricated are hung upon it with their lower portions dipping into a bath or well of oil. The rotation of the shaft causes the ring to travel around it and thus oil is carried to the upper surface of the shaft, where it spreads out to lubricate the bearing. Also see Bearings, ring-oiling.

RINGERS AND TOLLERS, BELL, MOTOR-OPERATED.—For large bells and gongs and in many cases where regular direct-current light or power circuits are available it is more convenient or economical to use a motor-operated bell ringer rather than install a battery system to avoid the troubles due to arcing at the contacts occurring at the higher voltage of the light and power circuits. Motors are used not only on the larger gongs, but on bells which must be rung for long periods and at frequent intervals when their use is often more practical or economical than the magnetically actuated types. Large church bells or community bells are sometimes tolled by electric motors through a reduction gear and eccentric with suitable connecting rod.

Manufacturers:

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
STATES CO., THE, 72 Francis Ave., Hartford, Conn. "Alert."

RINGERS, MAGNETO.—See Generators, magneto, telephone.

RINGERS, TELEPHONE.—A telephone ringer is the polarized electric bell used on subscribers' telephone sets to call the subscriber or to indicate by means of audible signals an incoming call for any particular subscriber. In its usual form, the ringer consists of two coils of fine wire connected in series and wound on soft iron cores. A permanent magnet is placed parallel to the coils and between them, with a soft iron armature pivoted at its center at the bottom. A slender rod terminating in a small metal ball is attached to the armature. When the armature vibrates the small metal ball is caused to strike two gongs. When no current flows through the coils the permanent magnet causes the armature to be attracted by both cores and it will rest against either one. When the current does pass, one of the coils will have its magnetism strengthened and the other weakened. This may or may not move the armature. If the current is reversed, however, the opposite polarity is given to the coils and the armature will be pulled over. Alternating current thus causes a vibration and rings the subscriber. The ringers range in resistance from 80 ohms for series ringers to 3500 ohms for bridging ringers. The usual resistance for ordinary lines is 1000 ohms.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., THE., 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The. Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

RINGING INTERRUPTERS, TELEPHONE.—This is a device in the telephone power plant for breaking up the ringing current into periods. Sometimes it takes the form of a dashpot relay, which pulls up quickly and descends slowly, passing wipers over a bank to cause different groups of boards to ring at different times. Sometimes it takes the form of contact springs on a slow-running shaft on the ringing machine. In all large offices the ringing interrupter distributes the ringing, so that only part of the connectors are ringing at a time. It enables a small generator to ring many lines.

Manufacturer:

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)

RINGING MACHINES, TELEPHONE.—Ringing machines generally constitute a rining generator, ringing interrupter and control apparatus. The generator is any electrical generator used to produce ringing current. It is usually an alternating-current generator, or one producing pulsating current. The interrupter is sometimes mounted on the shaft of the ringing generator or it may be separate. See Ringing interrupter, above. The control apparatus is necessary to give periodic ringing which is the system of ringing bells intermittently. Often the bell is rung for one second, with a rest of three or four seconds before the next ring begins. If the subscriber answers at any time, it stops the ringing, even if he takes off the receiver in the midst of a ringing period.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Butler-Edwards Electric Co., Easton, Pa.
Leich Electric Co., Genoa, Ill.
Warner Electric Co., Muncie, Ind.

RINGING, PUSH-BUTTON.—A method of ringing in an automatic telephone system. Each telephone has a push button with which to ring the called station after having dialed the call number. Used in three-wire systems.

RINGING, TELEPHONE PARTY LINE.—There are two principal methods of ringing used in telephone systems. These are often referred to as signaling systems. They are code signaling or ringing systems and selective calling systems.

In the code ringing systems many party lines have all their telephones equipped with similar bells so that all of them ring together. To enable subscribers to know which station is desired, a code of signals is arranged, two rings for one station, three rings for another, a short ring followed by a long ring for another, etc. This is sometimes referred to as "open" code ringing. The selective calling systems do not ring the bells of any but the subscriber called. For these systems see Telephone selective calling systems.

RINGS, BRIDLE.—Steel rings covered with an insulating enamel. They are used in telephone distributing frames to hold jumper wires where they change direction. They are also useful in other places, as mounted in a wall where a number of wires or circuits are placed loosely in the rings and thus held in place.

Manufacturers:

Brooks & Sons, M. S., Chester, Conn.
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Diamond."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Judd Co., H. L., 87 Chambers St., New York, N. Y.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."

RINGS, CABLE.—Cable rings are used for the same purpose as cable hangers, to support a cable from a messenger wire. They are generally made of galvanized steel strip formed into a ring and arranged with several methods of connecting to the strand. They are made in several diameters to accommodate the various cable sizes. Some types of rings are secured to the messenger by means of a special pair of locking or crimping pliers. (See Pliers, crimping.) Other types have two hooks that drop onto the supporting wire and in some cases are engaged by making a partial turn. Also see Clips, cable, and Hangers, cable.

Manufacturers:

Cameron Appliance Co., 48 Waters Ave., Everett, Mass. "Bonita," "Locke," "Cameron," "Yonkers."
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y. "Sebco."

RINGS, CHAIN-SUPPORTING, FIXTURE.—These are rings which offer a very simple method of attaching chain fixtures to outlet-box fittings and ceiling-outlet plates. They generally are made with a threaded portion so that they may be screwed onto fixture studs or connectors or may be attached to special outlet-box fittings provided for this purpose. The lower part of the ring has hooks attached to it from which the chains are supported. The ring is usually made of brass and finished to correspond with the fixture.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Reading Brass Works, Reading, Pa.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

RINGS COMMUTATOR.—See Commutator insulating rings and segments.

RINGS, FIBER, RUBBER AND OTHER INSULATING.—Fiber, rubber and other insulating materials, such as sheet mica, papers of various kinds, micarta or phenol fiber and other compositions, are often made up into rings to be used for various miscellaneous purposes in the manufacture of electrical apparatus. They are largely used by lighting fixture manufacturers to insulate the various parts of enclosed units and other fixtures. They are also extensively used in assembling other kinds of apparatus, such as telephone and telegraph appartus, etc.

Manufacturers:

Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.

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Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can. (leather).
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. (Fiber.)
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory." "Super Seasoned."
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.
Salisbury & Co., Inc., W. H., 308-10 W. Madison St., Chicago, Ill.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Standard Insulation Co., Rutherford, N. J. "Sico."
Tar Heel Mica Co., The, Plumtree, N. C.

RINGS, FIXTURE.—Fixture rings are threaded brass rings of such size as to screw onto a socket shell that is threaded for receiving a shade holder. Its purpose is to permit the attachment of ornamental pieces to an ordinary socket. The rings are usually about 2 ins. in diameter and pierced with two holes. Also see Fixture fittings and parts, miscellaneous.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Friedley-Voshardt Co., 733-737 S. Halsted St., Chicago, Ill.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Liberty Machine Co., Wauwatosa, Wis.
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
M. S. W. Co., Inc., 1527-1529 Niagara St., Buffalo, N. Y.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

RINGS, PACKING.—See Packing, cylinder, turbine, valve, etc.

RINGS, PISTON.—If a piston were made to fit as close to the cylinder as is necessary to prevent the leakage of steam or other fluid from one side to the other, the friction developed would be too great. To produce a steam-tight fit without this excessive friction rings which fit in grooves on the piston are used. The rings are made of spring steel and are usually slit so that they press firmly against the interior surface of the cylinder, giving a steam-tight fit, but due to their smaller surface, with little friction.

Manufacturers:

Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.
McQuay-Norris Mfg. Co., St. Louis, Mo. "Leak-Proof," "Superoyl," "Jiffy-Grip," "Step-Cut."
No-Leak-O Piston Ring Co., 824 W. North Ave., Baltimore, Md.
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
Stark-Inland Machine Works, Inc., 1629 Locust St., St. Louis, Mo.
United States Hammered Piston Ring Co., Irvington, N. J.
Victory Hammered Piston Ring Co., 494 Mulberry St., Newark, N. J.

RINGS, POLE.—Pole rings are sometimes used on wooden poles just below crossarms for the purpose of supporting brackets which carry insulators for the service wires to several customers. The rings are split so that they may be installed at any time and they are drilled so that more brackets may be added as needed. Braces are used to support the rings, which are used in pairs. These rings are sometimes called distributing circles, especially in the larger sizes.

Manufacturers:

Bethlehem Steel Co., South Bethlehem, Pa.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.

RINGS, SOCKET.—Socket rings are insulating rings made either of porcelain, soft rubber, hard rubber, composition, etc. They are threaded on the inside to screw onto a socket shell and when in place serve to protect and insulate the shell from any enclosing metal or fixture fittings. The soft rubber socket rings are for use on weatherproof sockets and are placed over the junction of the socket shell and the lamp to give a weatherproof joint.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
PARKER & SON, INC., J. H., Parkersburg, W. Va.

RISDON MFG. CO., THE.—Andrew Ave., Naugatuck, Conn. Manufacturer of brass and other metal stampings for electrical purposes. President, C. E. Beardsley; vice-president and general manager, L. A. Dibble; secretary and treasurer, G. T. Wigmore; sales manager, A. B. Brown.

RITCO.—Trade name for bell-ringing transformers manufactured by the A. E. Rittenhouse Co., Honeoye Falls, N. Y.

RITE-HEAT.—Trade name for electric disk stove manufactured by the American Electrical Heater Co., Woodward, Burroughs & Cass Aves., Detroit, Mich.

RITE-LITE.—Trade name for commercial lighting unit manufactured by the King Mfg. Co., St. Joseph, Mo.

RITER-CONLEY CO.—Pittsburgh, Pa. Manufacturer of steel transmission towers. Acting general manager, H. S. Sanford. Main office, Pittsburgh, Pa. Branch offices, Boston, Mass.; Chicago, Ill.; Cincinnati, Ohio; Detroit, Mich.; Cleveland, Ohio; New York, N. Y.; Philadelphia, Pa.; San Francisco, Cal.; Seattle, Wash.; Syracuse, N. Y.; Washington, D. C.

RITTENHOUSE CO., THE A. E.—Honeoye Falls, N. Y. Manufacturer of bell-ringing transformers, electrical toys and conduit benders.

RITTER DENTAL MFG. CO., INC.—Rochester, N. Y. Manufacturer of electrical dental laboratory apparatus. President, A. R. Shumway; vice-president, L. R. Brown; secretary, Herbert Noble; treasurer, I. H. Kline; general manager, E. L. Wayman. Main office and factory, 404 West Ave., Rochester, N. Y. Branch offices, 248 Boylston St., Boston, Mass.; 200 5th Ave., New York, N. Y.; 1619 Chestnut St., Philadelphia, Pa.; 249 Woodward Ave., Detroit, Mich.; 30 N. Michigan Blvd., Chicago, Ill.; 10th & McGee Sts., Kansas City, Mo.; 760 Market St., San Francisco, Cal.

RIVAL.—Trade name for measuring tapes manufactured by the Lufkin Rule Co., Saginaw, Mich.

RIVERSIDE ACID WORKS.—Warren, Pa. Manufacturers of acids. George J. Hesch, general manager.

RIVERSIDE IRON WORKS.—410 Riverside Blvd., N. E., Calgary, Alta., Can. Manufacturers of electric coal mining equipment.

RIVET-HEATING MACHINES, ELECTRIC.—These machines heat the rivets by passing through them a very high current. This current is produced by using a transformer having a large number of primary turns and a secondary of several turns of very heavy copper bars. The rivet is inserted between electrodes forming a part of the secondary circuit, the insertion of the rivet closing the circuit and starting the current through the rivet. In some types the electrodes are formed around the transformer core and when the rivet is in place complete a one-turn secondary. These machines consume about 20 kw-hrs. per 100 lbs. of rivets regardless of the size of rivet.

Electric heating of rivets has a number of advantages. Many rivets are spoiled by improper heating in the ordinary forge fire and this spoilage is almost completely eliminated when the electric heater is employed. The heater is semiportable and since it does not develop excessive heat or give off smoke and fumes as do the forge types it may be used directly adjacent to the work, producing a material economy of time in handling the material. It is claimed that the rivets when heated electrically hold their heat longer because when heated in this manner they are heated form the core outward rather than the reverse, which is true of the rivets heated in forge heaters.

Manufacturers:

American Car & Foundry Co., 165 Broadway, New York, N. Y. "Berwick."
Eveland Electric Riveter Co., 509 West End Trust Bldg., Phialdelphia, Pa. "Eveland."
GENERAL ELECTRIC CO., Schenectady, N. Y. An electric rivet heater, power consumption of which varies from 17 to 20 kw.-hr. per hundred pounds of rivets, depending upon the size and composition of the rivets. It can be provided with wheels at small additional cost, thus giving greater portability. See adv. pages 1203-1223.—Adv.



G-E Rivet Heater

Humil Corp., The, 101 Park Ave., New York, N. Y. "HM."
Liberty Electric Corp., Port Chester, N. Y.
Taylor Welder Co., The, Warren, Ohio.
Winfield Electric Welding Machine Co., Warren, Ohio.

RIVETING MACHINES, ELECTRICALLY OPERATED.—These machines are employed for rapid riveting in shops. The machine, by means of motor-driven gear mechanism, operates a hammer which in action reproduces the action of hammer blows delivered with a hand hammer or pneumatic riveter. Foot pedal control is used which makes operation of the machine very simple. Peens of various shapes are furnished so that flush riveting, filling of countersinks or forming heads of any shape desired may be accomplished. Solenoid or motor-operated portable riveting machines are used in shops and factories, in repair work, assembly of large sheet-metal forms, and other similar riveting where a stationary machine is not practicable. These portable riveters are similar in construction to the more common spring or hammer type portable brick or cement drills.

Manufacturers:

Eveland Electric Riveter Co., 509 West End Trust Bldg., Phialdelphia, Pa. "Eveland."
High Speed Hammer Co., Inc., The, 313 Norton St., Rochester, N. Y.
Rock River Machine Co., N. Main St., Janesville, Wis.
Winfield Electric Welding Machine Co., Warren, Ohio.
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

RIVETS, BRASS AND COPPER.—Brass and copper rivets, though not as strong as steel or iron rivets, have many applications where strength is not the first consideration, as in electrical apparatus where high conductivity is desired or where a soft and more ductile rivet is applicable. Such rivets are made in a wide variety of shapes and sizes for the many purposes to which they are put. Among these is the riveting of linemen's tool belts, safety straps, tool bags, etc.; leather belting for motors and generators, etc.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn. "Star Brand."
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Blake & Johnson Co., The, Box 1054, Waterbury, Conn.
Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
Champion Brass Works, Coldwater, Mich.
Clark Bros. Bolt Co., Milldale, Conn.
Cleveland Wrought Products Co., The, West 58th St., Cleveland, Ohio.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Pawtucket Screw Co., Pawtucket, R. I.
Reed & Prince Mfg. Co., Worcester, Mass.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.

RIVETT LATHE & GRINDER CO.—20 Riverview Rd., Brighton District, Boston, Mass. Manufacturer of heavy-duty grinding machines and threading machines. M. E. Johnson, sales manager.

R. I. W.—Trade name for protective paint manufactured by Toch Bros., 320 5th Ave., New York, N. Y.

R. I. W. INSULECTRIC.—Trade name for insulating paints manufactured by Toch Bros., 320 5th Ave., New York, N. Y.

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R-K.—Trade name for draft regulators manufactured by the Ruggles-Klingemann Mfg. Co., 15 Foster Court, North Salem, Mass.

RLM.—Abbreviation and trade designation for Reflector and Lamp Manufacturers' standard dome reflectors. See Reflector and lamp manufacturers' standard.

R. M. S.—Abbreviation for the root-mean-square value of an alternating current or alternating e.m.f.

ROACH & CO., INC., JOSEPH H.—Philadelphia, Pa. Manufacturer of mechanical stokers. President, Joseph H. Roach; vice-president, Joseph H. Roach, Jr.; secretary and treasurer, Joseph C. Laird. Main office, 221 S. 15th St., Philadelphia, Pa. Branch offices, Boston, Mass.; New York, N. Y.; Pittsburgh, Pa.; Cleveland, Ohio; Dayton, Ohio; Chicago, Ill.; St. Paul, Minn.; Denver, Colo.; Charlotte, N. C.

ROADLIGHTER.—Trade name for automobile lamp lenses manufactured by the C. A. Shaler Co., 22 Jefferson St., Waupun, Wis.

ROASTERS, CEREAL.—Cereal roasters are constructed similarly to the coffee roasters but differ in the interior construction of the cylinder. The auxiliary equipment also differs, particularly the cooling apparatus which is of an entirely different character.

Manufacturers:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.

ROASTERS, ELECTRIC, COCOA BEAN.—Cocoa bean roasters resemble the coffee roasters but due to the difference in the beans and method of treatment they differ in the cylinder construction and minor details. The auxiliary apparatus is much the same as that of the coffee roaster.

Manufacturers:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.

ROASTERS, ELECTRIC, COFFEE.—Coffee roasters consist essentially of a rotating drum or cylinder in which the coffee is placed and heated at the required temperature, generally by a coal or gas fire, or in some smaller types by electric heating elements. The smaller plants are usually constructed with auxiliary equipment, such as elevators, feed hoppers, exhaust or ventilating fans, and cooling apparatus, all machines being operated by a single electric motor. The larger plants have a battery of roasters driven by a single motor, the auxiliary equipment being operated by separate motors.

Manufacturers:

Deer Co., Inc., The A. J., Hornell, N. Y. "Royal."
Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich.

ROASTERS, ELECTRIC, PEANUT.—The roasters used in the peanut-butter industry are very similar to the coffee or cereal roasters, their chief difference being in the construction of the cylinder. The peanut roasters used in conjunction with popcorn machines, though somewhat similar in principle to the larger machines, serve mainly to keep the peanuts at a moderately warm, even temperature.

Manufacturers:

Cretors & Co., C., 620 W. 27th St., Chicago, Ill.
Deer Co., Inc., The A. J., Hornell, N. Y. "Royal."
Dunbar & Co., 2652 W. Lake St., Chicago, Ill.
Holcomb & Hoke Mfg. Co., Indianapolis, Ind.
Kingery Mfg. Co., 420-424 E. Pearl St., Cincinnati, Ohio.
Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich. "Lambert," "Economic."

ROBBINS & MYERS CO., THE.—Springfield, Ohio. Manufacturer of electric fans, motors and generators. Business established 1878. President, C. F. McGilvray; vice-president and general manager, W. J. Myers; secretary, W. A. Myers; treasurer, H. E. Freeman. Main office, Lagonda Ave. & Leah St., Springfield, Ohio. Factories, Springfield, Ohio; Xenia, Ohio; Brantford, Ont., Can. Branch offices and warehouses, 30 Church St., New York, N. Y.; 201 Devonshire St., Boston, Mass.; 1418 Walnut St., Philadelphia, Pa.; 406 Marshall Bldg., Cleveland, Ohio; 1444 Conway Bldg., Chicago, Ill.; 701 Rialto Bldg., San Francisco, Cal.; 821 Union Central Bldg., Cincinnati, Ohio; 1522 Chemical Bldg., St. Louis, Mo. District office, 831 Ellicott Square Bldg., Buffalo, N. Y.

ROBERTS.—Trade name for pole changer manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

ROBERTS CO., THE GEORGE J.—251 E. 2nd St., Dayton, Ohio. Manufacturer of electric pumps. President and general manager, George Light; vice-president, Edward Light; secretary, treasurer and sales manager, John C. Jamieson.

ROBERTS ELECTRICAL DEVICE CORP.—517 W. Monroe St., Chicago, Ill. Manufacturer of punch press guards. Secretary and treasurer, H. G. McClellan.

ROBERTS FILTER MFG. CO.—Darby, Conn. Manufacturer of water filters and softening apparatus. President, Charles V. Roberts. Main office and factory, 6th & Columbia Sts., Darby, Conn. Branch offices, Flatiron Bldg., New York, N. Y.; Mutual Bldg., Kansas City, Mo.

ROBERTS-HAMILTON CO.—413 S. 4th St., Minneapolis, Minn. Manufacturer of farm lighting and power plants. President, E. H. Roberts; secretary and treasurer, L. L. Hamilton.

ROBERTS MFG. CO.—Somerville Station, Boston, Mass. Manufacturer of bolt and rivet clippers. Manager, F. A. Roberts.

ROBERTS MOTORS.—Sandusky, Ohio. Manufacturer of gasoline engines. President and general manager, E. R. Johnston; secretary and treasurer, F. E. Bookerman.

ROBERTSON & SONS, JAMES L.—78-80 Murray St., New York, N. Y. Manufacturer of steam specialties. Business established 1879. President, James L. Robertson; vice-president and general manager, James L. Robertson, Jr.; secretary and sales manager, Frank Robertson.

ROBERTSON CHEMICAL CO.—Cleveland, Ohio. Manufacturer of impregnating compounds, insulating paints and varnishes.

ROBERTSON CO., H. H.—1st National Bank Bldg., Pittsburgh, Pa. Manufacturer of asbestos paper, etc.

ROBERTSON ELECTRIC CONSTRUCTION CO.—Mohawk & Niagara Sts., Buffalo, N. Y. Manufacturer of switchboards, panelboards, steel cabinets, boxes, etc. Business established 1902. President, J. D. Robertson; vice-president, W. R. Huntley; secretary, R. H. Sidway; treasurer, C. S. Sidway; general manager, W. E. Robertson.

ROBERTSON-THOMPSON.—Trade name for engine indicators manufactured by James L. Robertson & Sons, 78-80 Murray St., New York, N. Y.

ROBEY.—Trade name for semi-Diesel oil engines manufactured by the Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.

ROBIN, CHARLES G.—47 Warren St., New York, N. Y. Manufacturer of conduit end outlet bushings.

ROBINS CONVEYING BELT CO.—New York, N. Y. Manufacturer of electric coal and ash treating and handling equipment. President, Thomas Robins; vice-president, C. Kemble Baldwin; vice-president and general manager, Thomas Matchett; treasurer, E. J. Perkins; sales manager, R. K. Stockwell. Main office, 13 Park Row, New York, N. Y. Factory, Passaic, N. J. Branch offices, Old Colony Bldg., Chicago, Ill.; Newhouse Bldg., Salt Lake City, Utah; Union Arcade Bldg., Pittsburgh, Pa. Sales representatives, C. B. Davis Engineering Co., Brown-Marx Bldg., Birmingham, Ala.; The Griffen Co., Holbrook Bldg., San Francisco, Cal.

ROBINSON.—Trade name for automobile wrenches manufactured by the M. W. Robinson Co., 296 Broadway, New York, N. Y.

ROBINSON.—Trade name for lubricating oils and greases manufactuerd by the William C. Robinson & Son Co., 32 South St., Baltimore, Md.

ROBINSON & CO., T. L.—105 W. Monroe St., Chicago, Ill. Manufacturers of electric signs and lighting reflectors. Business established 1915. Partnership, C. H. Grier and J. D. W. King.

ROBINSON & SON CO., WILLIAM C.—32 South St., Baltimore, Md. Manufacturer of lubricating, transformer and insulating oils and lubricating greases. Refinery, Coraopolis, Pa. Warehouses, Boston, Mass.; New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Pittsburgh, Pa.; Charlotte, N. C.

ROBINSON CO., M. W.—296 Broadway, New York, N. Y. Manufacturer of hollow handle tool sets, automobile wrenches and nippers. Business established 1893. President and secretary, T. Nesbitt; vice-president, treasurer and general manager, E. H. Lewis.

ROBINSON MFG. CO., J. M.—3283 Spring Grove Ave., Cincinnati, Ohio. Manufacturer of motor-driven punches and shears, etc. President, Frank Johannigmann; secretary, treasurer and general manager, Clarence N. Frey.

ROBSON & CO., CHARLES.—N. W. Cor. 8th & Washington Ave., Philadelphia, Pa. Manufacturers of oven door illuminators and switch controllers.

ROCHE ELECTRIC MACHINE CO.—Grand Rapids, Mich. Manufacturer of violet-ray apparatus.

ROCHESTER.—Trade name for lubricators manufactured by Greene, Tweed & Co., 109 Duane St., New York, N. Y.

ROCHESTER.—Trade name for motors manufactured by the Rochester Electric Products Corp., 640 Driving Park Ave., Rochester, N. Y.

ROCHESTER.—Trade name for electric washing machine manufactured by the Rochester Rotary Washer Co., 87 Franklin St., Rochester, N. Y.

ROCHESTER.—Trade name for storage batteries manufactured by the Rochester Storage Battery Co., Inc., 23-30 Scio St., Rochester, N. Y.

ROCHESTER ELECTRIC PRODUCTS CORP.—640 Driving Park Ave., Rochester, N. Y. Manufacturer of motors, generators, buffers and grinders. Business established 1898. President, treasurer and general manager, Edward F. Davison; vice-president, J. H. Kimmel; secretary, E. D. Smith, Jr. Sales representatives, D. W. Smith, 149 Broadway, New York, N. Y.; Smith & Lewis, Real Estate Trust Bldg., Philadelphia, Pa.

ROCHESTER ROTARY WASHER CO.—87 Franklin St., Rochester, N. Y. Manufacturer of electric washing machines. Vice-president, Franklin H. Smith; secretary and treasurer, H. H. Stebbins, Jr.

ROCHESTER STAMPING CO.—Rochester, N. Y. Manufacturer of electric household cooking and heating appliances. President, George W. Robeson; vice-president, Irving S. Robeson; secretary, Louis S. Foulkes. Main office and factory, Rochester, N. Y. Branch office, 200 5th Ave., New York, N. Y.

ROCHESTER STORAGE BATTERY CO., INC.—28-30 Scio St., Rochester, N. Y. Manufacturer of storage batteries. President, A. C. Dyver; vice-president and treasurer, E. P. Dyver; secretary, W. W. Armstrong.

ROCHESTER WASHING MACHINE CORP.—87 Franklin St., Rochester, N. Y. Manufacturer of electric washing machines. Business established 1918. President, H. Arthur Nichols; vice-president, John M. Ward; secretary, treasurer and general manager, Henry H. Stebbins, Jr.

ROCHLITZ.—Trade name for electrically heated stills manufactured by the W. M. Lalor Co., 208 S. LaSalle St., Chicago, Ill.

ROCK DRILLS, ELECTRIC AND ELECTROPNEUMATIC.—See Drills, electropneumatic, rock; Drills, electric, rock.

ROCK ISLAND PLOW CO.—Rock Island, Ill. Manufacturer of cream separators. Business established 1855. President, S. S. Davis; vice-presidents, J. P. Weyerhaeuser and T. B. Davis; secretary and treasurer, C. E. Sharpe; sales manager, L. F. Cannon. Main office, Rock Island, Ill. Branch offices, Sioux Falls, S. D.; St. Louis, Mo. Sales representatives, Northern Rock Island Plow Co., Minneapolis, Minn.; Southern Rock Island Plow Co., Dallas, Tex.; Eastern Rock Island Plow Co., Indianapolis, Ind.; Western Rock Island Plow Co., Omaha, Neb.; Rock Island Implement Co., Kansas City, Mo.; Rock Island Implement Co., Oklahoma City, Okla.

ROCK OAK.—Trade name for leather belting manufactured by the Charles A. Schieren Co., 30-38 Ferry St., New York, N. Y.

ROCK RIVER MACHINE CO.—N. Main St., Janesville, Wis. Manufacturer of conduit bending machines, motor-driven punches, riveting machines and splitting shears. Business established 1890. Vice-president and general manager, A. A. Finkh.

ROCKBESTOS PRODUCTS CORP.—P. O. Drawer 1102, New Haven, Conn. Manufacturer of asbestos products and insulated wire and cable. Business established 1918. President, C. N. Haskell; vice-pres-

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ident and treasurer, William M. Cannon; secretary and general manager, Dixon C. Williams.

ROCKER RING.—A ring to which studs carrying the brush holders are mechanically attached, but from which they are electrically insulated. The rocker ring provides for some shifting of the brushes around the commutator for the purpose of placing them in the best commutating position. It is also called the brush yoke.

ROCKWOOD MFG. CO, THE.—1801 English Ave., Indianapolis, Ind. Manufacturer of paper pulleys. President, George O. Rockwood; secretary and treasurer, William M. Rockwood.

ROCKY MOUNTAIN DIVISION, N. E. L. A.—President E. A. Phinney, Golden, Colo. Secretary, A. C. Cornell, 1425 Curtis St., Denver, Colo.

ROCO.—Trade name for automatic counters manufactured by the C. J. Root Co., Bristol, Conn.

RODDING.—In underground cable construction, the method of drawing a cable into the conduit by first pushing through a number of conduit rods joined together is known as rodding. See Rods, duct, or conduit cleaning and fishing.

RODS, ANCHOR.—Where anchors are used the guy cable is usually attached by means of a rod of ½ to 1½ in. diameter which is brought a few feet above ground and provided with an eye. Such rods should be well galvanized. They are made in standard lengths which range from 5 to 12 ft. One end has a drop-forged or welded eye and the other end is usually threaded to fasten onto the anchor.

Manufacturers:

American Equipment Co., Norristown, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., Pittsburgh, Pa. Hubbard guy-anchor rods and eye bolts are made from open hearth steel, the eyes are drop-forged on all sizes up to 1¼ in. diameter and are hot galvanized. The drop-forged eyes are absolutely reliable in that they are stronger than the rod and have a breaking strength 40% greater than the welded type of eye. This is due to their being forged from solid metal at a much lower temperature than the welding heat, eliminating the possibility of burning or crystallizing of the metal as in the case of the welded type.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

RODS, DUCT OR CONDUIT CLEANING AND FISHING.—After an underground conduit has been installed and before cable can be pulled in, a rope of some kind must be gotten through from one manhole to the next. Jointed rods are used, each section being about 3 ft. long or short enough to be handled in the manhole, with some kind of locking joint at each end so as to permit them to be pushed end-to-end to the next manhole. The rope is pulled in by the last piece of rod and the rods disjointed as they come out of the far end. Ferrets have been used, utilizing their appetite for a rat which is sent through the duct in advance. But the ferret will not work continuously, refusing after a few hours.

Conduit rods are also equipped with various shaped cleaning brushes, reamers, cutters, etc., for cleaning away obstructions and for thoroughly cleaning the duct line before the cable is pulled in.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Empire."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y. "Trilent."

RODS, FIBER.—See Fiber sheet, rods, tubes and tubing.

RODS, GROUND.—In some cases rods of galvanized iron are used for ground connections when water pipes are not available. It is preferable to use pipe for this work in most cases. The ground is driven down into the ground to reach moist soil, if possible.

Manufacturers:

American Equipment Co., Norristown, Pa.
Burn Boston Battery & Mfg. Works, 80 Boylston St., Boston, Mass.
Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Copper Clad Steel Co., Rankin, Pa.
Goshen Lightning Rod Co., Goshen, Ind.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., Pittsburgh, Pa. Hubbard ground rods and pipes are furnished in any size from ½ to 1 in. The rods are made of high carbon steel with a long, sharp point, so they can be driven into any kind of soil with a minimum amount of trouble. They can be furnished either hot galvanized or plain.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

RODS, LIGHTNING.—These are metal rods attached to buildings and tall structures for the purpose of protection against lightning. Formerly so many frauds were perpetrated in their sale that the lightning-rod agent had a very bad name, but in recent years lightning protection has been put on a more scientific basis, and carefully compiled reports state that from 80% to 99% protection, depending on the nature of the building, is provided. One report on farm houses in the Middle West shows that with an equal number of farm houses rodded and not rodded, only one-fifteenth as many of the former were struck as of the latter.

During electrical storms the clouds tend to become charged with electricity and at a high potential above that of the earth. Buildings having high points, as towers and chimneys, tend to be struck first because closest to the clouds. Rods properly connected to the wet earth and ending in a sufficient number of points placed above the highest part of the building will lead off the slowly accumulated charge between earth and clouds, and will also conduct to earth the sudden discharge often resulting as a secondary effect from a lightning flash in the vicinity.

The rods do not need to be of copper, as iron, especially when galvanized, has been found very satisfactory. Sufficient points should be mounted, all connected together, and the system run to permanently wet ground by one and better two rods of sufficient size to be mechanically strong and secure. Most of these "rods" now consist of metal cables. All points must be permanently tight and conducting curves should be used instead of sharp bends, and the entire system should be firmly secured in place by good insulators. The vertical portion should always be placed outside the building and spaced from it, also kept away from gas pipes or similar metal conductors. The shape of the "rod" is not important, nor is the metal, as a rod, cable or pipe large enough to be mechanically strong will have sufficient conductivity. Rods are usually applied to farm houses and barns, churches and other buildings having steeples or high towers, and to tall chimneys. Telephone, telegraph and transmission line poles are also protected by attaching pointed wires every few poles, and running to ground. While there are many tall buildings in cities and very little protection installed, very few buildings are ever struck by lightning, which is possibly due to the large number of points, such as metal stacks, etc., extending into the air.

Manufacturers:

Bajohr Lightning Conductor Co., Carl, 4055 Keokuk St., St. Louis, Mo.
Boston Lightning Rod Co., 7551 Boylston St., Boston, Mass. "Wallace's."
Copper Clad Steel Co., Rankin, Pa.
Diamond Cable Co., Bourbon, Ind. "Diamond."
Electra Lightning Rod Co., 30 N. La Salle St., Chicago, Ill. "Electra."
Goshen Lightning Rod Co., Goshen, Ind.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Mast Lightning Rod Co., 929 Reibold Bldg., Dayton, Ohio. "Mast."
Moore Bros. Lightning Rod Co., Maryville, Mo. "Improved," "Perfect Top."
Nebraska Lightning Rod Co., Inc., 205 N. 17th St., Omaha, Neb. "Nebco."
Owen, J. D. & E. G., Janesville, Wis.
Roebling's Sons Co., John A., Trenton, N. J.
St. Louis Lightning Rod, 2135 DeKalb St., St. Louis, Mo. "Kretzer Brand."
Security Lightning Rod Co., The, 606-612 S. Pine St., Burlington, Wis. "Security."
Shinn Mfg. Co., W. C., 14 E. Jackson Blvd., Chicago, Ill. "Shinn-Flat."
Thompson Lightning Rod Co., Inc., The George E., Owatonna, Minn.
Universal Lightning Rod Co., The, Hespeler, Ont., Can. "Universal."
Washburne & Co., E. G., 207 Fulton St., New York, N. Y.

RODS, RESISTANCE.—These are rods made of resistance materials for use in various rheostats and instruments. The common materials for these rods are carbon and resistance alloys, the material used depending largely on the conditions of service.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Dixon Crucible Co., Joseph, Jersey City, N. J.
Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J.
HIGH TENSION SUPPLIES CO., Wilmington, Del.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

RODS, RUBBER.—See Rubber (hard) rods, sheets, tubes, tubing, etc.

RODS, WIRE.—Wire rods for electrical purposes are generally rolled from heated billets of copper or bronze. This results in long uniform rods that are round and of uniform size. They are used for drawing into wire. They usually range in diameter from 0.250 to 0.500 in. The copper or bronze used is specified as to conductivity and is usually about 98% for copper.

Manufacturers:

ANACONDA COPPER MINING CO., Rolling Mills Dept., 111 W. Washington St., Chicago, Ill. (See display adv. page 1246.)
Gulf States Steel Co., Brown-Marx Bldg., Birmingham, Ala.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Wickwire Bros., Cortland, N. Y.
Wickwire Spencer Steel Corp., Worcester, Mass.

RODTITE.—Trade name for asbestos packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

ROEBLING'S SONS CO., JOHN A.—Trenton, N. J. Manufacturer of wires, cables, insulating compounds, electrical tapes, lightning rods, etc. President, Col. W. A. Roebling; secretary and treasurer, F. W. Roebling, Jr.; sales manager, C. C. Cooley. Main office, Trenton, N. J. Factories, Trenton, N. J., and Roebling, N. J. Branch offices and warehouses, New York, N. Y.; Chicago, Ill.; Cleveland, Ohio; Atlanta, Ga.; San Francisco, Cal.; Los Angeles, Cal.; Portland, Ore.; Seattle, Wash.; Philadelphia, Pa.; Pittsburgh, Pa. District office, Boston, Mass.

ROECHLING-RODENHAUSER FURNACE.—One of the leading types of induction electric furnace for the manufacture of steel.

ROENTGEN, WILHELM KONRAD.—A German physicist, born at Lennep, Prussia, 1845. He received his doctor's degree at the University of Zurich, 1868, and then became an assistant to Professor Kundt, at Wurzburg. He was professor at Hohenheim, Strassburg and Geisser, and in 1885 became professor of physics at Wurzburg. In 1895 he read before the Physico-Medical Society of Wurzburg a paper upon his discovery of the rays which he called "X-rays;" these have since been tech-

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nically named "Roentgen rays," although still popularly known as X-rays. For this discovery he received many honors. Roentgen also conducted researches in various other branches of physics, including elasticity, cappillarity, the conduction of heat in crystals, the absorption of heat-rays by different gases, piezo-electricity, the electromagnetic rotation of polarized light, etc.

ROENTGEN APPLIANCE CO.—693 Mission St., San Francisco, Cal. Manufacturer of X-ray equipment. Business established 1919. President and general manager, Frank Rieber; vice-president, Charles S. Wheeler, Jr.; secretary and treasurer, T. R. Barrett. Exclusive distributors, Shaw Supply Co., Seattle, Wash.; Portland, Ore.; Tacoma, Wash.; R. L. Scherer Co., Los Angeles, Cal.; Wallerstedt & Paul, San Francisco, Cal.

ROENTGEN RAYS.—A form of radiation discovered by Wilhelm Konrad Roentgen in 1895, while experimenting with vacuum tubes. He called this form of radiation X-ray, because its exact nature was unknown. This term is still used and is much more common than the term Roentgen ray. See X-rays.

ROEPER CRANE & HOIST WORKS.—1730 N. 10th St., Reading, Pa. Manufacturer of electric hoists, traveling cranes and trolleys. H. P. Roeper, sole owner; sales manager, E. F. Hendricks.

ROESSLER & HASSLACHER CHEMICAL CO.—100 William St., New York, N. Y. Manufacturer of battery chemicals.

ROGERS ELECTRIC LABORATORIES CO., THE.—2015 E. 65th St., Cleveland, Ohio. Manufacturer of X-ray, violet ray and therapeutic equipment. President, F. J. Langer, vice-president, W. W. Drake; secretary, treasurer and general manager, P. C. Greenwell; sales manager, L. J. Haessly.

ROGERS FIBRE CO.—Boston, Mass. Manufacturer of insulation fibre. Main office, 121 Beach St., Boston, Mass. Factory, Kennebunk, Me. Branch offices, 43 W. 16th St., New York, N. Y.; 1024 Filbert St., Philadelphia, Pa.

ROGERS PAPER MFG. CO., INC., THE.—219 Hartford Rd., South Manchester, Conn. Manufacturer of insulating fiber products, paper and boards. Business established 1832. President and treasurer, G. H. Rogers; secretary, G. H. Pinney; general manager, Charles Ray.

ROGERS-PYATT SHELLAC CO.—New York, N. Y. Manufacturer of mica. Main office, 81 Water St., New York, N. Y. Branch offices, Boston, Mass.; Chicago, Ill.; San Francisco, Cal.; Philadelphia, Pa.

ROGERS SILVER PLATE CO.—Danbury, Conn. Manufacturer of lighting fixtures. Exclusive distributor, Eclipse Light Co., 587 Broadway, New York, N. Y.

ROGO.—Trade name for electric iron manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

ROHACO.—Trade name for farm lighting and power plants made by the Roberts,Hamilton Co., 413 S. 4th St., Minneapolis, Minn.

ROHN, GEORGE F.—524-26 Jackson St., Milwaukee, Wis. Manufacturer of sleet cutters, etc.

ROHNE.—Trade name for electric vulcanizers manufactured by the Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn.

ROHNE ELECTRIC CO., INC.—2434 25th Ave., S., Minneapolis, Minn. Manufacturer of electric heating devices. President, E. J. Rohne; vice-president, J. O. Handstad; secretary, J. J. O'Brien; treasurer, O. Kr. Boe.

ROLLER BEARINGS.—See Bearings, roller.

ROLLER-SMITH CO.—New York, N. Y. Manufacturer of portable and switchboard instruments, meters and circuit breakers. Business established 1908. President and general manager, F. W. Roller; vice-president, R. D. Smith; secretary, A. A. Whitman; treasurer, F. W. Iredell; sales manager, G. L. Crosby. Main office, 233 Broadway, New York, N. Y. Factory, Bethlehem, Pa. Branch offices carrying stock, 740 Monadnock Block, Chicago, Ill.; 6523 Euclid Ave., Cleveland, Ohio. District office, 1202 Majestic Bldg., Detroit, Mich. Sales representatives, General Machinery Co., Birmingham, Ala.; W. W. Gaskill, Boston, Mass.; W. G. Merowit, Buffalo, N. Y.; L. B. Gottschall, Dallas, Tex.; Alfred Collyer & Co., Montreal, Que., Can.; Perkins-Lenoir Co., Philadelphia, Pa.; W. A. McCombs Co., Pittsburgh, Pa.; Savage & Winter Co., St. Paul, Minn.; G. W. Piekesen, Railway Exchange Bldg., St. Louis, Mo.; Electric Material Co., San Francisco, Cal.; W. M. Price Co., Seattle, Wash.; Perkins-Lenoir Co., Baltimore, Md.; American Manufacturers Export & Import Co., Seattle, Wash.; R. M. Scrivener, Toronto, Ont., Can.

ROLLERS, CABLE.—Cable rollers are usually wooden rollers or spools mounted on a steel forging so designed that it may be secured to a messenger wire by means of two clamping screws. The overhead cable being run is placed over this roller or over several rollers and it may then be run out for several feet, without excessive strain or pulling on the cable, as it rolls easily over the wooden rollers.

Manufacturers:

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. "Matlock." (See display adv. page 1259.)

Mountain Lumber & Supply Co., Mount Union, Pa. (wood)

Specialty Device Co., The, 106 W. 3rd St., Cincinnati, Ohio. "Bierce."

Woodturning Products Co., Inc., Quincy, Mass. (wood)

ROLLINSON.—Trade name for electrical specialties manufactured by the Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J.

ROLLIS.—Trade name for hollow handle tool sets manufactured by the M. W. Robinson Co., 296 Broadway, New York, N. Y.

ROLLWAY.—Trade name for roller bearings manufactured by the Railway Roller Bearing Co., Syracuse, N. Y.

ROMA MFG. CO.—228-230 N. Jefferson St., Chicago, Ill. Manufacturer of electric ironing machines. Business established 1914. Copartnership, C. F. Roberg; August Malmberg, P. T. Roberg, H. E. A. Olson, L. W. Olson.

ROME BRASS & COPPER CO.—Rome, N. Y. Manufacturer of brass and copper bars, sheets, tubing, commutator bars, rings and segments and busbars. President and general manager, Barton Haselton; vice-president, J. J. Armstrong; secretary and sales manager, H. J. Rowland; treasurer, H. D. Wolfe. Main office and factory, Rome, N. Y. Branch offices, 233 Broadway, New York, N. Y.; Wells Fargo Bldg., San Francisco, Cal.; 115-119 N. Market St., Chicago, Ill.

ROME ELECTRICAL CO.—Rome, N. Y. Manufacturer of electrical wire. President, Newton H. Jones; vice-president, W. W. Parry; secretary and treasurer, George A. Clyde. Main office and factory, Rome, N. Y. Branch office, 211 High Ave., Cleveland, Ohio.

ROME HOLLOW WIRE & TUBE CO.—Railroad St., Rome, N. Y. Manufacturer of brass and copper sheets, rods and tubing. Business established 1909. President and general manager, Frank J. DeBisschop; vice-president, James A. Spargo; secretary and treasurer, Fred M. Shelley.

ROME MFG. CO.—Rome, N. Y. Manufacturer of brass, bronze and copper castings, electric railway forgings, fixture fittings, metal stampings, and other copper, brass, aluminum and steel products. President and general manager, P. C. Thomas; vice-president, Barton Hasleton, E. L. Spriggs; secretary, treasurer and sales manager, C. P. Drake. Main office and factory, Rome, N. Y. Branch offices, 50 E. 42nd St., New York, N. Y.; 1168 Peoples Gas Bldg., Chicago, Ill. Sales representatives, S. J. Fitzsimons Co., Cherry St., Detroit, Mich.; Osgood & Howell, Wells Fargo Bldg., San Francisco, Cal.; Casey Sheldon Foster, Inc., High St., Ft. Hill Sq., Boston, Mass.

ROME METAL PRODUCTS CO., INC.—23-31 W. 43rd St., New York, N. Y. Manufacturer of fixture loops. President, Max Loebenberg; secretary and treasurer, I. H. Lederman; sales manager, Frank H. Kimbell.

ROME QUALITY.—Trade name for brass and copper bars, sheets, tubing, commutator bars, rings and segments and busbars, manufactured by the Rome Brass & Copper Co., Rome, N. Y.

ROME WIRE CO.—Rome, N. Y. Manufacturer of electric wires and cables, bronze and copper rods. Business established 1901. President and general manager, H. T. Dyett; vice-president, F. M. Potter; secretary and sales manager, C. R. Keeney; treasurer, H. W. Barnard. Main office, Rome, N. Y. Factories, Rome, N. Y. and Buffalo, N. Y. Branch offices, 5 State St., New York, N. Y.; 833 San Fernando Bldg., Los Angeles, Cal.

RONSON.—Trade name for portable electric lamps manufactured by the Art Metal Works, Aronson Sq., Newark, N. J.

ROOKE AUTOMATIC REGISTER CO.—Providence, R. I. Manufacturer of fare registers for electric railways.

ROONEY LAMP CO., F. J.—Hoboken, N. J. Manufacturer of incandescent lamps and lamp filaments. Business established 1908. President and general manager, F. J. Rooney; vice-president, J. Rooney; secretary, J. C. Jackson; sales manager, C. Kaye. Sales representatives, James H. Healey, Boston, Mass.; Osterhout Electric Co., Philadelphia, Pa.; Panama Lamp & Commercial Co., San Francisco, Cal.; Smith Perry Electric Co., Dallas, Tex.; Electrical Material Co., Chicago, Ill.

ROOT CO., THE C. J.—Bristol, Conn. Manufacturer of automatic counters, spring wire and metal stampings. President and general manager, J. T. Chidsey; vice-president, F. S. Barnes; secretary, E. Beek; sales manager, W. F. Middlemas.

ROOT ELECTRIC SIGN CO., INC., THE.—20-30 Lock St., Lockport, N. Y. Manufacturer of electric signs. Business established 1919. President, Floyd A. Root; vice-president, Arthur L. Hoag; secretary, C. F. Metzger; treasurer, A. L. Hoag; sales manager, Howard A. Chase.

ROOT-MEAN-SQUARE VALUE. — The square root of the mean of the squares of the instantaneous values for one complete cycle. Abbreviated r.m.s. Also called "effective value," which see. Applied especially to the r.m.s. values of alternating currents and alternating e.m.f.'s.

ROOT SPRING SCRAPER CO., THE.—Kalamazoo, Mich. Manufacturer of street car fenders, snow plows and sweepers for electric and steam railroads. F. N. Root, president and general manager.

ROOTS.—Trade name for electric blowers, pumps, etc., manufactured by the P. H. & F. M. Roots Co., Connersville, Ind.

ROOTS CO., THE P. H. & F. M.—Connersville, Ind. Manufacturer of electric blowers and pumps. President, E. D. Johnston; vice-president, C. C. Abbott; secretary and treasurer, Erle G. Meeks. Main office and factory, Connersville, Ind. Branch offices, 432 Peoples Gas Bldg., Chicago, Ill.; 120 Liberty St., New York, N. Y.

ROPE CLAMPS.—See Clamps, rope.

ROPE CLEATS.—See Cleats, rope.

ROPE CLIPS, WIRE.—See Clips, wire rope.

ROPE FIRE ESCAPE CO.—1626 Market St., Philadelphia, Pa. Manufacturer of fire alarm boxes and gongs.

ROPE, LAMP LOWERING AND LAMP TRIMMERS'.—Lamp lowering rope, used for lowering and hoisting arc or other street lamps, is usually made of braided cotton and given a weatherproof finish to resist the effect of rain and snow. Lamp trimmers' ropes are a special rope having a snap hook at one end and several rings, clamped at any desired intervals at the other, so as to accommodate lamps hung at varying heights above the street. Trimmers' ropes are generally used in connection with hoisting ropes as portable extensions for the latter.

Manufacturers:

Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.

Roebling's Sons Co., John A., Trenton, N. J.

SAMSON CORDAGE WORKS, Boston, Mass. Samson spot cord for arc lamps. (See entry under Cord or cordage, for arc lamp suspension, car registers and bells, trolleys, etc.)—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

ROPE PAPER.—See Paper, fish and rope.

ROPE, STEEL WIRE.—Wire rope may be made with high strength, rigidity, elasticity, flexibility, or with almost any other quality that may be desired and has consequently many mechanical applications, such as for hoisting machinery, elevators, and haulage and transmission ropes. The rope is generally made up of standard wire, in the larger sizes of small stranded cables, wound around a core of steel or of hemp, the latter more commonly where flexibility is desired. For steel stranded wire used for cable messenger service, guy wires, catenary suspensions, etc., see Strand, galvanized steel.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of steel wire rope. Send for catalog.—Adv.

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Cope, T. J., 1620 Chancellor St., Philadelphia, Pa.
Driver-Harris Co., Harrison, N. J.
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Leschen & Sons Rope Co., A., 5909 Kennerley Ave., St. Louis, Mo. "Hercules."
Moon Co., George C., Garwood, N. J.
PITT ENGINEERING CO., 120 W Kinzie St., Chicago, Ill.
Roebling's Sons Co., John A., Trenton, N. J.

ROPE, TROLLEY, ELECTRIC CAR.—A special cord or rope of hard wear and weather-resisting exterior surface attached to the trolley wheel harp and used as a means of controlling the trolley pole, when the wheel leaves the wire, and to pull the pole down and place it under the holding hook when desired. It forms the connection between the trolley catcher, retriever or other means of attachment to the car, and the trolley pole. For manufacturers see Cord or cordage, braided.

ROPER CORP., GEORGE D.—Rockford, Ill. Manufacturer of electric pumps, time recording clocks and ranges. Business established 1884. President, George D. Roper; vice-presidents, W. E. Derwent, J. C. Curtain, M. R. Roper, H. J. Jilbert; assistant secretary, H. J. Jilbert; treasurer and general manager, M. P. Roper; sales managers, W. E. Derwent, J. C. Curtain. Main offices and factory, 707 S. Main St., Rockford, Ill. Branch office, San Francisco, Cal.

ROSE.—Trade name for X-ray and high frequency treatment apparatus manufactured by the Empire Electric Co., Inc., 2227 S. San Pedro St., Los Angeles, Cal.

ROSE BROS. CO.—Lancaster, Pa. Manufacturer of portable electric lamps. Business established 1880. President, James Rose; vice-president and general manager, David Rose; secretary and treasurer, J. Stanley Rose; sales manager, Newton H. Prather. Main office and factory, 221 E. Chestnut St., Lancaster, Pa. Branch offices, Chicago, Ill.; Philadelphia, Pa.; New York, N. Y.; Atlanta, Ga.

ROSE ELECTRIC MFG. CO.—160 N. Wells St., Chicago, Ill. Manufacturer of electrical novelties.

ROSE MFG. CO.—910 Arch St., Philadelphia, Pa. Manufacturer of automobile heaters, spotlights, signals and other automobile electrical accessories.

ROSENBERG ELEVATOR CO., F.—170-174 Reed St., Milwaukee, Wis. Manufacturer of electric passenger and freight elevators. Business established 1905. President and general manager, William A. Rosenberg; vice-president, Arthur A. Rosenberg; secretary, treasurer and sales manager, Oscar A. Rosenberg. Sales representatives, Cooley Elevator Co., 522 W. Monroe St., Chicago, Ill.; Minneapolis Elevator Repair & Supply Co., 19 High St., Minneapolis, Minn.

ROSENBUSH & SOLOMON.—33rd St. & Shields Ave., Chicago, Ill. Manufacturers of bronze powders, etc.

ROSETTE.—A device to permit a pendent or drop cord to be connected to and supported from a ceiling or fixture outlet. The body of the rosette is usually of porcelain and provides for receiving a cord-strain relief device or has a recess in which a knot in the cord may be held to remove the pull of the cord from its connecting terminals. The cord generally supports a pendent lamp with shade or reflector, but occasionally it supports a pendent switch. Rosettes are made both in one piece or in two, of which the body part fits into various types of caps or bases. Most rosettes are fuseless; fused rosettes are permitted only in mills with open wiring. The term rosette is also applied to a similar fitting for connecting a socket or fixture stem direct to the wiring without an outlet plate or outlet box; instead of having merely a round hole for the cord it has a short nipple or threaded bushing to which the socket or light fixture stem may be screwed. Canopy rosettes have the rosette concealed within a fixture canopy.

ROSETTE BODIES.—These consist of the porcelain body part of a plain rosette or a pull-switch rosette with a metal shell having notches at one end to permit engagement interchangeably with a variety of bases or caps. The same body with different bases can make various kinds of plain ceiling rosettes or switch rosettes; with different caps it can make various kinds of plain or switch type fixture rosettes. This is carried out on the same principle as making different types of sockets and receptacles from the same body with different caps and bases.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

ROSETTES, CEILING BUTTON.—These rosettes consist usually of a small round one-piece porcelain base having a recess to accommodate a knot in the pendent cord and holes for two mounting screws. The ends of the cord are intended to be connected directly to the line wires, the button being placed between them. Ceiling button rosettes are not used as much as cleat rosettes, which see.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. (See display adv. page 1301.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
National Electric Porcelain Co., The, Carey, Ohio.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PARKER & SON, INC., J. H., Parkersburg, W. Va.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

ROSETTES, CLEAT.—Rosettes designed to support pendent lamp cords and having an extension on each side carrying a wire terminal one-half inch or more above the bottom surface. They are designed for use on open cleat wiring and permit the circuit wires to be run straight through the rosette, which itself serves as a cleat. The circuit wires do not have to be cut but merely bared to connect to the rosette binding screws. Single-piece rosettes of this type have these terminals exposed; two-piece cleat rosettes have a base much like an ordinary porcelain half cleat but provided with connecting terminals in each wire groove, the cap fitting over these and having a hole and knot recess for the cord.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant." "Junior."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CRESCENT ELECTRIC CO., Mountain Grove, Mo. "Acme."
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security," "Five Hundred."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco," "Manhattan."
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Little Gem."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J. "Tecco."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

ROSETTES, CONCEALED BASE.—Rosettes of the two-piece type in which the base part entirely encloses the terminals. The fuseless type is often used with knob-and-tube concealed wiring systems. In the fused type a link or cartridge fuse is provided in the cap for each side of the circuit. The cap contacts fit against or under the base contacts, often with a rotary wiping action before the cap is screwed into place.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Junior."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CRESCENT ELECTRIC CO., P. O. Box 178, Mountain Grove, Mo. "Acme."
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security," "Five Hundred."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Little Gem."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. (See display adv. on pages 1282-1283.)
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

ROSETTES, CONDUIT BOX.—These rosettes are arranged to be mounted on the covers of conduit boxes or in some cases to fasten over the box and serve as the cover. If the rosette cap is for pendent cord it has a knot recess or other cord-strain relief device. The cap may be provided with a threaded nipple for a light fixture bracket or short stem.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security," "Five Hundred."
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Taylor-Campbell Electric Co., 237 Dundas St., London, Ont., Can.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

ROSETTES, FIXTURE.—The porcelain body of these rosettes has a round hole in

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the bottom for pendent cord. Surrounding the body is a metal shell with notches to permit securing to various kinds of interchangeable caps, such as are used on fixture sockets. The rosette may therefore be used on either bracket or pendent fixtures and harmonize with their finish. It affords means for making a secure connection for an extension to a desk lamp, boudoir lamp, or other appliance. It makes a neater connection at the fixture than a current tap, but cannot be disconnected without some trouble.

Manufacturers:

American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Fibreduro, Inc., 396 Broadway, New York, N. Y.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
VOIGT CO., 1741-47 N. 12th St., Philadelphia, Pa.

ROSETTES, FUSED.—Two-piece porcelain rosettes for pendent lamp cords, having a separable cap and a base in which are mounted suitable line terminals and binding screws or midget fuse clips for an open link or enclosed fuse in each side of the circuit. Fused rosettes are permitted only in certain buildings of mill construction. If link fuses are used they must not exceed 2 amperes at 125 volts; enclosed fuses up to 3 amperes at 250 volts are allowed.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Thomas."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Manhattan."
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

ROSETTES, METAL RACEWAY OR MOLDING.—These rosettes have the caps designed for pendent lamp cords or light fixture brackets and the base members are made especially to fit over or straddle across the base part of metal raceways or moldings. The circuit wires in the raceway can usually be connected to the rosette terminals without cutting.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. on pages 1302-1304.)
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Little Gem."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

ROSETTES, PULL SWITCH.—These rosettes have a porcelain body in which is mounted a pull-chain switch mechanism of the socket type with the chain coming out of the side as in a socket. The bottom of the rosette has a bushed round hole for a pendent cord. The body is enclosed in a metal shell that may be secured interchangeably to various kinds of caps or bases, depending on whether the rosette is to be fastened to a fixture or directly to a ceiling or wall circuit. By means of the pull switch the extension circuit supplied by the cord is controlled.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

ROSETTES, WOOD RACEWAY OR MOLDING.—These rosettes have the porcelain base formed to fit on or sometimes straddle over, the base member of the raceway, the capping of which is cut to fit against the rosette. Circuit wires may usually be looped through the rosette terminals without being cut. The rosette cap has a hole and knot recess for pendent cord; it is seldon used as a bracket support.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security."
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

ROSS.—Trade name for annunciators manufactured by the Samson Electric Co., Canton, Mass.

ROSS CARRIER CO.—Benton Harbor, Mich. Manufacturer of electric lumber carriers. President, H. B. Ross; vice-president, J. L. Peden. Branch offices, Seattle, Wash.; New Orleans, La.

ROSS ENGINEERING CO., J. J.—1006 E. Larned St., Detroit, Mich. Manufacturer of battery charging equipment. Business established 1915. President, treasurer and general manager, J. J. Ross; vice-president, Paul M. Dailey, secretary, A. M. Ross. Sales representatives, Mann-Sutherland, 30 E. Larned St., Detroit, Mich.

ROSS HEATER & MFG. CO., INC.—1407 West Ave., Buffalo, N. Y. Manufacturer of condensers, evaporators, feed water heaters and electric vacuum pumps.

ROTAPEX.—Trade name for electric washing machines manufactured by the Apex Electrical Mfg. Co., 1067 E. 152nd St., Cleveland, Ohio. (Exclusive distributor, Apex Electrical Distributing Co., 1089 E. 152nd St., Cleveland, Ohio.)

ROTARY.—Trade name for electric dishwashers manufactured by G. S. Blakeslee & Co., Cicero, Ill.

ROTARY CONVERTER.—An old and still quite commonly used name for the synchronous converter. See Converter, synchronous.

ROTARY GAP, RADIO.—See Spark gaps, radio.

ROTARY POLE CHANGERS. — See Changers, polarity or pole for telephone circuits.

ROTARY SWITCHES.—See Switches, rotary, flush and surface.

ROTATING ELECTRODES.—Either anodes or cathodes, or both, which rotate rapidly, in order to keep the electrolyte in rapid motion and thus renew the supply rapidly at the electrodes. Using this principle, much higher current densities of deposition may be used without liberating gas at the cathode and getting a poor deposit. Particularly useful in making quick plating deposits, where the anodes are usually rotated because the cathodes are too irregular in shape. In electrolytic analysis it is better to make the cathode circular and rotate it; very quick analyses can thus be made.

ROTATING FURNACES.—Electric furnaces have been made so as to rotate around a vertical or a horizontal axis in order to get uniform heating of the charge. The electrical heating is either by passing current through the charge itself, or by resistors embedded in the lining of the furnace.

ROTATING SOCKETS.—See Sockets, revolving.

ROTH BROS. & CO.—Chicago, Ill. Manufacturers of motors, generators, motor-generators and grinders. Business established 1894. President, Charles H. Roth; vice-president, A. P. Munning; secretary, R. C. Fenner; treasurer, G. A. Roth; general manager, H. E. Stocker. Main office, 1400 W. Adams St., Chicago, Ill. Branch office, 50 Church St., New York, N. Y. Sales representatives, Anderson & Branch, Indianapolis, Ind.; Morse & Co., St. Louis, Mo.

ROTHMOTORS.—Trade name for motors, generators and grinders manufactured by Roth Bros. & Co., 1400 W. Adams St., Chicago, Ill.

ROTO.—Trade name for boiler tube cleaners manufactured by the Roto Co., Hartford, Conn.

ROTO CO., THE.—Hartford, Conn. Manufacturer of boiler tube cleaners. J. D. Cherry, president.

ROTOKOLL.—Trade name for intercommunicating telephones manufactured by the Samson Electric Co., Canton, Mass.

ROTOPLATER.—Trade name for electroplating machine manufactured by the Connecticut Dynamo & Motor Co., Lyons Ave. & Coit St., Irvington, N. J.

ROTOR.—The rotating member of an electrical machine, usually that of an induction machine. It contains a part of the iron of the magnetic circuits and one or more of the electric circuits, commonly those of the secondary windings. The word rotor is also used to some extent for the rotating member of other machines, such as steam turbines.

ROTREX. — Trade name for electric vacuum pumps manufactured by the C. H. Wheeler Mfg. Co., Lehigh & Sedgley Aves., Philadelphia, Pa.

ROTURBO.—Trade name for electric and steam pumps manufactured by the Manistee Iron Works Co., Manistee, Mich.

ROUSE & CO., H. B.—2214 Ward St., Chicago, Ill. Manufacturers of motor-driven paper lifts. President and treasurer, H. B. Rouse; vice-president, William J. Knoll; secretary, Walter A. Sittig.

ROUTING MACHINES, MOTOR-DRIVEN.—These machines are essentially a motor-driven routing tool mounted in a frame suitable for guiding the tool. They are made in both bench and portable types. Cutting grooves for the treads and risers in stair constructions, grooves for shelving, and fluting in wood panels, are among their more common applications. Some of the portable types are constructed so that in the hands of a skilled workman they may be used for routing elaborate patterns in the wood following a pencil drawing on the surface.

Manufacturers:

American Router & Mfg. Co., P. O. Box 621, Pittsburgh, Pa. "Hunter."
Fay & Egan Co., J. A., 705-755 W. Front St., Cincinnati, Ohio. "Lightning."
KELLEY ELECTRIC MACHINE CO., 111 Dearborn St., Buffalo, N. Y. The Kelley Router is a portable bench operated machine: Routs or cuts in a straight or curved line and is a labor

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saver and production machine on repetition work. The cutter travelling at 6500 r. p. m. gives a perfect finished cut. Cutters made to any design. Built for all standard voltages. Used extensively for ten years for stair routing, column and pilaster fluting, sunken



Kelley Routing Machine

panel work, inlay routing, tank work, crowning and gaining for ribs in piano backs.—Adv.

Liberty Electric Corp., Port Chester, N. Y.

ROWAN CONTROLLER CO., THE.—308 N. Holliday St., Baltimore, Md. Manufacturer of controllers. President, J. S. Rowan; vice-president, W. C. Jackson; treasurer, A. M. Doty. Sales representative, Williams-Beasley Co., 53 W. Jackson Blvd., Chicago, Ill., and St. Louis, Mo.; Electrical Engineering & Mfg. Co., Pittsburgh, Pa.; Cleveland, Ohio.

ROWE MFG. CO., HENRY.—Newaygo, Mich. Manufacturer of wood parts, dowels, turnings and special woodwork. Business established 1899. President, A. A. Hemily; vice-president, W. J. Pike; secretary, treasurer and general manager, Henry Rowe.

ROXBRO.—Trade name for piston packing manufactured by the Boston Belting Co., 80 Elmwood St., Boston, Mass.

ROXITE.—Trade name for molded insulation manufactured by the Northern Industrial Chemical Co., 11 Elkins St., Boston, Mass.

ROYAL.—Trade name for electric meat and food choppers, grinders, roasters, slicers and peanut butter machines manufactured by the A. J. Deer Co., Inc., Hornell, N. Y.

ROYAL.—Trade name for electric vacuum cleaners, vibrators and hair driers manufactured by the P. A. Geier Co., 5112 St. Clair Ave., Cleveland, Ohio.

ROYAL.—Trade name for oil cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

ROYAL.—Trade name for mica and mica products manufactured by Meirowsky Bros., 11 McPherson Pl., Jersey City, N. J.

ROYAL.—Trade name for service cord manufactured by the National India Rubber Co., Bristol, R. I.

ROYAL.—Trade name for high-tension and other electrical specialties manufactured by the Royal Electric Mfg. Co., 556-606 E. 40th St., Chicago, Ill.

ROYAL ART GLASS CO.—243 Canal St., New York, N. Y. Manufacturer of lighting fixtures, portable lamps and domes. President and treasurer, Joseph Bruenn; vice-president, Benjamin Brafman; secretary, Rose Bruenn.

ROYAL CHANDELIER WORKS.—12-18 S. Hall St., Allentown, Pa. Manufacturers of electric chandeliers. Business established 1906. Partnership, C. D. Butz and E. H. Odenheimer.

ROYAL ELECTRIC MFG. CO.—556-606 E. 40th St., Chicago, Ill. Manufacturer of high-tension and electrical specialties. President, C. R. Lininger; vice-president, C. H Thomas; secretary, H. H. Herbert; treasurer, F. M. Utt. Sales representatives, J. H. Burroughs, Inc., Buffalo, N. Y.; General Machinery Co., Birmingham, Ala.; Herr Rubincam Co., Denver, Colo.; Eicher & Bratt, Seattle, Wash.; Indianapolis Engineering Co., Indianapolis, Ind.; Burlington Electric Supply Co., Burlington, Iowa; J. F. Schaefer & Co., Kansas City, Mo.; Northern States Electric Co., St. Paul, Minn.; Baker Joslyn Co., San Francisco, Cal.; Filer-Smith Machinery Co., Winnipeg, Man., Can.; Rose & O'Hearn, Toronto, Ont., Can.; Packard Electric Co., St. Catharines, Ont., Can.; Piper Engineering Co., Cincinnati, Ohio.

ROYAL-ROCHESTER.—Trade name for electric household cooking and heating appliances manufactured by the Rochester Stamping Co., Rochester, N. Y.

ROYERSFORD FOUNDRY & MACHINE CO., INC.—West Royersford, Pa. Manufacturer of motor-driven punches, shears, etc. President and treasurer, F. H. Deisher; vice-president and secretary, H. R. Willi.

ROZEE-LITE.—Trade name for electric lighting fixtures manufactured by the Rozee Mfg. Co., 10 Ionia Ave., S. W., Grand Rapids, Mich.

ROZEE MFG. CO.—10 Ionia Ave., S. W., Grand Rapids, Mich. Manufacturer of electric lighting fixtures. Business established 1920. M. Z. Rosenfield, proprietor. Sales representatives, Associated Manufacturers, Detroit, Mich.; R. E. Davis, London, Ont., Can.

ROZELLE.—Trade name for color decorations applied to Regent illuminating glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

R.P.M.—Abbreviation for revolutions per minute.

R.P.S.—Abbreviation for revolutions per second.

R. S. K.—Trade name for electric horn manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

RUBBER.—Rubber is derived from the milky secretion or latex of certain tropical trees and shrubs, found chiefly in South and Central America, Africa, Ceylon, and Malacca. The milky latex is dried and coagulated, giving crude rubber which is affected by the temperature, being soft and sticky when warm and stiff when cold. Crude rubber is usually in the form of lumps or biscuits, which are boiled in water, ground, washed, dried, mixed with sulphur, adulterants and filler and then rolled out or calendered. Rubber is almost always adulterated, due to the high cost of pure rubber; most high-grade rubber products contain only 20 to 30% of pure gum. Some of the adulterants used are paraffin, oil, pitch and ozokerite, and the fillers frequently used are white or red lead, barium sulphate, zinc oxide, chalk, lampblack, talc, etc.

Vulcanized rubber is obtained by heating rubber and sulphur above the melting point of sulphur, which is 120° C., when the two combine into a new product. Vulcanized rubber is more elastic, stronger and less affected by temperature changes than pure rubber. The electrical properties of rubber vary greatly according to its composition. Its dielectric strength is 11,800 to 20,000 volts per mm., and its resistivity about 10^{14} to 10^{16} ohm-cm. Its temperature coefficient is negative and is quite large, ranging from 2% to 4% per degree centigrade.

RUBBER BOOTS.—See Boots, linemen's rubber.

RUBBER BUSHINGS.—See Bushings, rubber.

RUBBER CALENDERS, MILLS AND OTHER RUBBER-WORKING MACHINERY, MOTOR-DRIVEN.—The reduction of crude rubber and preparation for use as insulating tubing, sheets, rods, etc., and the many other uses of rubber for non-electrical purposes, requires much motor-driven machinery. In the reduction process the lumps or biscuits of crude rubber are ground and mixed with sulphur and adulterants in motor-driven machinery. It is then calendered, or run between the large iron cylinders of a motor-driven machine. This process smooths the rubber out and rolls it into sheets. It is repeated many times and the sheets cut into strips and calendered again to thoroughly mix in the adulterants. The final smooth sheets are produced by these machines. In the production of the various forms, such as rods, tubing, etc., motor-driven machinery is also used to form and straighten the product.

Manufacturers:

Vaughn Machinery Co., The, Cuyahoga Falls, Ohio.
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, Ohio. "W-S-M."

RUBBER-COVERED WIRE.—See Wire, rubber-covered.

RUBBER FOR WIRE AND CABLE INSULATION.—Rubber used for wire and cable insulation is soft pure rubber that does not contain a large percentage of sulphur and other adulterants. The condition of the rubber depends upon the process to be used in the insulation of the wire. There are three processes by which rubber is usually put on the wire. In the first a straight, long, narrow strip is pressed around the wire. In the second a rubber tape is wound spirally around the conductor. The third process uses the rubber in bulk form and the wire is run through a die through which the compound is pressed on the wire as a seamless tube.

Manufacturers:

Aetna Rubber Co., 811-815 E. 79th St., Cleveland, Ohio.
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond Rubber Co., The, Akron, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Empire Rubber & Tire Corp., N. Clinton Ave. & Mulberry St., Trenton, N. J.
Essex Rubber Co., Trenton, N. J.
Faultless Rubber Co., Ashland, Ohio.
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.
Hodgman Rubber Co., Puckahoe, N. Y.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.
New York Belting & Packing Co., 91 Chambers St., New York, N. Y.
Traveler Rubber Co., Bethlehem, Pa.
UNITER STATES RUBBER CO., 1790 Broadway, New York, N. Y.

RUBBER GASKETS.—See Gaskets, rubber.

RUBBER GLOVES.—See Gloves, linemen's rubber.

RUBBER INSULATED METAL CORP.—Plainfield, N. J. Manufacturer of insulated pliers, etc.

RUBBER JARS, BATTERY.—See Jars, battery rubber.

RUBBER KEYS (SOCKET AND SWITCH).—See Keys, socket and switch.

RUBBER LININGS (SOCKET).—See Linings, socket.

RUBBER MATTING.—See Matting, rubber insulating.

RUBBER PLIER INSULATING SLEEVES.—See Plier insulating sleeves.

RUBBER RINGS.—See Rings, fiber, rubber and other insulating.

RUBBER (HARD) RODS, SHEETS, TUBES, TUBING, ETC.—Hard rubber, also called ebonite or vucanite, is a rubber compound with a high sulphur content and highly vulcanized. It possesses many desirable insulating properties at ordinary temperatures, having a resistivity of about 10^{15} to 10^{18} ohm-cm., and a dielectric strength from 39,000 to 80,000 volts per mm., for small thicknesses. It is a hard and brittle material, but can be worked into many shapes and machined and polished. It is made in many forms, such as sheets, rods, tubes, etc., which find extensive use in electrical apparatus. Hard rubber has in recent years been replaced by molded insulations to some extent, however.

Manufacturers:

Aetna Rubber Co., 811-815 E. 79th St., Cleveland, Ohio. "Aetnalite Compound."
Atlantic Tubing Co., 1756 Cranston St., Providence, R. I. (Tubing.)
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Davol Rubber Co., 69 Point St., Providence, R. I.
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Luzerne Rubber Co., The, Trenton, N. J.
Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass. "Universal."
Stokes Rubber Co., Joseph, Trenton, N. J.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. Parts of

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hard rubber for electrical apparatus and insulating purposes. Sheets, rod and tubing for electrical apparatus, and a wide variety of molded and turned articles for electrical insulating purposes. All of highest grade specially compounded hard rubber. Made standard or to meet specifications.—Adv.

RUBBER TAPE.—See Tape, rubber.

RUBBER (SOFT) TUBING, SHEETS, ETC.—Rubber that does not contain a large percentage of sulphur or other adulterants, and is not highly vulcanized is soft and flexible. In this form it is made principally in sheets or tubes, from which many rubber products are made. Soft, properly vulcanized rubber may be stretched to about seven times its original length. Its electrical properties are about the same as those described above under Rubber. Its principal electrical use is for rubber-covered wire.

Manufacturers:

Aetna Rubber Co., 811-815 E. 79th St., Cleveland, Ohio.
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond Rubber Co., The, Akron, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
Empire Rubber & Tire Corp., N. Clinton Ave., & Mulberry St., Trenton, N. J.
Essex Rubber Co., Trenton, N. J.
Faultless Rubber Co., Ashland, Ohio. "Wearever."
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Goodrich Rubber Co., B. F., Akron, Ohio.
Goodyear Tire & Rubber Co., 1144 E. Market, St., Akron, Ohio.
Hodgman Rubber Co., Tuckahoe, N. Y.
Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.
New York Belting & Packing Co., 91 Chambers St., New York, N. Y.
Salisbury & Co., Inc., W. H., 308-10 W. Madison St., Chicago, Ill.
Traveler Rubber Co., Box 589, Bethlehem, Pa.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

RUBBER VULCANIZING MACHINES.—See Vulcanizers, electric.

RUBBER WASHERS.—See Washers, miscellaneous insulating.

RUBBING AND POLISHING MACHINES, MOTOR-DRIVEN.—These machines are used for polishing and surfacing furniture, marble, lithographing stone, etc. The common types are portable, consisting of a flat grinding and polishing wheel directly driven by an electric motor, the machine being very similar to floor surfacing and polishing machines. Other more special machines are employed for rubbing furniture. These machines, usually large stationary machines, have a polishing shoe mounted on a belt or rod. A motor drives a mechanism which causes the shoe to move rapidly forward and back at the same time being moved, after each stroke, a short distance perpendicular to the stroke, so that the machine will cover an entire surface evenly. The length of the stroke may be adjusted to suit the piece being polished.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Campbell Machine Co., Inc., Wollaston, Mass.
Cavicchi Polishing Machinery Co., 3-5 Woodworth St., Neponset, (Boston), Mass.
Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Chicago."
Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Forbes & Myers, 172 Union St., Worcester, Mass.
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. "E-Z," "Two-In-One."

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y. The "International," an electrically-operated, portable machine for scrubbing floors of all materials, refinishing and polishing waxed hardwood floors. Also used for grinding marble, terrazo, mosaic and composition floors. The machine is self-propelling and can be easily operated by a woman. Made



International Floor Machine

in two sizes: Model "A" is equipped with a 1/3-hp. motor; weight of machine, 80 lbs.; diameter of brushes, 15 in. Model "B" is equipped with a 1/6-hp. motor; weight of machine, 40 lbs.; diameter of brushes, 11 in. Both models are very thoroughly constructed and equipped with ball bearings throughout.—Adv.

KELLEY ELECTRIC MACHINE CO., 111-119 Dearborn St., Buffalo, N. Y. (Floor.)
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Utility."
Mattison Machine Works, Rockford, Ill.
Wagner Machine Works, F., Laurel Hill, N. Y. "Wagner."
Webster & Perks Tool Co., The, Center & Jefferson Sts., S. E., Springfield, Ohio.

RUBEROID CO.—New York, N. Y. Manufacturer of insulating papers, compounds, paints, tapes and varnishes. Business established 1884. President, Michael Dreicer; vice-presidents, Herbert Abrahams, H. A. Gillespie; secretary and treasurer, Felix Jellenik; sales manager (Electrical Dept.), C. E. Smith. Main office, 95 Madison Ave., New York, N. Y. Factories, Bound Brook, N. J.; Joliet, Ill.; Montreal, Que., Can. Branch offices and warehouses, 417 S. Dearborn St., Chicago, Ill.; 10 High St., Boston, Mass.

RUBOIL.—Trade name for belting manufactured by the Ruboil Belting Co., 41 N. 10th St., Philadelphia, Pa.

RUBOIL BELTING CO.—Philadelphia, Pa. Manufacturer of belting. Business established 1901. President, C. P. Landreth; secretary and treasurer, N. S. Powell; general manager, E. P. Hara; sales manager, N. H. Lyke. Main office and factory, 41 N. 10th St., Philadelphia, Pa. Branch offices carrying stock, 77 Canal St., Boston, Mass.; 550 W. Lake St., Chicago, Ill. Sales representatives, Weber & Litten, 530 Duquesne Way, Pittsburgh, Pa.; Pacific Mill & Mine Supply Co., 616 Mission St., San Francisco, Cal., and 310 E. 3rd St., Los Angeles, Cal.

RUBY.—Trade name for sign receptacle manufactured by the Bryant Electric Co., 1421 State St., Bridgeport, Conn.

RUBY CHEMICAL CO., THE.—68-70 McDowell, Columbus, Ohio. Manufacturer of soldering flux. Business established 1909. President, Dr. A. P. Taylor; vice-president, H. A. Bishop; secretary, treasurer and general manager, Fred H. Perfect.

RUBYFLUID.—Trade name for soldering flux manufactured by the Ruby Chemical Co., 68-70 McDowell, Columbus, Ohio.

RUBY-JEFFERSON.—Trade name for automobile lamps manufactured by the Jefferson Glass Co., Follansbee, W. Va.

RUE-NELSON MFG. CO., INC.—1153 16th Ave., S. E., Minneapolis, Minn. Manufacturer of electric washing machines. President and treasurer, Edward Rue; vice-president, Alfred Nelson; secretary, A. Harvey Nelson.

RUEMMELI-DAWLEY MFG. CO., THE.—3911 Chouteau Ave., St. Louis, Mo. Manufacturer of motor-driven refrigerating and ice making machinery, tanks for power plants, boilers, etc. President, A. Ruemmeli; secretary, J. Nieywoehner; treasurer, H. Surber; sales manager, E. William Schadeck.

RUGGLES & RUGGLES.—Batavia, Ill. Manufacturers of flue cleaners. L. W. Johnson, owner and manager.

RUGGLES-KLINGEMANN MFG. CO.—15 Foster St., North Salem, Mass. Manufacturer of draft regulators.

RUHMKORFF COILS.—See Coils, induction, electrotherapeutic.

RULES, FOLDING AND ZIGZAG, ELECTRICIANS'.—The folding rules are commonly two-foot rules which fold, on hinges, into four sections so that folded the rules are 6 ins. long and may be easily carried in the pocket. To prevent wearing at the edges and splitting and cracking, the rule is generally brass bound on all edges. The zigzag rules are usually made up in lengths, unfolded, of 5 or 6 ft. and fold into short lengths so that the folded rule may be carried in the tool kit or pocket. Though the over-all lengths of this type rule are accurate, the scale divisions are not so finely marked and it is consequently used on rougher work than the two-foot folding rule.

Manufacturers:

American Rule Mfg. Co., Inc., 127 Humboldt St., Brooklyn, N. Y.
International Scale Co., Canby Bldg., Dayton, Ohio. "International."
Lufkin Rule Co., The, Saginaw, Mich.
Rustless Rule Co., Inc., The, 9 Lafayette Ave., Buffalo, N. Y. "Rustless."
Stanley Works, The, New Britain, Conn.

RULES FOR ELECTRICAL EQUIPMENT IN COAL MINES.—The Bureau of Mines, Washington, D. C., has issued "Suggested Safety Rules for Installing and Using Electrical Equipment in Bituminous Coal Mines." The title sufficiently indicates its scope. These rules were issued in 1916 and have not since been revised. Copies can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents each.

RULES, STEEL, STRAIGHT, ELECTRICIANS' AND MECHANICS'.—The straight steel rules are accurately scaled and are commonly used where a ruling edge and accurate scale are desired in one instrument. They generally have a greater variety of scale division, and are of course much more durable than the folding or zigzag rules.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Goodell-Pratt Co., Greenfield, Mass.
Lufkin Rule Co., The, Saginaw, Mich.

RUMSEY PUMP CO., LTD.—Seneca Falls, N. Y. Manufacturer of electric pumps. President, Henry R. Micks; secretary, R. R. Micks; treasurer, B. A. Wessell. Main office, Seneca Falls, N. Y. Branch offices, 49 Federal St., Boston, Mass.; 75 Warren St., New York, N. Y.

RUNNER.—The runner or rotor of a hydraulic turbine consists of the hub, crowns, rings and buckets. The design and method of construction vary greatly, depending on the conditions of service. Some runners are made in one solid casting and may be made of iron, steel or bronze. Tangential (impulse) wheels are usually made with separate body and buckets. This method permits of carefully polishing the bucket surfaces which adds slightly to the efficiency.

RUNOFF.—A term used in hydraulics to denote the quantity of water flowing in a stream at any time. It depends primarily on rainfall, but is influenced by many other elements and conditions. The runoff of any stream can only be determined by a long study of that particular section of the country. There is no direct relation between average runoff and rainfall, nor between average runoff and maximum and minimum, consequently each must be considered separately. Runoff is usually expressed in cubic feet per second. A dependable knowledge of its value is necessary preliminary to the design of a water-power plant.

RUNZEL-LENZ ELECTRIC MFG. CO.—1751 N. Western Ave., Chicago, Ill. Manufacturer of switchboard wire. Business established 1904. President, W. L. Runzel; secretary and treasurer, J. M. Lenz.

RUPTURE VOLTAGE.—That voltage which will break down the insulation between two conductors, permitting a spark to pass between them, is called the rup-

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ture voltage. Compare with Dielectric strength.

RURAL.—Trade name for oiling device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

RUSCO.—Trade name for power transmission belting manufactured by the Russell Mfg. Co., 520 Russell Ave., Middletown, Conn.

RUSH BROS. CO.—136 W. Lake St., Chicago, Ill. Manufacturer of porcelain lighting fixtures. Sales manager, C. G. Rush.

RUSSELL & STOLL CO.—New York, N. Y. Manufacturer of industrial and marine lighting equipment. President, Albert F. Stoll; vice-president and treasurer, William F. Meschenmoser; secretary, Fred H. Sander. Main office and factory, 17-27 Vandewater St., New York, N. Y. Branch offices, 326 W. Madjson St., Chicago, Ill.; American Bldg., Baltimore, Md.

RUSSELL CAR & SNOW PLOW CO.—Ridgway, Pa. Manufacturer of snow plows, cars and sweepers for steam and electric railroads. Business established 1902. President, H. R. Hyde; vice-president, L. G. Hall; secretary and treasurer, C. R. Slade; general manager, J. M. Fynn; sales manager, D. S. Dickinson. Sales representative, Wendell & Mac Duffie Co., 61 Broadway, New York, N. Y.

RUSSELL ELECTRIC CO.—140 W. Austin Ave., Chicago, Ill. Manufacturer of electric fans and electric heating appliances. Business established 1916. President, treasurer and general manager, Thomas C. Russell; vice-president, Howard W. Chittick; secretary, M. C. Russell.

RUSSELL ELECTRIC CO.—Danbury, Conn. Manufacturer of electric horns, toy engines and push buttons. Business established 1893. President and general manager, W. Earl Russell.

RUSSELL-HAMMER.—Trade name for electric horn manufactured by the Russell Electric Co., Danbury, Conn.

RUSSELL-KINKAID CO.—3028 S. LaSalle St., Chicago, Ill. Manufacturers of water treating compounds. Partnership, H. Russell and A. M. Kinkaid.

RUSSELL MFG. CO.—Middletown, Conn. Manufacturer of power transmission belting. H. W. Kelsey, sales manager. Main office and factory, 520 Russell Ave., Middletown, Conn. Branch offices, 349 Broadway, New York, N. Y.; 226 Jefferson Ave., E., Detroit, Mich.; 1438 Michigan Ave., Chicago, Ill.; 60 S. Forsyth St., Atlanta, Ga.

RUSSELL MFG. CO.—Niagara Falls, N. Y. Manufacturer of controller fingers. Richard Russell, owner. Main office, 814-818 Bath Ave., Niagara Falls, N. Y. Factories, Niagara Falls, N. Y., and Toronto, Ont., Can. Branch office, 557 King St., West, Toronto, Ont., Can.

RUSSELL SPECIALTY MFG. CO.—2944 W. Lake St., Chicago, Ill. Manufacturer of vulcanized sheets, rods and tubing. President and treasurer, F. H. Foster; secretary, W. R. Woodward.

RUST ENGINEERING CO.—Pittsburgh, Pa. Manufacturer of power plant chimneys. Main office and factory, Pittsburgh, Pa. Branch offices, Washington, D. C.; Birmingham, Ala.

RUSTLESS.—Trade name for zigzag rules manufactured by the Rustless Rule Co., Inc., 9 Lafayette Ave., Buffalo, N. Y.

RUSTLESS RULE CO., INC., THE.—9 Lafayette Ave., Buffalo, N. Y. Manufacturer of electricians' zigzag rules. President and treasurer, J. H. McCaffrey; vice-president, secretary treasurer and manager, T. G. McCaffrey.

RUSTNAUGHT.—Trade name for protective paint manufactured by the Billings-Chapin Co., 1153 E. 40th St., Cleveland, Ohio.

RUST PREVENTIVES.—To protect tools, fixtures, gages, machinery, etc., from rust while in shipment or storage, the metal surfaces, especially machined or highly finished surfaces, of such equipment and devices are usually coated with a special rust-preventing compound. Various compounds are employed, generally grease mixtures which will not run when subjected to reasonable temperature and which may be easily wiped off when it is desired to clean the surfaces covered.

Manufacturers:

Conversion Products Corp., 149 Broadway, New York, N. Y. "Stazon."
Dearborn Chemical Co., 332 S. Michigan Ave., Chicago, Ill. "No-Ox-Id."
Parker Rust-Proof Co., 623-45 Milwaukee Ave., Detroit, Mich. "Parker Process."

RUST-PROOF.—Trade name for electric washing machines manufactured by the Woodrow Mfg. Co., Newton, Iowa.

RUST SOLVENTS.—Rust may be removed by scraping or filing, but perhaps the easiest method is by use of special solvent compounds. Such compounds when applied to the surface will dissolve the rust without corroding or "eating" into the surface of the metal.

Manufacturer:

Frasse & Co., Peter H., 417 Canal St., New York, N. Y. "Meno."

RUTENBER ELECTRIC CO.—Marion, Ind. Manufacturer of electric cooking and heating appliances. President, Thomas Mahaffey; secretary, E. A. Rutenber; vice-president, E. E. Blackburn; treasurer, J. L. McCulloch.

RUTHERFORD MFG. CO., R. T.—Brooklyn, N. Y. Manufacturer of electric buzzers and bells. Exclusive distributor, Electrical Trading Co., 200 Broadway, New York, N. Y.

R. U. V. CO., INC., THE.—165 Broadway, New York, N. Y. Manufacturer of mercury vapor lamps and ultra-violet ray apparatus.

RVA.—Trade name for radio apparatus manufactured by the Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.

RWB.—Trade name for dynamotors manufactured by the Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.

RYAN CORP., THE.—Phoenix, N. Y. Manufacturer of electric flashers and automobile signals. Business established 1903. President, A. L. Jones; secretary, Glenn Fox; treasurer, H. D. Marriam; general manager, C. A. Larned.

RYERSON & SON, JOSEPH T.—Chicago, Ill. Manufacturers of babbitt bearings, tool steels, lathes, planers, drills and other steel products. Business established 1842. President, Clyde M. Carr; vice-presidents, Joseph T. Ryerson, Donald M. Ryerson, Edward L. Ryerson, Jr., and G. G. Moody; secretary and treasurer, E. L. Hartig; general manager, G. G. Moody; sales manager, A. M. Mueller. Main office, 16th & Rockwell Sts., Chicago, Ill. Factories, Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Buffalo, N. Y.; New York, N. Y. Branch offices and warehouses, 2208 N. 2nd St., St. Louis, Mo.; 1590 Euclid Ave., E., Detroit, Mich.; Bailey Ave. & Stanley St., Buffalo, N. Y.; 30 Church St., New York, N. Y. District offices, 40 Court St., Boston, Mass.; 1454 W. 9th St., Cleveland, Ohio; Hennepin Ave. & 6th St., Minneapolis, Minn.; 790 Broad St., Newark, N. J.; 6th & Oliver Ave., Pittsburgh, Pa.; Ideal Bldg., Denver, Colo.; 220 Main St., Houston, Tex.; 731 Wells Bldg., Milwaukee, Wis.; 617 Widener Bldg., Philadelphia, Pa.; 815 Balboa Bldg., San Francisco, Cal.; 419 Ohio Bldg., Toledo Ohio.

RYERSON-CONRADSON.—Trade name for motor-driven lathes, planers, radial drills, etc., manufactured by Joseph T. Ryerson & Son, 16th & Rockwell Sts., Chicago, Ill.

RYERSON HANDY.—Trade name for lamp guards manufactured by Frank W. Morse, 239 Congress St., Boston, Mass.

S

S.—The letter S is the chemical symbol for the element sulphur. It is also used as an abbreviation for south in marking the south-seeking pole of a permanent magnet. The form s is often used as an abbreviation for second, the unit of time, as in r.p.s.

S. A.—Trade name for steam-driven blowers and turbines manufactured by the Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y.

S. & C.—Trade name for high-voltage protective and switching equipment manufactured by Schweitzer & Conrad, Inc., 4431-4439 Ravenswood Ave., Chicago, Ill.

S & H.—Trade name for oil fuse and transformer cutouts manufactured by the Chemelectric Co., 4327 Kenmore Ave., Chicago, Ill. (Exclusive distributor, G. & W. Electric Specialty Co., 7440 S. Chicago Ave., Chicago, Ill.)

S & M LAMP CO.—118 W. 36th St., Los Angeles, Cal. Manufacturer of spotlights, headlights and searchlights. James R. Shirreffs, manager. Sales representatives, Consolidated Sales Co., 1159 Post St., San Francisco, Cal.; F. C. West Corp., 616 S. Michigan Ave., Chicago, Ill.; Werner & Butts, 17 Battery Pl., New York, N. Y.

S & N.—Trade name for electric hair wavers manufactured by the Le Bijou Specialties, 186 N. LaSalle St., Chicago, Ill.

S & S.—Trade name for friction clutch couplings and pulleys manufactured by A. L. Schultz & Son, 1675 Elston Ave., Chicago, Ill.

S & S AUTOMATIC GRATE CO.—320 E. North Water St., Chicago, Ill. Manufacturer of furnaces and chain grate stokers. President, E. W. Ritter; secretary and treasurer, W. T. Ritter.

S & W.—Trade name for oil filters manufactured by Seehausen, Wehrs & Co., 179 N. Franklin St., Chicago, Ill.

SAFE-LIGHT.—Trade name for photograph developing lamps manufactured by the Eastman Kodak Co., Rochester, N. Y.

SAFETEE GLASS CO.—326 N. Broad St., Philadelphia, Pa. Manufacturer of goggles and automobile headlight lenses. Vice-president and general manager, Constantine Shuman; secretary, Ralph A. Gibbs; sales manager, Charles A. McCusker. Factory, Wissinoming, Philadelphia, Pa. Sales representative, J. T. Ross, 601 Diversey Pkwy., Chicago, Ill.

SAFETY.—Trade name for ladders manufactured by the Kramer-Bissell Co., Inc., 6259 Duwamish Ave., Seattle, Wash.

SAFETY.—Trade name for mailing bags manufactured by the Milwaukee Bag Co., 216 S. Water St., Milwaukee, Wis.

SAFETY.—Trade name for respirators, fire extinguishers, etc., manufactured by the Safety Fire Extinguisher Co., 291-293 7th Ave., New York, N. Y.

SAFETY.—Trade name for insulated wires and cables manufactured by the Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y.

SAFETY.—Trade name for meter protective box manufactured by the Safety Meter Box Co., 217 Erie Bldg., Cleveland, Ohio.

SAFETY.—Trade name for metallic packing manufactured by the Steel Mill Packing Co., 238-42 W. Jefferson Ave., Detroit, Mich.

SAFETY.—Trade name for meter seals manufactured by the United Seal Co., Columbus, Ohio.

SAFETY CODE.—See National Electrical Safety Code.

SAFETY COMFO.—Trade name for electric heating pad manufactured by the Edison Electric Appliance Co., Inc., 5660 W. Taylor St., Chicago, Ill.

SAFETY CONFERENCE.—See Electrical Safety Conference.

SAFETY ELECTRIC CO.—431 S. Dearborn St., Chicago, Ill. Manufacturer of incandescent lamps. Business established 1906. President, E. E. Baker; vice-president, G. G. Tunell; secretary, treasurer and general manager, H. A. Baum; sales

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manager, A. M. Tomlinson. Factory, Des Plaines, Ill.

SAFETY ELECTRIC PRODUCTS CO., INC.—1548 Central Ave., Los Angeles, Cal. Manufacturers of switches, switchboards, panels, etc. Business established 1919. President, H. B. Woodill; vice-president, treasurer and general manager, F. H. Trimble; secretary, J. G. Ruperd.

SAFETY EQUIPMENT SERVICE CO. THE.—215-21 St. Clair Ave., N. E., Cleveland, Ohio. Manufacturer of respirators, first-aid equipment, etc. President and treasurer, Buell W. Nutt; vice-president, G. M. Nutt; secretary, B. H. Lang; general manager, Thomas P. Scully.

SAFETY FIRE EXTINGUISHER CO., THE.—291-93 7th Ave., New York, N. Y. Manufacturer of fire sirens, respirators, fire extinguishers, etc.

SAFETY FIRST.—Trade name for lamp changers manufactured by the Enterprise Mfg. Co., North West St., Easton, Pa.

SAFETY FIRST SUPPLY CO.—Pittsburgh, Pa. Manufacturer of safety appliances and first aid equipment. President, H. Blain Lacy; secretary, G. S. Shull; treasurer, H. W. Dinker. Main office, 107 3rd Ave., Pittsburgh, Pa. Branch offices, Bulletin Bldg., Philadelphia, Pa.; 312 Walnut St., Cininnati, Ohio. Sales representatives, E. S. Player, Greenville, S. C.; Huntington Supply & Equipment Co., Huntington, W. Va.; Minnesota Supply Co., Minneapolis, Minn.

SAFETY FIRST SWITCHBOARDS.—See Switchboards, dead front or safety first.

SAFETY FROST.—Trade name for white frosting compound for incandescent lamps, automobile headlights, glass prisms, etc., manufactured by the Arts Electrical Co., 25 Grand St., Troy, N. Y.

SAFETY GAS LIGHTER CO.—Roanoke, Va. Manufacturer of electric gas lighters. President, R. A. Poff; vice-president, H. M. Miller; secretary and treasurer, J. V. Yost.

SAFETY INSULATED WIRE & CABLE CO.—New York, N. Y. Manufacturer of insulated wires and cables. Business established 1888. President and general manager, LeRoy Clark; vice-president, C. E. Graham; secretary and sales manager, G. M. Haskell; treasurer, G. B. Wilson. Main office, 114 Liberty St., New York, N. Y. Factory, Bayonne, N. J. Branch offices carrying stock, Chicago, Ill.; San Francisco, Cal. District offices, Boston, Mass.; Birmingham, Ala.

SAFETY LAMPS.—See Lamps, miners' and miners' safety.

SAFETY METER BOX CO.—217 Erie Bldg., Cleveland, Ohio. Manufacturer of meter protective boxes. President, J. V. Becka; vice-president, L. M. Fiala; secretary and treasurer, J. E. Kovar.

SAFETY PLUG.—A hollow plug filled with a lead-tin alloy so proportioned as to melt at a temperature slightly above that of the steam in a boiler. These plugs are screwed into various places in the boiler, such as the fire box crown, or roof of the combustion chamber, etc. They are so designed that if the water in the boiler runs low the alloy will melt and run out, thus releasing the water and putting out the fire. They are also called fusible plugs.

SAFETY PRODUCTS.—Trade name for switches, switchboards, panels, etc., manufactured by the Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal.

SAFETY STRAPS.—See Straps, cable safety; Straps, linemen's safety.

SAFETY SWITCHES.—See Switches, safety, motor; Switches, safety, service entrance, and combined service and meter protective; Switches, safety, miscellaneous.

SAG OF WIRES.—The vertical distance from the level of the point of support to the level of the lowest part of a span of wire is called the sag of the span. In 100-ft. spans it is from 1 to 2 ft. according to the size of the wire and the condition of the line. The sag varies with changes in the temperature, being greater in warm weather and less in cold weather. In transmission spans of 500 ft. the sag is usually 20 to 25 ft. The sag decreases as the tension on the wires is increased for a given span length, and as the length of the span is decreased for a given tension.

SAGER.—Trade name for axes manufactured by the Warren Axe & Tool Co., Warren, Pa.

ST. CATHARINES BRASS WORKS, THE.—George St., St. Catharines, Ont., Can. Manufacturer of metal castings. Business established 1909. J. E. Riffer, proprietor.

ST. CHARLES FIXTURE MFG. CO.—1 E. Main St., St. Charles, Ill. Manufacturer of lighting fixtures. President, J. B. Horne; secretary, J. E. Jones; treasurer, C. E. Spillard.

ST. JOHN, THOMAS M.—East Windham, N. Y. Manufacturer of electrical toys and novelties. Business established 1896.

ST. LOUIS.—Trade name for trolley wire pickups manufactured by the Electric Service Supplies Co., 17th & Cambria Sts., Philadelphia, Pa.

ST. LOUIS.—Trade name for motors, generators, buffers, etc., manufactured by the Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo.

ST. LOUIS BRASS MFG. CO.—St. Louis, Mo. Manufacturer of brass and bronze castings, lighting fixtures, etc. President, E. F. Guth; vice-president, George S. Watts; secretary, Charles M. Wempner; treasurer, Oscar D. Guth. Main office, 2615 Washington Ave., St. Louis, Mo. Branch office, 108 S. LaSalle St., Chicago, Ill.

ST. LOUIS CAR CO.—8000 N. Broadway, St. Louis, Mo. Manufacturer of electric railway cars and car equipment.

ST. LOUIS CASH REGISTER CO.—2213 Lucas Ave., St. Louis, Mo. Manufacturer of fare registers for electric railways.

ST. LOUIS FROG & SWITCH CO.—6500 Easton Ave., St. Louis, Mo. Manufacturer of drop forgings, track work for steam and electric railways, manganese and machine steel castings. Business established 1906. President, John J. Lichter; vice-president, R. S. Colnon; secretary, treasurer and general manager, R. E. Einstein; sales manager, E. C. Argust. Sales representatives, Higgins & Co., McCormick Bldg., Chicago, Ill.; W. D. Jenkins, Proetorian Bldg., Dallas, Tex.; L. O. Cameron, Munsey Bldg., Washington, D. C.; Alfred Connor, Boston Bldg., Denver, Colo.; American Transmarine Co., Rialto Bldg., San Francisco, Cal.; R. J. Cooper, Kearns Bldg., Salt Lake City, Utah.

ST. LOUIS LIGHTNING ROD CO.—2135 DeKalb St., St. Louis, Mo. Manufacturer of lightning rods and accessories. Business established 1866. President and treasurer, S. D. Kretzer; vice-president, B. A. Kretzer; secretary, J. F. Kretzer; treasurer, S. D. Kretzer; sales manager, Edgar F. Meinhardt.

ST. LOUIS MALLEABLE CASTING CO.—7701 N. Conduit Ave., St. Louis, Mo. Manufacturer of pole-line hardware. President, Henry Ludinghaus, Jr.; vice-president, George C. Diederich; seceretary, treasurer and general manager, Charles G. Ette; sales manager, Herbert H. Ludinghaus.

ST. LOUIS PAPER CAN & TUBE CO.—4400 Union Blvd., St. Louis, Mo. Manufacturer of fiber tubing. President, J. H. Kuechenmeister; vice-president, secretary and treasurer, H. W. Kuechenmeister; vice-president, secretary and treasurer, H. W. Kuechenmeister; sales manager, C. G. Tredway.

ST. LOUIS PUMP & EQUIPMENT CO.—722 Chestnut St., St. Louis, Mo. Manufacturer of acid pumps, oil tanks and reservoirs, etc.

ST. LOUIS RUBBER CEMENT CO.—St. Louis, Mo. Manufacturer of friction and rubber tapes. Main office and factory, St. Louis, Mo. Branch office, 111 W. Monroe St., Chicago, Ill.

ST. LOUIS SCREW CO.—Clarence St. & Bulwer Ave., St. Louis, Mo. Manufacturer of bolts, screws, insulator pins, etc. Business established 1887. President and general manager, E. J. Miller; vice-president, W. S. Ashton; secretary and treasurer, George Gruenewald; sales manager, A. B. King.

ST. MARYS OIL ENGINE CO.—St. Charles, Mo. Manufacturer of oil and gas engines. President, J. R. Peters; vice-president and general manager, J. D. Anderson; secretary and treasurer, J. A. Anderson.

SALAMANDER.—Trade name for asbestos insulated wire manufactured by the Independent Lamp & Wire Co., 1737 Broadway, New York, N. Y.

SALAMMONIAC.—The commercial name for ammononium chloride (NH_4Cl), a substance employed in preparing the electrolyte used in some forms of primary batteries, such as Leclanché wet cells and dry cells. For manufacturers see Ammonium chloride.

SALE OF ELECTRICAL MERCHANDISE PER CAPITA.—The total sales of electrical mechandise which passed through established retail or wholesale trade channels during the year 1920 was estimated at $2,000,000,000 (see Merchandising, electrical). Based on a population of 105,000,000, the per capita sales of electrical mechandise in the United States were therefore $18.10.

SALEM ELECTRICAL SUPPLY CO.—9 Front St., Salem, Mass. Manufacturer of battery connectors, commutator brushes and wire terminals.

SALFIRE.—Trade name for protective paint manufactured by B. Binswanger & Cb., 829-835 N. 3rd St., Philadelphia, Pa.

SALIENT POLE.—See Pole, salient.

SALISBURY & CO., INC., W. H.—308-10 W. Madison St., Chicago, Ill. Manufacturer of rubber bushings, gaskets and other rubber products. Business established 1855. President, M. B. Salisbury; vice-president and treasurer, H. H. Salisbury; secretary, Richard H. Geier.

SAL-HYDE.—Trade name for electroplating chemicals manufactured by the W. Green Electric Co., 81 Nassau St., New York, N. Y.

SA-LITE.—Trade name for lighting fixtures manufactured by Shapiro & Aronson, Inc., 20 Warren St., New York, N. Y.

SALOM PROCESS.—A process for the cathodic reduction of galena (PbS) to produce spongy metallic lead, operated for some years on a large scale at Niagara Falls. Pure powdered galena was fed continuously into a ring-shaped cell of antimonial lead containing an electrolyte of 10% sulphuric acid. The base and sides of the cell constituting the cathode slowly revolved beneath the fixed anode, so that the galena was completely reduced at the end of the revolution. Hydrogen sulphide (H_2S) was evolved by the reaction. Also see Reduction, cathodic.

SAMOVARS, ELECTRIC.—So called from the Russian name. They are electric tea urns in which the tea leaves are suspended in the water in a perforated globe or ball attached to a chain. The tea ball is held at the top until the water has boiled, then it is dropped into the water for a short time while the tea is steeped. Also see Tea pots and urns, electric.

Manufacturers:

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SAMPSON AXCESS SYSTEM, INC.—434 Union St., Lynn, Mass. Manufacturer of lighting fixtures. Business established 1919. President and treasurer, A. T. Sampson; vice-president, Arthur G. Wadleigh; secretary, Julia M. Cotter.

SAMSON.—Trade name for soldering sticks manufactured by the L. B. Allen Co., Inc., 4519-29 N. Lincoln St., Chicago, Ill.

SAMSON.—Trade name for electric automobile horn manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

SAMSON.—Trade name for gray electrical marble used for switch bases, panelboards and switchboards, produced by the Davis Slate & Mfg. Co., 610-618 E. 40th St., Chicago, Ill.

SAMSON.—Trade name for electricians' auger bits, bit braces, machinists' wrenches and shears manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

SAMSON.—Trade name for rail benders manufactured by the Q & C Co., 90 West St., New York, N. Y.

SAMSON.—Trade name for storage batteries manufactured by the Samson Battery Mfg. Co., 230-300 E. 4th St., Fort Wayne, Ind.

SAMSON.—Trade name for windmills for driving generators manufactured by the Stover Mfg. & Engine Co., Freeport, Ill.

SAMSON BATTERY MFG. CO.—230-300 E. 4th St., Fort Wayne, Ind. Manufacturer of storage batteries.

SAMSON CORDAGE WORKS.—New York, N. Y. Manufacturers of braided cordage for lamp suspension and trolleys. Business established 1884. President and treasurer, Herbert G. Pratt; secretary, Frank J. Copley. Main office, 88 Broad St.,

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Boston, Mass. Factory, Shirley, Mass. Branch office and warehouse, 81 Walker St., New York, N. Y. Sales representative, Electric Service Supplies Co., Philadelphia, Pa., and Chicago, Ill.

SAMSON ELECTRIC CO.—Canton, Mass. Manufacturer of telephones, annunciators, fire alarms, bells, ignition outfits and other electrical specialties. Business established 1882. President and general manager, Clarence C. Colby; vice-president, John A. Simpson; secretary, treasurer and sales manager, Frank M. Mitchell.

SAMSON JR.—Trade name for electric automobile horn manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

SAN-FER-ANN.—Trade name for annunciators manufactured by Edwards & Co., Inc., 140th & Exterior Sts., New York, N. Y.

SANAX.—Trade name for electric vibrator manufactured by the Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y.

SAND & SONS, J.—4841-53 Rivard St., Detroit, Mich. Manufacturers of mechanics' and electricians' levels. Business established 1895. President, treasurer and general manager, Frank F. Sand; vice-president, J. Sand, Jr.; secretary, Ed. Sand.

SAND BARREL SETTING.—A method of pole setting sometimes used in overhead line construction where the soil is loose or sandy. A barrel partly filled with earth is placed in the soil to form a base into which the butt of the pole is set.

SAND-BLAST EQUIPMENT, MOTOR OR BELT-DRIVEN.—The abrasive action of a jet of sand carried in compressed air is utilized to clean or to roughen the surface of materials. Particles of sand when they strike the material are themselves abraded and considerable dust is always present whenever sand blasting is done, and the equipment consequently includes some means of disposal of this dust. The sand-blast equipment generally includes the nozzle and hose for the sand blast, and some form of cabinet which is exhausted continually to convey off the dangerous dust. Many of the cabinets form a part of a machine for handling the material as tumbling barrel cabinets, cabinets covering a part of a revolving table the material being placed on the table and carried through the cabinet, and many other special types for sand blasting some particular product. For general work, particularly large pieces, sand blasting is done in a large cabinet, a special room with a floor grating through which the dust and used sand is drawn out from the room. These equipments are used extensively in foundries for cleaning castings, and in various factories for finishing brass, frosting glass, etc.

Manufacturers:

Hoevel Mfg. Corp., Jersey City, N. J.
Macleod Co., The, 2232-38 Bogen St., Cininnati, Ohio. "Doelcam."
New Haven Sand-Blast Co., 6 Church St., New Haven, Conn. "New Haven."
Pangborn Corp., Hagerstown, Md.
Sly Mfg. Co., The W. W., 4700 Train Ave., Cleveland, Ohio. "Sly Line."
United States Silica Co., 1970 Peoples Gas Bldg., Chicago, Ill.

SAND TRAP.—In hydraulic power plants the presence of sand in the water is very objectionable because of its cutting action on the water-wheel blades and the bearings. In high-head plants, the velocity of the water is so high that a very small amount of sand will quickly cut through the wheel buckets. It is usually removed by providing a trap or settling basin at the upper end of the pipe, where the water comes to rest long enough to let the sand settle.

SANDERS, TRACK, ELECTRIC CAR.—Devices to place sand on the rails ahead of the car wheels in order to increase the friction between rails and wheels. The complete equipment consists of sand boxes, or hoppers, sand traps or receptacles, means for controlling the flow of the sand and hose or pipe for distributing it to the rails. When rails are slippery from any cause, such as mud or slime, wet leaves, etc., it is necessary in order to prevent wheel slippage to increase the friction between the surfaces in contact. Sharp dry sand has been found to accomplish this result economically and efficiently. The equipment used to distribute sand from the receptacles on the car is of two general types, gravity and pneumatic.

In the gravity type, dry sand carried in suitable metal boxes in the car is allowed to flow by gravity through proper pipes or hose to the rail. The control of the sand flow is arranged so that the motorman, by stepping on a pedal or operating a lever, opens a valve or trap at the bottom of the sand hopper, thus allowing sand to flow. The valves are usually closed by spring action. The pneumatic type makes use of compressed air, through suitable needle reducing valves, to blow sand from a receptacle at the bottom of the hopper, called the trap, through the pipes or hose to the desired point on the rail. The sander control valve is usually located adjacent to the motorman's brake valve so that he can conveniently and with minimum effort and loss of time cause sand to be applied to the rails. The general use of air brakes affording a supply of air and the more positive action and economical use of sand, has brought the pneumatic type of sander into almost universal use.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Brill Co., The, J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Nichols-Lintern Co., The, 8404 Lorain Ave., Cleveland, Ohio. "N-L."
OHIO BRASS CO., THE, Mansfield, Ohio. O-B sander valves are made in different styles, for convenient operation and mounting. O-B sand trap feeds freely. O-B hose applies sand even on curves. —Adv.

SANDING MACHINES, MOTOR-DRIVEN.—Sandpapering machines, using rapidly revolving disks or cylinders to which sandpaper is attached, for smoothing floors or other wooden surfaces, as in pattern shops, furniture, sash and door factories, etc., in which the driving power is supplied by an electric motor. They turn out a large volume of work and save much labor.

Manufacturers:

Boetcher Pattern Co., 440 N. Peoria St., Chicago, Ill. "Ideal."
Clarke Sanding Machine Co., 320 N. Ervay St., Dallas, Tex.
Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Fay & Egan Co., J. A., 705-755 W. Front St., Cincinnati, Ohio. "Lightning."
Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. "E-Z."
INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y, "International."
KELLEY ELECTRIC MACHINE CO., 111-119 Dearborn St., Buffalo, N. Y. (floor).
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Utility."
Mattison Machine Works, Rockford, Ill.

SANDOVAL ZINC CO.—410 N. Peoria St., Chicago, Ill. Manufacturer of sheet lead, zinc, copper, sulphate, etc.

SAND'S.—Trade name for mechanics' and electricians' levels manufactured by J. Sand & Sons, 4841-53 Rivard St., Detroit, Mich.

SANDS.—Trade name for hearing devices for the deaf and electric therapeutic apparatus, manufactured by Sharp & Smith, 65 E. Lake St., Chicago, Ill.

SANDUSKY WASHER CO.—Sandusky, Ohio. Manufacturer of electric washing machines. Business established 1905. President and general manager N. P. Lauritzen; vice-president, F. R. Lauritzen. Sales representatives, Hibard, Spencer, Bartlett & Co., Chicago, Ill.; Paxton & Gallagher Co., Omaha, Neb.; The Schaefer Co., Decatur, Ind.; Birdsell Mfg. Co., South Bend, Ind., Kansas City, Mo.; The Leutkemeyer Co., Cleveland, Ohio.

SANDWICH MFG. CO.—Sandwich, Ill. Manufacturer of gasoline engines. President, F. S. Mosher; vice-president, J. B. Castle; secretary and treasurer, C. C. Jones.

SANDY HILL IRON & BRASS WORKS.—Hudson Falls, N. Y. Manufacturers of electric pumps.

SANEQUO.—Trade name for therapeutic apparatus manufactured by the Sanitarium Equipment Co., Battle Creek, Mich.

SANGAMO ELECTRIC CO.—Springfield, Ill. Manufacturer of circuit breakers, ampere-hour and watt-hour meters. President, Jacob Bunn; vice-president and general manager, R. C. Lanphier. Main office, Springfield, Ill. Factories, Springfield, Ill.; Toronto, Ont., Can. Branch offices, Boston, Mass; Salt Lake City, Utah; San Francisco, Cal.; Philadelphia, Pa.; 37 W. Van Buren St., Chicago, Ill.; 50 Church St., New York, N. Y.

SANI-COPPER.—Trade name for electric washing machines manufactured by the Wenzelman Mfg. Co., Galesburg, Ill.

SANI PRODUCTS CO.—Chicago, Ill. Manufacturer of metal castings, bushings, store fixtures, etc. President, E. P. Sedwick; vice-president, Arthur Buttler; secretary, J. W. Ellis; treasurer, M. L. Burgess; general manager, C. G. Marks. Main office, 209 W. Randolph St., Chicago, Ill. Factories, Chicago, Ill.; Indianapolis, Ind.; North Chicago, Ill. Branch offices, Atlanta, Ga.; Boston, Mass.; Cleveland, Ohio.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Minneapolis, Minn.; New Orleans, La.; New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; San Francisco, Cal.; Salt Lake City, Utah; St. Louis, Mo.; Montreal, Que.; Winnipeg, Man., Can.

SANIFACIENT HUMIDOR CO.—310 W. Randolph St., Chicago, Ill. Manufacturer of electric cigar humidifiers.

SANITARIUM EQUIPMENT CO.—Battle Creek, Mich. Manufacturer of electrotherapeutic apparatus.

SANITARY.—Trade name for electric washing machines manufactured by the Dexter-Reynolds Mfg. Co., Inc., 128 N. Wells St., Chicago, Ill.

SANITARY REFRIGERATING MACHINERY CO.—Milwaukee, Wis. Manufacturer of motor-driven ice making and refrigerating machinery.

SANITAX.—Trade name for therapeutic lamp manufactured by the Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y.

SANITAX ELECTRIC CO.—143-147 E. 23rd St., New York, N. Y. Manufacturer of electric vibrators, driers, heating pads, etc.

SANOTHERM.—Trade name for electric heating pad manufactured by the Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y.

SANTISEPTIC MFG. CO.—26 Bay St., New Brighton, Staten Island, N. Y. Manufacturer of electric sterilizers for hospitals, laboratories, etc. Business established 1912. President, A. D. Pentz; vice-president, A. L. Dunham; secretary, J. B. Pentz; treasurer, R. H. Pentz; general manager, C. S. Matheson.

SARCO.—Trade name for battery sealing, waterproofing, insulating and impregnating compounds made by the Standard Asphalt & Refining Co., 208 S. LaSalle St., Chicago, Ill.

SARCO CO., INC.—New York, N. Y. Manufacturer of steam specialties. President, F. W. Roller; vice-president and general manager, Clement Wells. Main office, 229 Broadway, New York, N. Y. Branch offices, Monadnock Block, Chicago, Ill.; 1202 Majestic Bldg., Detroit, Mich.; 963 Drexel Bldg., Philadelphia, Pa.; 113 E. Franklin St., Baltimore, Md.; 325 Ellicott Sq., Buffalo, N. Y.; 7016 Euclid Ave., Cleveland, Ohio. Sales representative, Peacock Bros., Montreal, Que., Can.

SARGENT.—Trade name for electrical attachment for engine indicators manufactured by the Crosby Steam Gage & Valve Co., Boston, Mass.

SARGENT.—Trade name for automatic water still for gas, gasoline or steam manufactured by the Precision Scientific Co., 820-822 S. Tripp Ave., Chicago, Ill.

SARGENT & CO.—New Haven, Conn. Manufacturer of hand saws. Branch offices, 221 W. Randolph St., Chicago, Ill.; New York, N. Y.

SASGEN DERRICK CO., THE.—Chicago, Ill. Manufacturer of electric hoists. President, M. J. Sasgen; secretary, Albert Gloor; treasurer, M. T. Sasgen. Main office and factory, 3101-3129 Grand Ave., Chicago, Ill. Branch offices, 50 Church St., New York, N. Y.; 1 Wabash Ave., Toronto, Ont., Can.

SATURATION CURVE.—A curve, generally drawn on rectangular co-ordinate paper, showing the relation between the terminal voltage of a generator at constant normal speed and the exciting current, or the ampere-turns in its field windings. Saturation curves may be drawn for any constant value of load current (including zero), and in a-c. machines the current may have any constant angle of lead or lag. Saturation curves are most commonly drawn for zero load current (also called open-circuit saturation curve) and for full-load current, which in a-c. generators is often at zero power-factor, current lagging. These curves are used in calculating the voltage regulation and other characteristics of machines.

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SATURATION-FACTOR.—The ratio of a small percentage increase in field excitation to the accompanying percentage increase in voltage. Generally, the increase in excitation begins with that value which gives rated voltage at no load and rated speed.

SATURATION, PERCENTAGE. — The ratio in per cent, of the intercept on the axis of volts of the tangent to the saturation curve at any given excitation to the volts at that excitation. As a fraction, this ratio equals one minus the reciprocal of the saturation-factor.

SAUERMANN BROS.—53 W. Jackson Blvd., Chicago, Ill. Manufacturers of motor-driven excavators and coal and ash handling machinery. President and general manager, J. A. Sauermann.

SAUNDERS SONS, D.—Yonkers, N. Y. Manufacturers of reamers, drill chucks, etc.

SAV-A-LITE.—Trade name for sewing machine light manufactured by the Goldman Sav-a-Lite Co., 111 W. 23rd St., New York, N. Y.

SAVAGE EXPANSION BOLT CORP.—10 Desbrosses St., New York, N. Y. Manufacturer of expansion bolts.

SAVE.—Trade name for incandescent lamps made by the Save Electric Corp., 220-254 36th St., Broklyn, N. Y.

SAVE ELECTRIC CORP.—Brooklyn, N. Y. Manufacturer of incandescent lamps. Business established 1918. President, M. Ettinger; vice-president, M. L. Newman; treasurer, B. H. Price; general and sales manager, J. J. Steinharter. Main office and factory, 220-254 36th St., Brooklyn, N. Y. Branch office and warehouse, 3633 S. Racine Ave., Chicago, Ill. Sales representatives, Michigan Lamp Co., Grand Rapids, Mich.; Minneapolis Electric Lamp Co., Minneapolis, Minn.; E. F. Reinhardt & Co., St. Louis, Mo.; W. W. Bolz, 614 Fulton Bldg., Pittsburgh, Pa.; L. S. Shiro, 50 High St., Boston, Mass.

SAVELSBERG-WANNSCHAFF PROCESS.—One of the early processes for the electrolytic reduction of nickel from matte.

SAVETYSHIP.—Trade name for mailing bags manufactured by the Milwaukee Bag Co., 216 S. Water St., Milwaukee, Wis.

SAVOY MFG. CO.—115 E. 24th St., New York, N. Y. Manufacturer of lighting fixtures, portable lamps and lamp shades.

SAWS, CABLE.—Hand saws, usually double-edged, with one edge coarse, the other fine, for use by electricians in cutting off cable or such other similar work as may be necessary.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind. "Atkins' Silver Steel."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."

SAWS, HACK.—See Hacksaws, hand; Hacksaws, motor-driven.

SAWS, HAND.—Saws ordinarily used by carpenters in cutting boards and timbers by hand, and sometimes required by electricians in building staging, cutting fixture blocks, framing supporting panelboards, cabinets, etc.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind. "Atkins' Silver Steel."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Sargent & Co., New Haven, Conn.
Simonds Mfg. Co., Fitchburg, Mass.

SAWS, KEYHOLE.—Also called compass saws. Long, slender saws, operated by hand and adapted to be turned in the work so as to cut out small or irregular openings. They may be used by an electrician to cut odd-shaped holes for special conduit boxes, etc.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind. "Atkins' Silver Steel."
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."
Simonds Mfg. Co., Fitchburg, Mass.

SAWS, MOTOR-DRIVEN, BENCH AND PORTABLE. — Wood saws of this type are designed primarily for elimination of time-wasting hand sawing at the work bench. The saws, usually circular, are set in a small table, the saw being directly connected to a small motor mounted beneath the table. This outfit, being self-contained and light in weight, can be moved about the shop to any place desired. Special portable saws are used for such purposes as rail sawing.

Manufacturers:

Crane, Harold G., 322 Front St., Adrian, Mich. "Crane."
Grabo Machine Works, E. O., 180-182 Centre St., New York, N. Y. "Grabo."
Kaetker Saw Machine Co., The, Cincinnati, Ohio. "Reliance."
Oliver Instrument Co., Adrian, Mich. (metal)
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
Q & C Co., The, 90 West St., New York, N. Y. "Q & C." (Rail.)
Wallace & Co., J. D., 1401 W. Jackson Blvd., Chicago, Ill. "Wallace Universal."

SAWS, MOTOR-DRIVEN, MEAT AND BONE.—These saws are used in large meat markets, etc. The saw is a special form of band saw directly driven by an electric motor. It greatly facilitates the butcher's work in serving customers.

Manufacturer:

Vaughan Co., 730-740 N. Franklin St., Chicago, Ill.

SAWS, MOTOR-DRIVEN, WOOD OR LUMBER.—Under this classification are included the many wood-cutting saws, such as the various circular rip saws, swinging crosscut saws, lumber-mill saws, band saws, etc., that are so extensively used in lumber mills, planing, sash and door mills, furniture, piano and cabinet factories, carpenter and pattern shops and other woodworking establishments.

Manufacturers:

Kaetker Saw Machine Co., Cincinnati, Ohio.
Mereen-Johnson Machine Co., Minneapolis, Minn.
Pryibil Machine Co., P., 520 W. 41st St., New York, N. Y.
Tannewitz Works, The, Grand Rapids, Mich.
Yates Machine Co., P. B., Beloit, Wis.

SAWS, PRUNING.—Where trees must be trimmed out to make a clear passage for an overhead circuit, pruning saws and other special tools make the work easier, as they give access to the particular limbs which interfere, thus making it possible to more nearly satisfy the requirements of line construction and the wishes of property owners as well. The saws are sometimes on the end of a long pole combined with a tree trimmer, or they may be a special form of hand saw. Some are double-edged curved saws and all have special coarse "cross cut" teeth. Also see Trimmers, tree.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."

SAXMAYER.—Trade name for motor-driven tying machines manufactured by the National Bundle Tyer Co., Blissfield, Mich.

SAXON.—Trade name for automobile wrenches manufactured by the Kilborn & Bishop Co., Chapel & Lloyd Sts., New Haven, Conn.

SAXON.—Trade name for electric horn manufactured by the Russell Electric Co., Danbury, Conn.

SAYLORDUCT.—Trade name for non-metallic flexible conduit manufactured by the Saylor Electric & Mfg. Co., 57 18th St., Wheeling, W. Va.

SAYLOR ELECTRIC & MFG. CO.—57 18th St., Wheeling, W. Va. Manufacturer of non-metallic flexible conduit. President and general manager, F. D. Saylor; vice-president, treasurer and sales manager, W. L. Saylor; secretary, C. C. Saylor. Sales representatives, J. S. Jacobson Co., 627 W. Jackson Blvd., Chicago, Ill.; E. R. Bryant, 183 Congress St., Boston, Mass.; S. Robert Schwartz & Bro., 729 Broadway, New York, N. Y.

S-C.—Trade name for feed-water regulators, pump governors and pressure regulating valves manufactured by the S-C Regulator Mfg. Co., Fostoria, Ohio.

S-C REGULATOR MFG. CO., THE.—Fostoria, Ohio. Manufacturer of feed-water regulators, pump governors, and pressure regulating valves. Incorporated 1910. Secretary and treasurer, J. M. Barrett. Main office and factory, Fostoria, Ohio. Branch office, 1830 Lytton Bldg., Chicago, Ill.

SCAIFE & SONS CO., WILLIAM B.—Pittsburgh, Pa. Manufacturer of water purification and softening apparatus.

S. C. & H.—Trade name for electric furnaces and steam specialties made by the Strong, Carlisle & Hammond Co., Cleveland, Ohio.

SCALE REMOVERS, BOILER.—Scale removers are a very important adjunct in the successful operation of steam boilers. Various methods of preventing or combating the formation of scale are used in some plants but the available water used by other plants contains so much scale-forming material that it is necessary to remove it at certain intervals for the sake of efficiency. The scale that forms tends not only to clog up the tubes but it serves as a heat insulator and requires much more heat to convert the water into steam.

Several forms of scale removers are available, the selection of which depends upon the size and type of boiler and the nature and amount of scale to be removed. Many of these are scraping heads of various forms, having steel knives and spring-actuated steel cutters which when forced into a tube will loosen the scale. Another type utilizes a rotating motion imparted by a small water wheel or turbine in the head of the scraper. The water giving the motion is forced out past the knives and serves to flush out the loosened scale.

SCALES, COAL.—Coal scales are used in steam power plants to weigh all of the coal burned, as a check on the over-all efficiency of the plant. Some of the simplest forms of these are platform scales for weighing wagon or truck loads as delivered or for weighing railway cars. These are of the same type as are used by coal companies in their yards or at the mines for measuring the mine output. Scales used within the power plants, however, are quite different.

In one of these types, hoppers containing the coal and carried on knife-edge supports are weighed on standard beam scales. Two sets of hoppers are used, one being filled while the other is being weighed. Automatic scales of the hopper type are largely used for weighing anthracite coal. They are also used for bituminous coals, but are not as satisfactory for this as for anthracite as the spillage when closing the feeder gates makes the dribble a variable quantity. There are also a number of conveyor scales made.

Manufacturers:

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.
C. J. Mfg. Co., 3423 N. 5th St., Philadelphia, Pa.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.
Howe Scale Co., The, Rutland, Vt.
Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.
RELIANCE WEIGHING MACHINE DIVISION, STEARNS MOTOR MFG. CO., Ludington, Mich. "Reliance." (See display adv. page 1315.)

SCALES, WEIGHING AND COMPUTING ELECTRICALLY OPERATED AND LIGHTED.—Scales for use in stores having indicating and computing attachments and provided with interior contact springs so adjusted that a slight pressure on the weighing platform will cause them to complete the circuit to one or more illuminating lamps of small size mounted on the devices. Provision is made for connection to supply circuits by flexible cord and attachment plugs.

Manufacturers:

Dayton Moneyweight Scale Co., Dayton, Ohio.
Detroit Automatic Scale Co., 32 Antietam St., Detroit, Mich. "Detroit."
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "Dayton."
Moneyweight Scale Co., 326 W. Madison St., Chicago, Ill. "Dayton Moneyweight."
Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill. "Superb," "Imperial."

SCANLAN-MORRIS CO.—Madison, Wis. Manufacturer of operating room lighting fixtures, hospital furniture and sterilizing apparatus. President, S. Gwyn Scanlan; vice-president, I. H. Hettinger.

SCARFPINS, ELECTRICALLY LIGHTED.—An electrical novelty in which a miniature electric lamp is mounted on, or concealed in, a scarfpin. Small concealed wires run to a dry battery and push button in the wearer's pocket so that the lamp may be flashed at will.

SCARRIT CAR SEAT & MFG. CO.—5027 Mt. Kissock Ave., St. Louis, Mo. Manufacturer of car seats, etc.

SCHAAR & CO.—556-58 W. Jackson Blvd., Chicago, Ill. Manufacturers of elec-

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tric heaters. President, B. E. Schaar; secretary and treasurer, A. E. Schaar.

SCHAEDLER BROS. MFG. CO.—Philadelphia, Pa. Manufacturers of adapters. Main office, 5145-47 De Lancey St., Philadelphia, Pa. Branch office, 1520 Fulton St., Harrisburg, Pa.

SCHAEFER BROS. CO.—1059 W. 11th St., Chicago, Ill. Manufacturer of battery charging equipment, resistance units, rheostats, etc. President, Joseph Schaefer; vice-president, Peter Schaefer; secretary, Nellie Schaefer.

SCHAFER BEARING CORP.—4500 Ravenswood Ave., Chicago, Ill. Manufacturer of thrust bearings. President, J. E. Schafer; vice-president, George D. Bailey; secretary and treasurer, C. F. Ferguson.

SCHAPER.—Trade name for guy clamps manufactured by the General Electric Co., Schenectady, N. Y.

SCHATZ MFG. CO.—Poughkeepsie, N. Y. Manufacturer of ball bearings, sheet metal stampings and hardware specialties. Business established 1905. President, George D. Mackay; vice-president, J. W Schatz; secretary, G. H. Schatz; treasurer and general manager, H. A. Schatz; sales manager, H. F. Petersen.

SCHAWEL & CO., JAMES.—26 John St., New York, N. Y. Manufacturers of platinum sheet and wire.

SCHEDULES FOR STREET LIGHTING.—In order to make a contract for street-lighting service it is necessary to know at just what hours each night the lighting will be required and the total number of hours of lighting to be furnished each year. This is done by agreeing on a definite schedule for lighting. Numerous schedules are in use, the following four being the most common:

All-Night Schedule. Light lamps one-half hour after sunset and extinguish them one-half hour before sunrise every night of the year. This gives a total of about 3940 hours of lighting a year (3953 hours in leap year). This schedule is well adapted to all large and medium-sized cities in which safety requires abundant street lighting every night. In some cases the schedule calls for a total of 4000 or even 4100 hours annually. This is obtained by reducing the dependence on twilight, that is, lighting nearer after sunset and extinguishing nearer to sunrise.

Moonlight Schedule. This schedule provides no lighting when the moon is expected to be bright. The commonest rule is that known as the Philadelphia moonlight schedule: Light lamps one hour after sunset until the fourth night of new moon, also one hour before moonset; extinguish one hour before sunrise, also one hour after moonrise; provide no light at all on the night before, the night of, and the night after full moon. This schedule results in considerable economy in lighting cost, but makes no allowance for cloudy nights when the moon is obscured; in some cases special clauses are included in the contract to authorize some municipal or village official to order lighting on such cloudy nights, record being kept of the total number of extra hours and payment made at a stipulated amount per hour. Even with this clause, this schedule is not adapted to large cities where the dark shadows cast by tall buildings make moonlight a very uncertain quantity. The total number of hours of lighting by the moonlight schedule varies from year to year (about 2100 to 2275), depending on the number of full moons per year and just how the various phases occur. The schedule must be made up accurately each year from a reliable almanac giving the time of sunset, sunrise, moonset and moonrise, for the year in advance.

Frund Schedule. This schedule, named after its originator, combines the all-night schedule up to midnight and the moonlight schedule after midnight. Lighting is provided each night of the year up to 12 p. m., and after that only when called for by the moonlight schedule. This schedule must also be accurately made up each year, since it depends partly on moonlight. Its total hours vary from 2970 to 3120 from year to year. It is adapted to cities where use of the streets is quite heavy up to midnight and very light after that, so that utilization of moonlight in the morning hours is not seriously objectionable.

Moonlight-Midnight Schedule. This follows the moonlight schedule up to midnight, but no lighting is provided after midnight on any night of the year. This schedule is adapted only to very small communities in which there are no tall buildings to cast dark shadows and where there is practically no traffic or other use of the streets after midnight. Its total varies from about 1100 to 1175 hours per year, depending on the moon, and it must be made up each year.

For special business men's or "White Way" lighting there are many schedules in use, depending on the terms of the contract covering it. A favored one is to light the lamps at sunset and extinguish at 11 p. m., except Sunday, when no lighting is furnished; in other cases Sunday is included, but the hours are changed for that day; occasionally the time of extinguishment is later on Saturday.

SCHENECTADY VARNISH CO.—Schenectady, N. Y. Manufacturer of insulating varnishes and compounds.

SCHIEREN CO., CHARLES A.—New York, N. Y. Manufacturer of leather belting. Business established 1868. President, Charles A. Schieren; vice-president, G. Arthur Schieren; secretary and treasurer, Charles J. Schlegel. Main office and factory, 30-38 Ferry St., New York, N. Y. Branch offices, 35 E. Mitchell St., Atlanta, Ga.; 232 Summer St., Boston, Mass.; 116 W. Illinois St., Chicago, Ill.; 777 Rockwell Ave., Cleveland, Ohio; 1752 Arapahoe St., Denver, Colo.; Detroit, Mich.; 1324 W. 12th St., Kansas City, Mo.; 477 S. Main St., Memphis, Tenn.; 509 E. Water St., Milwaukee, Wis.; 226 N. 3rd St., Philadelphia, Pa.; 337 2nd Ave., Pittsburgh, Pa.; Dooly Bldg., Salt Lake City, Utah; 305 1st Ave., S., Seattle, Wash.; 112 N. 3rd St., St. Louis, Mo.; 257 Mission St., San Francisco, Cal.; Texas Charles A. Schieren Co., Inc., Murray & William Sts., Dallas, Tex.

SCHLEGEL MFG. CO., THE.—College & Goodman Sts., Rochester, N. Y. Manufacturer of insulating tapes. Business established 1885. President, C. P. Schlegel; secretary, G. C. Schlegel.

SCHLUETER, M. L.—225 W. Illinois St., Chicago, Ill. Manufacturer of motor-driven floor surfacing machines.

SCHMIDT ELECTRIC CO., A. R.—E. Water & Buffalo Sts., Milwaukee, Wis. Manufacturer of electrical cabinets and switchboards.

SCHMIDT ELECTROLYZER.—A cell for the production of hydrogen and oxygen by the electrolysis of water, using alkaline electrolyte and iron electrodes connected in series.

SCHOENHERR-HESSBERGER PROCESS.—One of the most successful of the arc processes for the production of nitric acid from the air. The striking feature of this process is the maintenance of an arc several meters in length, along which the air is drawn in a tangential helical path. The gases carry 1.5 to 2.0% of nitrous oxide corresponding to 68 grams of nitric acid per kilowatt-hour. The furnaces take about 300 amp. at 3500 volts.

SCHOLHORN CO., WILLIAM.—New Haven, Conn. Manufacturer of cutting pliers, etc.

SCHOOLS, ELECTRICAL.—Under the general article on Education, electrical, will be found lists of colleges and technical schools teaching electrical engineering, trade schools and others teaching various branches of electrical work, and correspondence schools teaching electrical subjects of either elementary or advanced character.

SCHOONMAKER CO., A. O.—88 Park Pl., New York, N. Y. Manufacturer of mica insulating materials. Vice-president and treasurer, Marshall W. Greene; secretary, Henry F. Butler.

SCHOOP ELECTROLYZER.—An apparatus for the electrolytic production of hydrogen and oxygen using dilute sulphuric acid as electrolyte and lead electrodes.

SCHRAMM & SON, INC., CHRIS D.—West Chester, Pa. Manufacturer of electric pumps, hoists, drills and air compressors. Business established 1898. President, Chris D. Schramm; vice-president, treasurer and general manager, Henry N. Schramm; secretary, Harry Miller; sales manager, Milyon Anne. Branch office, 480 Lexington Ave., New York, N. Y.

SCHRIVER CO., O. P.—Cincinnati, Ohio. Manufacturer of cutting pliers.

SCHUCKERT ELECTROLYZER.—An aparatus for the electrolytic production of hydrogen and oxygen, using an alkaline electrolyte and iron electrodes.

SCHULTZ & SON, A. L.—1675 Elston Ave., Chicago, Ill. Manufacturers of friction clutch couplings and pulleys. President, A. L. Schultz; secretary, A. F. Schultz; treasurer, F. J. Schultz.

SCHUNCK & OGG.—235 Canal St., New York, N. Y. Manufacturers of electric vibrators and illuminated barbers' poles.

SCHUTTE & KOERTING CO.—Philadelphia, Pa. Manufacturers of feed water heaters, injectors and other power plant specialties. President and general manager, E. A. Fisher. Main office, 1156 Thompson St., Philadelphia, Pa. Branch offices, 50 Church St., New York, N. Y.; 10 High St., Boston, Mass.; 503 Union Bldg., Cleveland, Ohio; First National Bank Bldg., Denver, Colo.; 2137 Oliver Bldg., Pitsburgh, Pa. Sales representatives, A. C. Nell, 730 Lumber Exchange Bldg., Chicago, Ill.; Southern Engineering Co., 425 Gravier St., New Orleans, La.; Willam J. Neville, 1522 Candler Bldg., Atlanta, Ga.; I. Hardeman, Security Bldg., Charlotte, S. Carolina.

SCHUTZ BROS., INC.—152 Chambers St., New York, N. Y. Manufacturer of wood handles and other wood turnings.

SCHUYLER ELECTRIC CO.—Berkeley, Cal. Manufacturer of electric washing machines.

SCHWARTZ.—Trade name for automatic electric guiders manufactured by the Blake Electric Mfg. Co., Boston, Mass.

SCHWARTZ & BRO., S. ROBERT.—729-31 Broadway, New York, N. Y. Manufacturers of portable electric lamps and conduit fittings. Business established 1910.

SCHWARTZ BELTING CO.—New York, N. Y. Manufacturer of leather belting. Main office, 74-76 Murray St., New York, N. Y. Branch office, Detroit, Mich.

SCHWARZE ELECTRIC CO.—E. Church St., Adrian, Mich. Manufacturer of bells, horns and other electrical specialties. Business established 1904. President, J. N. Sampson; vice-president, A. Matthes; secretary and treasurer, Arnos Kello; general and sales manager, D. E. Sampson.

SCHWEITZER & CONRAD, INC.—Chicago, Ill. Manufacturer of high-voltage protective and switching equipment. President, E. O. Schweitzer; secretary, treasurer and general manager, N. J. Conrad; sales manager, R. Roth. Main office and factory, 4431-4439 Ravenswood Ave., Chicago, Ill. Branch offices, 88 Broad St., Boston, Mass.; 207 I. W. Hellman Bldg., Los Angeles, Cal.; 30 Church St., New York, N. Y.; Denham Bldg., Denver, Colo.; 1124 Metropolitan Life Bldg., Minneapolis, Minn.; Hoge Bldg., Seattle, Wash.

SCHWEITZER & HERZ.—231 N. Wells St., Chicago, Ill. Manufacturers of lighting fixtures and specialties. Partnership, E. O. Schweitzer and Alfred Herz.

SCIENTIFIC.—Trade name for electric feed grinders manufactured by the Bauer Bros. Co., Springfield, Ohio.

SCIENTIFIC.—Trade name for electric clothes driers manufactured by the Scientific Heater Co., Cleveland, Ohio.

SCIENTIFIC.—Trade name for spark plugs manufactured by George T. Simmons, R. R. 8, Janesville, Wis.

SCIENTIFIC HEATER CO., THE.—Cleveland, Ohio. Manufacturer of electric clothes driers. O. J. Kuenhold, president.

SCIENTIFIC INSTRUMENT CO.—711 8th St., Detroit, Mich. Manufacturer of hydrometers, thermometers, barometers, etc. President, R. Papendell, Sr.; vice-president, R. Papendell, Jr.; secretary and treasurer, A. V. Papendell; general manager, H. L. Emhoff; sales manager, A. Emhoff.

SCIENTIFIC MFG. CO.—8010 Superior Ave., Cleveland, Ohio. Manufacturer of bronze powders, etc.

SCIENTIFIC PRODUCTS CO., THE.—Castle Shannon, Pa. Manufacturer of bronze powders, etc.

SCIENTIFIC SPARK PLUG CO.—R. R. 8, Janesville, Wis. Manufacturer of spark plugs. Business established 1917. George T. Simmons, owner.

SCIENTIFIC UTILITIES CO., INC.—18 E. 16th St., New York, N. Y. Manufacturer of electrotherapeutic apparatus. Business established 1917. President, George Grunberg; vice-president, M. F. Hayes; treasurer, B. Zippert; general manager, G. Grunberg.

SCISSORS BILL.—Trade name for pole-top switch manufactured by the Electric Power Equipment Co., Philadelphia, Pa.

SCISSORS, ELECTRICIANS'.—Small size scissors having stout cutting blades intended for use by wiremen handling telephone, signal, or other circuits employing small size wires.

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Manufacturers:

HERBST, PAUL W., Chicago, Ill. We can supply a complete line of scissors designed for use by electricians and mechanics. See display advertisement page 1258.—Adv.

Wiss & Sons Co., J., 33 Littleton Ave., Newark, N. J.

SCOOP.—Trade name for lighting reflector manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

SCOOPETTE. — Trade name for show case lighting reflector manufactured by the National X-Ray Reflector Co., 235 W. Jackson Blvd., Chicago, Ill.

SCOTT & CO., WALTER.—Plainfield, N. J. Manufacturer of motor-driven printing presses. General manager, B. J. Scott. Main office, Plainfield, N. J. Branch offices, 53 W. Jackson Blvd., Chicago, Ill.; New York, N. Y.; Boston, Mass.

SCOTT CORP.—105 N. Clark St., Chicago, Ill. Manufacturer of automobile locks and testers. President, Herbert Scott; vice-president, Guy B. Rickenbaugh; secretary and treasurer, George M. Scott.

SCOTT-SPENCER AUTOMATIC TOOL CO., INC.—2683-2689 Madison Rd., Cincinnati, Ohio. Manufacturer of reamers, taps and special tools. President and general manager, Tom J. Scott; vice-president, Thomas E. Parker; secretary and treasurer, M. T. Scott.

SCOTT SYSTEM OF PHASE-CHANGING TRANSFORMERS.—Two transformers are combined to transform from three-phase to two-phase or vice versa. One of these, say A, is a standard transformer with one winding, say the primary, wound for the three-phase voltage, and the other for two-phase voltage. The second transformer, B, has the number of primary turns related to those of the primary of transformer A, as the length of the perpendicular is to the length of a side of an equilateral triangle, that is 0.866. The primary winding of transformer B is connected to the middle point of the primary winding of transformer A. If then the three free ends of the latter winding are connected to a three-phase system, electromotive forces 90° apart in phase will be produced in the unconnected secondary windings of the two transformers. These secondary windings have the same number of turns, to give the same two-phase voltage.

SCOTT-ULLMAN CO., THE.—3311-25 Perkins Ave., N. E., Cleveland, Ohio. Manufacturer of lighting fixtures. President, Albert Ullman; vice-president, M. C. Rosenfeld; secretary and general manager, Robert Moses; treasurer, Sidney S. Friedman.

SCOTT VALVE MFG. CO.—Detroit, Mich. Manufacturer of valves. F. P. Thomas, secretary.

SCOTTDALE.—Trade name for grates and gas engines manufactured by the Marion Machine, Foundry & Supply Co., Marion, Ind.

SCOVILL MFG. CO.—Waterbury, Conn. Manufacturer of brass and bronze in sheets, plates and wire rods, also special stampings. Business established 1802. President and general manager, E. O. Goss; vice-president, J. H. Goss; secretary, L. P. Sperry; treasurer, C. M. DeMott; sales manager, E. S. Sanderson. Main office and factory, 99 Mill St., Waterbury, Conn. Branch offices and warehouses, Detroit, Mich.; 224 W. Lake St., Chicago, Ill. District offices, Boston, Mass.; Philadelphia, Pa.; Rochester, N. Y.; Cleveland, Ohio; 280 Broadway, New York, N. Y. Sales representative, Stewart & Co., Gloversville, N. Y.

SCRANTON ADVERTISING SIGN CO.—320 Connell Bldg., Scranton, Pa. Manufacturers of electric signs. Business established 1904. President and general manager, P. F. Duffy, Jr.; vice-president, James L. Duffy; secretary and treasurer, Collis Sutcliffe; sales manager, Ambrose Bradley.

SCRANTON BUTTON CO., THE.—Scranton, Pa. Manufacturer of molded insulations. President and treasurer, Charles R. Connell; vice-president, Philip L. Sylvester; secretary, F. C. Stackhouse; general manager, Louis G. Sylvester. Main office, 409 Cherry St., Scranton, Pa. Branch office, 50 Union Sq., New York, N. Y. Sales representatives, Gordon D. Wilson, 645 Washington Blvd., Chicago, Ill.; Mueller Electric Co., 2135 Fairmount Rd., Cleveland, Ohio.

SCRANTON GLASS INSTRUMENT CO. Scranton, Pa. Manufacturer of hydrometers, thermometers, etc. Business established 1919. President, H. T. Madden; vice-president and general manager, R. A. Amennan; treasurer, R. H. Keffer. Main office and factory, 322 N. Washington Ave., Scranton, Pa. Branch office, 185 Madison Ave., New York, N. Y. Sales representative, Gordon D. Wilson, 645 Washington Blvd., Chicago, Ill.

SCRAPERS, ELECTRIC TROLLEY WIRE.—See Sleet cutters, trolley wire.

SCRAPERS, SLEET, THIRD RAIL.—A device attached to the car truck to scrape sleet off of the top or contact surface of the conductor or third rail, consisting of a stiff wire brush or steel blades, carried in vertical position and which are provided with means for pressing the brush or blades to the rails. In some cases only a multiple-bladed scraper is used, and in others, a cutting wheel is used to break up the sleet followed by a brush or scraper to remove it from and clean the rail. Both flat leaf springs and air cylinders are employed in providing the pressure between the scrapers and the rail. These devices are carried on the same wooden beam, attached to the car truck, which holds the third-rail shoe.

SCRAPERS, WIRE.—Hand tools used by electricians for removing insulation from conductors prior to making splices, joints, or other connections. Also an electrically driven machine, having a number of sharp revolving knives, for cutting the insulation from the ends of wires and cables when a great deal of this work has to be done.

Manufacturer:

France Mfg. Co., The, 10325 Berea Rd., Cleveland, Ohio. "F-F."

SCREENS, ELECTRIC OR MAGNETIC.—An electric screen is used to protect delicate instruments from the effects of external electrostatic induction. The screen is usually composed of perforated tinfoil or of wire gauze, although any metal enclosure will serve to exclude electrostatic fields. Many instruments also require magnetic screens to protect the movable elements and to eliminate the effect of external magnetic fields upon the readings. These screens are made of iron or steel, which being magnetic, seem to absorb the lines of force and prevent any from penetrating within the screen.

SCREENS, ELECTRIC, VIBRATING.—Electric vibrating screens are used for screening sand, gravel, etc., and for the separation and concentration of crushed ores. They consist of metallic cloth or wire screens on a framework, usually inclined, that is caused to vibrate by an electric motor, either placed above or below the screen. The vibrations are sometimes applied as a hammer blow from above or they may be supplied from underneath as a very rapid and continuous vibration. The crushed ore and material passing over the screen is forced up into the air and thrown to another part of the screen so that a thorough agitating motion is obtained. Also see Riddles, foundry, and Vibrators, foundry.

Manufacturers:

Stimpson Equipment Co., Felt, Bldg. Salt Lake City, Utah. "Mitchell."

Tyler Co., W. S., Cleveland, Ohio. "Hum-Mer."

Vulcan Enginering Sales Co., 1765 Elston Ave., Chicago, Ill. "Hanna."

SCREENS, WATER INTAKE.—Power plant water for condensing is taken in through one or more intake tunnels. Where the water is received from wells and city water supply mains, the water is clean and free from foreign matter and can go direct to the pumps and thence through the condenser. Where river water or sea water is used, care should be taken that the intake is well below water level, even at the most unfavorable season of the year. Yet an intake placed too low may cause trouble from silt, etc. Intakes of concrete are preferable to those of metal, as sewage and industrial wastes tend to be extremely corrosive. In using this water, however, all kinds of debris, such as leaves, twigs and other vegetation, fish and industrial wastes may be drawn in unless suitable screens are provided.

As hundreds of thousands of gallons of water per day may pass through an intake screen and, further, as interruption of water may shut down a station, it is vital that the circulation of water should not be interfered with by clogging of the intake screens. Screens should be in duplicate so as to permit one set to be in service while another is being cleaned, or the screens should be revolving so as to never become clogged up. Facilities for cleaning stationary screens are important, and without stopping the water supply. Duplicate or sectionalized water intakes are often warranted on this score.

Revolving or traveling screens have offered much in the way of labor reduction and higher efficiency for the condenser as they reduce the necessity for cleaning the screens and the condenser tubes. They are usually made of metallic screen cloth on heavy metal frames, or of a screen in the form of a belt. They are installed in either a vertical or an inclined position and revolve with an upward motion on the inlet side. In one type sectional screens are caused to rotate over sprockets at the top and bottom. A small ledge is secured to each screen to collect the mud and debris and carry it up over the sprocket where it is blown or washed off the screen into a rubbish trough. The revolving screens are generally motor-driven, and their constant cleaning makes it practically unnecessary to shut down except for repairs.

Manufacturers:

Chain Belt Co., 736 Park St., Milwaukee, Wis. "Rex."

LINK-BELT CO., Philadelphia, Chicago, Indianapolis. Link-Belt traveling water screens for condenser intakes automatically remove debris and foreign matter from the water, and insure a steady supply of clean water to the condensers at all times. They maintain full efficiency of condensers and therefore, of the plant. They reduce to a minimum the necessity for cleaning condensers and repairs are reduced in condensers and pumps, avoiding interruption of service, conserving fuel. They are automatically operated with but little power consumption and furnish a flexible screening system of separately driven, reliable and efficient units.—Adv.

SCREW ANCHORS.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

SCREW, CONTACT.—A machine screw furnished with a contact point at the end to be used to complete and open a circuit. Contact screws are largely used on relays of various kinds.

SCREW DRIVERS, AUTOMATIC.—Screw drivers which are equipped in the handle with a spiral mechanism, usually reversible, to give a rotary motion to the blade by pushing down on the handle. They operate on the same principle as the automatic drills and greatly facilitate the driving and removing of screws.

Manufacturers:

Goodell-Pratt Co., Greenfield, Mass.

Millers Falls Co., Millers Falls, Mass. "Millers Falls."

North Bros. Mfg. Co., Lehigh Ave., & American St., Philadelphia, Pa. "Yankee."

SCREW DRIVERS, INSULATED.—Screw drivers for electric use around live circuits and apparatus. The handle and metal shank are thoroughly covered with rubber or other durable insulating compound, leaving only a short length of the metal blade exposed. These screw drivers not only protect the electrician from shock, but prevent short-circuiting the apparatus by a long exposed metal shank.

Manufacturers:

Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y. "Star," "Indestructible," "Cabinet Electric," "Elmira."

Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa. "Disston."

Goodell-Pratt Co., Greenfield, Mass.

Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y. "Hyvoltage."

Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass. "Service."

Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Perpetuo."

M-B Tool Co., Danielson, Conn. "Insulectric," "Hi-Speed."

SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."

Stanley Works, The, New Britain, Conn.

Starrett Co., The L. S., Athol, Mass.

Strong Machinery & Supply Co., 21 Walker St., New York, N. Y.

Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

SCREW DRIVERS, MOTOR-DRIVEN.—Where a great deal of wood work has to be put together with screws or where quantities of machine screws are to be driven into metal parts, it sometimes effects considerable saving in time and labor to have screw drivers motor-driven. They

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may be portable, like an electric drill, or permanently mounted on the bench. In the latter case multiple-spindle drivers are often provided to drive a set of adjoining screws at one time.

Manufacturers:

Clark Jr., Electric Co., Inc., James, 520 W. Main St., Louisville, Ky. "Willey."
Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. "Electro."
Neil & Smith Electric Tool Co., The, 813-815 Broadway, Cincinnati, Ohio. "Ideal."
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Wodack Electric Tool Co., 23-27 S. Jefferson St., Chicago, Ill. "Wodack."

SCREW DRIVERS, RATCHET.—Screw drivers in which a ratchet mechanism in the handle permits screws to be driven without removing the hand from the driver or the blade from the screw slot. Such drivers are usually reversible to permit unscrewing as well as driving screws.

Manufacturers:

Cincinnati Tool Co., Norwood, Cincinnati, Ohio. "Hargrave."
Goodell-Pratt Co., Greenfield, Mass.
North Bros. Mfg. Co., Lehigh Ave. & American St., Philadelphia, Pa. "Yankee."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

SCREW DRIVERS, SPECIAL.—Screw drivers are so widely used by electricians, manufacturers' and utility employees, etc., that they are often required to be made up into novel forms and special sizes and types for some particular purpose. There are also screw drivers made to secure some special result, making possible an extra leverage when the screw is tight. Combination screw drivers including other tools, such as a hammer, are also made.

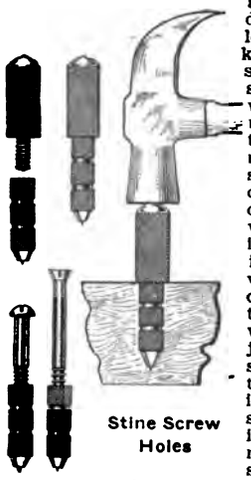
Manufacturer:

Crescent Tool Co., Jamestown, N. Y. "Hamr-Handl."

SCREW HOLES.—This rather odd name is given to metal sockets for screws, that are placed in wood or other soft material to provide a threaded hole that will permit a screw to be placed in it and removed several times. They also permit the use of machine screws with these soft materials. The screw holes are metallic cylinders having prongs or corrugations on the outside so that they will not come out after they are driven into a hole drilled for them. The threaded screw hole is in the center of the metal cylinder or socket.

Manufacturer:

STINE SCREW HOLES CO., THE, Waterbury, Conn. Stine Screw Holes are a new, inexpensive aid to manufacture. They are made of brass, in the form of a hollow cylinder, pointed at lower end, with knurled outer surface and screw threads within. They make it possible to remove and re-use any wood screw or machine screw as often as desired, without mutilating the receiving material and without danger of stripping the threads or weakening the job when the screw is retightened. To install, they are simply driven into any material, hard or soft, with a few blows of a hammer, thus enabling the user to standardize to wood or machine screws in all operations. Stine Screw Holes are rustless, permanent, convenient and economical, and widely indorsed in manufacturing circles.—Adv.



Stine Screw Holes

SCREW-MACHINE PRODUCTS. — A term applying to a very large class of small parts, manufactured on screw machines. They are almost exclusively of metal and usually of brass. The screw machine is a special lathe, sometimes hand-controlled, but usually automatic in its operation, on which are set up the cutting tools, taps, dies, etc., necessary to produce the particular piece of work in hand. These tools are mounted on a revolving turret and the material is fed through the hollow shaft of the machine in the form of long rods or tubes. As each operation is completed the next tool is brought into position, and when the piece is finished it is cut off, the rod fed up and another piece started. A very large number of the small metal parts used in the manufacture of many electrical and other articles, such as screws, bolts, nuts, caps, bushings, washers, pins, inserts, binding posts, etc., are produced on automatic screw machines, at a cost very much below that which would be possible on the ordinary lathe. These machines, however, require a large first investment and a skillful and specially trained attendant. Considerable time is required to arrange the tools for or "set up" a new job, but a single attendant can care for several screw machines after they are set up. It consequently is more economical to operate them in a "battery" of several machines, and on jobs running into many thousands of pieces. Only larger manufacturers find it economical to produce their own screw-machine parts, since companies making this their business can produce them more cheaply.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Art Craft Fixture Co., 85 Academy St., Newark, N. J.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Belvidere Screw & Machine Co., Belvidere, Ill.
Blake & Johnson Co., The, Box 1054, Waterbury, Conn.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Burgess-Norton Mfg. Co., Geneva, Ill.
Corbin Screw Corp., New Britain, Conn.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
Harper Screw Works, F. C., 29 S. Clinton St., Chicago, Ill.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn. "H. M. S."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Levi, Benjamin, 355 W. Broadway, New York, N. Y.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich.
Midwest Brass & Copper Co., 480 Broome St., New York, N. Y.
Miles, Franklin S., 205 Quarry St., Philadelphia, Pa.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Sewing Machine Co., Belvidere, Ill.
National Marine Lamp Co., The, Forestville, Conn.
New Britain Machine Co., New Britain, Conn. "New Britain."
New Haven Screw Co., New Haven, Conn.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Premier Mfg. Co., Inc., Sandy Hook, Conn.
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SCREW MACHINE PRODUCTS CORP., THE.—Providence, R. I. Manufacturer of telephones. Business established 1908. President and general manager, George Briggs; secretary and sales manager, Robert I. Jamieson; treasurer, Harry M. Mays. Main office, 1012 Eddy St., Providence, R. I. Branch office, 459 5th Ave. Bldg., New York, N. Y. Sales representatives, Charles Sherwood, Box 664, Waterbury, Conn.; George J. Beattie, 72 Victoria St., Toronto, Ont.; Enterprise Electric Construction & Fixture Co., 6509 Euclid Ave., Cleveland, Ohio; Electric Sales Co., 253 S. Broadway, Los Angeles, 393 Mission St., San Francisco, Cal.

SCREWIT.—Trade name for porcelain knobs manufactured by J. H. Parker & Son, Parkersburg, W. Va.

SCREWS, BRASS.—Brass screws are very generally used on electrical instruments and appliances, sockets, receptacles and other wiring devices and on the finer classes of other electrical work, not only because of their better appearance, but because they do not rust like steel or iron screws. In some cases they form part of the circuit and are therefore necessary, where iron could not be used because of its low conductivity. They may be secured in all standard styles and sizes.

Manufacturers:

American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Blake & Johnson Co., The, Box 1054, Waterbury, Conn.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Faries Mfg. Co., Decatur, Ill.
Hall Switch & Signal Co., Garwood, N. J.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Lamson Electrical & Mfg. Co., 625 W. Jackson Blvd., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
National Acme Co., The, E. 131st St. & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Marine Lamp Co., The, Forestville, Conn.
Parker Supply Co., Inc., 781 E. 135th St., New York, N. Y.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.

SCREWS, EXPANSION OR ANCHOR.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

SCREWS, LAG.—Heavy screws, or bolts, usually made from steel, with a square head, a sharp point, and wide spacing between threads, for use in heavy woodwork, such as attaching motor brackets to beams or floors, crossarms to poles, etc. A hole approximately the size of the bolt at the beginning of the thread is bored into the timber or pole and the lag screw is driven in with a wrench, the sharp threads cutting their way into the wood.

Manufacturers:

HUBBARD & CO., Pittsburgh, Pa. Hubbard lag screws are furnished in three styles and made of open hearth steel, hot galvanized, and on all orders for lag screws the fetter-drive style of thread is furnished, as it conforms with the specification of the National Electric Light Association, American Telephone & Telegraph Co. and the Railway Signal Association.—Adv.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.

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SCREWS, MACHINE.—Screws which have a straight shank or body and a square or blunt point, as distinguished from wood screws or lag screws which have a tapering body and a sharp point. Machine screws have closely cut threads and are for use principally in metal, using either a threaded nut or fitting into parts previously tapped, while wood screws cut their own threads. Machine screws can be secured with either flat or round heads, also a large number of other shapes. The length of a screw is measured to the top of the head in a flat-head screw, and to the bottom in a round-head screw. The principal forms of threads now standard for machine screws in the United States are the V-thread, which has its surfaces at an angle of 60° and meeting at the top and bottom in a sharp point; and the U. S. thread, which is the same except that it has a small portion of the top and bottom of the V squarely cut off. Machine screws are made in iron, steel, brass and other metals in a large variety of types and sizes. They are used very extensively in electrical machinery, appliances, instruments, etc., many millions of them being so used every year.

Manufacturers:

American Screw Co., Providence, R. I.
Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Blake & Johnson Co., The, Box 1054, Waterbury, Conn.
Corbin Screw Corp., New Britain, Conn.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Hall Switch & Signal Co., Garwood, N. J.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lamson Electrical & Mfg. Co., 625 W. Jackson Blvd., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
National Marine Lamp Co., The, Forestville, Conn.
Parker Supply Co., Inc., 781 E. 135th St., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Reed & Prince Mfg. Co., Worcester, Mass.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
St. Louis Screw Co., Clarence St., & Bulwer, Ave., St. Louis, Mo.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.

SCREWS, SET.—Screws, usually of steel, mounted in the hubs of pulleys, clutches or couplings to prevent their turning on the shaft, or in other parts of machinery where it is desired to prevent movement of a part. Set screws usually have sharp or cup-shaped points and square or slotted heads, the former for wrenches, the latter for screw drivers.

Manufacturers:

Atlas Bolt & Screw Co., The, 1100-1144 Ivanhoe Rd., Cleveland, Ohio.
Boss Nut Co., 1732-54 N. Kolmar Ave., Chicago, Ill. "Boss."
BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Clark Bros. Bolt Co., Milldale, Conn.
Corbin Screw Corp., New Britain, Conn.
Hall Switch & Signal Co., Garwood, N. J.
Harper Screw Works, F. C., 29 S. Clinton St., Chicago, Ill.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
National Acme Co., The., E. 131st & Coit Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
National Marine Lamp Co., The, Forestville, Conn.
Reed & Prince Mfg. Co., Worcester, Mass.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.

SCREWS, WOOD.—Screws having a sharp tapering point and widely spaced threads, for use in wood. While the machine screw has closely set threads, because it usually fits into metal of equal strength, the wood screw secures its hold in a weaker material and therefore must have a greater proportion of the thread space. Flat or round heads are usually furnished on wood screws, although other styles can be secured. Wood screws are mostly made of iron or steel, but brass screws are also much used where freedom from rusting is important as in electrical instrument bases and boxes. They are made in a wide range of standard sizes.

Manufacturers:

American Screw Co., Providence, R. I.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Parker Co., The Charles, 48 Elm St., Meriden, Conn.
Reed & Prince Mfg. Co., Worcester, Mass.
Southington Hardware Co., The, Southington, Conn.
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Stowell Screw Co., Ltd., The, 290 St. Paul St., W., Montreal, Que., Can.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SCRUBBERS, MOTOR-DRIVEN, FLOOR.—Machines in which horizontal rotary brushes are driven by electric power. In some machines a tank of water and a supply of washing powder or liquid soap are carried as part of the machine. These are fed onto the floor, automatically, just ahead of the revolving brush. Attachments for picking up the dirty water are also made. They consist of two converging squeegees with a motor-driven pump for sucking up the water. These machines are used for scrubbing floors where the space is large, as in office-building halls, or where the floors are particularly old or dirty. While a machine of this sort is not well adapted to use in small rooms or where there are many obstructions, it may be used to considerable advantage where the area is large, especially in long corridors, large assembly halls and dining rooms with removable furniture, depot writing rooms, etc. One machine does the work of a large group of scrubwomen.

Manufacturers:

American Scrubbing Equipment Co., Inc., 180 N. Wabash Ave., Chicago, Ill. "Finnell."
Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Electrical & Specialty Supply Co., 9 S. Clinton St., Chicago, Ill. "Connersville."
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. "Two-In-One," "E-Z."
INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y. "International." See descriptive advertisement under Rubbing and polishing machines, motor-driven.—Adv.
KELLEY ELECTRIC MACHINE CO., 111 Dearborn Street, Buffalo, N. Y. The Kelley floor machine for waxing, polishing and refinishing all floor surfaces, for scrubbing or shampooing carpets, and for surfacing or rubbing down composition, mosaic, terrazzo, and concrete floors, is a big labor saver and does efficient and thorough work in one-fifth of the time of old methods, equipped with scrubbing, waxing and polishing or wire brushes, grinder head with carborundum stones or sanding pad. Cut shows machine on scrubbing brush. Insert grinder head. Built to operate on lighting circuits of 110 or 220 volts, a-c. or d-c. The special Kelley Universal operates on either 25-cycle, 60-cycle or direct current and is the machine for contractors to use. Furnished with floor handle for floor work or table handles for bench work.



Kelley Floor Machine

Machine is ball bearing equipped throughout.—Adv.
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Utility."
Landers, Frary & Clark, United Vacuum Appliance Division, Connersville, Ind. "Connersville."

SCRULIX.—Trade name for guy anchors manufactured by W. N. Matthews & Brother, Inc., 2912 Easton Ave., St. Louis, Mo.

SE.—The form Se is the chemical symbol for the element selenium.

SEA LINE PLANER.—Trade name for power transmission belting manufactured by the Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

SEA WAVE.—Trade name for electric washing machines manufactured by the Voss Bros. Mfg. Co., Davenport, Iowa.

SEABOARD METAL CORP.—North Arlington, N. J. Manufacturer of solder, etc. Branch, New York, N. Y.

SEACO.—Trade name for electric heating pad manufactured by the Standard Electrical Appliance Co., Beverly, N. J.

SEAL OIL.—Trade name for belt dressing manufactured by the Whitlock Mfg. Co., 1506 W. 112th St., Cleveland, Ohio.

SEALET.—Trade name for terminal fittings manufactured by the Butte Electric & Mfg. Co., 534 Folsom St., San Francisco, Cal.

SEALING MACHINES, ELECTRICALLY HEATED.—Machines which are heated by electric coils for sealing operations, such as fastening the wrappings on loaves of bread, cartons containing cereals, biscuits, etc. The term is also sometimes applied to electrically heated machines for melting the sealing compound used to fill over the countersunk screw heads on the backs of switches, cutout bases, etc.

Manufacturers:

Miller Mfg. Co., 1008 S. West St., Kalamazoo, Mich. "Miller."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

SEALING PLUGS.—See Plugs, conduit sealing.

SEALING TOOLS, METER.—Sealing tools are hand punches of special construction arranged with dies in the jaws which compress the meter seal to prevent the withdrawal of the wires. The dies are often engraved with the purchaser's initials, a monogram or an emblem, so that these will be shown on the seal when it is sealed. This makes it necessary to destroy the seal or the emblem in order to remove the sealing wire.

Manufacturers:

American Casting & Mfg. Corp., 30 Main St., Broklyn, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Spencer Mfg. Co., S. M., Washington & Cornhill Sts., Boston, Mass.

SEALING WAX.—Sealing wax is a compound of wax and rosin that is plastic when warm and hard or brittle when cold. It is used on electrical apparatus to seal up cracks and holes, especially to cover screw holes and seal the screws in place. It is also used to insulate otherwise exposed metal parts, as pieces of copper or brass on switches, sockets and receptacles,

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where the metal is set in a slot or depression in the body or base.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Row, New York, N. Y.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
Mitchell-Rand Mfg. Co., 18 Vesey St., New Yorp, N. Y.
Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Zinsser & Co., William, 195 William St., New York, N. Y.

SEALING WAX MELTERS.—See Melters, wax, electrically heated.

SEALS, METER.—Meter seals are small disks of lead with two holes drilled through parallel to the faces. They are used to seal watt-hour and demand meters to prevent tampering with them by unauthorized persons. A wire is looped through holes in two studs on the meter base in such a way as to prevent the removal of the cover, and the two ends are drawn through the holes in the meter seal. A sealing tool is then used to compress the disk sufficiently to prevent the withdrawal of the wire.

Manufacturers:

American Casting & Mfg. Corp., 30 Main St., Brooklyn, N. Y.
Corbin Cabinet Lock Co., New Britain, Conn.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Spencer Mfg. Co., S. M., Washington & Cornhill Sts., Boston, Mass.
United Seal Co., Columbus, Ohio. "Safety," "Peerless."

SEARCHLIGHT.—Trade name for electric clocks manufactured by the Darche Mfg. Co., 643 W. Washington Blvd., Chicago, Ill.

SEARCHLIGHTS.—Searchlights are special projectors designed to give a very narrow spread to a light beam of extremely high intensity so as to project the light to very great distances. Almost all searchlights are of the arc-lamp type employing carbon electrodes. Where a low intensity of projected light and limited range is sufficient incandescent lamps may be used, but their field is quite restricted because the filament is not sufficiently concentrated in the larger sizes, such as 1000 watts; incandescent searchlights are more commonly called spotlights, which see. Searchlight arcs are arranged either for automatic feeding or hand feeding. The reflectors used on searchlights are almost invariably true parabolic with long focal length. They are made of silvered glass which is heavily painted on the back so that the silvering is not affected by the atmosphere, but must be protected as much as possible against hot particles of carbon falling on them.

In most of the commercial forms of searchlights a metal drum or housing encloses the mirror, carbon and lamp mechanism. Ventilation is provided in such a manner as to prevent the entrance of rain or dirt. A glass cover is held in place in the front of the housing; the whole unit may be turned horizontally or vertically, in the case of large searchlights by means of a motor. Recent developments in searchlights for military and other special purposes have led to the use of open type searchlights of very large diameter which increases the focal length and narrows the beam. During the recent war many searchlights of this type were mounted on special automobile trucks, and were designed especially for use at a very high angle and successfully employed in anti-aircraft service.

Searchlights are used for a great variety of purposes and their use is constantly increasing. On naval and mercantile vessels a powerful light is required for taking bearings, to pick out buoys, wreckage and other craft, in special signaling and in docking. On land searchlights are used for military and some spectacular lighting purposes, such as illumination of Niagara Falls and other waterfalls, balloons and other aircraft, etc.

Manufacturers:

American-LaFrance Fire Engine Co., Elmira, N. Y. "LaFrance."
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Imperial."
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y A complete line of searchlights which meet fully the demand for durable, efficient and reliable projectors, including an 18-in. incandescent lamp, 1000-watt, 110-volt searchlight, and arc lamp searchlights in standard commercial sizes; 9, 13, and 24 inches in diameter. Larger projectors of 30, 36, 60 and 80 inches in diameter can be supplied. G-E searchlight projectors are arranged for hand, pilot-house, shaft, rope and electric control. The electrically controlled projector, athough more expensive, provides the most satisfactory form of distant or remote control since it requires less attention, is easier to operate than the rope-controlled, and the control wiring may be run by the most convenient route without regard to obstructions or changes of direction. The training is accomplished by motors mounted in the base and electrically connected to a small controller, which is so wired that the searchlight beam follows the movement of its handle. (Bulletin 43856A.) See adv. pages 1203-1223.—Adv.



NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Newton, Charles I., 305 W. 15th St., New York, N. Y.
National Marine Lamp Co., The, Forestville, Conn. (Marine.)
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
S & M Lamp Co., 118 W. 36th St., Los Angeles, Cal.
Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.

SEARS, HENRY D.—Boston, Mass. Manufacturer of electrical wiring devices and specialties. Main office, 80 Boylston St., Boston, Mass. Factory, Schenectady, N. Y. Branch office, 345 Fifth Ave., New York, N. Y.

SEATS, CAR, PASSENGER.—Of two general types (a) cross seats and (b) longitudinal seats. They consist of supporting frames to carry seat cushions and backs, and when placed crosswise of the car are known as cross seats. On account of the limitations of car width and the necessity for an aisle or passageway lengthwise of the car, this type of seat usually is designed to accommodate only two passengers. The parts of cross seats are, the pedestal, seat, frame ends, supporting frame, seat cushion, reversing mechanism (if of reversible type) and back with cushion and handle. When the car operates from either end according to direction of trip, cross seats are frequently designed to be reversible, i. e., the back can be placed at either side of the cushion according to direction of car or desire of passengers. Seats arranged along the sides of a car are called longitudinal seats. These consist simply of cushions, supporting frame and back.

The seating arrangement of electric railway cars is usually a combination of the cross and longitudinal types, although the use of longitudinal seats only provides the maximum width of aisle and standing room. The combination of the two types with the minimum allowance in longtitudinal seats consistent with clear spaces at car ends, provides the most comfortable and popular seating arrangement. On street railway and on many interurban and steam railway suburban cars seat cushions and backs are upholstered with rattan. This makes a light, cool, easily cleaned, economical and sanitary seat.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Du Pont de Nemours & Co., Inc., E. I., Fabrikoid Division, Wilmington, Del. ("Fabrikoid" upholstery material for seats.)
Hale & Kilburn Corp., 1800 Lehigh Ave., Philadelphia, Pa.
Heywood Bros. & Wakefield Co., 209 Washington St., Boston, Mass. "Heywood-Wakefield."
St. Louis Car Co., 8000 N. Broadway, St. Louis, Mo.
Scarrit Car Seat & Mfg. Co., 5027 Mt. Kissock Ave., St. Louis, Mo.

SEATS, CONDUCTORS' AND MOTORMEN'S.—An item of car equipment frequently provided for motorman or conductor on street railway and many interurban cars, usually of stool type and portable, so that it may be changed from one end of car or train to the other as the trainmen change ends at terminals. On some electric railways, notably elevated and subway roads, the motorman's seat is of fixed folding type of such design that it will fold back against the end of vestibule or it may be folded up and placed behind a panel or door when not in use, and thus be out of the way and not take up useful space.

Manufacturers:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.
Heywood Bros. & Wakefield Co., 209 Washington St., Boston, Mass.

SEATS, LINEMEN'S POLE.—Where linemen have occasion to do a considerable amount of work on a pole in one position, as in jointing cables, the use of a lineman's seat facilitates the work. The provision of such facilities tends to increase efficiency and expedite the work. These seats are usually made of angle or channel iron, with either a wooden seat or iron slats. The frame is securely braced to the pole by two bracket arms.

Manufacturers:

Diamond Expansion Bolt Co., 90 West St., New York, N. Y. "Diamond."
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
HUBBARD & CO., Pittsburgh, Pa. Peirce pole seats, in a competitive test, held a dead weight of 1,700 lbs. without deflection. The frames and braces of all styles of Peirce seats are made of 1 by ⅛-in. channel, open hearth steel. These seats are made in four styles and will be found notably lighter and stronger. Hubbard & Co. also manufacture four different styles of seats made under the specifications of the Bell Telephone Co. See pages 212 and 213 of Hubbard's catalog. (Slater & Barnard, Ltd., of Hamilton, Ont., act as Hubbard's Canadian agents.)—Adv.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Meckel, Fred L., 9-13 E. 13th St., Chicago, Ill.

SEATTLE MACHINE WORKS.—Lander St. & East Waterway, Seattle, Wash. Manufacturers of motor-driven lumber stackers. Business established 1900. President, Eric Johnson; vice-president and general manager, Louis H. Simon; secretary and treasurer, Emil V. Grisvard.

SEBCO.—Trade name for cable and wire insulator and other circuit supporting devices manufactured by the Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y.

SECHLER IMPLEMENT & CARRIAGE CO.—Moline, Ill. Manufacturer of electric washing machines.

SECO.—Trade name for electric cigar lighters and dash lamps manufactured by the Spielman Electric Co., 193[illegible] Broadway, New York, N. Y.

SECO.—Trade name for wrenches manufactured by the Shuster Engineering Corp., Erie Ave. & Allen St., Philadelphia, Pa.

SECOHMMETERS.—Strictly speaking these are not meters or measuring instruments, but commutators used in bridge measurements of self-inductance with direct currents. The commutators are usually paired and driven by a small motor. One commutator is in series with the galvanometer and the other is connected in series with the battery. The synchronous reversal of current in the two branches produces a steady deflection of the galvanometer while the current through the common bridge arms is pulsating. The common term secohmmeter is a misnomer.

Manufacturer:

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

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SECOND.—The unit of time in scientific measurement is the 1/86400th part of a mean solar day. It is called a second. A mean solar day is the average, throughout a year, of the time between two successive transits of the sun across the meridian at any place. It is the second of the ordinary watch or clock when it is properly regulated. The minute, hour, day, week or year are also in common usage as units of time. These units are often combined with others, for example; the watt-minute, kilowatt-hour, ampere-hour, etc.

SECONDARY BATTERY OR SECONDARY CELL.—A battery which is reversible, so that when run down it can be restored to its original condition of electrical activity by forcing through it a charging current in the opposite direction to the discharge current. The common storage battery is the best example, and the lead battery the best known of these. Starting with one plate spongy lead and the other lead peroxide, the electrolyte being dilute sulphuric acid, the discharging action forms lead sulphate on both plates. The charging current changes these back to spongy lead and lead peroxide, and sends the acid back into the electrolyte, thus restoring the original condition. On discharge, therefore, such a battery serves as a secondary source of e.m.f. and it is therefore called a secondary battery, as contrasted with a primary battery which produces electrical energy direct from a nonreversible chemical reaction. See Batteries; also Batteries, storage.

SECONDARY OF A TRANSFORMER.—The winding of a transformer which delivers energy to the outgoing line is termed the secondary in distinction from the primary which receives the incoming energy. In a transmission system the secondary is the higher voltage at the point of supply and the lower voltage at the receiving station. In distribution systems the secondary is the low-voltage circuit from which buildings are supplied. The term secondary, as applied to circuits, is therefore most frequently associated with low voltages.

SECONDARY REACTIONS. — Assumed chemical reactions which the ions, upon being liberated by the electrolyzing current, exert upon the electrodes or the electrolyte. At the cathode, for instance, the cation may reduce the cathode, as in cathodic reduction, or it may reduce or decompose the electrolyte, as in electrolytic reduction, or as when the sodium ion liberated from a sodium salt in solution is said to decompose water and liberate hydrogen: $Na+H_2O=NaOH+H$. At the anode the anion may combine with the anode and bring it into solution, as in metal refining; or it may adduce the electrolyte, as in electrolytic oxidation, or as when the SO_4 ion converts a ferrous salt in solution into a ferric salt: $2\ FeSO_4+SO_4=Fe_2(SO_4)_3$.

SECRET-PHONE.—Trade name for telephonic listeners for detectives, made by the Globe Phone Mfg. Co., Reading, Mass.

SECTION.—A section, in electrical circuits, is an insulated length of line furnished with its own feeding circuit. The term is used mostly on electric railway lines where the trolley wire is sectionalized and supplied by feeders from the various substations. These are called section feeders.

SECURITY.—Trade name for wiring devices manufactured by the E. H. Freeman Electric Co., 803 E. State St., Trenton N. J.

SECURITY.—Trade name for portable lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

SECURITY.—Trade name for lightning rods manufactured by the Security Lightning Rod Co., 606-612 S. Pine St., Burlington, Wis.

SECURITY ELECTRIC LAMP CO.—134 S. Clinton St., Chicago, Ill. Manufacturer of incandescent lamps. President, W. Grossman; secretary and treasurer, S. Grossman.

SECURITY ELECTRIC MFG. CO.—1463 W. Ohio St., Chicago, Ill. Manufacturer of electric heating appliances. Partnership, H. Ostermann and Fred Hartmann.

SECURITY LIGHTNING ROD CO., THE.—Burlington, Wis. Manufacturer of lightning rods and lightning rod fittings. President, I. G. Wheeler; vice-president, William F. Brehm; secretary, G. W. Waller; treasurer and general manager, H. A. Runkel. Main office and factory, 606-612 S. Pine St., Burlington, Wis. Branch office, 1004 Press Bldg., Binghamton, N. Y.

SECURO.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

S. E. D.—Abbreviation for the Society for Electrical Development, Inc.

SEE-DRO SEPARATOR CO.—Berkeley, Cal. Manufacturer of storage battery separators.

SEE ELECTRIC ELEVATOR CO., A. B.—New York, N. Y. Manufacturer of electric elevators and dumb-waiters. Alonzo B. B. See, sole owner; general manager, Nils O. Lindstrom. Main office, 220 Broadway, New York, N. Y. Factory, Jersey City, N. J. Branch offices, Washington, D. C.; Baltimore, Md.; Boston, Mass.; Philadelphia, Pa.; Cleveland, Ohio; Hartford, Conn.; Montreal, Que., Can.

SEEBECK EFFECT.—If, in a closed circuit consisting of two different metals, the two junctions are kept at different temperatures, a permanent current will flow. If the circuit is made of copper and iron and if one junction is kept at the temperature of melting ice and the other at that of boiling water, it will be found that the current passed from copper to iron across the hot junction. If, however, the temperature of the hot junction be raised gradually the e.m.f. in the circuit slowly reaches a maximum, then sinks to zero and is finally reversed. This is known as the Seebeck effect.

SEEBURG PIANO CO., J. P.—419 W. Erie St., Chicago, Ill. Manufacturer of electrically operated pianos and organs. President, J. P. Seeburg; vice-president, W. L. Pace.

SEEHAUSEN, WEHRS & CO.—179 N. Franklin St., Chicago, Ill. Manufacturers of oil filters and boiler-tube cleaners.

SEELITES.—Trade name for luminous pendants and tacks manufactured by T. C. Smith & Co., 1531 Cherry St., Philadelphia, Pa.

SENGA CHEMICAL CO., THE.—359 Pine St., Providence, R. I. Manufacturer of soldering paste.

SEFTON MFG. CO.—1301 W. 35th St., Chicago, Ill. Manufacturer of corrugated fiber cartons and boxes. President and treasurer, J. E. Clenny; vice-president and general manager, W. J. Evans, Jr.; secretary, H. H. Wilson. Factories, Chicago, Ill.; Anderson, Ind.; Brooklyn, N. Y.

SEGUR.—Trade name for armature coil winding, taping, forming machines, etc., manufactured by the Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill.

SEGUR.—Trade name for coil winding machines manufactured by the Peerless Equipment Co., Hanover, Pa.

SEIBT.—Trade name for static radio condensers manufactured by Emil J. Simon, 217 Broadway, New York, N. Y.

SEIDLER-MINER CO.—36 E. Larned St., Detroit, Mich. Manufacturer of marine electrical fixtures and wiring devices. Business established 1891. President and general manager, Frank J. Miner; vice-president, Anthony Nunnold; secretary, treasurer and sales manager, John J. Miner. Sales representative, Hecker L. Parker, 111 New Montgomery St., San Francisco, Cal.

SEIGELITE.—Trade name for gasket packings manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

SELBY.—Trade name for solder, copper sulphate, cable splicing sleeves and other lead products manufactured by the American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal.

SELCO.—Trade name for bells manufactured by the Spies Electric Co., 564 W. Van Buren St., Chicago, Ill.

SELDEN.—Trade name for packings for pistons, valves, etc., manufactured by Randolph Brandt, 70 Cortlandt St., New York, N. Y.

SELDNER & ENEQUIST, INC.—86-112 Hausman St., Brooklyn, N. Y. Manufacturer of soldering fluid, nitric acid and other chemicals.

SELECTIVE CALLING SYSTEMS, TELEPHONE.—See Telephone selective calling systems.

SELECTOR-REPEATER.—An automatic telephone switch which first acts as a selector and then, having seized a trunk, acts as a repeater of impulses.

SELECTOR, TELEGRAPH.—An automatic calling device in use on railroad and commercial telegraph circuits by means of which a train dispatcher, or a circuit supervisor may attract the attention of an operator or attendant at a distant station. A pre-arranged sequence of impulses is transmitted which operate an alarm bell or cause an electric lamp to light up.

SELECT-O-PHONE.—Trade name for telephone selective calling systems manufactured by the Screw Machine Products Corp., 1012 Eddy St., Providence, R. I.

SELENIUM.—A nonmetallic element, resembling sulphur and tellurium chemically. Symbol Se; at. wt. 79.2; m. p., 217° C.; b. p., 690° C.; sp. gr., 4.3 to 4.8. Selenium is found in several allotropic forms, to a small extent in native sulphur and combined in sulphides, also as selenides. It is obtained as a brick red or dark red amorphous powder or as a brownish or black crystalline mass. Metallic selenium burns in air with a bluish flame and a disagreeable odor. It conducts electricity in varying degrees, its resistance being dependent upon the effect of light, decreasing as it is exposed to light. It is used for electrical purposes in the manufacture of selenium cells.

Manufacturers:

Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.
Foote Mineral Co., Philadelphia, Pa.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo.
Roessler & Hasslacher Chemical Co., 100 William St., New York, N. Y.

SELENIUM CELLS.—Selenium cells utilize the property of selenium in which the resistance is affected by the action of light, being decreased by exposure to light. Cells made up to utilize this property consist of two bare copper wires wound on a mica cylinder, the space between the turns being filled with selenium. When light falls upon the cell the resistance will be decreased according to the intensity of the light. Selenium cells are used in submarine cable telegraphy as receiving instruments, as they are very sensitive to small currents. They have also been used in systems for transmitting photographs by telegraph. The photographic film is suspended in front of the selenium cell and a small beam of light projected on part of it. The variations in transparency of the film will produce a current of similar variation which current may be sent over the wire and received by another similar device or a mechanical receiving instrument. Another use for selenium cells is for automatically governing the lighting and extinguishing of lighthouses, buoys and other navigation guide lights. The use of cells for such purposes is interesting, but has not as yet become commercially important.

Manufacturers:

Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

SELF-DISCHARGE.—The action of a cell in discharging itself whenever a circuit is left through which the discharging current can flow. This may be a slow leakage or direct short-circuit within the cell, as through some conducting material lodging between its plates or other electrodes, or a more or less rapid leakage or even short-circuit due to external bridging of the terminals or their connection through a conductor of appreciable resistance. Self-discharge applies especially to storage cells.

SELF-INDUCTANCE. — The magnetic property of a circuit by virtue of which a change of current in the circuit induces an e.m.f. in the circuit which tends to oppose the change in the current. An increase in the current is retarded and a decrease in current is likewise retarded even beyond the opening of the circuit so that an arc or spark may jump across the opening switch gap. This property was formerly called self-induction. Also see Inductance.

Self-inductance may also be defined as the ratio of the magnetic flux threading through a circuit to the current in that circuit producing it. Like that of inductance, its symbol is L and its unit is the henry.

SELF-INDUCTION.—An old name for self-inductance, which see.

SELF-STARTERS, AUTOMOBILE.—See Starters, automobile, electric, complete.

SELF VITALIZER.—Trade name for electrotherapeutic apparatus manufactured by Adon Products, Inc., 516 5th Ave., New York, N. Y.

SELFAST.—Trade name for electrical advertising specialties manufactured by the Herberts Engineering Co., Inc., 500 5th Ave., New York, N. Y.

SELIGRAPH CO., THE.—Brooklyn, N. Y. Manufacturer of switches for motion-picture machines.

SEMAPHORE.—Trade name for annunciators manufactured by Edwards & Co.

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Inc., 104th & Exterior Sts., New York, N. Y.

SEMAPHORES, RAILWAY SIGNALING, ELECTRICALLY OPERATED.—The semaphore consists of a wood or steel arm fastened at its inner end to a casting called the spectacle. The spectacle includes the hub upon which the semaphore rotates and it holds the clear and colored glass roundels whose various positions in front of the signal lamp at night give indications of corresponding positions of the arm. Almost all tracks protected by automatic semaphores employ electrically operated mechanisms for operation of the semaphore. These mechanisms are of two general types, bottom-post and top-post. The bottom-post mechanism has the motor inclosed within the base; this, by means of gears and levers, transmits the movement necessary for operation of the arm to a rod, running inside of the mast, which is connected to a crank arm on the semaphore shaft. Some types have an additional device, an electrical latch which must be energized to bring the semaphore to a proceed position. The top-post mechanism has the motor directly connected through gears to the semaphore shaft. When the mechanism for any reason is out of order the signals are generally so arranged that the arm will drop by gravity to the stop position and the mechanisms are consequently so designed that as little torque as possible will be required to bring the arm to this signal.

Manufacturers:

Hall Switch & Signal Co., Garwood, N. J.
Union Switch & Signal Co., Swissvale, Pa.

SEMCO.—Trade name for automobile ammeters manufactured by the Clark Electric Meter Co., Oshkosh, Wis.

SEMIBRONZE.—Trade name for asbestos metallic sheet packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

SEMIPERMEABLE MEMBRANE. — A membrane, such as a bladder, which is permeable to one constituent of a solution and not to another. One can be made artificially by soaking a porous cell or partition in potassium ferrocyanide solution, rinsing it off quickly with water and then immersing in copper sulphate solution. The latter causes precipitation of a layer of cupric ferrocyanide in the pores of the partition, making an excellent semipermeable membrane or diaphragm. Such diaphragms are used to measure osmotic pressures of solutions.

SENATE.—Trade name for rubber belting manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

SENDER, TELEPHONE.—In the panel type automatic telephone system, the switchbanks are arranged by fives and the groups of trunks by other numbers, while the call number is decimal as in other systems. The sender is necessary to receive the call number from the calling device and transform it so that it will correctly govern the switches. That part of the sender which makes this change is called the "translator." The sender is useful in a trunk network which was laid out for manual exchange work, because the translator can be made to change the call number differently in different offices.

SENECA.—Trade name for electrical wire manufactured by the Seneca Wire & Mfg. Co., Fostoria, Ohio.

SENECA WIRE & MFG. CO., THE.—Fostoria, Ohio. Manufacturer of wire. President, J. H. Jones; vice-president, J. A. Wonderly; secretary and general manager, L. E. Kinn; treasurer, Ira Cadwallader.

SENG AUTO DEVICE CO.—1452 Dayton St., Chicago, Ill. Manufacturer of electric horn switches. President, W. P. Seng; vice-president, G. Burkhardt; secretary and treasurer, M. J. Seng; general manager, Harry E. Wood.

SENIOR.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

SENSATION.—Trade name for belting manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

SENSITIVENESS.—The degree to which the needle of a galvanometer, ammeter, voltmeter or other similar deflecting instrument will respond to the influence of a definite electric current in producing deflection.

SENTINEL.—Trade name for motor-driven air compressors manufactured by the Bawden Machine Co., Ltd., 163-75 Sterling Road, Toronto, Ont., Can.

SEPARATORS, ELECTROSTATIC. — Electrostatic separators are used for the concentration and separation of ores and other materials. They operate to separate the minerals in ore electromechanically, by utilizing the difference in electrical conductivity of the mineral and the rock. Most minerals are good conductors of electricity while most gangues or rocks are very poor. The separators are made in a number of forms, depending upon the nature of the ore being handled. In general, they operate by passing crushed ore over a series of revolving rolls by the action of gravity. As they are passing over the roll they are brought close to an electrically charged electrode which places the ore in an electrical field. By this action the mineral particles are pulled closer to the electrode and the rock particles stay near the roll. A divider is arranged to separate the particles as they fall from the roll. This process is carried out in several succeeding rolls over which the ore passes and when it reaches the bottom is complete.

Manufacturer:

Huff Electrostatic Separator Co., Box 66, Arlington, Mass.

SEPARATORS, MAGNETIC OR IRON. —The purpose of magnetic separators is to remove magnetic metals from ores and other materials, such as foundry refuse or machine shop refuse. They usually handle the material to be separated on a conveyor belt which at some point in its course passes an electromagnet. The metal is separated by either being drawn from the belt by attraction or the belt is passed around a magnetic pulley, the nonmagnetic materials falling off, the magnetic material remaining on the belt, held there by the attraction of the pulley. Another method is to drop the material onto a rotating cylinder at such an angle that it will tend to rebound. A stationary magnet within the cylinder magnetizes it at the point struck by the falling material. The nonmagnetic material rebounds, separating it from the magnetic metals which cling to the cylinder until they reach its nonmagnetic portion. For separation of iron of low or various degrees of permeability separators with a series of magnets of increasing intensity are used. The material is conveyed on a belt beneath the magnets and each kind of iron separated at the magnet of intensity sufficient to remove it. The iron of low permeability in passing beneath each magnet receives some magnetism and when it reaches the last stage is sufficiently magnetized to be removed.

Separators are sometimes designed for a special purpose and embody other features; for instance, for separation of foundry refuse they divide the dirt into sand and lumps as well as removing the iron. Aside from their use in separating different grades of iron ore or removing iron nails, screws, chips, etc., from refuse of foundries, machine shops, etc., magnetic separators are used to remove iron nails, tools, nuts, spikes, or broken parts of machinery from material to be crushed or ground; in this way the crushers or grinders are protected from serious damage that would result if the iron materials were left in.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Magnetic Separators are used extensively for removing tramp iron from coal, and nonmagnetic ores before the material enters the crusher. C-H Magnetic Separators are also used in paper mills, in the production of cement, gypsum, limestone, terra cotta, as well as in the freeing of grain, spices and tobacco from bits of iron and steel before grinding. The C-H Magnetic Separator



C-H Magnetic Separator Pulley

operates as follows: As the bulk material passes over the magnetized pulley, the iron or magnetic material is attracted to and held firmly against the belt until outside of the magnetized zone at some point beyond the under side of the pulley. Here the iron drops off the belt and may be collected in a box or otherwise disposed of and thus kept separate from the nonmagnetic material, which continues on its course. See display adv. pages 1225-1230.—Adv.

Dings Magnetic Separator Co., 800 Smith St., Milwaukee, Wis. "Dings."
K & B Co., 495-497 N. 3rd St., Philadelphia, Pa.
Magnetic Mfg. Co., 774 Windlake Ave., Milwaukee, Wis.
Tyler Co., W. S., Cleveland, Ohio. "Hum-mer."
United Iron Works, Inc., Kansas City, Mo.

SEPARATORS, OIL.—The exhaust steam leaving an engine cylinder contains small quantities of cylinder oil which would coat the inside of condenser tubes or boilers. The effect of this film of oil is that of a heat insulator, reducing the efficiency of the condenser and possibly causing pockets to develop in the boiler where exposed to the flames in the furnace; the latter is a serious source of danger, and it is therefore necessary, as well as desirable, to remove this oil from the exhaust steam. This is done in a separator connected in the exhaust pipe of the engine by reversing sharply the direction of the current of steam by means of baffle plates, etc., much the same as in the steam separator.

Manufacturers:

Anderson Co., The V. D., 1935 W. 96th St., Cleveland, Ohio.
Burt Mfg. Co., The, Akron, Ohio. "Burt."
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott."
Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y. "Bundy."
Hoppes Mfg. Co., The, Belmont & Larch Sts., Springfield, Ohio.
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill. "Eclipse."
National Pipe Bending Co., The, River & Lloyd Sts., New Haven, Conn. "National."
Ohio Body & Blower Co., Swartwout Specialty Division, Cleveland, Ohio.
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa. "Washington."
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
United Machine & Mfg. Co., Canton, Ohio. "Mosher."
Webster & Co., Warren, Camden, N. J.
Williams Valve Co., The D. T., Cincinnati, Ohio. "Cookson."
Wright-Austin Co., Detroit, Mich. "Austin."

SEPARATORS, STEAM.—Free water in the steam entering an engine cylinder or turbine is undesirable because it carries away the energy of the steam, and in excessive quantities may cause the breakage of the valve mechanism or even of a cylinder head and also severe erosion of turbine blades. To remove it a steam separator is installed at the boiler, or in the live steam header leading to the steam chest. With an efficient separator the dry steam should not contain above 2% of water at most. The separators operate mostly on the principle of a sudden change in direction of the steam, which throws out and collects the heavier particles of water. The important makes may be classed, according to their construction, into (1) reverse current, (2) centrifugal force, (3) baffle plate, and (4) mesh types. By using superheated steam the necessity for a separator is eliminated.

Manufacturers:

Anderson Co., The V. D., 1935 W. 96th St., Cleveland, Ohio.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Direct Separator Co., Syracuse, N. Y. "Sweet."
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott."
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y. "Stranton."
Hoppes Mfg. Co., The, Belmont & Larch Sts., Springfield, Ohio.

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H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill. "Eclipse."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Nicholson & Co., W. H., 125 Oregon St., Wilkes-Barre, Pa. "Wyoming."
Ohio Body & Blower Co., Swartwout Specialty Division, Cleveland, Ohio.
Patterson-Kelley Co., Inc., 28 Cortlandt St., New York, N. Y.
Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa.
Plant Engineering & Equipment Co., Inc., 192 Broadway, New York, N. Y.
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Robertson & Sons, James L., 78-80 Murray St., New York, N. Y. "Hine Eliminator."
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
United Machine & Mfg. Co., Canton, Ohio. "Mosher."
Webster & Co., Warren, Camden, N. J.
Whitlock Coil Pipe Co., Hartford, Conn.
Williams Valve Co., The D. T., Cincinnati, Ohio. "Cookson."
Wright-Austin Co., Detroit, Mich. "Austin."

SEPARATORS, STORAGE-BATTERY, RUBBER, WOOD, ETC.—Separators are used in storage batteries for the purpose their name indicates, to separate the plates. Rubber and wood are used almost entirely now, though formerly glass tubes and rods, glass wool, porous porcelain plates and certain gelatinous compounds were used to a limited extent. Wood separators are generally made of cherry or some other hard wood. They are grooved on both sides, leaving a central web with ridges on each side. The size of the separator is approximately that of the plates and in thickness they range from ⅛ to 3/16 in. They are usually treated with acid before being placed in the battery.

Rubber separators have been made in a number of types. Flat sheets with a few perforations have been used, but these had the disadvantage of not permitting the electrolyte to act on the plates as freely as was necessary. To overcome this, various methods of using ribbed and corrugated plates have been developed. Some very thin sheets of finely perforated rubber are sometimes used in conjunction with wood separators as a protection for the positive plates.

Manufacturers:

Baltimore Battery Separator Co., 5145 Reisterstown Rd., Arlington, Baltimore, Md.
Campbell Electric Co., 1529 Wyandotte St., Kansas City, Mo.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Carlile & Doughty, Inc., 2530 N. Broad St., Philadelphia, Pa. "C. & D."
Champion Storage Battery Corp., 193 Church St., Poughkeepsie, N. Y. "Champion."
Ermet Mfg. Co., 16th St. & Sherman Drive, Indianapolis, Ind. "Ermet Process."
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y. (Wood.)
Federal Battery Mfg. Corp., Owen Bldg., Washington, D. C.
Ferry Mfg. Co., 2113 S. 4th St., St. Louis, Mo.
Indianapolis Mfg Co., 1030 E. Pratt St., Indianapolis, Ind. (Wood.)
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Philadelphia Storage Battery Co., Ontario & C Sts., Philadelphia, Pa.
See-Dro Separator Co., Berkeley, Cal.
Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex. "Capillary."
Stewart Estate, William E., 14th & Elm Sts., Flint, Mich.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.
Victor Storage Battery Co., Rock Island, Ill. "S. O. S."

SEPCO.—Trade name for electric controllers and heating appliances manufactured by the Automatic Electric Heater Co., Warren, Pa.

SEPCO.—Trade name for electric heating devices manufactured by the Steam-Electric Products Co., 1250 W. 76th St., Cleveland, Ohio.

SERIES.—Connected in tandem or end to end so that the circuit current passes through all the parts in succession, as a series circuit, a series motor (armature and field in series), series battery (cells in series). Also used to designate any apparatus designed to be connected in a series circuit even though the apparatus has but a single important element, as a series incandescent lamp. Also a part of an apparatus in series with its main element, as the series field of a d-c. compound generator, series coil of a differential arc lamp.

SERIES CONNECTION.—A method of connecting apparatus in electrical systems, so that the current passes through each device in the circuit, one after the other. When the series connection is used the current is the same in all parts of the circuit, regardless of the resistance of any one device. The total resistance of the circuit or the impedance with alternating currents, and the applied e.m.f. determine the value of the current. In a series connection of d-c. generators or of primary or storage batteries, the positive of one generator or battery is connected to the negative of the next, etc. The total e.m.f. in this case is equal to the sum of the e.m.f.'s of the individual generators or batteries.

SERIES-MULTIPLE OR SERIES-PARALLEL.—A circuit connection with certain unit parts in series and these series groups at the same time connected in multiple or parallel, or the unit parts in parallel and the parallel or multiple groups in series. Dry-cell batteries are sometimes grouped in series-parallel. Series-multiple connections are not widely used because of the possibility of unequal division of load among the elements. Series-parallel control provides for first connecting motors in series and later in parallel across the line; see Controllers, series-parallel.

SERIES SYSTEM IN ELECTROLYTIC PROCESSES.—The placing of the plates or electrodes in a metal refining tank in series, that is, alternating anode and cathode. In practice, only plates of the metal to be refined are used, a number of such being hung in a row or series in a tank. Each plate receives current in one side and gives it out at the other. Electrically, there are therefore, a number of electrolytic cells contained in a single tank, the current passing many times from anode to cathode in each individual tank. The subsequent arrangement of such tanks in parallel or in series, with each other is immaterial; the term series system applies only to the series arrangement of electrodes in the individual tank.

SERIES WINDING.—See Wave winding.

SERVICE.—Trade name for friction tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

SERVICE.—Trade name for fuses manufactured by the Interstate Electric Co., 356 Baronne St., New Orleans, La.

SERVICE.—Trade name for telephone switchboards manufactured by the Kellogg Switchboard & Supply Co., Adams & Aberdeen Sts., Chicago, Ill.

SERVICE.—Trade name for linemen's insulated tools manufactured by the Mathias-Hart Co., 516 Atlantic Ave., Boston, Mass.

SERVICE.—Trade name for electric curling irons and wavers manufactured by the Northern Electric Co., 542 St. Clair St., Chicago, Ill.

SERVICE BOXES.—See Boxes, service.

SERVICE BRAND.—Trade name for cedar poles produced by L. D. McFarland, Sandpoint, Idaho.

SERVICE CONNECTION.—The connections from a distributing main to buildings are called service connections. From overhead lines they are commonly carried overhead to a point on the building not over 25 ft. above ground (where the interior wiring is brought out as a service entrance fitting) and are terminated on a suitable service bracket. Underground services are brought into basements, subsidewalk spaces, if available, or to a short pole at the edge of the property and carried thence to the building overhead.

SERVICE ELECTRIC CO., INC.—2337 N. Hoyne Ave., Chicago, Ill. Manufacturer of lighting fixtures. Business established 1920. President, J. L. Reque; vice-president, A. B. Olson; secretary, L. Reque; treasurer, M. M. Reque; general manager, A. C. Reque; sales manager, William Norberg.

SERVICE ENTRANCE FITTINGS.—Where service wires enter buildings in conduit, which is the customary manner, it is required that the end of the conduit be bent down and equipped with a service entrance fitting, which consists of an iron casting adapted to be firmly attached to the end of the conduit and to carry a porcelain plate with usually two or three rounded openings to permit the entrance of the service lines, which are thus separated and insulated. This fitting serves to exclude moisture from the conduit.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
GILLETTE-VIBBER CO., New London, Conn. "GeeVee."
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. " H & S."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn. "Noark."
KILLARK ELECTRIC MFG. CO., 3940-48 Easton Ave., St. Louis, Mo. "Electrolet" conduit fittings include the Type FB service entrance fittings which have reversible hubs, permitting their being used either on a vertical or



Type FB Electrolet

horizontal conduit. All parts, except the hubs, are interchangeable on the ½, ¾, and 1-in. sizes and also on the 1¼, 1½ and 2-in. sizes. They are very light and strong and are extremely simple. They are covered by basic patents of July, 1915.—Adv.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago, Ill. Type "MF" Powerlet service heads are made of iron castings and porcelain covers are packed and sold separately. Illustration shows service cap casting alone and also a casting with porcelain cover assembled ready for installation. The



Type "MF" Powerlet Service Cap

Type "MF" service head is designed with a weatherproof removable cap that permits the wires to be drawn through the pipe on a straight pull and distributed before threading through the porcelain cover. These fittings are light in weight and neat in appearance. A stock of castings with a quantity of two and three hole porcelain covers will take care of all requirements.—Adv.
Phelps, James C., Springfield, Mass. "J. C. P. Caplets."
Standard Electrical Mfg. Co., 220-222 High Ave., S. E., Cleveland, Ohio. "Standard."
Standard Specialty Mfg. Co., Cleveland, Ohio. "Diamond E."
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

SERVICE METER OR REGISTER, MESSAGE.—This is a device for recording the number of completed calls, which are made by a subscriber. See Service, telephone; also Meters, telephone call counting.

SERVICE PRODUCTS CO., THE.—Greenawalt Bldg., Springfield, Ohio. Manufacturer of automotive service station equipment and electrical apparatus for

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automobiles. Business established 1915. President, P. P. Crabill; vice-president, Paul A. Staley; secretary, treasurer and general manager, R. B. Miller; sales manager, J. A. Cadle.

SERVICE PROTECTIVE COMBINATIONS OR UNITS.—It frequently happens that high-tension transmission lines pass close to small towns or to individual users desiring electric current but in quantities too small to justify the expense of a regular substation. To meet this condition service units have been devised which can be mounted on one of the poles and connected to the high-voltage lines. They consist of a disconnecting switch to be safely operated from the ground, a protective equipment (usually including choke coil, horn gap arrester, fuse, and resistor in the ground connection) and a stepdown transformer of proper capacity and voltage. Aside from the convenience of having 24-hour light and power service, it is evident that many operations in small towns and on the farm can be carried on much more safely and economically when motor-driven. The branch service line is usually single phase, either two or three-wire.

The protective equipment is all mounted on a combined base or unit in many cases to facilitate shipment and installation.

Manufacturers:

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three-E."
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."

SERVICE STATION SUPPLY CO.—30-32 E. Larned St., Detroit, Mich. Manufacturer of equipment for storage battery service stations. Business established 1918. General manager, Clement F. Krueger.

SERVICE SWITCHES.—See Switches, safety, service entrance, and combined service and meter protective; also Switches, enclosed, miscellaneous.

SERVICE, TELEPHONE. — Telephone exchange service is divided into three general classes, measured service, flat-rate service and special service.

Measured Service or Measured-Rate Service. This is telephone exchange service paid for according to the amount of use. The usual unit is the call, but payment for total time has been proposed. Prepayment or cash measured service requires a coin box to receive pay before talking ("nickel first" requires a coin before calling, "nickel last" requires a coin after the called station answers but before talking). Credit measured service records calls on a meter at the telephone or in the central office.

Flat-Rate Service. Telephone service for which a definite charge is made for a period of time (month or year), no limit being placed as to the number of calls.

Special or Miscellaneous Services. Such services as are usually rendered free to the public by the telephone company, such as calls for information, fire, police, officers of the telephone company, etc.

SERVING.—The wrappings of cotton or silk insulating material applied to wires are called servings. The term also refers to the paper or other insualting wrapping applied to the core of a cable before the lead sheath is applied, or on the lead sheath if the cable is armored.

SERVUS RESCUE EQUIPMENT CO.—50 Columbia St., Newark, N. J. Manufacturer of respirators.

S. E. T.—Trade name for manhole frames and covers manufactured by the S. E. T. Valve & Hydrant Co., 50 Church St., New York, N. Y.

S. E. T. VALVE & HYDRANT CO.—New York, N. Y. Manufacturer of manhole frames and covers. Business established 1912. President, Albert B. Serley; vice-president, Thomas S. Cheshire; secretary, Daniel E. Sealey; treasurer, Warren C. Seaman; general manager, Chester L. Lincoln. Main office and factory, 50 Church St., New York, N. Y. Branch office, 433 Commercial Trust Bldg., Philadelphia, Pa.

SET SCREWS.—See Screws, set.

SEVENTY-FIFTY.—Trade name for cord switch manufactured by the Cutler-Hammer Mfg. Co., Milwaukee, Wis.

SEW-E-Z.—Trade name for sewing machine motors manufactured by the Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

SEW-MOTOR.—Trade name for sewing machine motor manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SEWAGE TREATING SYSTEMS, ACTIVATED SLUDGE, ETC., ELECTRICAL EQUIPMENT FOR.—In small cities and towns the disposal of sewage is no serious problem, for it may usually be run into a neighboring stream, where, on account of the large volume of water mixed with it, it quickly disappears, since running water will clear itself through settling and exposure to the air in a few miles. But with the growth of large cities and the need for a larger pure water supply, some artificial method of sewage disposal becomes necessary, and several extensive systems have been deveoped. One of the common methods uses the Emscher tank system, designed by Dr. Imhoff, in which the sewage is allow to stand for some time in a tank or well 15 to 40 ft deep, the heavier portion settling and decomposing in the bottom, from which it is drawn off through pipes for disposal. This heavier part is called the sludge and may be spread out on the ground or on beds of crushed limestone and allowed to dry sufficiently to be hauled away. When thoroughly dried it has considerable fuel or fertilizer value.

Another recently developed method uses the activated-sludge system, in which it is attempted to duplicate the effect of running water by placing the sewage in a tank having a bottom of slightly porous "filtros" plates (made from quartz fused with powdered glass) through which air is forced, rising through the liquid in minute bubbles. These air bubbles tend to oxidize the sewage, after which it is drawn off into shallow tanks, allowed to settle, and disposed of as before. In all of these operations considerable quantities of power are required, which is usually electrical on account of its adaptability to the driving of blowers, pumps, etc. In the activated sludge system large volumes of air are used, at a pressure of 5 lbs. or more per sq. in., to force it through the filtros plates. As much as 1.75 cu. ft. of air per gallon may be required. Three types of compressor are in use, the positive-pressure blower, the centrifugal compressor and the reciprocating compressor, of which the first seems to give the most satisfactory results. All should be driven by variable-speed motors, or otherwise equipped to efficiently vary the volume of air furnished. The pumps are usually centrifugal direct-connected to the driving motors.

SEWAGE TREATING SYSTEMS, ELECTROLYTIC.—For a great many years experiments have been conducted with a view to the purification of sewage by means of the electric current. Several equipments of moderate size have been buit and operated by various cities, both in this country and abroad. The usual arrangement is a series of closely spaced plates, alternately connected to positive and negative terminals, through which the sewage is allowed to flow. The electrolytic process has been found to be more costly than the mechanical and bacteriological processes, and it is doubtful if it will come into general use unless greatly improved.

SEWING MACHINE LIGHTS.—See Lights, sewing machine.

SEWING MACHINE MOTORS.—See Motors, sewing machine.

SEWING MACHINE POWER TABLES.—In clothing and similar factories, where large numbers of operators require sewing machines which are used intermittently, it is common practice to group a large number of machines on a single long table or bench and to connect them under suitable control, to a single shaft, driven by one motor. These are known as power tables. The motor is usually mounted at one end close to the floor and adjoining it is its starter. The motor is either direct-connected, belted or geared to the line shaft, which runs under the table top. Belts connect to the individual machines. In many cases machines are placed on each side of the table all run from the shaft below the middle. As many as 12 machines may be so grouped on one table.

Manufacturers:

Osann Co., Frederick, 245 7th Ave., New York, N. Y.
Singer Sewing Machine Co., 149 Broadway, New York, N. Y. "Singer."
Standard Sewing Machine Co., The, Cedar Ave. & C. & P. Ry., Cleveland, Ohio. "Standard."

SEWING MACHINES, MOTOR-DRIVEN, HOUSEHOLD, DESK TYPE.—A new and special form of electric sewing machine, in which the machine parts, when not in use, are totally enclosed in a desk or small cabinet, which is an ornamental piece of furniture and may be used as a lady's writing desk or sewing table.

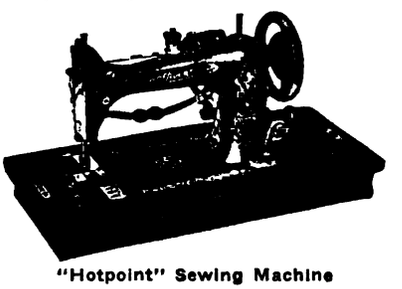
Manufacturers:

FREE SEWING MACHINE CO., 18th Ave. & 13th St., Rockford, Ill. "Free Westinghouse."
Singer Sewing Machine Co., 149 Broadway, New York, N. Y. "De Luxe."

SEWING MACHINES, MOTOR-DRIVEN, HOUSEHOLD, PORTABLE.—A motor-driven sewing machine which is enclosed in a case, small enough to be readily carried from place to place or stored away when not in use. It may be set on any table and entirely dispenses with the cabinet or supporting framework customarily on the ordinary sewing machine. Its compactness and convenience of use in any room has made this type quite popular, especially in small apartments.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Davis Sewing Machine Co., The, Dayton, Ohio. "Davis."
EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. Two types of sewing machines are made—the rotary and vibrating shuttle. The vibrating shuttle type is made in two sizes, three quarter and full head. The



"Hotpoint" Sewing Machine

features of these machines are: Adjustable tension, automatically released when pressure foot is lifted; four motion feed: short, self-threading needle; handy stitch regulator, controlled from front of machine. They also have an automatic bobbin winder, with even thread distributor, a self-threading feature. Highest quality of woodwork, golden oak, richly rubbed. Equipped with splendid high speed universal type motor. Furnished complete with foot rheostat and complete set of attachments. See display adv. pages 1292-3.—Adv.

FREE SEWING MACHINE CO., Rockford, Ill. Family sewing machines. Universal Westinghouse motor, built in complete sewing unit. Operates from any electric light socket, either a-c. or d-c. circuit. Detailed information on request.—Adv.
National Sewing Machine Co., Belvidere, Ill. (Exclusive distributor, Western Electric Co., Inc., 195 Broadway, New York, N. Y.)
New Home Sewing Machine Co., Orange, Mass. "New Home," "Greyhound."
Singer Sewing Machine Co., 149 Broadway, New York, N. Y. "Singer."
Standard Sewing Machine Co., The, Cedar Ave. & C. & P. R. R., Cleveland, Ohio. "Standard."
Willcox & Gibbs Sewing Machine Co., 658 Broadway, New York, N. Y.

SEWING MACHINES, MOTOR-DRIVEN, HOUSEHOLD, SEMIPORTABLE OR CABINET TYPE.—The standard type of household electric sewing machine, similar to the common foot-power machine except that it is operated by an electric motor, which may be mounted either above or below the table, in a variety of ways. The machine is usually controlled as to starting, stopping, or speed by a foot or knee lever governing a control rheostat.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Mason Mfg. Co., A. G., 7817 St. Clair Ave., N. E., Cleveland, Ohio. "Wilson," "Wilson Rotary," "Crown."
National Sewing Machine Co., Belvidere, Ill. (Exclusive distributor, Western Electric Co., Inc., 195 Broadway, New York, N. Y.)
Singer Sewing Machine Co., 149 Broadway, New York, N. Y. "Singer."

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White Sewing Machine Co., 7821 St. Clair Ave., Cleveland, Ohio. "White," "White Rotary."
Willcox & Gibbs Sewing Machine Co., 658 Broadway, New York, N. Y.

SEWING MACHINES, MOTOR-DRIVEN, TAILORS', SHOE MAKERS', HATTERS', ETC.—The flexibility of electric drive has caused its adoption in many manufacturing processes, among which are the extensive list using the power sewing machine. The equipments vary, from the heavy machines used in shoe factories and repair shops to those used for light tailor work. In the latter it is often found advantageous to use the group system of drive, in which one motor operates, through shaft or otherwise, a considerable number of intermittently used machines. Thus each operator has a machine at his immediate disposal, but the expense of a large number of individual motors is avoided. There are many special machines, however, for which individual drive is best.

Manufacturers:

Canadian General Eectric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Mason Mfg. Co., A. G., 7817 St. Clair Ave., N. E., Cleveland, Ohio. "Wilson," "Wilson Rotary," "Crown."
Singer Sewing Machine Co., 149 Broadway, New York, N. Y. "Singer."
Union Special Machine Co., 400 N. Franklin St., Chicago, Ill. "Union Special."
United Shoe Machinery Corp., 205 Lincoln St., Boston, Mass. (Shoemakers'.)
White Sewing Machine Co., 7821 St. Clair Ave., Cleveland, Ohio. "White," "White Rotary."
Willcox & Gibbs Sewing Machine Co., 658 Broadway, New York, N. Y.

SEXTET-RENCH.—Trade name for automobile wrenches manufactured by E. Edelman & Co., 2638-56 N. Crawford Ave., Chicago, Ill.

SEXTON CAN CO.—123 Broad St., Boston, Mass. Manufacturer of battery, switch and letter boxes.

SEYMOUR MFG. CO., THE.—Seymour, Conn., Manufacturer of phosphor bronze and nickel sheets, rods, anodes, etc. President and treasurer, G. E. Mathies; vice-president, F. S. Jerome; secretary, O. F. G. Boeker.

SHADE COVERS.—Shade covers are cloth covers or bags used to protect silk, parchment and other lamp shades on lamps stocked in electric shops, etc. The shade covers are often made of Argentina cloth, a specially prepared cloth having a waxy or polished surface. They are made as bags and fit over the entire shade.

Manufacturer:

Green, Green & Green, 604 E. 39th St., Chicago, Ill.

SHADE FRAMES.—See Frames for lamp shades.

SHADE HOLDERS.—See Holders, shade, globe and reflector.

SHADE, LAMP.—This term is applied in a general sense to a variety of conical, bell, dome or other forms of usually translucent materials used chiefly to diminish the glare of a lamp and commonly also to improve its appearance. The term is technically restricted to such devices as are open at the bottom and have for their primary purpose the reduction of glare, though they may be partially reflecting. When reflection of the light becomes the main purpose of the shade, it is commonly called a reflector; sometimes when the shade has a special shape it is more frequently called by a more descriptive name, as a dome or a lantern. Totally enclosing glassware is seldom called shade, but more frequently ball, globe, stalactite, acorn or other name suggestive of its shape.

Glass, silk, parchment, and metal are the commonest materials of which shades are made because of their translucence and because they may be made in decorative designs, a matter of considerable importance, especially in shades for portable lamps, candle and other direct-lighting fixtures. The principal types of shades are classified below according to material and a more detailed discussion of the uses of the various types is contained therein

SHADES, ASBESTOS.—Pressed asbestos fiber is quite commonly used in the conical shades used on drop lights. The fiber shade is brass bound to give it strength and painted with a white or aluminum reflecting paint on the inside and coated with paper sheet or special paint on the outer side to give it a more attractive appearance. Although generally called shade, this type is really a form of reflector of rather crude and simple design.

Manufacturers:

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Charland, E. W., Tilton, N. H.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Kewanee Private Utilities Co., Kewanee, Ill. "Kewanee."
STORRS MICA CO., Owego, N. Y.
Utility Shade Co., Tenafly, N. J. "Utility."
Wellington Glass Co., Cumberland, Md.

SHADES, GLASS, PLAIN, OPAL, DECORATIVE OR "ART."—As a shade material glass permits obtaining the most varied effects, from the cheapest to the most expensive and truly beautiful. Glass is the most used shade material. One of the commonest of all the types of shades is the clear glass shade, roughed or etched to make it more or less diffusing; such shades are sometimes tinted or the glass may be entirely clear except for an etched or molded pattern. Opal glass, a form of diffusing glassware of various densities, is most used for shading gas-filled tungsten lamps, whose high filament brightness makes a high-grade diffusing glass shade necessary. Desk lamps often have opal shades that are green on the outside and white inside. Art glass, a special kind of glass of mixed coloring, is used extensively for portable lamps, particularly table lamps, and for lantern type fixtures. One form of decorative glass, used almost exclusively in portable lamps, is glass which by a special process has been colored to reproduce a landscape painting or other such artistic design. Among other types of decorative glass shades are those made of tiffany, iridescent or opalescent glass. Such glass is used more commonly in the bell-shaped shades found on shower fixtures.

Manufacturers:

Aglow Sales Co., 671 3rd Ave., New York, N. Y.
Art Shade Co., 224 N. Desplaines St., Chicago, Ill.
Bent Glass Novelty Co., The, 394 Canal St., New York, N. Y.
Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Consolidated Lamp & Glass Co., Coraopolis, Pa.
Daison Mfg. Co., Inc., 916 Chestnut St., Philadelphia, Pa.
Eagle Mfg. Co., Wellsburg, W. Va.
Edwards Lighting Fixture Co., 20 E. Lake St., Chicago, Ill.
Gilbert Electric Shade Co., 101 Warren St., New York, N. Y.
Gill Glass Co., Inc., Amber & Venango Sts., Philadelphia, Pa. "Una."
Gillinder & Sons, Inc., Tacony St., Philadelphia, Pa. "Franklin," "Nemalite," "Nebulite," "Micra."
Gillinder Bros., Port Jervis, N. Y.
Gleason-Tiebout Glass Co., 99 Commercial St., Brooklyn, N. Y.
Imperial Glass Co., Bellaire, Ohio. "Nuart."
IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO., 5716 Euclid Ave., Cleveland, Ohio. "Regent." (See display adv. pages 1266-1269.)
Jeanette Shade & Novelty Co., Jeanette, Pa.
Jefferson Glass Co., The, Follansbee W. Va.
Lamb Bros. & Greene, Nappanee, Ind.
LUMINOUS UNIT CO., DIVISION ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Manufactures a large variety of silk and parchment decorative or art shades, especially designed for Brascolite fixtures, but applicable as well to fixtures of other manufacturers. See display advertisement on pages 1276-1277 for description and illustration of these decorative shades, also for other Brascolite products.—Adv.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Northwood Co., H., 36th & Wetzel Sts., Wheeling, W. Va. "Luna."
Opalux Mfg. Co., The, 200 Fifth Ave., New York, N. Y. "Opalux."
Phoenix Light Co., 525 Market St., Milwaukee, Wis.
Pittsburgh Lamp, Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y. "Berylite."
Starbuck & Sons, R. M., 63 Asylum St., Hartford, Conn.
Steuben Glass Works, Corning, N. Y. "Aurene," "Calcite."
U. S. Glass Co., Pittsburgh, Pa. "Colonial," "Lenox."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

SHADES, PARCHMENT, PAPER AND CELLULOID.—Parchment, decorated with hand-painted designs or by various other treatments, is now extensively used for shade material for decorative and portable lamps and certain fixtures. The more common shades are large, aproximately conical in shape, and are most used on table, boudoir and floor lamps. This material is also used for small shades for candle fixtures and for the half shades or shields commonly used on candle brackets. Various treatments may be applied by which some very beautiful designs have been produced and the shades of this material have consequently become quite popular in recent years. They are also less easily soiled than silk shades and not as easily broken as glass shades. Celluloid and paper have also been used for decorative shades, but are more commonly employed for the simple drop-light shades described under Shades, tin, etc.

Manufacturers:

Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.
Baetz Bros. Specialty Co., Ltd., Kitchener, Ont., Can.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Daison Mfg. Co., Inc., 916 Chestnut St., Philadelphia, Pa.
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y. (Parchment).
Decker Art Studios, M. R., 4026 N. Keeler Ave., Chicago, Ill. (Parchment).
LIGHTOLIER CO., 569-71 Broadway, New York, N. Y.
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Parchment shades manufactured by this company are especially designed for use with Brascolite fixtures but are applicable with others as well. They are made in a variety of types and patterns suitable for use in high class shops, restaurants, hotels, semi-public institutions and in the home. The shade illustrated is one of four standards which have been adopted for manufacture in large quantities. This



Parchment Shade

Renaissance design is finished gold metal frame. Background is tan and the panels and festoons are in Italian colors. Made in four sizes, 14, 18 and 22 ins. for 10¼, 14¼ and 18-in. Brascolites, and a 5-in. shade for electric candles. Other standard types are Adam, Autumn Leaf and Empire designs, all made in the same sizes as the Renaissance. See display advertisement pages 1276-7 for other Brascolite products.—Adv.

Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
Parch-O-Lite Co., 74 E. Roosevelt Rd., Chicago, Ill. (Parchment.)
Pittsburgh Lamp, Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Polychrome Art Works, 2700 Diversey Ave., Chicago, Ill.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
Riddle Co., The Edward N., 27 Broadway, Toledo, Ohio. "Vellumesque."
Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.
Villmont & Co., Peter S., 20 W. 22nd St., New York, N. Y.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."

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SHADES, REED, RATTAN OR WOOD-FRAMED.—These shades of reed or wood framework are usually made with panels of glass lined with some cloth shade, such as silk or cretonne. Some types simply fasten or suspend the cloth within the frame, but the glass and cloth shade is the more comomn. These shades are sometimes used on fixtures, but are generaly a part of a floor or table lamp of the same material as the shade framework.

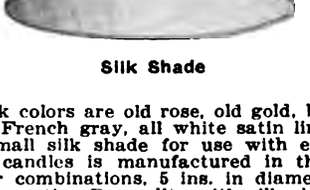
Manufacturers:

Chicago Reedware Mfg. Co., 780-82 Milwaukee Ave., Chicago, Ill. "Chicago."
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308).

SHADES, SILK, CRETONNE, LINEN, OR OTHER FABRIC.—Silk because of the attractive appearance of shades of this material has been very popular, particularly for the decorative floor, table and boudoir lamps, and for candle fixtures. The shades of this material, formed upon wire frames, are made in an almost unlimited variety of shapes and designs of various plain or figured silks. Cretonne, used to some extent in shades formed upon wire frames, is more commonly used in shades having glass panels supported in a reed or wood framework. Linen and other fabrics are found to a limited extent in shades of various types, those used in decorative shades being usually treated with colored paints, varnishes or enamels.

Manufacturers:

Adjustable Fixture Co., The, 62 Mason St., Milwaukee, Wis.
Aglow Sales Co., 671 3rd Ave., New York, N. Y.
Baetz Bros. Specialty Co., Ltd., Kitchener, Ont., Can.
Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Chicago Lamp & Fixture Co., 517 W. Jackson Blvd., Chicago, Ill.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Daison Mfg. Co., Inc., 916 Chestnut St., Philadelphia, Pa.
Dale Lighting Fixture Co., Inc., 107-9 W. 13th St., New York, N. Y. (silk).
Eclipse Electric Mfg. Co., Northwestern Furniture Exposition Bldg., St. Paul, Minn.
Fine Arts Lamp & Shade Co., 2301 Wabansia Ave., Chicago, Ill.
Gudeman & Co., 30 Irving Pl., New York, N. Y. (Silk.)
Ideal Lamp Shade Co., 5503 N. Clark St., Chicago, Ill.
Kaplan, Inc., 1243 S. Wabash Ave., Chicago, Ill. "Quality."
Lamb Bros. & Greene, Nappanee, Ind.
Liberty Lamp & Shade Co., 103 Court St., Brooklyn, N. Y.
LIGHTOLIER CO., 569-71 Broadway, N. Y.
LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Manufactures silk shades especially for use with Brascolite fixtures. They may be used, however, with fixtures of other manufacture. Made in four sizes, 14, 18 and 22 ins. diameter, in one style as indicated in the illustration, for 10¼, 14¼ and 18-inch Brascolites.



Silk Shade

Stock colors are old rose, old gold, blue and French gray, all white satin lined. A small silk shade for use with electric candles is manufactured in these color combinations, 5 ins. in diameter. A decorative Brascolite with silk shade and twisted cord hanger to match can be furnished in the stock colors noted. Diameter of shade 14 ins.—length over all 24 ins. Finish of canopy and socket cover, antique gold. See display advertisement pages 1276-7 for other Brascolite products.—Adv.

McDowell, Inc., J. M., 222 E. 42nd St., New York, N. Y.
Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
Modern Lamp & Shade Co., 1104 S. Wabash Ave., Chicago, Ill.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Parisienne Lamp & Shade Co., 1220 W. 6th St., Cleveland, Ohio. "Parisienne."
Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.
Randall Co., A. L., 180 N. Wabash Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308).
Savoy Mfg. Co., 115 E. 24th St., New York, N. Y.
Standard Lamp Mfg. Co., 1323 S. Michigan Ave., Chicago, Ill.
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.
Timberlake & Sons, J. B., 114-116 E. Washington Ave., Jackson, Mich.
Utility Shade Co., Tenafly, N. J. "Utility."
Villmont & Co., Peter S., 20 W. 22nd St., New York, N. Y.
Wabash Shade Co., 426 S. Wabash Ave., Chicago, Ill.
Waldo Co., 45 E. 20th St., New York, N. Y.
Whaley & Co., J. A., 118 5th Ave., New York, N. Y. "Kno-Glair."
Will & Baumer Co., Syracuse, N. Y.
Williams Re-Lart Lamp Co., 426 S. Throop St., Chicago, Ill. "Re-Lart."
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

SHADES, SPECIAL AND MISCELLANEOUS.—Though shades have been here classified according to material and practically all materials have been included, some miscellaneous types of rather limited use were not so listed. Among these are pig and sheep skin used in decorative shades; though entirely practical and made in attractive designs, these have not yet come into common use.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
Bloch & Co., L. D., 37-41 E. 18th St., New York, N. Y.
Collins-Wagner Mfg. Co., 122 W. 43rd St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill.
LUMINOUS UNIT CO. DIVISION, ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Manufactures special silk and parchment decorative shades for standard Brascolite fixtures, and for electric candles. See display advertisement pages 1276-1277.—Adv.
Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.
Mercer Lamp & Shade Co., 120 Hamilton Ave., Trenton, N. J.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Straus-Hohenstein Co., 132-134 W. 21st St., New York, N. Y.

SHADES, TIN, ALUMINUM, BRASS, ZINC, STEEL AND OTHER METAL.—Small conical shades used on drop lights or desk lamps are generally made of metal. Various metals, each having some desirable quality, are used. The external surface of such shades is usually painted or enameled a dark green, the interior surface being coated with a white reflecting paint or in case the metal oxidizes slowly, as aluminum, the polished metal itself may form the interior surface. For desk lamps pear-shaped half shades are much used as they fit over the incandescent lamp snugly.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Faries Mfg. Co., Decatur, Ill.
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Kosmolite Mfg. Co., 5-7 E. 16th St., New York, N. Y.
National Screw & Tack Co., The, AB Products Division, Cleveland, Ohio.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
OVERBAGH & AYRES MFG. CO., 411 S. Clinton St., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y. "White Diamond."
Young Co., William B., 1733 N. 6th St., Philadelphia, Pa.
Young, Inc., Lorin W., 214 E. 40th St., New York, N. Y.

SHAFT COUPLINGS.—See Couplings, shaft.

SHAFT, TELEPHONE CABLE.—A vertical shaft in a building for telephone cables, etc.

SHAFTING OR SHAFTS, FLEXIBLE.—Flexible shafts and shafting are often used with portable and semi-portable motor-driven appliances and tools in which the motor does not form part of the working unit. The motion is transmitted through a shaft enclosed in a flexible steel casing and usually packed with grease. Several methods are used in the manufacture of the shaft, some having small rectangular pieces linked together as in a chain. Others use different methods of connecting the short units, which are always linked together so that when bent or twisted the constant-speed driving is obtained. The shafts are usually made to definite lengths and in several diameters, equipped with terminal couplings. Shafting is composed of several small driving units and may be obtained in long pieces to be cut into sections as desired or may be used for exceptionally long sections.

Manufacturers:

Breeze Metal Hose & Mfg. Co., 22 Calumet St., Newark, N. J.
Caldwell Co., W. E., Brook & D Sts., Louisville, Ky.
Challenge Co., Batavia, Ill.
Chicago Pulley & Shafting Co., 40 S. Clinton St., Chicago, Ill.
Dow, Inc., L. B., Keene, N. H.
Gee Electric Co., Wheeling, W. Va.
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.
Haskins Co., R. G., 27 S. Desplaines St., Chicago, Ill.
Moltrup Steel Products Co., Beaver Falls, Pa.
Pryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.

SHAIN, CHARLES D.—Times Plaza, Brooklyn, N. Y. Manufacturer of battery connectors and cable and wire terminals. Business established 1901.

SHALER CO., C. A.—20 Jefferson St., Waupun, Wis. Manufacturer of electric vulcanizers, automobile light dimmers and lamp lenses. Business established 1906. President, C. A. Shaler; vice-president, W. E. Graham; secretary, M. E. Faber; transurer and general manager, F. E. Jones; sales manager, R. B. Dunlap. Sales representatives, Consolidated Sales Co., Montgomery Bldg., San Francisco, Cal.; Prescott W. Robinson Sales Co., Ltd., 332 Bleury St., Montreal, Que., Con.

SHAPIRO & ARONSON, INC.—20 Warren St., New York, N. Y. Manufacturer of lighting fixtures and portable lamps. Business established 1895. President, D. Shapiro; vice-president, I. H. Shapiro; secretary, M. Rosenberg; treasurer and sales manager, N. W. Belmuth. Factory, Brooklyn, N. Y.

SHARP & SMITH.—65 E. Lake St., Chicago, Ill. Manufacturers of hearing devices for the deaf and electrotherapeutic apparatus. President, W. N. Sharp; treasurer, R. O'Connor.

SHARP-MILLAR. — Trade name for photometer manufactured by the Foote,

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Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.

SHARP SPARK PLUG CO.—Wellington, Ohio. Manufacturer of spark plugs. President, John F. Johnson; vice-president, Rollin H. Mills; secretary and treasurer, Frank D. Johnson.

SHARPE ELECTRIC APPLIANCE CO.—502-8 Murphy Bldg., Detroit, Mich. Manufacturer of electric heaters and lamps for automobiles.

SHARPLES MILKER CO.—West Chester, Pa. Manufacturer of electric milking machines. Business established 1902. President, D. T. Sharples; vice-president, P. M. Sharples; secretary and treasurer, H. B. Carlisle; general and sales manager, L. P. Sharples. Branch offices and warehouses, 565 W. Washington Blvd., Chicago, Ill.; 2368 Dundas St. West, Toronto, Ont., Can. Sales representative, Jordan Hill Co., San Francisco, Cal.

SHARPLES SEPARATOR CO.—West Chester, Pa. Manufacturer of motor-driven cream separators and other dairy machinery. President, P. M. Sharples; vice-president and general manager, C. M. Burdette; secretary and acting treasurer, W. F. Voelz.

SHAVE HOOKS.—A long knife with a handle at either end similar to a draw knife. It is used for shaving bark or decayed wood from the surface of poles used for overhead telephone, telegraph, railway, light and power lines.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Stortz & Son, John, 210 Vine St., Philadelphia, Pa.

SHAVELIGHT CORP.—30 Church St., New York, N. Y. Manufacturer of electrically lighted shaving mirrors.

SHAVING MACHINES FOR DICTATING-MACHINE CYLINDERS, ELECTRIC.—The record cylinders used in dictating machines may be used many times by shaving the surface of the cylinder, thereby removing the record. The machine in which this is done is essentially a very simple form of lathe with a special form of cutting tool which takes a fine smooth cut from the surface of the cylinder. These machines are electrically driven and are semiautomatic. The cutting tool is set for the required cut and the motor started. The tool then takes care of itself, traveling over the entire surface of the cylinder, making a smooth cut and producing a new surface ready for receiving a new record.

SHAVING MIRRORS.—See Mirrors, shaving or toilet, electrically lighted.

SHAVING MUGS.—See Heaters, electric, shaving mug.

SHAW BLUE PRINT MACHINE CO. INC., THE.—9 Campbell St., Newark, N. J. Manufacturer of electric blueprinting and blueprint drying machines. Business established 1905. President, secretary and general manager, Stuart T. Mead; treasurer, Helen A. Mead.

SHAW INSULATOR CO.—5-7 Kirk Pl., Newark, N. J. Manufacturer of molded insulation and lightning arresters. President, H. M. Shaw; vice-president, F. H. Shaw; secretary, A. G. Maney; treasurer, M. V. Yelverton.

SHAWLAC.—Trade name for molded insulation manufactured by the Shaw Insulator Co., 5-7 Kirk Pl., Newark, N. J.

SHAWMUT.—Trade name for fuses, fuse wire, ribbon, links, cutout bases and ground connection clamps manufactured by the Chase Shawmut Co., Newburyport, Mass.

SHEAR-KLEAN.—Trade name for grates manufactured by the Marion Machine, Foundry & Supply Co., Marion, Ind.

SHEARS, BENCH AND PEDESTAL.—Shears for cutting sheet metal, small bars and rods are used very extensively by toolmakers and others in the manufacturing of electrical products. They are made in both the hand-operated and motor-driven types for bench and pedestal mounting. The mechanism consists of a pair of movable and stationary hardened steel knives that are brought together either by the motion of the motor or by a lever arrangement, which transmits the power to the shears applied by hand to a long level arm. They are usually provided with adjustable stops so that any number of pieces may be cut to the same exact length, or they may be used merely for trimming off small pieces.

Manufacturer:

Tucker, W. F. & C. F., 191 Franklin Ave., Hartford, Conn. "Hercules."

SHEARS, BRUSH TRIMMING.—A special form of shears used for trimming motor or generator brushes. They are made with straight blades for straight cutting or with curved blades for curved cutting.

Manufacturer:

Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.

SHEARS, ELECTRICIANS', OR TINNERS'.—Electricians' shears are used for cutting fine wires, trimming ends of cables, and other similar cutting. Tinners' shears are commonly used for cutting sheet brass, copper, etc., in shops and construction or repair work. The tinners' shears are the common form of metal shears or snips, the electricians' differing slightly from this form in that they are sharply pointed and have a proportionally longer blade.

Manufacturer:

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. "Buffalo."
Follansbee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa.
Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. "Niagara."
Peck, Stow & Wilcox Co., The, Southington, Conn. "1819 Original," "Samson," "Lyon," "Hercules," "Trojan."
Rock River Machine Co., N. Main St., Janesville, Wis.
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
White Co., The L. & I. J., 143 Perry St., Buffalo, N. Y.

SHEATH.—The final protective coating applied to a cable or cable joint. This is often made of pure lead, but in the case of armored submarine cable, consists of the steel armor wires and sometimes on this a serving of hemp.

SHECK UNIVERSAL.—Trade name for projecting lamp adapters manufactured by Argus Enterprises, Inc., 815-823 Prospect Ave., Cleveland, Ohio.

SHEDD ELECTRIC CO., INC.—Clay & Locust Aves., Roselle Park, N. J. Manufacturer of motors and generators. President, C. W. MacQuoid; vice-president and treasurer, A. B. Moore; secretary, M. F. Moore.

SHEEP-SHEARING MACHINES, MOTOR-DRIVEN.—These machines are similar to the ordinary types of hair clippers but are slightly larger in size. The clipper is driven by an electric motor through flexible shafting. The motor may be mounted on a stand or suspended from a trolley, whichever method is most suitable. These shears are much superior to hand shears in that they are rapid and allow the wool to be cut close to the skin without danger of cutting the animal.

Manufacturers:

Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill. "Stewart."
Coates Clipper Mfg. Co., 237 Chandler St., Worcester, Mass.
Gillette Clipping Machine Co., 129-31 W. 31st St., New York, N. Y.

SHEET ALUMINUM, BRASS, COPPER, FIBER, IRON, LEAD, MICA, RUBBER, STEEL.—See these respective items.

SHELBY.—Trade name for incandescent lamps manufactured by the Shelby Lamp Division, National Lamp Works of General Electric Co., Shelby, Ohio.

SHELBY LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Shelby, Ohio. Manufacturer of incandescent lamps. C. C. Skiles, general manager.

SHELLAC, INSULATING.—Shellac is produced from a gum converted by a species of insects from a rosin found in certain trees of India. This gum is collected, melted and cooled in flakes, and when dissolved in alcohol is known as liquid shellac or shellac varnish. It is frequently adulterated with rosin. Although widely used as such, shellac is not very satisfactory as an electric insulator, as it absorbs moisture and softens under heat. It may be used for coating low-voltage coils not subject to moisture or much heating. It is also used extensively as a cementing varnish in insulating and other products.

Manufacturers:

California Paint Co., 11th, 12th & Pine Sts., Oakland, Cal. "Fremo."
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SHELLS. EXPANSION.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

SHELLS, CHANDELIER.—These shells are metal spinnings, commonly of brass, used as ornaments in fixture stems. The spinnings are generally approximately spherical, conical or pear-shaped and may be either plain, fluted or of other such ornamental forms.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Faries Mfg. Co., Decatur, Ill.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Vester Sons, Inc., Alfred, 5 Main St., Providence, R. I.
Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio. "V. M. C. Brass."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SHELLS, FUSE.—These shells are the tubular casings of cartridge type enclosed fuses. They are also called tubes or fuse casings, and are almost invariably made of vulcanized hard fiber. For renewable type fuses the ends of the tube or shell are often threaded so that the caps or ferrules may be screwed on. A small hole may be provided near the middle which is sealed over by the label and serves as an indicator by being charred when the fuse is blown. Fuse shells are of various diameters and lengths, depending on the current and voltage ratings of the fuses for which they are to be used.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bridgeport Brass Co., Bridgeport, Conn.
CRESCENT ELECTRIC CO., P. O. Box 178, Mountain Grove, Mo.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
PATTON-MACGUYER CO., 31 Mathewson St., Providence, R. I.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Wilmington Fibre Specialty Co., Wilmington, Del.

SHELLS, SOCKET.—Lamp-socket shells are generally made of spun or drawn metal (mostly brass) or glazed porcelain or molded insulating material, and are used as enclosures for the current-carrying parts and mechanism. The metal shells are made in the candelabra, medium and mogul sizes, the porcelain and composition chiefly in the medium and mogul sizes only. Socket shells are sometimes made by metal-spinning companies for the manufacturers of sockets. Porcelain and molded composition shells are likewise made by producers of electrical porcelain and makers and molders of molded insulation. Socket caps are also furnished to correspond to the shells. Metal shells and caps may be finished in brushed or polished brass, nickel-plated, enameled, oxidized, etc.

Manufacturers:

AMERICAN INSULATOR CORP., New Freedom, Pa. (Composition.)
American Pin Co., The, Waterbury, Conn. "Ampinco."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."

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Art Lamp Mfg. Co., 521 S. Wabash Ave., Chicago, Ill.

BEST ELECTRIC CORP., 476 Broadway, New York, N. Y. This illustration shows the interlocking device of the "USE" shell and cap. The tongue shown on the shell interlocks with the loop which is pierced into the cap, thereby forming a positive grip. When once locked into position, no jarring or excessive vibration will cause the sections to come apart. The illustration also shows the thread on the lower part of the shell adaptable for the "USE" husk. Both key and keyless sockets are furnished with ⅛, ¼ and ⅜ in. caps. Key and keyless sockets with pendant cap and with ⅜ in. male thread cap are included in the line.—Adv.



"U S E" Shell and Cap.

Bridgeport Brass Co., Bridgeport, Conn.

CRESCENT ELECTRIC CO., Mountain Grove, Mo.

Federal Porcelain Co., The, Carey, Ohio. (Porcelain.) "Fedco."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Motor Specialties Co., Waltham, Mass.

National Marine Lamp Co., The, Forestville, Conn.

PATTON-MAC GUYER CO., Providence, R. I. We specialize in miniature and candelabra socket shells for Christmas-tree outfits. Improved manufacturing methods insure against loose porcelains. Medium and Mogul shells also supplied.—Adv.

Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.

SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)

UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SHELLS, TELEPHONE RECEIVER.—Telephone receiver shells are generally made of hard rubber. They are used to enclose the parmanent magnets and coils and to provide a means of attaching the ear cap. With most telephones the shell is long, also serving as a handle. In other cases it may be quite small, as in shells for watchcase or head receivers.

Manufacturers:

Electrose Mfg. Co., Brooklyn, N. Y. "Electrose."

General Insulate Co., 1004-1024 Atlantic Ave., Brooklyn, N. Y.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

Leich Electric Co., Genoa, Ill.

Rome Mfg. Co., Rome, N. Y. "Rome."

Siemon Hard Rubber Corp., The, State St., Bridgeport, Conn.

Stromberg-Carlson Telephone Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SHELTON.—Trade name for electric hair driers manufactured by Mathias Thome, 22 W. Monroe St., Chicago, Ill.

SHELTON ELECTRIC CO.—New York, N. Y. Manufacturer of electric vibrators, hair driers, cutters and other electrical appliances. President, Gentry Shelton; vice-president, R. T. Shelton; secretary, A. J. Crowley. Main office, 16 E. 42nd St., New York, N. Y. Branch offices, Boston, Mass.; San Francisco, Cal.; 30 E. Randolph St., Chicago, Ill.

SHENTON, THOMAS H.—Slatedale, Pa. Manufacturer of slate for electrical purposes.

SHEPARD ELECTRIC CRANE & HOIST CO.—Montour Falls, N. Y. Manufacturer of electric cranes and hoists. President, S. G. Turner; vice-president and general manager, F. A. Hatch; secretary and sales manager, R. H. McGredy; treasurer, Miss Mary Dunham. Main office and factory, Montour Falls, N. Y. Branch offices, 122 S. Michigan Ave., Chicago, Ill.; Lexington Bldg., Baltimore, Md.; Union National Bank Bldg., Cleveland, Ohio; Hudson Terminal, New York, N. Y.; Bulletin Bldg., Philadelphia, Pa.; Union Arcade Bldg., Pittsburgh, Pa.; 16 California St., San Francisco, Cal.

SHERARDIZING OVENS.—See Ovens, electric sherardizing.

SHERARDUCT.—Trade name for zinc-treated rigid conduit manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

SHERMAN.—Trade name for grinding wheel dressers manufactured by the Desmond-Stephan Mfg. Co., Urbana, Ohio.

SHERMAN, EUGENE M. — Bellevue, Wash. Manufacturer of brass castings.

SHERMAN MFG. CO., H. B.—Battle Creek, Mich. Manufacturer of motor-generators, motors, clamps, battery connectors, etc. Business established 1895. President and general manager, H. B. Sherman; vice-presidents, C. E. Kolb, A. H. Warner, Jr.; secretary and treasurer, G. E. Townsend; sales manager, A. H. Warner, Jr.

SHERWIN-WILLIAMS CO.—601 Canal Rd., Cleveland, Ohio. Manufacturer of insulating varnishes and compounds. Business established 1866. President, W. H. Cottingham; vice-president, S. P. Fenn; sales manager, H. D. Whittlesey. Factories, Cleveland, Ohio; Chicago, Ill.; Newark, N. J.; San Francisco, Cal.

SHERWOOD MFG. CO.—1702-1712 Elmwood Ave., Buffalo, N. Y. Manufacturer of ejectors, injectors, soot blowers and other power plant equipment. Incorporated 1890. President, H. S. Madden; vice-president, P. J. Smith; secretary and treasurer, J. B. Madden; sales manager, William C. Ihde.

SHIELD BRAND. — Trade name for weatherproof, slow-burning wires, etc., manufactured by the Ansonia Electrical Co., Ansonia, Conn.

SHIELD BRAND.—Trade name for insulating and protective paints and compounds, manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

SHIELDS, EXPANSION.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

SHIELDS, FACE, WELDERS'. — See Helmets and face masks or shields, welders'.

SHIELDS, LINEMEN'S PROTECTIVE.—Linemen working around live wires are always in danger of accidental contact with these wires and many men have been killed or seriously injured in such accidents. To minimize the possibility of contact, the live lines are frequently covered with a shield. These shields are usually made of high-grade rubber-coated fabric and have high insulating qualities, being entirely safe on lines up to 10,000 volts; the usual factory tests of the shields are at 25,000 to 30,000 volts.

Manufacturers:

Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill. "Harco."

Lanz & Sons, Mathew, Pittsburgh, Pa.

Linemen Protector Co., 850 Penobscot Bldg., Detroit, Mich. "Marshall's."

SHIELDS, WELDERS'.—See Helmets and face masks or shields, welders'.

SHIFFLER.—Trade name for steel transmission towers manufactured by the American Bridge Co., 30 Church St., New York, N. Y.

SHIMS, POLE OR GUY.—The strain put upon the wood of a pole by a guy cable wrapped about it is likely to cut into the wood in time, thus weakening the pole. Shims or strips are therefore placed between the guy cable and the pole to give greater bearing surface. These should be of galvanized metal, about 1½ x 6 x ⅝ inch.

Manufacturers:

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

Lanz & Sons., Mathew, Pittsburgh, Pa.

SHINN-FLAT.—Trade name for lightning rods manufactured by the W. C. Shinn Mfg. Co., 14 E. Jackson Blvd., Chicago, Ill.

SHINN MFG. CO., W. C.—Chicago, Ill. Manufacturer of lightning rods. Business established 1900. President, W. C. Shinn; vice-president, W. F. Harrah; secretary, L. B. Shinn; treasurer, W. H. Parkin; sales manager, R. L. Bradley. Main office, 14 E. Jackson Blvd., Chicago, Ill. Factories, Niles, Mich.; Guelph, Ont., Can. Branch office, Shinn Mfg. Co. of Canada, Ltd., Guelph, Ont., Can.

SHIP PROPULSION, ELECTRIC.—Historically, electric drive for ships was first projected in 1838, by Professor Jacobi, a distinguished Russian physicist and electrician. From that time to the present the development of the application has progressed with the development of the electrical art. A full discussion of the various steps of development to the applications of today would take too much space. Suffice it to say that from this early experiment larger craft were equipped with motors until Mr. Mavor, of England, designed the propelling machinery for the S. S. Tynemouth. This equipment consisted of two generating sets connected to Diesel oil engines and one motor wound for a differing number of poles. Thus speed changes could be accomplished by varying the connections.

In the United States the Navy Department placed orders for electric propulsion for the collier Jupiter designed by W. L. R. Emmet. The Jupiter was one of three colliers, the other two by comparison being propelled, respectively, by reciprocating engine and geared turbine. The result of the comparison showed that the Jupiter was entirely satisfactory and to such a degree that it led to the now adopted practice of electric propulsion of battleships and battlecruisers. The equipment consisted of a Curtis-Rateau turboalternator of 5450 kw. at 1990 r.p.m., driving two induction motors rated 2750 hp. at normal speed (110 r.p.m.) and direct-connected to the propeller shafts. When it is realized that this vessel was operated from the beginning with a crew unfamiliar with electrical machinery, not only is weight added to a good record but also is emphasis placed on the application of electric drive for general cargo vessels. The trial data show that the Jupiter is an economical ship, as fully loaded her consumption of water per shaft horsepower (total) at full speed was 14.75 lbs. and that she could make 2.82 knots with one ton of coal. That she is economical in upkeep is signalized by the fact that the Navy Department considers that her "repair bills are practically nil."

In Sweden, Mr. Ljungstrom patented a special design of turbine and generator which he applied with much success to the S. S. Mjolner. This vessel, in comparison with a sister ship (the Mimer) propelled by reciprocating engines, showed that she (Mjolner) could perform the same work with 42.3% less coal. This vessel used steam at 218 lbs. per sq. in. and 235° superheat. It is this performance that still makes the engineer hold to the application of electric drive to all types and sizes of ships, because the Mjolner is only 225 ft. long with a displacement of 2225 tons and the generating plant has a capacity of 800 kw. The important point in this illustration is the use of superheat. Outside of a large and growing difference of opinion there is little doubt that a great reduction in fuel consumption results from the use of high superheat. It is also apparent that this gain cannot be accomplished by any method requiring the reversal of the prime mover. Electric generators always run in the same direction, but the propelling motors are readily reversed.

Just prior to the entrance of the United States into the World War, two 12,500-ton general cargo vessels were to be equipped with electric generators and motors. The increased need of other ships required the postponement of the building of these vessels for the sake of hastening the program. The readjustment of the commercial condition surrounding their construction after the signing of the armistice prevented the installation of the apparatus, which was built and delivered. The design provided for two generators driven by steam turbines at a steam pressure of 195 lbs. and 200° superheat. Two motors of 1500 hp. were pinioned to a common reduction gear which operated the propeller. Following this belated application, it is now understood that 12 cargo vessels owned by the United States Government are to be equipped with one steam turbogenerator and one motor. The performance of these vessels will be followed with interest.

The first battleship to be so equipped was the U. S. New Mexico with a displacement of 32,000 tons and a speed of 21 knots. Her propulsion outfit consists of two turbogenerators of 11,500 kw. each at 80% power-factor at a speed of 2100 r.p.m. and four induction motors wound for 24 and 36 poles rated at 7250 hp. each

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at 167 r.p.m. The generator is capable of speed changes by throttle from 700 to 2200 r.p.m. The motors are direct-connected to the propeller shafts and by pole changing give a speed reduction of 12 to 1 and of 18 to 1, which permits the turbo-generator to run at full speed both at 15 knots and 21 knots.

The official trials of the New Mexico show very successful results and reports of the operation of her machinery satisfactory in every way. The steam consumption per shaft horsepower at different speeds was as follows:

21.08 knots .....12.01 lbs. of steam
19.37 knots .....12.33 lbs. of steam
14.98 knots .....12.475 lbs. of steam
10.26 knots .....13.96 lbs. of steam

The electrical propulsion equipment of the New Mexico was furnished by the General Electric Co. and that of the Battleship Tennessee was furnished by the Westinghouse Electric & Mfg. Co. The equipment for the Tennessee in general is similar to the New Mexico's, i. e., two turbogenerators operating four a-c. motors direct-connected to the propeller shafts. The motors are a combination design so that with the 24-pole connection the motor is of the wound-rotor type and by means of cross connections it will function as a 36-pole squirrel-cage induction motor. The generators will have a capacity of 10,000 kw. and the motors will be each 6700 hp. at 175 r.p.m. on 24 poles and 2125 horsepower at 118.3 r.p.m. on 36 poles, with a 25% overload capacity. The Tennessee has not yet performed her official trials so that performance results are not at hand.

From the experience thus gained the Navy Department has adopted electric drive for all of the battleships and battle-cruisers now building. The importance of this action, beside the weight of military advantage, is seen in the large horsepower required for driving the battlecruisers, which is estimated at very nearly 200,000. In this field of large capacity in small space electricity has no competitors at the present time.

Undoubtedly the question of electric propulsion is now engaging more attention due to the increased cost of fuel. There is little difference in this regard between coal and oil and therefore the points of economy must be looked for in the type of transforming apparatus, i. e., the agencies used between the generating of fuel and the propeller.

In this emergency the trend seems to be towards the use of Diesel oil engines driving small generating sets, say 400 to 500 hp. There are a good many Diesel engine ships now being built, but this does not occasion much saving in fuel and the large-sized unit is not in high favor for propulsion due to the many auxiliaries and the shock of reversal. The operation of Diesel-driven generators is ideal for this type of prime mover. It is proposed to use direct current and connect the generating sets in series, thus providing a flexible voltage supply for speed changing and as well a safety arrangement in case of repairs at sea. The small Diesel engine will have cylinders of relatively small size, easy to handle while under way, permitting the possibility of carrying spares, thus allowing for replacement without coming into port and yet maintaining a fair speed even if all generators were out of order and voltage were supplied by the auxiliary lighting and power generator. In short, such an arrangement of machinery would preclude all possibility of stoppage except for the total loss of oil fuel—a condition that cannot well be included in an engineer's calculation.

SHIP STABILIZERS.—See Stabilizers, airplane and ship, motor-driven gyroscopic.

SHIRK.—Trade name for hand, power and electric house and deep well pumps manufactured by the Blue Ball Machine Works, Blue Ball (Lancaster County), Pa.

SHOCK, ELECTRIC.—The sudden stimulation of the nerves or convulsion or contraction of the muscles, with the feeling of a concussion, caused by the discharge, through the animal system, of electricity from a charged body or circuit. Sometimes, especially in the case of high voltages, the shock is painful and dangerous and is accompanied by burns. The voltage is the main element of shock, as this determines the current that will pass through the body. The allowable current that may be passed through the human body is also dependent upon the frequency of the current. High-frequency alternating currents produce little sensation when passed through the body, when compared with low-frequency currents of equal strength. Tests have been made to determine the maximum or "tolerance current" that a man may take through his arms and body without marked discomfort or distress. A man can tolerate about 0.03 ampere at 11,000 cycles per second but can tolerate nearly 0.5 ampere at 100,000 cycles.

The shock, if sufficiently severe as from a very high voltage of low-frequency, will cause death. The condition of the body after death by electric shock corresponds exactly to that found after death by asphyxia. The shock paralyzes or destroys the nerve center which controls the respiratory movements; the passage of venous blood into the arterial system causes contraction of the arterioles and stoppage of the heart. There is therefore always hope of resuscitation, except when the respiratory nerve center has been destroyed. See Resuscitation; also Resuscitation apparatus.

SHOE DRIERS, ELECTRIC. — See Driers, shoe, electric.

SHOE FACTORY IRONING MACHINES.—See Ironing machines, electric shoe factory and other industrial.

SHOE-REPAIRING MACHINES, ELECTRIC.—Most modern shoe-repair shops are equipped with electrically driven machinery, which greatly increases both the quality and the quantity of the work turned out. There is usually a heavy sewing machine which may have an electrically heated device for warming wax, and a long frame or rack supporting one or more shafts, upon which are mounted the various wheels for grinding, buffing and finishing the work, all driven from a single motor. Most of these machines have dust collectors, and many of them are worked out into a very complete plant for the repair man's use.

Manufacturers:

Landis Machine Co., St. Louis, Mo.
Progressive Shoe Machinery Co., 3116-36 Snelling Ave., Minneapolis, Minn. "Progressive."
Specialty Shoe Machinery Co., 201 W. Colorado Ave., St. Joseph, Mo. ("Crowe" nailer)
United Shoe Machinery Corp., 205 Lincoln St., Boston, Mass.

SHOE SEWING MACHINES.—See Sewing machines, motor-driven, tailors', shoemakers', hatters', etc.

SHOE-SHINING MACHINES, ELECTRIC.—Machines which are designed, by means of motor-driven brushes, to clean and polish shoes. They have been introduced to a limited extent as prepay machines. The wide varieties of shoes and boots now worn introduce complications for motor-driven machines.

Manufacturers:

Electroshine, Inc., 253 W. 34th St., New York, N. Y.
Progressive Shoe Machinery Co., 3116-36 Snelling Ave., Minneapolis, Minn. "Progressive."

SHOES, BOOTS, LEGGINGS, ETC., FIREPROOF, FOR WELDERS, FURNACE TENDERS, ETC.—Spattered metal will usually not produce a serious burn on the skin unless it adheres to or is held upon the spot it strikes by burning into the clothing or catching in a crease, pocket, or other crevice. To prevent burns on the legs or feet, workmen employed in welding and furnace tending are consequently provided with smooth-surfaced fireproof foot coverings, such as shoes, boots, spats and leggings. Heavy leather with a fireproof coating or asbestos cloth with a smooth finish is used for making such footwear and leg coverings. Also see Garments, fireproof.

Manufacturers:

Safety Equipment Service Co., 215-221 St. Clair Ave., N. E., Cleveland, Ohio.
Safety First Supply Co., 107 3rd Ave., Pittsburgh, Pa.

SHOES, LINEMEN'S INSULATED.—Among the various safety devices for linemen are shoes of suitable insulating material, which are a desirable accessory with grounded-neutral systems, or with high-tension line work. These shoes are usually made of high-grade rubber.

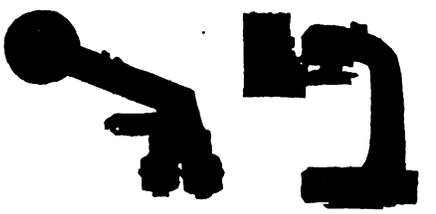
Manufacturers:

Linemen Protector Co., 850 Penobscot Bldg., Detroit, Mich.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

SHOES, THIRD OR CONTACT RAIL.—Sliding shoes for collecting current from a third or contact rail are of two general types: those whose pressure against the rail is actuated exclusively by means of springs, and those in which the pressure is due entirely or mainly to gravity. Where protected rails or underrunning rails are used it is necessary to use shoes that have a hinged or pivoted arm carrying the contact member, which is actuated by springs. The shoes are generally made of cast iron and consist of only a few parts. The contact members or wearing parts, whose pressure against the rail is usually adjustable, are removable so that they may be replaced when worn out. The shoe has securely bolted or brazed to it a heavily insulated flexible cable carrying the current to the car body. In the case of unprotected overrunning third rails, the shoe is arranged so that sleet cutters or scrapers can be attached during the sleet season. Third or contact rail shoes are used not only by railways with third rails instead of trolley wires for power supply, but also by large traveling cranes, open-hearth-furnace or coke-oven charging machines, ore bridges, and other electrically operated traveling machines that use a contact rail. Railway signal systems that include cab signals or track-circuit emergency control of the locomotive also use special contact rails and contact shoes. The current capacity of power-type third-rail shoes is much in excess of any of the overhead forms of current-collecting apparatus used, such as trolley wheels or pantograph collectors, and in tests have indicated values of 2000 amperes per shoe at a speed of 35 miles per hour.

Manufacturers:

ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria, Sts., Philadelphia, Pa. Keystone contact rail material consists of complete lines of contact rail standards, insulators, shoes and collectors.



Rail Collector Typical Assembly

Typical assembly is shown on right. Keystone universal contact rail collectors are adapted for practically all classes of industrial or crane, conveyor and other work requiring a moving contact of medium power capacity. They are made for use in any position and with all styles of contact wheels and shoes. Typical collector is illustrated on left.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SHOLDER-EXCEL MFG. CO., THE.—Clyde, Ohio. Manufacturer of switchboard instruments. William Antony, sole owner. Sales representative, D. A. Schnebel, 90 W. Broadway, New York, N. Y.

SHONBERG, INC., T.—Brooklyn, N. Y. Manufacturer of solder, babbitt metals, etc. President and treasurer, B. Shonberg; secretary and general manager, T. Mayer. Main office, 122-126 Flushing Ave., Brooklyn, N. Y. Branch offices, Cleveland, Ohio; Norfolk, Va.; Baltimore, Md.; New Orleans, La.

SHORT.—A contraction of the term "short-circuit," commonly used by electricians and repair men.

SHORT-CIRCUIT. — A low-resistance connection joining two parts of an electric circuit, offering a path of much lower resistance for the current than the main circuit. Most of the current therefore will flow through the short-circuit. It is a fault often caused by imperfect insulation or by mechanical abrasion that damages the insulation. It is also a connection made under certain conditions for testing or protective purposes.

SHORT-CIRCUIT CURRENT. — The current which exists after a generator is short-circuited. This current may be many times full-load value. In the case of d-c. generators the short-circuit is opened by the action of circuit-breakers, some of these acting within a few thousandths of a second after the short-circuit occurs. A flashover at the commutator may follow a short-circuit.

With a-c. generators, on account of their frequent great load capacity, enormous currents may exist immediately after a short-circuit with excessive mechanical stresses and possible damage.

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The initial rush of current is limited largely by the inductive reactance of the armature and may be many times full-load value. The current rapidly decreases and its final value is limited by the synchronous impedance of the armature and may not be greatly different from full-load value. Current-limiting reactors are sometimes installed in series with large low-frequency turbogenerators to prevent the initial rush of short-circuit current reaching a destructive value.

Batteries, especially dry cells, are often rated according to the short-circuit current they give when fresh. This is a crude measure of their internal resistance, a high short-circuit current indicating a very low resistance.

SHORT ELECTRICAL MFG. CORP.—Penn Yan, N. Y. Manufacturer of flexible steel and nonmetallic conduit. President, H. M. Short; vice-president, L. D. Baily; secretary and treasurer, S. E. Short; general manager, F. J. Saxton.

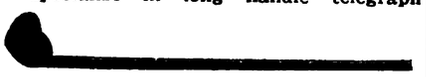
SHOVELS AND SPOONS, POLE OR POST HOLE.—The usual depth of holes dug for poles is 5½ to 7 ft. which necessitates the use of long-handled shovels for the work. When the hole becomes deeper the dirt is lifted by a bent shovel known as a spoon. These tools are essential in pole setting work and are available in various forms.

Manufacturers:

Ames & Sons Corp., Oliver, North Easton, Mass. "Ames."
Columbus Handle & Tool Co., The, Columbus, Ind.
HERBST, PAUL W., Chicago, Ill. We specialize in shovels of all kinds used



in electrical construction. We also specialize in long handle telegraph



spoon shovels. See display adv. page 1258.—Adv.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)
Pittsburgh Shovel Co., Oliver Bldg., Pittsburgh, Pa.
Wood Shovel & Tool Co., The, Piqua, Ohio.

SHOVELS, ELECTRIC POWER.—See Excavators, electric.

SHOW WINDOW AND SHOWCASE LIGHTING FIXTURES.—See Fixtures, lighting window and showcase; Reflectors, showcase and window.

SHOWCASES AND WALL CASES, STORE.—Electrical dealers' stores of the modern types have well made showcases and wall cases designed not only to add an attractive appearance to the store but to show off the material to best advantage. They often combine glass tops, sides and adjustable shelves with various lighting effects, and have hardware and wooden frames to match the other hardware and woodwork of the store; sometimes highly nickel-plated metal frames are used.

Manufacturers:

Detroit Show Case Co., 1654-1700 W. Fort St., Detroit, Mich. "Silent Salesman."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y.
Grand Rapids Show Case Co., Grand Rapids, Mich. "New Way."
Heller & Co., W. C., Montpeller, Ohio.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Stevens & Co., 375 Broadway, New York, N. Y. "Heller."
Wade Mfg. Co., H. M., Charlotte, N. C.
Walrus Mfg. Co., Decatur, Ill.
Weber Show Case & Fixture Co., 440 Seaton St., Los Angeles, Cal.
Wilmarth Show Case Co., 1544 Jefferson Ave., Grand Rapids, Mich.

SHOWERS, FIXTURE OR LIGHTING.—The term shower is applied to a wide variety of residence ceiling fixtures which consist of several sockets suspended from a plate by chains or rods. A three or four-socket fixture with the sockets more or less freely suspended is the commonest type. This fixture, at one time almost the only type of living-room fixture, is still the commonest type in use. Also see Fixtures, lighting, residence.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Bayley & Sons, Inc., 105 Vanderveer St., Brooklyn, N. Y.
BEARDSLEE CHANDELIER MFG. CO., 216 S. Jefferson St., Chicago, Ill.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Faries Mfg. Co., Decatur, Ill.
INTERIOR LAMP & FIXTURE WORKS, 4888 N. Clark St., Chicago, Ill.
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plaut & Co., L., 434 E. 23rd St., New York, N. Y.
Polly Mfg. Co., Milwaukee, Wis.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

SHUNT.—A shunt is a parallel circuit or a bypass in a circuit. It is often designed to carry a certain percentage of the total current in the main circuit, as in the case of ammeter shunts or galvanometer shunts. To shunt any apparatus or circuit is to bypass it or connect a conductor or another circuit across its terminals. A shunt apparatus or circuit is one connected as a shunt or which contains a shunt, as a shunt field, shunt motor or generator (one with a shunt field). "Parallel" and "multiple" are other common adjectives meaning shunt.'

SHUNT, INDUCTIVE.—A shunt which has self-inductance in addition to its resistance. An inductive shunt is sometimes placed across the interpole winding of a d-c. machine, the inductance of the shunt being so adjusted with respect to its resistance that current through the interpole winding will rise and fall with that through the armature.

SHUNT, RESONANT.—A shunt in which the self-inductive reactance is equal to the condensive reactance for a current that is wanted in the shunt. A resonant shunt is sometimes placed across the terminals of a d-c. generator to eliminate the pulsations in the direct current due to commutation.

SHUNT, SERIES.—A shunt across the series winding of a compound-wound machine for the purpose of adjusting the compounding to the desired value. Since the number of turns per pole of a series winding are few and fractional turns are not possible, it is practicable, when a whole number of turns does not give the desired compounding to shunt a portion of the current around a slightly larger number of turns than would be required if all of the current passed through them.

SHUNTS, AMMETER, WATTMETER AND WATT-HOUR METER.—The movable coil of an ammeter carries only a very small part of the measured current. An ammeter shunt is a bypass or parallel circuit of low resistance which bears a constant ratio to the resistance of the movable coil. Such shunts are used with direct-current instruments only. For low-capacity ammeters the shunt is mounted under the cover or is an integral part of the instrument. Such ammeters are called self-contained. For measuring large currents, the shunt is mounted separately and the instrument is connected to the terminals of the shunt by small wires called leads. For portable instruments the external shunts are also portable; for switchboard instruments they are mounted on the back of the board. Shunts should be made of material of low temperature coefficient, such as manganin, and should be well ventilated; this is usually done by laminated construction, the leaves being spaced apart and silver-soldered into heavy copper terminal blocks that have suitable connections for the main circuit and separate, smaller binding posts for connecting the leads to the ammeter. The shunt and the instrument must be designed to go together, else large errors may result. External shunts are made for any current capacity desired; shunts to 20,000-ampere rating are listed by several American makers.

Shunts for the current circuits of d-c. wattmeters and watt-hour meters are made up of the same general design as ammeter shunts. For wattmeters both portable and switchboard types are made. For watt-hour meters only certain switchboard types, as a rule, have external shunts.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See display adv. pages 1203-1223.)
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

SHUNTS, GALVANOMETER.—These are resistors intended for parallel connection with galvanometers. The shunt is designed to carry a known fraction of the whole current and hence its resistance is a fraction of the galvanometer resistance, usually 1/9, 1/99, 1/999. It is usual to construct small shunt boxes containing three or four coils for each galvanometer, these coils being marked 0.1, 0.01, 0.001 to specify the fractional part of the total current that flows through the galvanometer. A special form of galvanometer shunt, called the Ayrton universal shunt, may be used with any galvanometer, regardless of its resistance.

Manufacturers:

Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
General Radio Co., 11 Windsor St., Cambridge, Mass.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Pyrolectric Instrument Co., 663-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

SHUNTS, MULTIPLYING POWER OF.—This is a term applied chiefly to galvanometer shunts and is the ratio of the sum of the resistances of the galvanometer and shunt to that of the shunt. It may also be defined as that factor by which the current through a shunted instrument must be multiplied to give the total current.

SHURLOK.—Trade name for locking type socket and wall receptacle manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

SHURO.—Trade name for battery tester manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

SHUSTER CO., F. P.—New Haven, Conn. Manufacturer of wire straightening machines. Business established 1866. President and treasurer, E. F. Shuster; vice-president, G. D. Phillips; secretary, L. F. Shuster.

SHUSTER ENGINEERING CORP.—Erie Ave. & Allen St., Philadelphia, Pa. Manufacturer of wrenches. President and general manager, A. Eltow Davis; vice-president in charge of production, Myer M. Shuster; treasurer and general sales manager, V. Francis Voldes; secretary, John N. Inman, Jr.

Si.—The form Si is the chemical symbol for the element silicon.

SIBERIAN.—Trade name for motor-driven refrigerating and ice-making machinery manufactured by the Armstrong Machinery Co., 3201-3219 E. Riverside Ave., Spokane, Wash.

SICO.—Trade name for insulating materials manufactured by the Standard Insulation Co., Rutherford, N. J.

SIDE TONE AND ANTISIDETONE.—Side tone is sound heard in the receiver of a telephone while the subscriber talks. It is due to the subscriber's own voice and to room noises. Antisidetone arrangements of apparatus reduce this noise but usually at the expense of good transmission of the voice.

SIDEBOTHAM, INC., JOHN.—1317 Griscom St., Frankford, Philadelphia, Pa. Manufacturer of electrical tapes. Busi-

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ness established 1820. President, John B. Sidebotham; secretary and treasurer, Frank L. Sidebotham.

SIDNEY.—Trade name for electric washing machine manufactured by the Sidney Washing Machine Co., Sidney, Ohio.

SIDNEY WASHING MACHINE CO., THE.—Sidney, Ohio. Manufacturer of electric washing machines. Business established 1919. President, W. H. Persinger; vice-president, J. D. Barnes; secretary and sales manager, John Perry; treasurer and general manager, William A. Perry.

SIEBEN MERCHANDISING CO.—614 Gumbel Bldg., Kansas City, Mo. Manufacturer of electric washing machines, clothes driers and temperature regulators.

SIECO.—Trade name for motors and switch boxes manufactured by the Sieffert Electric Co., 210 Main St., Evansville, Ind.

SIEFFERT ELECTRIC CO.—210 Main St., Evansville, Ind. Manufacturer of motors, lighting fixtures, switch boxes and soldering paste. Business established 1913. President and general manager, Frank W. Sieffert; secretary, Fred W. Stocker; treasurer, Chas. R. Tigeman, Sr.

SIEGEL LIGHT SUPPLY CO.—231 Market St., Philadelphia, Pa. Manufacturer of portable electric lamps.

SIEGFRIED, G.—130 N. State St., Chicago, Ill. Manufacturer of electric hair driers. Proprietor, G. Siegfried.

SIEMENS-HALSKE PROCESS. — In this process for gold refining the ore is leached with cyanide solution, dissolving the gold, and the solution is then electrolyzed. The tanks are divided into 10 or 12 compartments, each containing electrodes, and the whole solution flows through each. The gold with some silver deposits on spiral strips of lead, which are removed and refined in a shallow porous cup when they carry about 10% of their weight in gold. The anodes are of iron, which is slowly attacked, forming Prussian blue. They are enclosed in canvas bags, and by adding a small amount of alkali to the electrolyte are made to last for years.

SIEMON HARD RUBBER CORP., THE.—State St., Bridgeport, Conn. Manufacturer of telephone mouthpieces, receiver shells, insulating materials, push buttons, etc. Business established 1903. President, treasurer and general manager, Carl F. Siemon; vice-president and secretary, Waldo C. Bryant; sales manager, Carl M. Siemon.

SIEMUND.—Trade name for welding wire manufactured by the Siemund Wenzel Electric Welding Co., 30 Church St., New York, N. Y.

SIEMUND WENZEL ELECTRIC WELDING CO.—30 Church St., New York, N. Y. Manufacturer of arc welding equipment. President, L. M. Smith; vice-president, T. R. Rumney; secretary and treasurer, M. R. Wilkin.

SIGN FLASHERS.—See Flashers, sign, motor-driven; Flashers, sign, thermal; Flashers, socket type.

SIGN FRAMES.—See Frames and supports for electric signs.

SIGN LENSES.—See Lenses, sign letter.

SIGN LETTERS.—See Letters, sign, glass; Letters, sign, metal.

SIGN RECEPTACLES.—See Receptacles, sign.

SIGN LAMPS.—See Lamps, incandescent, sign.

SIGN LIGHTING TRANSFORMERS.—See Transformers, sign lighting.

SIGNAL.—Trade name for bells, buzzers, medical batteries, telegraph instruments and wireless apparatus manufactured by the Signal Electric Mfg. Co., Menominee, Mich.

SIGNAL ELECTRIC MFG. CO.—Menominee, Mich. Manufacturer of bells, buzzers, medical bateries, telegraph instruments and wireless apparatus. Business established 1919. President, John Henes, Jr.; vice-president, George Fussner; secretary, treasurer and general manager, Charles E. Hammond. Main office and factory, Menominee, Mich. Branch office and warehouse, 33 S. Clinton St., Chicago, Ill. Sales representatives, P. M. Dreyfuss Co., 150 Chambers St., New York, N. Y.; C. H. Walles & Co., 1433 Syndicate Trust Bldg., St. Louis, Mo.; Globe Commercial Co., 618 Mission St., San Francisco, Cal.; A. W. Marshall Co., 213 Jefferson Ave., Detroit, Mich.; Brian & Powers, 304 Canal Bank Bldg., New Orleans, La.; R. E. T. Pringle Co., 95 King St., East, Toronto, Ont.; Federal Agencies, Royal Alexandria Hotel, Winnipeg, Man., Can.

SIGNALING SYSTEMS, CODE CALLING FOR FACTORIES, OFFICES, STORES, ETC.—For quickly locating officials and special employees in large factories, stores, offices, institutions and similar establishments a code-calling system is employed. The calls are made by ringing bells or gongs, or by sounding whistles or horns, located at various points throughout the establishment, the number of rings indicating the person called by any number code which may be desired. The calls are sent from a central station, generally at the telephone switchboard, so that the person called may call back from any telephone he happens to be near at the time of calling or, in case no interior telephone system is used, the call may simply notify him that he is wanted at the operator's desk or main office and he may return to that desk. The control is simple, consisting of a number of telephone keys or push buttons which when pressed may give one round of the signal only or by means of spring or electric motor-operated contactors the call may be repeated any definite number of times or indefinitely, subject to the control of the operator. The signals may also be used in connection with fire alarm, telephone or program clock systems. For special applications see Signaling systems, hospital nurses' and doctors', and Signaling systems, silent call or visual.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

Auto Call Co., The, Shelby, Ohio.

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin Industrial Signals, for use on audible call or warning systems, have a peculiar tone pitch which is distinguishable above ordinary noises. Horns are less expensive and more effective than good bells and require less attention in service. They respond immediately to electric impulse and may be operated with the fastest code signaling.—Adv.



Benjamin Industrial Signal

Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."

Cincinnati Time Recorder Co., The, 1733 Central Ave., Cincinnati, Ohio.

Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."

HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices, motor-generators and dynamos, hospital, fire alarm, factory call, school, bank and other signaling systems. The instant man-finder. Tell the telephone operator who is wanted and the coded call goes out all over the plant in as many different locations as desired; the man wanted answers on the nearest telephone. Illustrative booklets on all Holtzer-Cabot signaling systems will be forwarded on request.—Adv.

KLAXON CO., Newark, N. J. "Klaxocator."

McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.

Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio. "Tele-Call."

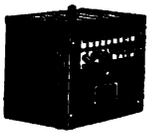
National Scale Co., Chicopee Falls, Mass. "National."

Ostrander & Co., W. R., 371 Broadway, New York, N. Y.

Pettes & Randall Co., 152 Nassau St., New York, N. Y.

Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.

STANDARD ELECTRIC TIME CO., THE, Springfield, Mass. The "Standard" calling instrument requires no hand winding; is equipped with quick operating telephone type ringing keys, giving 47 different code numbers; tell tale lamp signal for operator; neat cabinet finish.—Adv.



"Standard" Code Call

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau," "Faraday."

SIGNALING SYSTEMS, HOSPITAL NURSES' AND DOCTORS'.—In hospitals it is necessary that some calling system be provided so that any patient may summon a nurse to his or her bedside and obtain prompt attention. Such systems may be entirely visual, or both visual and audible. To insure the call being answered, such systems are generally arranged so that the signal is maintained until the nurse or attendant actually goes to the bedside and presses an answering button or inserts an answering key. The various systems consist primarily of calling buttons which, when depressed, will light a number of signal lamps mounted at various places in the hospital and so placed as to come directly under the observation of responsible nurses or doctors. The calling buttons are usually pendent push buttons on cords which extend to the bedsides of the patients. The visual signal is generally in the form of a pilot lamp mounted in the corridor over the door of the private room or ward, and in the wards at the bed of each patient. Pilot lamps are also mounted in the diet kitchen, duty room and other points where they will be under constant observation, or, where lamps in such locations would be very numerous, an annunciator may be substituted. Emergency calling systems which allow the answering nurse to call for additional help may also be included. Supervisory stations and elapsed-time recorders may be installed so that the time of entering a call and of the answering signal may be observed by a supervisor or a permanent record of calls obtained on the recorder.

Besides nurses' calling systems doctors' calls are also necessary to locate one of the house physicians or internes when he may be in any one of a number of places about the hospital. These systems may be similar to the nurses' calling system or may consist of a lamp annunciator or similar visual signal which indicates by code which physician or interne is wanted. The doctor answering the call goes to the nearest telephone to learn where he is wanted. The doctors' calls are usually controlled from a station located at the main telephone switchboard.

Manufacturers:

Auth Electrical Special Co., 422 E. 53rd St., New York, N. Y.

Autocall Co., The, Shelby, Ohio.

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."

Faraday Co., The, 746 Chapel St., New Haven, Conn. "Faraday."

HOLTZER-CABOT ELECTRIC CO., THE. Main office and factory, 125 Amory St., Boston, Mass. Branch offices at Chicago, New York, Baltimore, Philadelphia, Detroit, St. Louis and Minneapolis. Manufacturers of fractional horsepower motors for labor-saving devices; motor-generators and dynamos; hospital, fire alarm, factory call, school, bank and other signaling systems. Over 500 hospitals at home and abroad are equipped with Holtzer-Cabot hospital or nurses' call system. The patient presses a pendant button which indicates the private room or the ward and bed in that ward which is calling. The nurse answers the patient calling, and extinguishes all signals by operating a release in the pendant button at the patient's bedside. Electrical engineers and contractors are requested to send blueprints and data and our signaling system staff will be glad to lay out the type of system most suitable for the hospital or institution. Illustrative booklets on all Holtzer-Cabot

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signaling systems will be forwarded on request.—Adv.
Klaxon Co., Newark, N. J.
Mead Electric Signal Co., The, 2109 Marquette Rd., Cleveland, Ohio. "Tele-Call."
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Stanley & Paterson, 34 Hubert St., New York, N. Y. "DeVeau."
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."

SIGNALING SYSTEMS, MARINE.—Marine signaling systems are very extensive and complete and it is by means of these signals that a vessel's operation may be controlled by one officer. Important stations on the ship are connected by a speaking tube or telephone system or both. Telephones must be used when the distance is more than 150 ft. The trend today is for loud-speaking telephones made water-tight and capable of being heard distinctly 5 ft. from the receiver. Call bell systems operating annunciators and fire and general alarm systems are always provided. See Alarm systems, fire, marine. The general alarm system consists of a number of large electric gongs distributed throughout the ship with contact makers in the principal compartments so that the officer in command can quickly arouse the crew or sound a general alarm. Telegraph systems consisting of electrical transmitters and indicators are also used for communication, for anchor operation, steering, docking, laying the course, etc.

Interior communication is partly mechanical in its action. The principal form is known as the engine telegraph and is the communication between the pilot house and engine room. It consists of brass dials located in the engine room and on the navigating bridge. The wheels and dials are actuated by chains and brass wire running over pulleys and in pipes. To provide against derangement of the engine telegraph, jingle bells and gong pulls are installed between the pilot house and engine room. The main steam whistle is usually operated by mechanical means. To sound the whistle at set intervals of time automatically, a clock mechanism located in the chart house is connected electrically through a manual switch on the bridge to a magnet operating the main steam whistle valve. See also Signaling systems, naval.

Manufacturers:

Arnessen Electric Co., 109 Broad St., New York, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Illustration shows Benjamin watertight Howler and push button,



Watertight Push Button



Watertight Howler

particularly designed for marine service or where signaling units must be watertight, of especially durable construction and absolutely dependable in operation. Benjamin signals have great volume of tone, distinctive tone quality, consume but little current, and are instantly responsive to the shortest impulses of electric current.—Adv.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Liberty Electric Corp., Port Chester, N. Y.
National Marine Lamp Co., The, Forestville, Conn.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Stanley & Paterson, 34 Hubert St., New York, N. Y.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

SIGNALING SYSTEMS, MINE.—Code calling signals are employed in the mine for transmitting a signal from various locations on the surface to points within the mine or between points in the mine, the signals being used to call individuals, for general alarm signaling, time signals or similar signals where a simple code may be used. The system may form a part of the telephone system to obtain economy in wiring or may be entirely independent. The equipment is extremely rugged and is constructed to resist gases or corrosive vapors and moisture, in fact, some of the devices will operate when completely submerged in water.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Sturdy gongs, horns, buzzers and push buttons for use in mine signaling system.—Adv.
Federal Signal Co., Albany, N. Y.
Flint Electric & Mfg. Co., The, 1412 Delgany St., Denver, Colo. "Colorado."
KLAXON CO., Newark, N. J.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Stromberg-Carlson Telephone Co., 1050 University Ave., Rochester, N. Y.

SIGNALING SYSTEMS, NAVAL.—Battleship and naval signaling systems covering the operation of the ship are similar to the systems in use on merchant vessels described under Signaling systems, marine. Since battleships and other naval vessels generally operate in fleets, the signaling system must include means of communication between vessels. Much of this is accomplished by means of radio and also by visual signals, such as the blinker system, searchlights, flags, semaphore systems, etc.

Battleships generally have a more complete telephone system than merchant vessels, as this system not only comprises a complete general communication system for the ship but also a special system for maneuvering the vessel and for the control of gun fire. The turrets are so equipped that communication with any part of the ship may be made over two independent telephone systems. There is also a separate system of loud-speaking telephones used for the purpose of general announcing. The control of the guns is electrically operated and the system is such that the turret officer of a modern ship is informed at the instant of all changes in range or bearing of the target and corrections to his own fire.

A submarine signal is also used on many naval vessels. This is based on the perception of water vibrations. Two tanks of brine are located on each side of the vessel. Telephone transmitters (microphones) are connected to each tank with receivers located in the pilot house. By listening, external water noises may be heard. Submerged bells along the coast may be readily picked up and the ship kept safely on her course. The approach of other steam vessels can be detected by hearing the working of the main engines and the intensity of the sound will establish the relative position of the vessels as well as their distance from each other. A further extension of this method is the development of the submarine oscillator. It functions on the principle of a diaphragm floating in a magnetic field and transmitting thereby sound vibration through the water.

Manufacturers:

Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Liberty Electric Corp., Port Chester, N. Y.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. See projectors, floodlight; adv. page 1405.—Adv.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

SIGNALING SYSTEMS, POLICE.—See Police telephone and signaling systems.

SIGNALING SYSTEMS, RAILWAY BLOCK AND INTERLOCKING.—Block signaling is employed to indicate whether or not a train is in the "blocks" or sections of track covered by the respective signals, its purpose being to avoid collision of trains by giving signals which indicate the spacing of trains on the track. The track is divided into blocks, the length of each block being determined by the traffic conditions. Two signals are usually provided for each block, a home and a distant signal, the home signal indicating whether or not the block about to be entered is clear, the distant signal conveying the same information for the next following block, so that the engineman or motorman may be prepared to bring his train to a stop at the next block, if necessary. Block signals are automatic or nonautomatic. Automatic block signals are controlled automatically by track circuits, being governed by the presence of any rolling stock set within a block. The nonautomatic signals are set by a station agent or towerman on orders from the train dispatcher, sent either by telegraph or telephone.

Interlocking signals have to do with the control of the movement of trains approaching and passing through points of crossing or divergence. They are so designed to provide various safety features, as control of signals so that the signal over any movable track must be in stop position before the track parts can be shifted, or so that the track parts must be locked in the proper position before the proceed signal can be given. The apparatus generally consists of signals, movable track parts and operating mechanisms, and an interlocking machine located in the signal and switching tower together with various auxiliary apparatus. Interlocking signals may be operated mechanically, by wire or pipe connections to levers in the interlocking machines, electrically by means of motors or solenoids, or by electrically controlled pneumatically operated mechanisms. Combinations of electrical and mechanical operation are also used, particularly when the capacity of a mechanical machine must be increased.

Manufacturers:

Blake Signal & Mfg. Co., 221 High St., Boston, Mass. "Blake."
Federal Signal Co., Albany, N. Y.
Hall Switch & Signal Co., Garwood, N. J.
KLAXON CO., Newark, N. J.
Nachod Signal Co., Inc., 4771-4777 Louisville Ave., Louisville, Ky.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Tecla Co., Inc., Detroit, Mich.
Union Switch & Signal Co., Swissvale, Pa.
United States Electric Signal Co., West Newton, Mass.

SIGNALING SYSTEMS, SILENT CALL OR VISUAL.—Various signal systems of this type are used in stores, offices, theaters, etc. The system provides a means of transmitting a call to a particular person by means of flashing lamps or lamps of various colors, or lamp annunciators. They are commonly employed where an audible signal is objectionable because of noise or where it is desired that the signal be silent because of desired secrecy, as for calling a house or store detective. The signals may be controlled from a central control station, usually a telephone switchboard, or they may be controlled from a number of stations by means of push buttons located at various places throughout the establishment. Also see Signaling systems, hospital, nurses' and doctors'.

Manufacturers:

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
McFe'l Signal Co., 2857 S. Halsted St., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

SIGNALITE.—Trade name for attachment plug manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

SIGNALOID.—Trade name for lamp coloring and frosting compound manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

SIGNALRITE.—Trade name for bell-ringing transformers manufactured by the Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill.

SIGNALS, AUTOMOBILE HORN.—See Horns, electric, automobile.

SIGNALS, AUTOMOBILE MOVEMENT AND PARKING.—Arm signaling to indicate a proposed turn or stop to drivers following, while commonly employed by automobilists, is sometimes uncertain and in closed cars sometimes impossible. Collisions and other accidents consequently may occur unless some other positive signal is provided. Such signals are coming

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into use, commonly mounted on the rear and sometimes on the front fender. There are two general types (1) the illuminated sign box in which the desired caution, that is, Stop, Right, Left, indicating the intended movement of the automobile, is flashed on by control buttons, and (2) a semaphore type in which arms, operated by solenoids controlled from a small switch mounted on the steering wheel are caused to swing out from a small box, a legend on the arm giving the signals similarly to those given by the illuminated sign-box type. The parking signal is simply a lamp mounted on the fender containing a clear lens in front and a red lens in back to indicate the presence of the parked automobile to others that may be passing.

Manufacturers:

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio. "Auto-Guide."
Boesch Lamp Co., 960-62 Mission St., San Francisco, Cal. "Right-O-Way."
Chicago Automatic Signal Co., 56 W. Randolph St., Chicago, Ill. "Little Signal Man."
Chicago Die & Specialty Co., 551-557 W. Monroe St., Chicago, Ill. "Kobzy."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Denver Traffic Signal & Mfg. Co., The, 1835 Williams St., Denver, Colo. "DTS."
Double Safety Signal Co., 192 N. Clark St., Chicago, Ill.
Dunkle Co., Arthur J., 50 Church St., New York, N. Y. "Flaray."
Glazier Headlight Corp., 25-27 Otsego St., Rochester, N. Y.
Gray & Davis, Inc., Boston, Mass.
K-D Lamp Co., The, 108-12 W. 3rd St., Cincinnati, Ohio. "K-D."
KLAXON CO., Newark, N. J.
Lunoe & Soule, 622 79th St., Brooklyn, N. Y. "Warno."
Mirror-Park Lite Corp., 208 W. 17th St., New York, N. Y. "Mirror-Park Lite."
Morse, Frank W., 289 Congress St., Boston, Mass.
Rose Mfg. Co., 910 Arch St., Philadelphia, Pa. "Neverout."
Ryan Corp., The, Phoenix, N. Y. "Bates."
Singer Auto Traffic Signal Co., 4018 Greer Ave., St. Louis, Mo. "Singer Signals."
Smith Mfg. Co., Inc., F. A., 183-87 N. Water St., Rochester, N. Y. "Smith."
Smith Signal Corp., 66-68 S. Main St., Phillipsburg, N. J. "Smith Auto Signal."
Spielman Electric Co., 1931 Broadway, New York, N. Y. "Seco."

SIGNALS, ELECTRIC, MISCELLANEOUS.—There are many types of electrical signals used that are not listed or described herewith under signals or signaling systems, nor under alarms, bells, buzzers, gongs and telegraphs. These miscellaneous signals are used for special purposes, such as pilot signals indicating whether lines or machines are live or dead, signals indicating switch position, warning signals cautioning about various abnormal conditions, etc.

Manufacturers:

McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill. (lecturer's)
Painter Co., G. E., 324 N. Charles St., Baltimore, Md. "Painter's."
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

SIGNALS, ELECTRIC RAILWAY CAR AND BUS.—Car signals as a whole embrace conductors' signal bells operated by hand cord, buzzers operated by push buttons, single-stroke bells operated by push buttons, and door signals to indicate by lamp or otherwise when all car doors are closed. Single-stroke bells electrically operated are sometimes used to signal between motorman and conductor of a car or between conductors of motor car and trailer, as in train operation. Door signals are used to indicate, by miniature lamps conveniently located in a small case near the motorman's position, when all car doors are closed and it is safe to proceed. Single-stroke bell signals and car-door lamp signals are usually operated from the trolley circuit through suitable resistors. Also see Buzzers, electric railway car and bus; Bells, electric railway car; Gongs, electric railway car.

Manufacturers:

Consolidated Car Heating Co., Albany, N. Y.
Nichols-Lintern Co., The, 8404 Lorain Ave., Cleveland, Ohio. "N-L."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "Faraday."

SIGNALS, ELEVATOR.—See Elevator signals.

SIGNALS, FIRE ALARM.—See Horns, electric, fire alarm and miscellaneous; Sirens, electric, city, factory, etc.; Whistles, electric, factory, plant, city, etc.

SIGNALS, HEATER.—See Plugs, signal; Receptacles, heater, indicating or pilot lamp.

SIGNALS, MISCELLANEOUS, TELEPHONE SYSTEMS.—In the operation of a telephone system many signals are given to the operators, subscribers and attendants. Some of these are defined below:

Alarm Signals. This is an audible signal to warn the maintainer that apparatus has failed. It is usually general, actuated by some one of the telltales.

Busy Signal. A mechanical signal, electromagnetic, displaying a target when the trunk with whose jack it is associated is busy. It takes the place of the busy lamp and does not generate as much heat.

Clearing Out Signal. Any signal on a cord circuit which means that the subscriber is through talking.

Disconnect Signal. A drop or lamp used to signal the operator to disconnect.

Guard Signal. Usually a lamp on a trunk circuit arriving at a B board to guard the B operator against mistake.

Tell Tale Signal. A visual signal, usually a lamp, to warn the maintainer that some apparatus has failed. It usually indicates for a group of apparatus.

SIGNALS, RAILWAY AND HIGHWAY CROSSING.—See Alarms, railway and highway crossing.

SIGNALS, STREET TRAFFIC DIRECTING.—A number of signals and signs are used for direction and control of street traffic. Some types are used to assist the traffic officer in his work where the traffic is very congested and it is difficult for the officer to maintain his position in the street and give clear visible signals, or where more than two streets intersect and one officer can control the traffic, but it is difficult to indicate which of the streets has the right-of-way. These signals often consist of a rotating lamp sign showing usually green for go ahead and red for stop, or the words "Go" and "Stop" illuminated or a set of semaphores controlled by push buttons or cord switches in the hands of the traffic officer. The signals are mounted on posts or suspended from the overhead trolley network so as to be clearly visible from a distance and several of them may be so located that they may control traffic in all streets within view of one man. Various signs, generally illuminated, are used to properly direct traffic over divergent roads or in the proper directions into one-way streets. Other types may be simply illuminated caution signs to indicate an approaching turn, bridge, railroad crossing, etc. All such signals facilitate traffic and increase its safety, both to vehicles and pedestrians.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. "Benjamin" traffic signals. Write for circular.—Adv.
Denver Traffic Signal & Mfg. Co., The, 1835 Williams St., Denver, Colo. "DTS."
Indestructible Sign Co., 232½ N. High St., Columbus, Ohio. "Indestructible."
KLAXON CO., Newark, N. J.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Painter Co., G. E., 324 N. Charles St., Baltimore, Md. "Painter's."
Singer Auto Traffic Signal Co., 4018 Greer Ave., St. Louis, Mo. "Singer Signals."
Wright Traffic Signal Co., Cincinnati, Ohio. "Which Way."

SIG-NO-GRAPH MFG. CO.—1400 S. Michigan Ave., Chicago, Ill. Manufacturer of electric signs and bulletin boards. President, Nathan Herzog.

SIGNS, CAR DESTINATION AND ROUTE.—Letters, numerals or words, placed on transparent material or painted on boards or metal plates, and fixed or attached to the sides, ends or both, and sometimes on the roof of cars to indicate the route and destination of the car or train. Signs may be permanently fixed or merely hooked in place so that they can be changed to display opposite sides or replaced with those having entirely different reading or indications. Fixed signs are usually arranged so that they may also be read during the hours of darkness. This may be accomplished either by lamps specially placed for the purpose or they may be located so that the lights of the car provide the necessary illumination. A modern type of car sign comprises two geared rollers mounted in a suitable box with glass window and a long strip of translucent sign cloth wound on the rollers. Several route names are printed on the cloth, which can be wound to show any route being followed.

Manufacturers:

Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. The line of Keystone and Hunter il-



Illuminated Car Destination Sign

luminated car destination signs consists of every practical type of illuminated roller curtain sign. They are used extensively on electric railway cars, busses and in railway terminals. —Adv.
Horn Posting Sign System, W. J., 420 N. 5th St., Springfield, Ill.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.

SIGNS, ELECTRIC, BOX TYPE OR INTERNALLY LIGHTED.—Electric signs for display purposes consisting of enclosures of sheet-metal or other weatherproof material containing receptacles for lamps to illuminate the sign faces, which may be perforated or provided with translucent or transparent windows in the form of panes, lenses, bull's eyes, etc., arranged to form the letters, symbols or other design. The translucent letters are usually colored or opal glass set in a contrasting background so that the sign may be read in daylight thus making such signs of value during both day and night. Box signs require but few clamps and are nearly always double-faced.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill. "Daylo."
American Sign Co., Cooley & Willard Sts., Kalamazoo, Mich. "American Lens."
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Brilliant Mfg. Co., 1037 Ridge Ave., Philadelphia, Pa.
Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo. "Brilliant."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal. "Besco."
Century Mfg. Co., Inc., Elizabethtown, Pa. "Reflex."
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Day-N-Ite."
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Broadway, New York, N. Y.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Polaralite."
Greenwood Advertising Co., Knoxville, Tenn. "Individuality."
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Horn Posting Sign System, W. J., 420 N. 5th St., Springfield, Ill.
Indestructible Sign Co., 232½ N. High St., Columbus, Ohio. "Indestructible."
Jones Co., A. E., 819 W. Diamond St., N. S., Pittsburgh, Pa.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.

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Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y. "Kolite."
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Maxwell Co., The R. C., 413 E. State St., Trenton, N. J.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill. "Multiform."
National Retailers Advertising Corp., 1846-48 Ogden St., Indianapolis, Ind.
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Rawson & Evans Co., 710-712 Washington Blvd., Chicago, Ill.
Redfield-King, 2448 Washington Ave., Ogden, Utah.
Robinson & Co., T. L., 105 W. Monroe St., Chicago, Ill. "Edge-Glow."
Root Electric Sign Co., Inc., The, 20-30 Lock St., Lockport, N. Y. "Resco."
Scranton Advertising Sign Co., 320 Connell Bldg., Scranton, Pa.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
SMITH-HECHT CO., Indianapolis, Ind. The "Auroralite", made and sold by the Smith-Hecht Co., is an internally lighted sign, with a clear glass exposure 11½ by 17½ ins., and extreme outside dimensions of 13½ by 19½ ins., using a single incandescent lamp. Although stationary, a constantly changing, variegated color effect is obtained,



The Auroralite

arresting and attracting attention. The "Auroralite" display is an entirely new idea, and is suitable for manufacturers, hotels, clubs, lodges, motion picture theaters, etc. Advertising matter is printed or painted directly on translucent pyralin sheeting, which is inserted in front of a sheet of ground glass, which is part of the equipment. These pyralin slides are interchangeable, and can be furnished in any desired decoration, design, trademark or coloring. Numerous stock designs are available. The sign is furnished complete, with lamp and cord, ready for attachment to either a-c. or d-c. circuit. Expense of operation is trivial. Sign may readily be moved as desired.—Adv.
Smith Sign Co., 608 LaBranch St., Houston, Tex.
Snowite Sign Works, 2124-2130 N. Hudson Ave., Chicago, Ill. "Snowite."
Splinter, H., 2141 N. Clark St., Chicago, Ill.
Standard Signs, Inc., 428 6th Ave., S., Minneapolis, Minn.
Strachan, Inc., R. & H., 395 Fulton St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."
Yoerger Electric Sign Co., P. F., 62½ E. Long St., Columbus, Ohio.

SIGNS, ELECTRIC, CHANGEABLE OR SECTIONAL LETTER.—These electric signs are in the form of individual built-up letters or other characters with enclosed lamp receptacles and with terminals for making temporary connections to the circuits on the sign structure, permitting changes to be made at will. They are extensively used in theater signs, for which they are commonly double-faced, two letters being mounted on opposite faces. The letters are of several types, with projecting lamps on the letter block with light troughs containing the letters, etc.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
American Sign Co., Cooley & Willard Sts., Kalamazoo, Mich. "American Lamp."
Brilliant Mfg. Co., 1037 Ridge Ave., Philadelphia, Pa.
Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo. "Brilliant."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Bulletin Machine Co., 10-16 Lock St., Buffalo, N. Y.
Century Mfg. Co., Inc., Elizabethtown, Pa.
Chase Electric Co., 105 S. Dearborn St., Chicago, Ill. "Mov-A-Lite."
Clinton Sign Co., 134 5th Ave., Clinton, Iowa.
Crystal Electric Sign Co., 922 S. Vandeventer Ave., St. Louis, Mo.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Flashtric Sign Works, 2124-2130 N. Hudson Ave., Chicago, Ill. "Flashtric."
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Greenwood Advertising Co., Knoxville, Tenn. "Individuality."
Horn Posting Sign System, W. J., 420 N. 5th Ave., Springfield, Ill.
Indestructible Sign Co., 232½ N. High St., Columbus, Ohio. "Indestructible."
Jones Co., A. E., 819 W. Diamond St., N. S., Pittsburgh, Pa.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y. "Kolite."
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill. "Multiform."
Munn Sign & Advertising Co., Atlanta, Ga.
National Retailers Advertising Corp., 1846-48 Ogden St., Indianapolis, Ind.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Rawson & Evans Co., 710-712 Washington Blvd., Chicago, Ill.
Redfield-King, 2448 Washington Ave., Ogden, Utah.
Scranton Advertising Sign Co., 320 Connell Bldg., Scranton, Pa.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."
Yoerger Electric Sign Co., 62½ E. Long St., Columbus, Ohio.

SIGNS, ELECTRIC, EXIT AND ENTRANCE.—Electric signs for the special purposes indicated and illuminated by interior lamps. It is required by the National Electrical Code that exit and similar emergency service lamps, as in corridors, stairs, etc., be connected to an independent source of supply or at least to a service connected outside the main fuses for the building. In private plants, an an independent unit or a storage battery may be used. These signs are required in all theaters, assembly halls and other interiors where many people congregate. They are also used in stations, factories, etc.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Century Mfg. Co., Inc., Elizabethtown, Pa.
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Polaralite."
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill.
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Horn Posting Sign System, W. J., 420 N. 5th St., Springfield, Ill.
Jones Co., A. E., 819 W. Diamond St., N. S., Pittsburgh, Pa.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Redfield-King, 2448 Washington Ave., Ogden, Utah.
Robinson & Co., T. L., 105 W. Monroe St., Chicago, Ill. "Edge-Glow."
Scranton Advertising Sign Co., 320 Connell Bldg., Scranton, Pa.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."

SIGNS, ELECTRIC, FLASHING.—Movement of any kind in an electric sign will always attract more attention than a simple nonmoving sign. One of the simplest means of accomplishing this movement is to flash off and on any stationary sign either the whole sign or in case of double-faced signs alternately one face, then the other. This same flashing principle is applied to practically all types of signs, especially the large special spectacular signs.

Manufacturers:

Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Rainbow."
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Flashtric Sign Works, 2124-2130 N. Hudson Ave., Chicago, Ill. "Flashtric."
Greenwood Advertising Co., Knoxville, Tenn. "Individuality."
Maxwell Co., The, R. C., 413 E. State St., Trenton, N. J.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
SMITH-HECHT CO., Century Bldg., Indianapolis, Ind. "Auroralite."

SIGNS, ELECTRIC, MINIATURE LETTER.—Display signs for show windows or other indoor use consisting of small glass letters with exhausted interiors, each enclosing one or more small electrically illuminated filaments connected to contacts carried by the letters and designed for insertion into mounting troughs or strips. The letters are interchangeable so that the sign legend may be changed, if desired. Each letter is a lamp unit by itself.

Manufacturers:

Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Century Mfg. Co., Inc., Elizabethtown, Pa.
Chicago Electric Sign Co., 2219-2229 W. Grand Ave., Chicago, Ill. "Day-N-Ite."
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y. "Kolite."
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La. "Pelican."
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill. "Multiform."
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.

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Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."

SIGNS, ELECTRIC, SPECIAL AND MISCELLANEOUS.—Practically all large electric signs are specially designed. They involve various contacting devices and motor-driven flashers and other parts which control the lamps or drive the moving parts of the sign. Such signs may give the appearance of action, as a man bowling or playing billiards, tires rolling around the border of the sign, lightning flashing, burning fires, etc., or the parts of the sign may actually move as the rotating vanes of a wind mill. On most these signs the wording on the sign is caused to change by selective flashing of the lamps on the sign. Much ingenuity has been applied to producing highly spectacular effects. The variety of special effects which may be produced by combinations of action, flashing and moving signs is almost limitless.

Manufacturers:

A & W Electric Sign Co., The, Cleveland, Ohio. "Walzer."
Ahern Co., James D., 1157 S. Wabash Ave., Chicago, Ill.
A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
American Luminous Products Co., Huntington Park, Cal.
American Sign Co., Cooley & Willard Sts., Kalamazoo, Mich. "American Lens."
Beacon Mfg. & Sales Co., Inc., Freeport, N. Y. "Beacon."
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Brilliant Sign Co., 3531 Washington Ave., St. Louis, Mo. "Brilliant."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Century Mfg. Co., Inc., Elizabethtown, Pa.
Commercial Utilities Mfg. Co., 160 N. Wells St., Chicago, Ill. "Spiralite."
Crystal Electric Sign Co., 922 S. Vandeventer Ave., St. Louis, Mo.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Day Co., Thomas, 725 Mission St., San Francisco, Cal.
Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. Federal patented porcelain enameled blue and white embossed steel sign. Federal patented Silveray sign with raised milk white glass letters. Interiorly lighted. Federal steel border light sign. Federal interchangeable theatre sign with raised white glass letters. Federal roof signs. Federal patented miniature indoor sign, a high grade electric sign for every kind of business. Five factories and branch offices everywhere. See display adv. page 1291.—Adv.
Flashtric Sign Works, 2124-2130 N. Hudson Ave., Chicago, Ill. "Flashtric."
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Hardy & Co., F. A., 10 S. Wabash Ave., Chicago, Ill.
Henrich Reflector Co., Inc., 222 W. 35th St., New York, N. Y.
Hi-Glo Sign Co., Schmulbach Bldg., Wheeling, W. Va.
Horn Posting Sign System, W. J., 420 N. 5th St., Springfield, Ill.
Indestructible Sign Co., 232½ N. High St., Columbus, Ohio. "Indestructible."
Jones Co., A. E., 819 W. Diamond St., N. S., Pittsburgh, Pa.
K-H Sign Mfg. Co., 819 Locust St., Pittsburgh, Pa.
Kollath Bros., 424 Brandywine Ave., Schenectady, N. Y.
Liberty Mfg. Co., Inc., 320-41 Carrollton Ave., New Orleans, La.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Maxwell Co., The R. C., 413 E. State St., Trenton, N. J.
Mitenius Sign Co., E., 8 Steeple St., Providence, R. I.
Multiform Corp., 1926 S. Wabash Ave., Chicago, Ill. "Multiform."
National Retailers Advertising Corp., 1846-48 Ogden St., Indianapolis, Ind.
O. D. System Signs, Inc., 534 Edison St., Milwaukee, Wis.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
RANDALL SIGN CO., Eau Claire, Wis. "Randallized."
Redfield-King, 2448 Washington Ave., Ogden, Utah.
Robinson & Co., T. L., 105 W. Monroe St., Chicago, Ill. "Edge-Glow."
Root Electric Sign Co., Inc., The, 20-30 Lock St., Lockport, N. Y. "Resco."
Scranton Advertising Sign Co., 320 Connell Bldg., Scranton, Pa.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Smith Sign Co., 608 LeBranch St., Houston, Tex.
Standard Signs, Inc., 428 6th Ave., S., Minneapolis, Minn.
Strachan, Inc., R. & H., 395 Fulton St., Brooklyn, N. Y.
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."
Yoerger Electric Sign Co., P. F., 62½ E. Long St., Columbus, Ohio.

SIGNS, ELECTRIC, TALKING AND TRAVELING LETTER.—Electrically operated display signs consisting of banks of incandescent lamps each connected in a circuit leading to a control apparatus which may consist of a series of contact springs, operated by a selective mechanism to cause the illumination of certain lamps forming desired letters. There are various traveling letter types. One type is controlled by a continuous perforated paper band which permits contact springs in the individual lamp connections to complete certain circuits, causing the progression of combinations of illuminated lamps in the form of letters across the sign structure from right to left. A modification of this type are signs, made up of a bank of lamps which are flashed on so as to form the letters consecutively across the sign but the words themselves remain stationary. Another type, instead of flashing one letter at a time illuminates the complete words in consecutive order to form the complete legend. A cheaper form of traveling sign, instead of causing the lamps to flash progressively, has an illuminated box, the front of which is a transparent screen or glass plate. A long strip on which are inscribed the letters or words of the sign is passed by a motor continuously before this screen. The letters of the strip are translucent, the background opaque so that the letters illuminated by the lamps within the box may be clearly read.

Manufacturers:

A. K. S. Sign Co., The, 936-940 W. Madison St., Chicago, Ill.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Brumfield Electric Sign Co., 18 7th St., San Francisco, Cal.
Bulletin Machine Co., 10-16 Lock St., Buffalo, N. Y.
Century Mfg. Co., Inc., Elizabethtown, Pa.
Cusack Co., Thomas, Harrison & Loomis Sts., Chicago, Ill.
Flexlume Sign Co., 74 Kail St., Buffalo, N. Y. "Oplex," "Flexlume," "Day-Night."
Frink, Inc., I. P., 239-43 10th Ave., New York, N. Y. "Polaralite."
Jones Co., A. E., 819 W. Diamond St., N. S., Pittsburgh, Pa.
Luminous Sign Sales Corp., 431 S. Dearborn St., Chicago, Ill.
Opal Sign Works, Inc., 254 10th Ave., New York, N. Y.
Sig-No-Graph Mfg. Co., 1400 S. Michigan Ave., Chicago, Ill. "Sig-No-Graph."
Viking Sign Co., Inc., 617 8th Ave., New York, N. Y. "Viking."

SIL-O-CEL.—Trade name for heat insulating brick, blocks, powder and cements manufactured by the Celite Products Co., 1134 Van Nuys Bldg., Los Angeles, Cal.

SILENT ALAMO.—Trade name for farm lighting and power plants made by the Alamo Farm Light Co., 703 Tower Bldg., Chicago, Ill.

SILENT SALESMAN.—Trade name for show cases for electrical stores manufactured by the Detroit Show Case Co., 1654-1700 W. Fort St., Detroit, Mich.

SILENT WASHER CO.—Clintonville, Wis. Manufacturer of electric washing machines.

SILICA.—Silica is an oxide of silicon (one of the nonmetallic elements) and forms an important part of the earth's crust, being present in nearly all rocks and in sand, etc., and in its amorphous form is found as the ruby and the opal. It is usually found in the crystalline form known as quartz, and is sometimes called flint. Silica is the chief constituent of glass. Fused silica is a good insulator, having a resistivity of 10^{14} to 10^{22} ohm-cm. at ordinary temperatures, and a dielectric strength of about 24,000 volts per mm.

SILICON.—A dark gray metal used only as a reducing agent or an alloying element. Symbol Si; at. wt. 28.4; sp. gr. 2.5; m. p. 1430° C; b. p. 2800° C. It is made by reduction of pure silica (SiO_2) in the form of quartz sand in an electric arc furnace, using carbon as a reducing agent.

SILICON CARBIDE.—A very hard, crystalline, refractory and chemically inactive substance used as an abrasive and a refractory material. Its chemical formula is SiC. It is sold under various trade names, as "carborundum," "electrolon," "exolon" and "silundum." These are produced electrically by means of a furnace which usually consists of a firebrick bed mounted in sections in curved iron frames. In the type used for carborundum, which is typical of others, each end is terminated by a brick wall through which a bundle of carbon electrodes enters. A charge of granulated coke is put in the furnace to the lower level of the electrodes and on this is heaped the main charge of sand, coke, sawdust and salt. The sawdust is soon burned away, thus serving to make the charge more porous so that the gases evolved in the reaction of silica and carbon may escape. The salt forms volatile chlorides of some of the impurities, thus removing them. The charge carries the current between the electrodes and due to its high resistance acts as a heating core, by which means all the necessary heat is supplied. A furnace 30 ft. long and 10 ft. in diameter requires about 2000 hp. As the temperature rises, the resistance decreases, but as the voltage falls the current is raised, keeping the power constant. The carbon monoxide evolved burns at the top and sides of the furnace. Silicon distills out from the center where the temperature is the highest, so that at the end the products are in zones, with graphite next to the core, then carborundum, then siloxicon, then half converted charge and finally unchanged material.

SILK CLOTH, VARNISHED.—Silk cloth is sometimes used as an insulating material and as a base for varnished or impregnated tapes, sheets, tubing, etc. Without treatment, silk is slightly hygroscopic, but is superior to cotton and is much improved by impregnation. Varnished silk cloth is the silk cloth treated with a mixture of boiled linseed oil, resin, and benzine. The oil oxidizes upon drying and leaves a smooth, hard surface. This thickness may be regulated by the number of coats. The material is used to insulate small coils for armatures, etc., also to make washers and gaskets and other punched parts.

Manufacturers:

IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. The best grades of imported silk are used in this product, which has the highest dielectric and mechanical strength obtainable, coupled with extreme thinness. It is used principally in magneto work and also for punched parts, washers, gaskets and coil insulations. See display adv. page 1319 for all Irvington electrical products.—Adv.

SILK SHADES.—See Shades, silk, cretonne, etc.

SILK TAPE.—See Tape, silk.

SILK THREAD.—See Thread, insulating, silk, linen, cotton, etc.

SILKENAMEL.—Trade name for silk-covered magnet wire manufactured by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill.

SILKENITE.—Trade name for silk-covered magnet wire manufactured by the Acme Wire Co., New Haven, Conn.

SILUNDUM.—Trade name for silicon carbide manufactured by the Norton Co., Worcester, Mass.

SILOXICON.—A grayish green powder approximating the composition Si_2C_2O. It is formed by partial conversion of silica and carbon to silicon carbide. Some is always produced in the operation of the carborundum furnace. It is used as a refractory material for furnace linings, etc., but is more easily oxidized than carborundum, so that it should be used only in a reducing atmosphere.

SILVER.—A brilliant white metal, very malleable and ductile, and the best conductor of heat and electricity. Symbol Ag; at. wt. 107.93; sp. gr. 10.5; m. p. 962° C.; b. p. 1955° C. It occurs native or combined, and associated with copper and lead ores. There are many producing countries, but Mexico and the United States are by far the greatest. The world's

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production in 1919 amounted to 187,000,000 troy oz., of which Mexico produced 75,000,000 oz. and the United States 55,000,000. The average value was $1.11 per oz. Methods of extraction of silver from its ores are similar to those for gold, namely by amalgamation, cyaniding, and from the slimes resulting from electrolytic refining of copper and lead, or in the fire refining of lead. See these processes. It may be parted from gold by solution in nitric acid and subsequent precipitation by metallic copper, or by electrolytic parting as in the Moebius process, which see.

SILVER BARS.—See Silver for electrical purposes.

SILVER CORD.—Trade name for lightning conducting cable manufactured by the George E. Thompson Lightning Rod Co., Inc., Owatonna, Minn.

SILVER COULOMETER.—The most accurate type of coulometer. It measures the quantity of electricity flowing through it by the weight of silver deposited from a solution of silver nitrate. A platinum dish containing the solution serves as cathode, while the anode is a piece of pure silver enclosed in a porous cup. The solution should contain 20 to 40 grams of silver nitrate in 100 grams of distilled water. The current density should not exceed 0.2 ampere per sq. cm. at the anode or 0.02 ampere per sq. cm. at the cathode. One ampere-second (one coulomb) deposits 0.0011183 gram of silver. Also see Voltameters, copper, gas and silver.

SILVER FOR ELECTRICAL PURPOSES.—Silver is furnished for electrical purposes in the form of bars or plates, such as for anodes for electroplating, etc. The bars are in such shape that they may be worked easily into the desired form. Silver is used in some instruments like the coulometer and for parts of relays, etc. It is made into contact points and wire, etc., and used for these purposes in places where it is desired to resist corrosion and arcing or pitting of contacts. Also see Anodes, electrolysis and electroplating, miscellaneous; Points, contact and sparking; Solder, silver; Wire, silver.

Manufacturers:

Anaconda Copper Mining Co., 42 Broadway, New York, N. Y.
Canadian Seamless Wire Co., Ltd., 198 Clinton St., Toronto, Ont., Can.
Handy & Harman, 59 Cedar St., New York, N. Y.

SILVER LAKE CO.—Newtonville, Mass. Manufacturer of braided cordage.

SILVER STAR.—Trade name for electric washing machine manufactured by the Star Washing Machine Co., 549 Quincy St., Chicago, Ill.

SILVER-STRAND.—Trade name for lightning conducting cables manufactured by the Electra Lightning Rod Co., 30 N. La Salle St., Chicago, Ill.

SILVER THREAD.—Trade name for gaskets manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

SILVER TIP.—Trade name for lightning rod points manufactured by the George E. Thompson Lightning Rod Co., Inc., Owatonna, Minn.

SILVERITE.—Trade name for nickel anodes manufactured by the General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

SILVERMAN.—Trade name for microscopic illuminator manufactured by Ludwig Hommel & Co., 530-534 Fernando St., Pittsburgh, Pa.

SILVERTIP.—Trade name for projection lamp carbons manufactured by the National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio.

SILVEX CO.—Bethlehem, Pa. Manufacturer of spark plugs.

SIMCO.—Trade name for leatherheads and washers manufactured by the Simplex Mfg. Co., Auburn, N. Y.

SIMCORE.—Trade name for rubber-covered wire manufactured by the Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.

SIMES CO., THE.—22-26 W 15th St., New York, N. Y. Manufacturer of lighting fixtures. Business established 1903. R. S. Simes, Jr., sole owner.

SIMMONS, GEORGE T.—R. R. 8, Janesville, Wis. Manufacturer of spark plugs.

SIMMONS HAND STOKER CO., THE.—Wilmington, N. C. Manufacturer of hand stokers and grates. Business established 1919. President, W. J. Thomas; secretary and treasurer, C. E. Hooper; general manager, L. H. Simmons.

SIMMONS UNIT-POLE.—Trade name for magnetic chucks manufactured by the Taft-Pierce Mfg. Co., Woonsocket, R. I.

SIMMS MAGNETO CORP., THE.—East Orange, N. J. Manufacturer of farm lighting plants and automobile lighting and starting equipment. Business established 1910. President and general manager, R. C. Anderson; vice-president, Charles Hayden; secretary and treasurer, A. A. Fisher; sales manager, Alfred J. Poole.

SIMON, EMIL J.—217 Broadway, New York, N. Y. Manufacturer of radio apparatus. Business established 1916. President, Emil J. Simon; secretary, N. Malkind; general manager, E. J. Sampter. Sales representative, Intercity Radio Co., 1133 Williamson Bldg., Cleveland Ohio; 1519 Woodward Ave., Detroit, Mich.; 7 W. Madison St., Chicago, Ill.

SIMONDS MFG. CO.—Fitchburg, Mass. Manufacturer of hack saws and blades for hand power or machine use. Business established 1832. President, A. T. Simonds; vice-presidents, T. F. Howarth, H. A. Sargent, O. A. Olson, R. R. Fox; secretary, J. E. Kelley; treasurer, H. K. Simonds; general manager, G. K. Simonds. Main office, 470 Main St., Fitchburg, Mass. Factories, Fitchburg, Mass.; Chicago, Ill.; Lockport, N. Y.; Montreal, Que., Can. Branch offices and warehouses, 1604 S. Western Ave., Chicago, Ill.; New Orleans, La.; Memphis, Tenn.; San Francisco, Cal.; Portland, Ore.; Seattle, Wash.; Vancouver, B. C., Can.; Montreal, Que., Can.; St. John, N. B., Can. District offices, 90 W. Broadway, New York, N. Y.; Lockport, N. Y.

SIMPLEX.—Trade name for electric ironing machines manufactured by the American Ironing Machine Co., 166 N. Michigan Ave., Chicago, Ill.

SIMPLEX.—Trade name for motor-driven pumps manufactured by the Barnes Mfg. Co., N. Main St., Mansfield, Ohio.

SIMPLEX.—Trade name for electric heating and ironing outfits for shoe factories manufactured by the Boston Last Co., 44 Binford St., Boston, Mass.

SIMPLEX.—Trade name for motor-driven machinery for dairies and creameries manufactured by D. H. Burrell & Co., Inc., Little Falls, N. Y.

SIMPLEX.—Trade name for commercial lighting unit manufactured by the Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio.

SIMPLEX.—Trade name for feed water heaters manufactured by the Houston, Stanwood & Gamble Co., Cincinnati, Ohio.

SIMPLEX.—Trade name for rail joints manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

SIMPLEX.—Trade name for automobile lamp manufactured by the International Incandescent Lamp Works, Inc., 80-86 Bergenline Ave., Union Hill, N. J.

SIMPLEX.—Trade name for gas engines manufactured by the Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.

SIMPLEX.—Trade name for electric blueprint paper coating machines manufactured by the C. F. Pease Co., 829 N. Franklin St., Chicago, Ill.

SIMPLEX.—Trade name for shade holders manufactured by the Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.

SIMPLEX.—Trade name for plug fuses manufactured by F. W. Powell, 420 Penn Ave., Pittsburgh, Pa.

SIMPLEX.—Trade name for steam-driven blowers and turbines manufactured by the Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y.

SIMPLEX.—Trade name for motor-driven motion-picture machines manufactured by the Precision Machine Co., Inc., New York, N. Y.

SIMPLEX.—Trade name for burglar alarms for banks manufactured by the Simplex Alarm Co., 405 Montgomery Bldg., Milwaukee, Wis.

SIMPLEX.—Trade name for farm lighting plant manufactured by the Simplex Utilities Corp., 360 Madison Ave., New York, N. Y.

SIMPLEX.—Trade name for wire and cable manufactured by the Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.

SIMPLEX.—Trade name for solderless ground clamp manufactured by Alexander B. Simpson, 152 E. 53rd St., New York, N. Y.

SIMPLEX.—Trade name for farm lighting plants manufactured by the Stearns Motor Mfg. Co., Box 252, Ludington, Mich.

SIMPLEX.—Trade name for electric washing machines manufactured by the Superior Machine Co., De Kalb, Ill.

SIMPLEX.—Trade name for jacks made by Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill.

SIMPLEX.—Trade name for trolley bases manufactured by the Trolley Supply Co., Massillon, Ohio.

SIMPLEX.—Trade name for coal and ash handling equipment manufactured by the United Conveyor Corp., Old Colony Bldg., Chicago, Ill.

SIMPLEX ALARM CO.—405 Montgomery Bldg., Milwaukee, Wis. Manufacturer of burglar alarm systems for banks.

SIMPLEX ELECTRIC HEATING CO.—85 Sidney St., Cambridge, Mass. Manufacturer of electric heating devices. Business established 1893. President, Everett Morss; vice-president, George U. Crocker; secretary and treasurer, Henry A. Morss; general manager, Lyneham Crocker; sales manager, R. P. Ingalls. Branch office, 15 S. Desplaines St., Chicago, Ill.

SIMPLEX MAGNETO CO., INC.—1790 Broadway, New York, N. Y. Manufacturer of magnetizers.

SIMPLEX MFG. CO.—Auburn, N. Y. Manufacturer of leather packings, leatherheads and washers. Business established 1916. General manager, W. J. Merritt.

SIMPLEX METAL SPINNING & STAMPING CO., INC., THE.—24-34 New Chambers St., New York, N. Y. Manufacturer of fixture parts and metal spinnings and stampings.

SIMPLEX PHOTO PRODUCTS CO.—Richmond Hill, N. Y. Manufacturer of photographic lamps.

SIMPLEX UTILITIES CORP.—360 Madison Ave., New York, N. Y. Manufacturer of farm lighting plants. Business established 1920. President and sales manager, Rollin W. Hutchinson, Jr.; vice-president, Howard C. Seaman; secretary and treasurer, Jacob L. Blum.

SIMPLEX WIRE & CABLE CO.—Boston, Mass. Manufacturer of cable and wire. Business established 1895. President, Everett Morss; vice-president, John W. Morss; secretary and treasurer, Henry A. Morss; general manager, James H. Mason; sales manager, William S. Davis. Main office, 201 Devonshire St., Boston, Mass. Factory, Cambridge, Mass. Branch office and warehouse, 15 S. Desplaines St., Chicago, Ill. Sales representatives, Joseph G. Brobeck, 120 W. 32nd St., New York, N. Y.; Harris & Evans, 1333 Real Estate Trust Bldg., Philadelphia, Pa.; Stickle & Taylor Co., 305 Union Arcade Bldg., Pittsburgh, Pa.; Garnett Young & Co., 612 Howard St., San Francisco, Cal.

SIMPLICITY.—Trade name for phonograph motor manufactured by the Shelton Electric Co., 16 E. 42nd St., New York, N. Y.

SIMPSON, ALEXANDER B.—152 E. 53rd St., New York, N. Y. Manufacturer of solderless ground clamps and connectors.

SIN.—Contraction of sine, when referring to this function of a definite angle, as sin α, sin 60°, sin ω.

SINCLAIR.—Trade name for lubricating oils, greases, etc., manufactured by the Sinclair Refining Co., Conway Bldg., Chicago, Ill.

SINCLAIR REFINING CO.—Chicago, Ill. Manufacturer of lubricating oils, greases, etc. President, Joseph M. Cudahy; vice-president and sales manager, H. F. Wilkins; secretary, J. G. Murray; treasurer, M. L. Gosney. Main office, Conway Bldg., Chicago, Ill. Branch offices, Atlanta, Ga.; Albany, N. Y.; Denver, Colo.; St. Louis, Mo.; Detroit, Mich.; Minneapolis, Minn.; Omaha, Neb.; Kansas City, Mo.; Newark, N. J.; Dallas, Tex.; Cleveland, Ohio.; Rock Island, Ill.; Wichita, Kans.; Louisville, Ky.

SINE.—One of the three most used trigonometric functions. In a right angled triangle the sine of one of the acute angles is the ratio of the side opposite this angle to the hypotenuse. In mathematical expressions and when referring to a particular angle the contracted form sin is nearly always used, as sin $30° = \frac{1}{2}$.

SINE-FLUX.—Trade name for violet ray apparatus manufactured by the Master Electric Co., 113 S. Jefferson St., Chicago, Ill.

SINE WAVE, EQUIVALENT.—An equivalent sine wave is a sinusoidal wave which has the same effective value and frequency as a composite wave. Any wave other than a sine wave may properly be called a composite wave, although this is not customary. Nearly all a-c. waves

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are really composite waves, since it is exceptional when they are true sine waves.

SINE WAVE, FUNDAMENTAL.—When an alternating-current wave is represented by a series of sine functions, the one of the lowest frequency is commonly called the fundamental sine wave or fundamental harmonic. See Alternating wave form; also Harmonic analysis.

SINGER.—Trade name for thermionic tubes manufactured by Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

SINGER.—Trade name for motor-driven sewing machines manufactured by the Singer Sewing Machine Co., 149 Broadway, New York, N. Y.

SINGER AUTO TRAFFIC SIGNAL CO.—4018 Greer Ave., St. Louis, Mo. Manufacturer of automobile signals. Business established 1917. President, secretary and general manager, William A. R. Borghoff; vice-president, I. G. McNiece; treasurer, F. W. A. Vesper.

SINGER SEWING MACHINE CO.—New York, N. Y. Manufacturer of motor-driven sewing machines. Main office, 149 Broadway, New York, N. Y. Branch office, 1019 W. Jackson Blvd., Chicago, Ill.

SINGER SIGNALS.—Trade name for automobile signals manufactured by the Singer Auto Traffic Signal Co., 4018 Greer Ave., St. Louis, Mo.

SINGLE PHASE.—This term may apply to a generator or to the circuit supplied by it. A single-phase generator is one in which a single alternating e.m.f. is developed. On a clock diagram this e.m.f. is represented by a single vector. A single-phase circuit is one energized by a single alternating e.m.f. Such a circuit is usually supplied through two wires.

SINGLE-PHASE MOTORS.—See Motors, a-c., induction, single phase; Motors, a-c., repulsion-induction.

SINTEELO.—Trade name for electric labor-saving devices for hotels and restaurants manufactured by the Maxim Mfg. Co., 700 W. 22nd St., Chicago, Ill.

SINUSTAT.—Trade name for electrotherapeutic apparatus manufactured by the Ultima Physical Appliance Co., 136 W. Lake St., Chicago, Ill.

SIPHONS, ACID.—Acid siphons are used for handling acid for use in storage batteries as electrolyte and for other acid or similar electrolytes in electroplating or electrolytic processes, etc. They consist usually of a combination of glass and rubber tubing with limbs of unequal length and are used to transfer the acid from a jar or carboy to other vessels. These siphons operate on the principle of hydrostatic balance, that is, the flow of liquid is due to the fact that the weight of liquid in one leg is much greater than that in the other. They serve to convey corrosive liquids without spilling or waste and without injury to the operative's clothes or hands.

Manufacturers:

BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.

SIRENO CO., THE.—18-20 Rose St., New York, N. Y. Manufacturer of electric horns and sirens. Business established 1913. President, Walter H. Pearce; vice-president, Charles F. Pearce; secretary and general manager, O. R. Ketcham; treasurer, George H. Tanslyn.

SIRENS, ELECTRIC, CITY, FACTORY, ETC.—Signaling machines consisting of direct-connected, motor-driven means for producing air vibrations of high frequency, loudness and great penetration. They are used for general fire alarms in cities, or for giving fire and other signals in noisy locations, such as factories, especially boiler and riveting shops, etc.

The advantage claimed for the siren are that it produces a peculiar tone, easily distinguished from ordinary signals, much more penetrating than the tones of a bell, and requiring less equipment and expense than either a steam or air whistle, unless the latter can be mounted on an industrial plant. Even then it has the advantage of a distinctive tone.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Industrial signals for use on call or warning systems in factories, machine shops, yards and other noisy places. Signals with a distinctive, penetrating tone pitch, made in weatherproof and open wiring types for d-c. and a-c. circuit from 6 to 250 volts.—Adv.



Benjamin Industrial Signal

Box Iron Works Co., William A., Blake & 33rd Sts., Denver, Colo.
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. The Federal electric siren, with its peculiar screech ranging from a rumbling groan to a piercing shriek, is heard loud and clear above ordinary and unreliable signals, such as steam whistles and bells. Always ready for instant use. Made to give long satisfactory service. Made in various styles and sizes for both exterior and interior use. See display adv. page 1291.—Adv.
Hendrie & Bolthoff Mfg. & Supply Co., The, Denver, Colo. "Denver Siren."
Interstate Machine Products Co., Rochester, N. Y. "Sterling."
Safety Fire Extinguisher Co., The, 291-93 7th Ave., New York, N. Y.
Sireno Co., The, 18-20 Rose St., New York, N. Y. "Sireno."

SIROCCO.—Trade name for electric blowers and ventilating fans manufactured by the American Blower Co., Detroit, Mich., and the Canadian Sirocco Co., Ltd., Windsor, Ont., Can.

600.—Trade name for lighting fixtures and fixture fittings and parts manufactured by the Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.

SIX IN ONE.—Trade name for renewable plug type fuse manufactured by the Multiple Electric Products Co., Inc., 450 4th Ave., New York, N. Y.

SIX PHASE.—This is a term characterizing a generator or circuit in which the e.m.f.'s differ by one-sixth of a period. On a clock diagram the e.m.f.'s are represented by six vectors differing in phase by 60 degrees.

SIX-S.—Trade name for lighting fixtures manufactured by the National Lighting Fixture Mfg. Co., 176-180 Grand St., New York, N. Y.

16-21.—Trade name for commercial lighting unit manufactured by the Lightolier Co., 569 Broadway, New York, N. Y.

SKEDOODLE.—Trade name for socket plugs manufactured by the Solar Electric Co., 124 W. Lake St., Chicago, Ill.

S K F.—Trade name for bearings manufactured by the S K F Industries, Inc., 165 Broadway, New York, N. Y.

S K F INDUSTRIES, INC.—New York, N. Y. Manufacturer of bearings. President, F. B. Kirkbride; vice-presidents, W. L. Batt and A. L. Malone; secretary, Julius Zieget; treasurer, C. H. Burr; sales manager, S. B. Taylor. Main office, 165 Broadway, New York, N. Y. Factories, Philadelphia, Pa., and Hartford, Conn. Branches offices, 513 Healey Bldg., Atlanta, Ga.; 711 Little Bldg., Boston, Mass.; Fidelity Trust Bldg., Buffalo, N. Y.; 1114 Independence Trust Bldg., Charlotte, N. C.; 1314 Marquette Bldg., Chicago, Ill.; 134 E. 4th St., Cincinnati, Ohio; 1036 Guardian Bldg., Cleveland, Ohio; Majestic Bldg., Detroit, Mich.; 1624 Real Estate Trust Bldg., Philadelphia, Pa.; 115 New Montgomery St., San Francisco, Cal.; 622 Chamber of Commerce Bldg., New Haven, Conn.

SKIHI.—Trade name for gaskets manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

SKIN EFFECT.—There is unequal distribution of alternating current throughout a conductor. The varying magnetic flux within the substance of the conductor sets up unequal electromotive forces which crowd the line current to the surface. This is known as "skin effect," and its result is to reduce the active cross-sectional area of the conductor and thus increase its effective resistance. Skin effect is greater at high frequencies and with large conductors and especially with iron conductors. Where it becomes serious tubular conductors may be used to advantage.

SKINNER CO., M. B.—562 Washington Blvd., Chicago, Ill. Manufacturer of conduit benders. Business established 1900. President, M. B. Skinner; vice-president, K. G. Merrill; secretary and treasurer, F. G. White.

SKINNER ENGINE CO.—Erie, Pa. Manufacturer of steam engines.

SKINNERS, WIRE.—These tools are used by electricians in removing the insulation from electric conductors prior to making joints, splices or other connections. The tool is usually made of a strap spring bent in the form of tweezers with the ends bent and notched so that when compressed they will cut sectionally through the insulation, making it easy to pull off the insulation in short lengths.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
HERBST, PAUL W., Chicago, Ill. We manufacture the "Perry" and also the "P. & G." wire skinners, illustrated



Perry P & G

herewith. They remove the braid and insulation from lamp cord with one pull. Can be used on any sized wire up to No. 4, either braided or stranded. The only tool that will remove outer braid from B. X. See display adv., page 1258.—Adv.

SKY-ROCKET.—Trade name for lightning arresters manufactured by the Chance Co., Centralia, Mo.

SLATE.—A hygroscopic, highly stratified rock, consisting mainly of silica and alumina, with small percentages of magnesia, potash, soda and iron or other oxides. The pressure exerted in its formation makes it possible to split the slate into thin even plates. Metallic veins, which are sometimes present, render the slate unsuited for electrical insulation, but otherwise it is much used for switchboard panels because of its desirable mechanical and fireproof qualities. The resistivity is about 10^8 to 10^{10} ohm-cm. and the dielectric strength about 200 to 400 volts per mm. Slate is sometimes boiled in paraffin after drying and is much improved electrically by this treatment. It is used extensively for low-tension switchboards, panels, switch bases, barriers, etc.

SLATE, FINISHED, FOR SWITCHBOARDS, PANELS, BASES, BARRIERS, ETC.—Electrical slate is widely used for switchboard panels; isolated control, instrument and switching panels; switch, circuit breaker and other apparatus bases; terminal and fuse blocks; barriers between indoor circuit breakers, lightning arresters, choke coils, etc.; border strips for panelboards and switch cabinets; bus supports, etc. Where it is employed for mounting apparatus with live parts in contact with the panel it is limited to about 1200 volts and must be free from metallic veins; for barriers it may be used for higher voltages. It is one of the mechanically strongest materials available for panels, can be fairly easily drilled and given a fine finish. It is cut in slabs from 1 to 3 ins. thick, although 2 ins. is the usual maximum thickness; border strips are obtainable thinner than 1 inch. Face dimensions range in many standard sizes from 2 to 48 ins. in width and 2 to 72 ins. in length. Slate furnished to small switchboard manufacturers and contractors is usually finished with the face of the panel either sand-rubbed or hone-finished and then treated with oil or other special finish; the edges are usually beveled. Panels so finished are often called switchboard blanks; they require merely drilling for mounting bolts, instrument and switch studs, etc. For barrier use the exposed corners are well rounded and the edges beveled.

Manufacturers:

Bangor Fidelity Slate Co., Bangor, Pa.
Bangor Structural Slate Co., Bangor, Pa.
Bullard, E. A., Tremont Bldg., Boston, Mass.
Clark-Flanagan, Inc., Fair Haven, Vt.
DAVIS SLATE & MFG. CO., 610-618 E. 40th St., Chicago, Ill., and 127-131 Shaftesbury Ave., Toronto, Ont., Can. "Peerless," "Imperial."

When writing to manufacturers please mention the
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Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fair Haven Marble & Marbleized Slate Co., Fair Haven, Vt.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Genuine Washington Slate Co., Slatington, Pa.
Hydeville Slate Works, Hydeville, Vt.
Kennan Structural Slate Co., Bangor, Pa.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Old English Slate Quarries, 10 Milk St., Boston 9, Mass.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Portland-Monson Slate Co., Portland, Me.
Shenton, Thomas H., Slatesdale, Pa.
Slatington Slate Co., Slatington, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Structural Slate Co., Pen Argyl, Pa. "Pyramid."
Unger Slate Co., Slatington, Pa.
Washington Slate Co., Slatington, Pa.
Woodley Slate Co., Bangor, Pa.
Young Co., A. B., Fair Haven, Vt.

SLATE, UNFINISHED, FOR SWITCHBOARDS, PANELS, ETC.—Large manufacturer of switchboards and other extensive users of electrical slate often purchase standard size slabs unfinished. In such cases they must have facilities for smoothly surfacing the face of the panel, polishing and finishing it and also smoothing and beveling its edges before drilling is done. Cutting the slab to proper dimensions is also necessary in some cases, although the tendency is to use standard dimensions.

Manufacturers:

Bangor Fidelity Slate Co., Bangor, Pa.
Bangor Structural Slate Co., Bangor, Pa.
Clark-Flanagan, Inc., Fair Haven, Vt.
DAVIS SLATE & MFG. CO., 610-618 E. 40th St., Chicago, Ill., and 127-131 Shaftesbury Ave., Toronto, Ont., Can.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fair Haven Marble & Marbleized Slate Co., Fair Haven, Vt.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Genuine Washington Slate Co., Slatington, Pa.
Hydeville Slate Works, Hydeville, Vt.
Keenan Structural Slate Co., Bangor, Pa.
Old English Slate Quarries, 10 Milk St., Boston 9, Mass.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Portland-Monson Slate Co., Portland, Me.
Shenton, Thomas H., Slatesdale, Pa.
Slatington Slate Co., Slatington, Pa.
Structural Slate Co., Pen Argyl, Pa. "Pyramid."
Unger Slate Co., Slatington, Pa.
Washington Slate Co., Slatington, Pa.
Woodley Slate Co., Bangor, Pa.
Young Co., A. B., Fair Haven, Vt.

SLATER CO., LTD., N.—34 Sydney St., Hamilton, Ont., Can. Manufacturer of pole-line hardware. Business established 1907, as Slater & Barnard, Ltd. President, Norman Slater; vice-president and general manager, W. G. Milne; secretary, treasurer and sales manager, W. N. Elliot.

SLATINGTON SLATE CO.—Slatington, Pa. Manufacturer of slate for electrical purposes.

SLAUGHTER CO., WILLIAM E.—1716 S. Michigan Ave., Chicago, Ill. Manufacturer of electric heating appliances.

SLEEPER & HARTLEY, INC.—335 Chandler St., Worcester, Mass. Manufacturer of winding machines for fine wires and filaments. President, Frank H. Sleeper; secretary, treasurer and general manager, George D. Hartley.

SLEET CUTTERS, TROLLEY WIRE.—Devices inserted in the trolley wheel, or special trolley wheels, to cut or scrape sleet from the overhead trolley wire of electric railway systems. The special device which is inserted in the trolley harp and in the groove of the trolley wheel consists of a casting having a groove with a cutting edge fitting on the trolley wire and a lug on one end to hook into the trolley harp, and hold the cutter in position. Special trolley wheels for removing sleet consist of wheels of the same size as the standard, but having the rim and groove, which bear on the wire, divided into a number of radial sections separated by open spaces. The edges of the radial sections act as cutters in loosening and removing sleet from the trolley wire. Both types of this device are successfully used.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Bayonet Trolley Harp Co., 404 Mitchell Bldg., Springfield, Ohio. "Bayonet."
Rohn, George F., 524-26 Jackson St., Milwaukee, Wis.

SLEEVES, CABLE PROTECTIVE.—See Protectors, cable and cable splice.

SLEEVES, CABLE-SPLICING, LEAD.—The joint in lead-sheathed cables is encased in a lead sleeve of a diameter slightly larger than that of the cable. This sleeve is wiped to the lead sheath by a plumber's joint and protects the joint from moisture. It is generally furnished in lengths of about 12 ft. and cut up into the proper lengths as needed.

Manufacturers:

American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal. "Selby."
Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Lawrence Shot & Lead Co., 27th & A Sts., Omaha, Neb.
National Lead Co., 111 Broadway, New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

SLEEVES, EXPANSION.—See Expansion or anchor bolts, screws, shells, shields and sleeves.

SLEEVES, LEAD, FOR EXPANSION BOLTS.—Lead tubes used as a part of expansion bolts, in attaching brackets, etc., to masonry walls or ceilings. A hole is drilled in the masonry, the end of the bolt with a tapering head inserted, the lead sleeves slipped over the bolt and driven back against the tapering head. Upon the bolt being drawn up the lead spreads out into the rough walls of the drilled hole and forms a firm anchor for the bolt.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
National Lead Co., 111 Broadway, New York, N. Y.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

SLEEVES, PAPER, FOR CABLE CONDUCTORS.—In jointing paper-insulated cable the work of taping the joint is saved in part by the use of paper sleeves that are placed over the individual conductors after they have been soldered together. These act as mechanical separators and insulators.

Manufacturers:

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Pairpoint Corp., The, New Bedford, Mass.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
St. Louis Paper Can & Tube Co., 4400 Union Blvd., St. Louis, Mo.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Stone Straw Co., 30-40 O St., N. E., Washington, D. C.

SLEEVES, POLE REPAIR.—See Reinforcing sleeves, pole.

SLEEVES, RUBBER.—See Plier insulating sleeves.

SLEEVES, TROLLEY-WIRE SPLICING.—The early form of trolley wire splicing sleeve was made of brass or copper tubing tapered at the ends and only slightly larger than the trolley wire into which the ends of the trolley wire to be spliced were soldered. The section thus permitted the trolley wheel to pass over the splice without serious interference. More modern devices accomplish the same result by gripping the trolley wire mechanically, thus avoiding the necessity of using solder. For this latter type of splicing device see Splicers, trolley wire.

Manufacturers:

American Mine Door Co., The, Canton, Ohio.
Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
National Lead Co., 111 Broadway, New York, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. Soldered splicing sleeves and mechanical splicers. High mechanical strength, smooth under-run, sparkless operation. Holds without slipping beyond breaking strength of wire.—Adv.
Standard Railway Supply Co., Cincinnati, Ohio. "K-I."

SLEEVES, WIRE SPLICING, MISCELLANEOUS.—Copper tubes usually with a "figure-eight" cross-section, used for splicing wires. One wire is run into each tube, in opposite directions, and the whole is then thoroughly twisted, forming a strong and permanent joint. They are listed for a wide range of sizes from No. 17 wire to No. 0000 wire or cable.

Manufacturers:

American Mine Door Co., The, Canton, Ohio.
Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Lead Co., 111 Broadway, New York, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."

SLEEVING, ASBESTOS, COTTON, SILK.—Sleeving is a braided tubing made either of asbestos fibers or cotton or silk threads. It is made to slip over bare or partly insulated wires of many sizes and runs from about 1/32 in. for cotton or silk and ⅛ in. for asbestos to ½ in. in diameter. Asbestos sleeving is largely used for insulating conductor wires of arc lamps or for covering other wires where fireproof protection is required. The cotton and silk braids are used for insulating single wires or groups of wires or a small cable in some cases. They are also used for the protection and insulation of armature coils and some other types of coils. The silk sleeving is often impregnated after it is in place. Use of sleeving is much more convenient than taping and makes a more uniform covering.

Manufacturers:

ANCHOR WEBBING CO., Pawtucket, R. I. Cotton sleeving in all standard sizes, furnished in white, red, blue, and black, made to standard specifications agreed upon by some of the largest makers of electrical apparatus in the country. Send for catalog.—Adv.



Cotton Sleeving

Asbestos Fibre Spinning Co., North Wales, Pa. (Asbestos.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldentape."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hone Webbing Co., Providence, R. I. "Hope."
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Pearce Co., Inc., The R. T., 12-16 E. Pike St., Covington, Ky. "Pearce."
Roebling's Sons Co., John A., Trenton, N. J.

SLICERS, BREAD AND SANDWICH ROLL, ELECTRIC.—These devices are for use in restaurants, at lunch counters, etc., or wherever a large quantity of bread is to be sliced. They are motor-driven machines in which a revolving disk knife is moved across the loaf of bread. The loaf is held in place by a series of guides and a clamping arrangement, and as each slice is cut the loaf is advanced forward a distance equal to the thickness of the slice.

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Other special attachments are also provided for splitting sandwich rolls, etc.

Manufacturers:

Anstice & Co., Inc., Josiah, Rochester, N. Y. "Sterling."
Liberty Bread Slicer, Inc., 108 Platt St., Rochester, N. Y. "Liberty."

SLICERS, MEAT, ELECTRIC.—Machines are used to slice meat, cheese and other foods in meat markets, restaurants, delicacy stores, etc. The machines may be set to any thickness of slice and will automatically cut the food by a rotating knife, which, after each slice, resets itself for the next cut. The motors used are usually universal and may be connected to any lighting circuit.

Manufacturers:

Anstice & Co., Inc., Josiah, Rochester, N. Y. "Sterling."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Braun Co., The, 1615-35 N. 23rd St., Philadelphia, Pa. "Coles."
Deer Co., Inc., The A. J., Hornell, N. Y.
U. S. Slicing Machine Co., LaPorte, Ind. "U. S.," "V. B. P."

SLICKS, POST OR POST-HOLE DIGGING.—A long wooden tool with a sharp iron tip, used in digging postholes. Also called "loy." It aids in dislodging clods of hard clay, stones, gravel, etc.

SLIDE WIRE BRIDGE.—A form of Wheatstone bridge in which the ratio arms consist of a uniform fine nickel-silver or other resistance wire stretched tightly between two contacts. A sliding contact is moved on the slide wire and along an adjoining graduated scale until the balance position is found. The two sections of the slide wire on either side of the balance position are the ratio arms. See Bridges, Wheatstone.

SLIMES.—The residues left at the anodes in electrolytic cells when using impure metal as anodes. They consist largely of the precious metals, and either sink as mud to the bottom of the bath, or are caught in cotton bags placed around the anodes, or sometimes, as in lead refining, the slime adheres to the anode as a pasty coating which can be scraped off. The slimes may also contain undissolved particles of slag, or matte, of the metal being refined. They are carefully collected, washed and dried, and then treated chemically to separate the valuable constituents. Copper refinery slimes usually contain some copper and lead, also silver, gold, platinum, palladium, iridium and osmium.

SLIP.—By slip is meant the difference between the synchronous speed of the rotor of an induction motor and the actual speed expressed as a per cent or fractional part of the synchronous speed. Thus, if f and p are, respectively, the impressed frequency and number of poles of the motor, the speed of the revolving magnetic field is $n_1=60\times 2f/p$ where n_1 is given in number of revolutions per minute. If the actual speed of the rotor is n_2, then $s = 100\ (n_1-n_2)/n_1$ where s is the slip.

Slip is necessary in the operation of an induction machine either as a motor or as a generator and depends mainly upon the load and the secondary resistance.

SLIP METERS.—Compact devices have been placed on the market by means of which the slip can be measured. (See Measurement of slip). One device consists of a rotating commutator having the same number of segments as the motor has poles. This commutator is pressed against the end of the motor shaft and thus rotates at the same speed. An ammeter is connected in series with the the commutator and a resistor to one phase of the power supply. As the rotor lags behind the revolving field the pointer of the ammeter oscillates at a frequency proportional to the slip. Another slip meter consists of a conical cylinder which is rotated by the shaft of the motor and at the same speed. On an axis parallel to the conical cylinder and pressing against it is a wheel of the same diameter as the small end of the cylinder. This wheel carries a rotating commutator, as described above. The connections are also made as above described. In operation, the speed of the wheel is increased by moving it towards the large end of the cylinder until the ammeter ceases to oscillate. The distance that it has been moved is graduated directly in terms of slip.

SLIP-ON.—Trade name for the electric rotary blower manufactured by the Anderson Electric & Equipment Co., 154-160 Whiting St., Chicago, Ill.

SLIP-ON.—Trade name for cord adjusters manufactured by the Electric Specialty Sales Co., 90 West St., New York, N. Y.

SLIP RINGS.—A contact ring or set of rings placed on and electrically connected with a winding of a rotating part, such as an a-c. armature or a field structure, upon which one or more stationary brushes may bear so that an electrical connection is made between a stationary and a moving part of a circuit. Slip rings are used almost entirely with a-c. machinery, especially to connect the rotors of induction motors to controllers, to connect the revolving fields of a-c. generators and synchronous motors to excitation circuits, the a-c. side of synchronous converter armatures to the line, etc. On inverted synchronous converters and revolving-armature a-c. generators the slip rings are still often called collector rings. Slip rings are made as continuous flat rings of good conducting metal, usually copper. They are thoroughly insulated from the shaft and from each other, a set of two or three being usually placed side by side with insulating and barrier rings between them.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.

SLO-FLO.—Trade name for lubricating grease manufactured by the Swan & Finch Co., 522 5th Ave., New York, N. Y.

SLOAN & ZOOK.—101 Main St., Bradford, Pa. Producers of lubricating oils. President, R. T. Zook; secretary and treasurer, William J. Sloan; sales manager, C. R. Kerr.

SLOAN, INC., A. H.—Moffet Bldg., Detroit, Mich. Manufacturer of gas and oil meters.

SLOANE AND SLOANE HANDY.—Trade names for electric vacuum cleaners manufactured by W. & J. Sloane, 5th Ave. & 47th St., New York, N. Y.

SLOANE, W. & J.—5th Ave. & 47th St., New York, N. Y. Manufacturer of electric vacuum cleaners. Branch office, 1508 H St., N. W., Washington, D. C.

SLOCOMB CO., J. T.—35 Oxford St., Providence, R. I. Manufacturer of micrometer gages. President, J. H. Drury; vice-president, W. B. McSkimmon; treasurer, C. L. Lyall.

SLOCUM, AVRAM & SLOCUM LABORATORIES, INC.—Woolworth Bldg., New York, N. Y. Manufacturer of magneto parts. Hugh Herndon, treasurer. Factory, Newark, N. J.

SLOT PITCH.—The number of slots spanned by a coil of an armature.

SLOT STICKS OR WEDGES.—See Pegs or wedges, armature slot.

SLOTS, ARMATURE.—The slots which are made in the armature core for holding the armature conductors. Also, by slotting the armature, it is possible to reduce the reluctance of the air gap and excite the machine with a lower expenditure of power than if a smooth armature core were used. The size and shape of the slots has an effect on the effective armature resistance, the leakage reactance and on the losses in the pole faces and in the teeth, or projections left between the slots.

SLOTTING, COMMUTATOR. — See Commutator slotting.

SLOTTING FILES AND DEVICES.—See Commutator slotting files and devices.

SLOTTING MACHINES.—See Commutator slotting machines.

SLOW BURNING WIRE.—See Wire, slow-burning.

SLY LINE.—Trade name for foundry equipment manufactured by the W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio.

SLY MFG. CO., THE W. W.—4700 Train Ave., Cleveland, Ohio. Manufacturer of sand-blast equipment, foundry tumbling and cinder mills. President, W. C. Sly; vice-president, George J. Fanner; secretary, treasurer and general manager, R. J. Emerich.

S-M.—Trade name for marine electrical fixtures and wiring devices manufactured by the Seidler-Miner Co., 36 E. Larned St., Detroit, Mich.

SMITH.—Trade name for water turbines manufactured by the S. Morgan Smith Co., Lincoln & Hartley Sts., York, Pa.

SMITH.—Trade name for motor-driven concrete mixers manufactured by the T. L. Smith Co., Old Colony Bldg., Chicago, Ill.

SMITH.—Trade name for power plant gas producers manufactured by the Smith Gas Engineering Co., Dayton, Ohio.

SMITH.—Trade name for electric lamps and accessories for bicycles, motorcycles and automobiles made by the F. A. Smith Mfg. Co., Inc., 183-87 N. Water St., Rochester, N. Y.

SMITH, WINFIELD H.—10-16 Lock St., Buffalo, N. Y. Manufacturer of gears, pulleys and revolving display tables.

SMITH & CO., T. C.—1531 Cherry St., Philadelphia, Pa. Manufacturers of heating device plugs and luminous attachments for switch buttons, etc. T. C. Smith, sole owner.

SMITH & HEMENWAY CO., INC.—Irvington, N. J. Manufacturer of boring machines, wrenches, pliers and other linemens' and electricians' tools. President, L. P. Smith; secretary and treasurer, J. F. Hemenway; sales manager, D. G. Smith. Main office and factory, Irvington, N. J. Branch offices, State-Lake Bldg., Chicago, Ill.; 261 Broadway, New York, N. Y.

SMITH & MC CRORKEN, INC.—407 E. 18th St., New York, N. Y. Manufacturer of zinc sheets, plates and ribbon, solder, soldering coppers, dry batteries, sheet iron for electrical purposes, bolts and other metal products. Business established 1905. President, treasurer and general manager, Morris H. Smith; secretary, Samuel Smith.

SMITH & NICHOLAS, INC. — New York, N. Y. Manufacturer of waxes. President, Higbie Smith; vice-president and treasurer, George Orton Elmore; secretary, Stewart P. Drummond. Main office, 121 Maiden Lane, New York, N. Y. Factory, Carlstadt, N. J. Branch office, 88 Broad St., Boston, Mass.

SMITH AUTO SIGNAL.—Trade name for electric signaling device manufactured by the Smith Signal Corp., 66-68 S. Main St., Phillipsburg, N. J.

SMITH BATTERY CO., F. V. L.—Atlanta, Ga. Manufacturer of storage batteries. Business established 1920. President, treasurer and general manager, F. V. L. Smith; vice-president, J. W. Moore; secretary, S. L. Manson. Main office and factory, 10½ Auburn Ave., Atlanta, Ga. Branch office, 200 Broadway, New York, N. Y.

SMITH CO., CLARENCE L.—52 Vanderbilt Ave., New York, N. Y. Manufacturer of electric street sweepers.

SMITH CO., THE H. B.—Cambridge, Mass. Manufacturer of water-tube boilers. Main office, 640 Main St., Cambridge, Mass. Factory, Westfield, Mass. Branch offices, 10 E. 39th St., New York, N. Y.; 17th & Arch Sts., Philadelphia, Pa.; 57 Main St., Westfield, Mass.

SMITH CO., S. MORGAN.—York, Pa. Manufacturer of water turbines. Business established 1870. President, C. E. Smith; vice-president, S. F. Smith; secretary, C. E. Etnier; treasurer, A. J. Glossbrenner. Main office and factory, Lincoln & Hartley Sts., York, Pa. Branch offices, 176 Federal St., Boston, Mass.; 76 W. Monroe St., Chicago, Ill.; 405 Power Bldg., Montreal, Que., Can.

SMITH CO., THE T. L.—Old Colony Bldg., Chicago, Ill. Manufacturer of motor-driven concrete mixers. Factory, Milwaukee, Wis.

SMITH-CUMMINGS.—Trade name for revolution counters manufactured by the Cummings Ship Instrument Works, 10 High St., Boston, Mass.

SMITH GAS ENGINEERING CO.—Dayton, Ohio. Manufacturer of power plant gas producers.

SMITH HEATER CO., THE PETER.—1725 Mt. Elliott Ave., Detroit, Mich. Manufacturer of car heating and ventilating equipment.

SMITH-HECHT CO.—Century Bldg., Indianapolis, Ind. Manufacturer of electric signs and sign lighting equipment. Business established 1900. President, H. E. Smith; secretary, Leon Hecht.

SMITH MFG. CO., THE PHILIP.—Sidney, Ohio. Manufacturer of electric washing machines. President, L. M. Studevant; vice-president, A. J. Hess; secretary, R. G. Hess; treasurer, H. K. Hess; general manager, J. G. Troester.

SMITH MFG. CO., INC., F. A.—183-87 N. Water St., Rochester, N. Y. Manufacturer of electric lamps and accessories for bicycles, motorcycles and automobiles. Business established 1900. President, Frederick A. Smith; secretary, H. Toppin; treasurer, M. A. Sylvester.

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SMITH SIGN CO.—608 LaBranch St., Houston, Tex. Manufacturer of electric signs. J. W. Smith, sole owner.

SMITH SIGNAL CORP.—Phillipsburg, N. J. Manufacturer of electrical signaling devices. Business established 1917. President, Claude de F. Smith; vice-president, O. A. Ware; secretary and sales manager, R. L. Ware; treasurer, C. L. D. Konn. Main office and factory, 66-68 S. Main St., Phillipsburg, N. J. Branch office carrying stock, 49-51 W. 66th St., New York, N. Y.

SMITH WIRE & IRON WORKS, F. P.—Fullerton, Clybourn & Ashland Aves., Chicago, Ill. Manufacturers of turnstiles for stations, elevator cabs, etc. Franklin P. Smith, proprietor; sales manager, Keith Thorp; general manager, Edward McClure.

SMOOTH-ON MFG. CO.—Jersey City, N. J. Manufacturer of waterproof cement. Main office and factory, Jersey City, N. J. Branch offices, 221 N. Jefferson St., Chicago, Ill.; 56 Sacramento St., San Francisco, Cal.

SMURR & KAMEN MACHINE CO.—328 N. Albany Ave., Chicago, Ill. Manufacturer of motor-driven wire working machinery. President, John S. Kamen; secretary, B. E. Spencer.

SMYSER-ROYER CO.—York, Pa. Manufacturer of street and other exterior lighting equipment. Business established 1907. President, B. Frank Royer; vice-president, Frederick C. Newboure, Jr.; secretary and treasurer, William H. Myers; sales managers, John R. Keers, Frank C. Royer. Main office and factory, York, Pa. Branch office, 1609 Sansom St., Philadelphia, Pa. Sales representative, James P. Lynch, 217 W. Madison St., Baltimore.

SNAP.—Trade name for cable connectors manufactured by the E. & B. Mfg. Co., 965 Woodward Ave., Detroit, Mich.

SNAP-CATCH.—Trade name for porcelain sockets and receptacles manufactured by the General Electric Co., Schenectady, N. Y.

SNAP SWITCHES.—This group or type of switch includes any small switch usually for lighting circuits that has a quick acting make and break mechanism. Several constructions are used, such as rotary, push button, toggle or tumbler, push through, etc. For these respective types see Switches, pendent and cord, snap; Switches, push button, flush and surface; Switches, push through; Switches, rotary, flush and surface; Switches, toggle or tumbler, snap.

SNAPON.—Trade name for lighting units manufactured by the Art Metal Mfg. Co., Cleveland, Ohio.

SNEAK COILS FOR TELEPHONE PROTECTION.—See Heat coils, telephone.

SNOW & CO., E. W.—29 W. Water St., Rochester, N. Y. Manufacturers of fuses and soldering paste.

SNOW FLAKE.—Trade name for soldering flux produced by the Grasselli Chemical Co., Cleveland, Ohio.

SNOW FLAKE.—Trade name for soldering salts manufactured by the Highland Electro-Chemical Mfg. Co., Connellsville, Pa.

SNOW MELTERS, ELECTRIC.—In railroad terminal yards and in sections adjoining interlocking railroad crossings where there are many track switches, much trouble is experienced in winter from the freezing of the switches at times of heavy storms. To prevent this, it is usually necessary to keep large gangs of men ready to clean the snow, ice and sleet from between the switch points and the rails. To save this labor and also the delays to train service that frequently result, use has been made of electric snow melters, which are special waterproof heaters installed adjacent to the switch points and fed from a special heating circuit. Although the installation expense is somewhat high, the saving resulting more than compensates for this and such equipments have been very successful, even though not yet installed in many places.

Manufacturer:

Q & C Co., The, 90 West St., New York, N. Y. "Q & C."

SNOW SWEEPERS AND PLOWS, ELECTRIC RAILWAY. — Self-propelling cars carrying power-driven revolving brooms mounted on suitable framework with the operating controllers and broom-driving motor mounted in a cab or structure on the frame work. Snow sweepers are more particularly adapted to cleaning snow from paved track. The circular brooms are of rattan and are carried diagonally, one at each end of the car. Suitable broom-raising and lowering mechanism operated from the cab is provided so that the brooms may be raised to clear obstacles or lowered to obtain the desired pressure on the pavement or right-of-way. Canvas aprons are provided over each broom so that small stones, etc., cannot be thrown a sufficient distance to cause damage to persons or structures along the street. The brooms are carried diagonally with respect to the rails and revolved so as to throw the snow clear of the track and to the outside of the right-of-way.

In deep falls of snow, plows are necessary to clear the track and such equipment is used on interurban railways for snow removal. Snow sweepers, however, are a necessary part of the equipment of street railways operating in climate where any considerable amount of snow falls during the winter months.

Manufacturers:

Q & C Co., The, 90 West St., New York, N. Y. "Q & C."

Root Spring Scraper Co., The, Kalamazoo, Mich.

Russell Car & Snow Plow Co., Ridgeway, Pa. "Russell."

SNOWITE SIGN WORKS.—2124-2130 N. Hudson Ave., Chicago, Ill. Manufacturer of electric signs. Proprietor, Fred Parker; sales manager, Harry S. Parker.

SNYDER.—Trade name for electric furnaces manufactured by the Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill.

SNYDER-McFADDEN CO.—602 Pierce St., Sioux City, Iowa. Manufacturer of lighting fixtures. President, E. L. Snyder; secretary, W. J. McFadden.

SNYDER MFG. CO., THE BROCK.—Grimsby, Ont., Can. Manufacturer of electric irons. Brock Snyder, proprietor. Exclusive distributor, Wentworth Electric Co., Lister Bldg., Hamilton, Ont., Can.

SOAPSTONE.—A soft, oily stone of grayish-green or brown color, sometimes called talc, of which it is one form. It is used for hearths and sink linings and occasionally for electrical insulation in the form of barriers or slabs for bus compartments, circuit breakers, switches, etc. (Also see Talc.)

SOAPSTONE BARRIERS, SLABS, ETC., FOR DISCONNECTS, BUS COMPARTMENTS, SWITCH CELLS, ETC.—Soapstone is frequently used for arc-preventive barriers between adjacent poles of high-tension disconnecting switches, circuit breakers, lightning arresters, etc., and to form the cell compartments for large-capacity oil switches, reactors, etc., in large power houses. It is also used to form bus compartments, long slabs being run between the busbars. Soapstone is easily cut and machined and is not affected by acids, oils or alkalies and is therefore very useful for insulating slabs.

Manufacturers:

Alberene Stone Co., 228 E. 23rd St., New York, N. Y.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

SOAPSTONE, PULVERIZED, FOR LUBRICANT.—This lubricant is commonly used for lubricating fish wire or tape in fishing a conduit, also for metal parts which do not require a high-grade lubricant.

Manufacturers:

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.

Talc Products Co., 7 Hanover St., New York, N. Y.

Williams & Co., C. K., Easton, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.—This organization came into existence in October, 1912. It has a membership of over 1,300 leading central stations, electrical manufacturers, jobbers, dealers and contractors from every State in the Union, and a few members in European countries, Canada, the Hawaiian Islands, Australia, Porto Rico and Japan. An Electrical Development Association has recently been started in Great Britain patterned upon the same general plan to develop the electrical industry there.

Everybody in the electrical industry, whether making, selling or installing electrical apparatus or making and distributing electric current, everybody using electric power in factories and the public at large, all these are interested in knowing what, how and why things are done electrically, and what, how and why other things could or should be done electrically. The dissemination of such information among the men in the industry and to the consumer of the industry's product, is one of the chief activities of the Society for Electrical Development, and is undoubtedly the most effective work possible for developing further uses of, and increased demand for electricity.

The purpose of the Society is to popularize electric service, just as automobiling has been popularized, and thus increase the use by the public of electric current for all useful purposes as a means for developing a greater demand for current, for apparatus, for supplies and for appliances; to promote co-operative planning and execution of various methods effective to this end, and thus promote the development of the electrical business; also to maintain the industry in the highest confidence of the public. Its educational object is expressed by its slogan, "Do It Electrically."

The by-laws are so drawn as to give all branches of the electrical industry equal representation on the Board of Directors and the Executive Committee. Care is also taken to have all branches represented on any special committees appointed.

The Society has taken the leadership in national electrical trade activities by promoting and conducting, with the assistance of the united electrical interests, four great campaigns: "Electrical Prosperity Week," Nov. 29 to Dec. 4, 1915; "America's Electrical Week," Dec. 2 to Dec. 9, 1916; "America's Electrical Christmas," December, 1917; "Save-By-Wire Month," September, 1918. Also the spring house-wiring campaigns: "Wire Your Home Month," 1916; "Wire Your Home Time," 1917; "Electrify Your Home," 1919; and the "Electrical Christmas," 1918, 1919, 1920. The purpose of these various campaigns was to bring forcibly to the attention of the public important electrical facts, to concentrate the attention simultaneously all over the country and thereby create a greater demand for electric service and appliances.

The Society has found it necessary to do considerable educational work within the industry and has issued a number of booklets, prominent among which is the "Electric Range Handbook." The Society also issues a monthly periodical known as the "Monthly Sales Service." It contains selling suggestions, campaign ideas and advertising copy prepared for use in newspapers. The necessary cuts or matrices are supplied free of charge. Where sufficient local co-operation is secured, the newspapers are supplied, by the Society, with reading matter of an electrical character but of general interest to run with the advertising and in many cities a special electrical page is carried at least once a week in the leading newspapers.

The Society maintains a staff of advertising specialists who render personal service to members upon request and without charge. They are regarded as on the members' staff to be called upon at any time for any assistance they can render.

While this special service is an important part of the Society's work, its most important activity is its all-the-year-around education of the public to a greater appreciation of electricity as a convenience in the household, factory, mill, shop, on the farm, etc.

Officers for 1920-1921 are: President W. W. Freeman; vice-presidents, J. E. Montague, A. W. Burchard, Fred. Bissell, J. R. Crouse, J. R. Strong; assistant to president, William L. Goodwin; secretary-treasurer, J. Smieton, Jr.; chairman of Executive Committee, C. L. Edgar. The Society has its headquarters at 522 5th Ave., New York, N. Y.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOCKET.—A socket is an outlet of an electric circuit and designed to receive and grip the end of an incandescent lamp or attachment plug, and to complete the electric circuit connections therefor. Specifically, a socket is such a device as is designed with a cap having a threaded hole of such size as to screw onto a fixture pipe or stem or fixture arm, or having a smooth insulating bushing inserted in the threaded hole, to be used on a drop cord or extension cord. As such it may receive an incandescent lamp or an attachment plug to permit the use of small-capacity household or similar appliances.

Much confusion exists among the public

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and to a limited extent in the electrical industry in the use of the words socket and receptacle. A receptacle may also be designed to accommodate an incandescent lamp or an attachment plug. The distinction between the two is in the method of mounting, the receptacle having a base designed for rigid mounting on a wall or other flat surface or in an outlet box, while the socket is intended for use on a fixture or cord.

Sockets are made for a large number of related purposes. They have been very largely standardized so that even for the various special forms, the part to receive the lamp or attachment plug is the same in each of five standard sizes and forms. Medium-base screw sockets are the most widely used, and in addition there are the automobile or bayonet, miniature and candelabra sockets and the mogul types. Many years ago a large number of types of connections were used, many types employing a plug or bayonet connection. Standardization has resulted in the use of the Edison screw shell for all makes in the United States now, with the exception of the bayonet type that is still used for automobile lamps.

SOCKET ADAPTERS, REDUCERS OR EXTENSIONS.—See Adapters, reducers and extensions, socket.

SOCKET ATTACHMENTS.—See Attachments, socket.

SOCKET BODIES.—The interior porcelain bodies with contacts and with or without switching mechanism used in the assembly of electric lamp sockets, especially of the interchangeable types. Generally socket bodies are provided with an enclosing metal shell. They are made in three principal forms, keyless, with a key or with pull-chain mechanism. The bodies are used to provide a certain amount of flexibility in socket construction. Any type of body may be used with any type of socket cap to provide different size nipples either male or female, fixture caps, pendent caps, angle caps, etc.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SOCKET BUSHINGS.—See Bushings, socket.

SOCKET CHAINS.—See Chains, ball or bead, for pull sockets, etc.

SOCKET CLUSTERS. — See Clusters, fixture and socket.

SOCKET COVERS OR HUSKS.—See Covers, socket.

SOCKET FLASHERS.—See Flashers, socket type.

SOCKET KEYS.—See Keys, socket and switch.

SOCKET LININGS. — See Linings, socket.

SOCKET RINGS.—See Rings, socket.

SOCKET SHELLS.—See Shells, socket.

SOCKET TRANSFORMERS. — See Transformers, socket type.

SOCKET TAPS.—See Current taps.

SOCKETS, ANGLE.—Angle sockets are made out of any standard socket body by means of an angle cap. They are generally used on fixtures where the stem is set horizontal or at an angle and it is desired to have the lamp vertical. The angle caps are made for ⅛, ¼, or ⅜-inch stems. Keyless, pull-chain, key, push-button and locking socket bodies may all be made up as angle sockets. They are also made with either brass or porcelain shells.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

SOCKETS, AUTOMOBILE AND OTHER EDI-SWAN OR BAYONET.—These sockets have slotted shells to fit the pins of the bayonet type lamps and are made for either of the two common types of bayonet bases, that is, with either one or two contacts in the base. The automobile sockets are often made as an integral part of an automobile lamp fitting for attachment to some particular part of the automobile.

Manufacturers:

Accessories Mfg. Co., 2311-29 N. Crawford Ave., Chicago, Ill.
ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Chicago Electric Mfg. Co., 2801-2819 S. Halsted St., Chicago, Ill. "Handy."
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Morse, Frank W., 289 Congress St., Boston, Mass.
Pollak Tool & Stamping Co., 81-85 Freport St., Dorchester, Boston, Mass. "Universal."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SOCKETS, CANDELABRA AND MINIATURE.—Lamp-holding devices designed to be fastened to a threaded pipe as on fixtures or hung on the supply wires as a pendant and having screw shells of nominal ½-in. diameter for the candelabra size and ⅜-in. for the miniature size. They are used principally on special decorative lighting fixtures or for other decorative purposes. Candelabra sockets are rated at 75 watts, 125 volts maximum, or not more than one ampere at any voltage for the keyless type, and 75 watts, ¾ ampere maximum for the key type. Miniature sockets are used extensively for flashlights, Christmas tree lighting sets, small decorative fixtures, etc. They are not provided with switching mechanism and often have no external casing or shell.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Campbell Co., A. S., 161 Prescott St., East Boston, Mass. "Cello."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, 12th St., & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Hubbell, Inc., Harvey, Bridgeport, Conn. "Quick Catch."
Morse, Frank W., 289 Congress St., Boston, Mass.
Motor Specialties Co., Waltham, Mass.
National Marine Lamp Co., The, Forestville, Conn.
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless E-Z-Wire."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Waldman, John J., 64 Murray St., New York, N. Y.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

SOCKETS, CANDLE. — Lamp-holding devices in the form of tubular casings enclosing screw shells and wiring connections, designed to imitate the appearance of candles on candelabra fixtures, chandeliers, etc. Some are made as extension sockets having a screw shell at the top and the connecting screws placed at the bottom, either in connection with a switch mechanism or on a porcelain base. Other sockets are made to be supported on an adjustable stem inside of the candle casing.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Candle socket for fixtures and portables in wood.—Adv.
Best Electric Corp., 476 Broadway, New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Wrinklet."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto., Ont., Can.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)
Yost Electric Mfg. Co., 1805 Hawthorne St., Toledo, Ohio.

SOCKETS, COMPOSITION. — Lamp-holding devices having the enclosing shells or bodies of molded insulating materials. They are generally in the form of weatherproof sockets having the wires inserted and sealed in the socket. They are generally made without any switching mechanism. Use of composition instead of porcelain has made considerable headway because of the fragility of porcelain and toughness of the compositions.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Freeman."
GARFIELD MFG. CO., Garfield, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Hubbell, Inc., Harvey, Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PARKER & SON, INC., J. H., Parkersburg, W. Va. Composition weatherproof sockets, made to withstand extreme service conditions. The condensite sockets are suitable for use where high temperatures exist, and will withstand 500° F.—Adv.



Weatherproof Socket

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Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)

SOCKETS, DECORATIVE LIGHTING OR STREAMER.—These sockets are used for strings of lamps hung in outdoor locations for decoration in amusement parks, carnivals, pageants, and for street parades or like celebrations. The sockets are a weatherproof type generally having short pigtail wires for attachment to the lines permanently fastened within the socket.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. "Woodwin."

SOCKETS, DIMMING OR REGULATING.—To regulate the brightness of incandescent lamps they are dimmed by inserting a resistance in the lamp circuit. Dimming sockets, similar in appearance to the ordinary types, have this resistance concealed within the socket body or shell and permanently connected in the lamp circuit. Various devices are used to regulate or vary this resistance. Two cords may hang from the socket to move a sliding contact back or forth, or the socket shell may be provided with a securely attached shade holder so that turning of the shade moves the sliding contact. These sockets serve the same purposes as the separate lamp dimmers, but are fastened to the fixture instead of being screwed into an ordinary socket. Also see Dimmers, lamp socket.

Manufacturers:



ANYLITE ELECTRIC CO., Fort Wayne, Ind. Anylite Electric Dimmer. Designed for devices consuming not more than 40 watts. A socket type regulator which cuts down the light by a series of steps, or regulates the speed of a small fan. Direct or alternating current.—Adv.

Wirt Co., 5221 Greene St., Philadelphia, Pa. "Dim-A-Lite."

SOCKETS, DOUBLE-DUTY.—A special form of duplex or twin sockets. See Sockets, duplex or twin.

SOCKETS, DUPLEX OR TWIN.—A combination in one body of an attachment plug and two sockets all wired in parallel. The plug fits any standard medium-base socket or receptacle and the two sockets are usually also medium-base type and are mounted at an angle to each other, the three elements being arranged like an isosceles triangle. The device makes two sockets out of one and thus permits attaching two lamps, or a lamp and an appliance, or two appliances to an originally single outlet. It is therefore of special value in rooms where there is but one outlet and connection of an appliance to that outlet would deprive one of the use of the lamp that belongs in it. These sockets have many other uses, however, and have proven quite popular. They serve the same purpose as a multiple type current tap. To emphasize the possibility of using twin or duplex sockets both for a lamp and an appliance, some of them are called "double-duty" sockets.

For trough reflectors or fixtures and similar lighting devices, it may be desired to have two sockets on one current outlet. For such purposes double sockets which fasten to standard size fixture pipe are made. These have the two sockets facing in opposite directions, the socket bodies being joined on directly opposed sides of a central stem or common cap that fits into the outlet at right angles to the axes of the sockets.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., St. Louis, Mo. The Ajax No. 22 is a double socket, with moulded husks of high heat-resisting material. It is of solid, sturdy construction, designed to permit lamp to remain in position intended Uses ordinary W. P socket shade holder, and side sockets at 45 deg. angle, for convenience of making attachments and preventing interference with door of receptacle plates. —Adv.



Ajax Double Socket

ANYLITE ELECTRIC CO., Fort Wayne, Ind. The "Anylite-Twin" Plug. An improved double socket. Construction entirely new, being built like a bridge. Equipped with spring contacts. Light and strong. Outer covering serves merely as an insulation. Every home needs three. Write for bulletin—Adv.



BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin twin sockets are adaptable to many classes of work from window and cove lighting to electric railway lighting and signaling Furnished in porcelain body as illustrated, or in brass shell with fibre or porcelain lining. Also two to six outlet clusters, plug or socket type.—Adv.



Benjamin Twin Socket

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Esler Electric Mfg. Co., 416 Lincoln St., Marion, Ind. "Jiffy."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Greist Mfg. Co., New Haven, Conn. "Wallace."
Hubbell, Inc., Harvey, Bridgeport, Conn.
PARKER & SON, INC., J. H., Parkersburg, W. Va. The "Tusum" double socket plug is constructed of highly finished, strong composition, of a dark brown color, having shade holder rings for "Uno" type shade holder. They are wired in multiple or in series, and will withstand 450 degrees of heat without injury.—Adv.



"Tusum" Double Socket Plug

RICHARDS & CO., GEORGE, 555 W Monroe St., Chicago, Ill. Exclusive distributor of the Hemco Twin-Lite Plug; a practical utility, giving twin service from a single socket. The Twin-Lite can be used wherever an extra light is needed or an attachment desired for operating an electric fan, washing machine, vacuum cleaner, flat iron, percolator, etc. It is made of indestructible Condensite, molded into one piece, with a highly-polished, seamless surface, and will stand up under continuous rough usage. The Twin-Lite has a wide field of application in homes, hotels, clubs, factories, etc.—Adv.



Hemco Twin-Lite Plug

Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y. "2-1."
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)

SOCKETS FOR ELECTRON TUBES.—Sockets for electron tubes are generally made of the bayonet type. They have four connections, as a rule, and the base of the socket is provided with four holes, into which the prongs of the tubes may fit. They are generally made with a locking arrangement so that when the tube is inserted a slight twisting action is necessary to complete the circuit and secure the tube in place. Special sockets are also made having different numbers of contacts for special electron tubes in which the lead-in wires may be brought out of both ends of the tube, or for tubes containing more than three elements. Also see Electron tubes.

Manufacturers:

General Radio Co., 11 Windsor St., Cambridge, Mass.
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y.

SOCKETS, LOCKING.—Lamp sockets provided with means for locking a lamp screwed into the socket to prevent theft or removal by unauthorized persons or losening due to vibration on street cars or similar locations. There are several attachments and methods of locking, all of which require a special key to operate. The locking is usually accomplished by running a set screw down to engage the lamp base or by using a free swiveling screw shell which is made rigid for removing the lamp by insertion of the key. These sockets are made in the ordinary metal shell type, also porcelain or molded composition types.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrolock."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benjamin locking socket No. 86 effectively prevents the removal of lamps until the proper key is used, altho it permits a lamp to be inserted and locked without the use of a key. The illustration is a phantom view showing interior construction and key No. 1399 (upper half) inserted. It is medium base of two-piece porcelain, easy-to-wire type and is applicable to indoor or outdoor service. This is a dependable device for the prevention of lamp theft.—Adv.



Benjamin Locking Socket

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Brylock."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Pushlok."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

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L. M. T. Lamp Saving Device Co., 168 Bridge St., Springfield, Mass. "L. M.T."
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Shurlok."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

SOCKETS, MAGNETIC HOLDING.—Lamp holding sockets having bases enclosing magnetic coils with the windings usually in series with the lamps and intended to be placed in contact with machinery, work benches with metal tops, etc., the magnetic attraction securing them in convenient locations.

SOCKETS, MEDIUM AND MOGUL, STANDARD.—Lamp-holding devices designed to be fastened to threaded pipe as on fixtures or hung on the supply wires as pendants. These sockets have screw shells of 1-in. diameter for the medium-base size and 1½-in. diameter for the mogul-base size. Medium sockets are by far the most widely used size, being standard for practically all lighting fixtures and portable lamps, except in the very large and very small ratings for individual lamps. They may be made up in a number of forms from three standard socket bodies and interchangeable caps; they are generally provided in the three standard types, keyless, key and pull-chain, the two latter including switching mechanisms. They are generally rated at 250 watts, 250 volts for key and pull-chain or push-through switch types, unless provided with a special quick-make and quick-break mechanism. Keyless sockets are rated at 660 watts, 250 volts. Mogul sockets are nearly always made without a switching mechanism and are rated at 1500 watts, 250 volts.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y. "Leviton."
Armstrong & White, Renshaw Bldg., Pittsburgh, Pa.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant," "Wrinklet."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
Federal Hardware & Electric Co., Everett, Mass.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn. "Quick Catch," "Presturn," "Lockshell."
McGill Mfg. Co., Valparaiso, Ind. "Levolier."
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Fluto," "Flutolier," "Goliath," "Passmour."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless E-Z-Wire."
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
Yost Electric Mfg. Co., 1805 Hawthorne St., Toledo, Ohio.

SOCKETS, PORCELAIN. — Lamp-holding sockets in which the bodies together with the outer shells are made of glazed molded porcelain. They are made either in the keyless type or having key, pull-chain or push-through switching mechanisms. Porcelain sockets are arranged either for pendent or fixture mounting and are furnished in white, gray, brown or blue porcelain, sometimes having an ornamental form. They are used largely for outside work, as weatherproof sockets, also for fixtures and lamp outlets in damp or corrosive places, as in basements, laundries, vat rooms, packing houses, chemical and battery rooms, boiler rooms, etc. In hospitals and sometimes in bathrooms they are used with white-enameled fixtures to secure a harmonious finish. Occasionally porcelain sockets are provided with metal caps.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CRESCENT ELECTRIC CO., P. O. Box 178, Mountain Grove, Mo. "Acme."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Porcelain Sockets are manufactured in the standard C-H push-button type and have the regular C-H capacity—600 watts. The porcelain casing is proof against shock and makes a very desirable fixture for bathrooms, laundries, and other locations where cement floors are used. The porcelain, when soiled, can be wiped off with a moist cloth and made to look like new after years of service. See display adv. pages 1225-1230.—Adv.


CH 7400

Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. Federal sockets are all of the best workmanship possible. Features of No. 325 standard Federal socket are as follows: The lamp shelves are pure copper and can be removed from the front. They are fastened in by means of bronze machine screws. The terminals are situated at the bottom of grooves in the porcelain, through which the conductors run, thus reducing the chances of short circuit to a minimum. See display adv. page 1291.—Adv.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Security," "Five Hundred."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
National Porcelain Co., Trenton, N. J.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Paiste Co., H. T., Philadelphia, Pa. "Multipo," "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.
PARKER & SON, INC., J. H., Parkersburg, W. Va.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P & S."
Paulding, Inc., J. I., New Bedford, Mass.
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
WAKEFIELD BRASS CO., THE F. W., Woodland Rd., Vermilion, Ohio.
Weber Electric Co., Schenectady, N. Y. "Weber."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SOCKETS, PUSH-BUTTON. — Lamp-holding sockets having switching mechanism to control the lamp circuit operated by push buttons projecting through the outer shell or casing. They have a quick make and break action and therefore are generally rated at 660 watts, 250 volts. Push-button sockets are made in both the pendent and fixture types. They have the advantage of indicating by the position of the button whether or not the circuit is closed, one of the buttons being usually white and the other black.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Push Sockets are well-known, the Cutler-Hammer Push button switches having been in use for some fourteen years. Brass shell and porcelain sockets are made. See display adv. pages 1203-1223. —Adv.



GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

SOCKETS, REFLECTOR. — Reflector sockets are generally made of porcelain with a one-piece steel reflector enclosing it and forming a protecting shell. The socket is fastened to conduit by means of a special fitting which permits the reflector to be raised while the socket is being wired. The reflector is then lowered to the proper place. They are used for industrial lighting units, either indoor or outdoor, and are provided with several styles and sizes of reflectors which are usually porcelain-enameled. Wide bearing surfaces between the reflector and porcelain sockets are provided to give sufficient strength, especially for resisting wind and side pressure.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. R. L. M. Bowl, Shallow bowl, Cone and Elliptical angle reflectors of porcelain enameled steel, fitted with heavy substantial connection for iron pipe support and porcelain socket.—Adv.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.
Hubbell, Inc., Harvey, Bridgeport, Conn.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

SOCKETS, REVOLVING.—Lamp-holding devices used in advertising novelties, etc., in which the device is caused to revolve, presenting changeable effects of illumination and thus attracting more attention than a stationary light.

Manufacturer:

Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.

SOCKETS, SERIES STREET LIGHTING.—Sockets for series street lighting

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are of two general types. They are usually made to receive mogul-base lamps. In one type, known as the film-cutout type, a special pair of contacts separated by a paper or silk film are connected in parallel with the lamp. When the lamp burns out or is broken the voltage across it increases rapidly. At a slight increase above normal the film punctures and short-circuits, this again completing the circuit. Circuits with this type of socket require a constant-current regulator at the station.

The other type of socket, known as the reactance socket, consists of a mogul-base socket with a special reactance coil mounted above or below it and connected in multiple or shunt with the lamp. The reactance coil is so designed that when the lamp burns out the reactance coil is thrown in series into the circuit and has the same voltage drop across it as the lamp had. At the same time it only consumes 4 or 5% of the power of the lamp. This type of socket is used on circuits where no constant-current regulator is required and where the circuit is connected to a constant-potential system.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Circle F."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

SOCKETS, SPECIAL AND MISCELLANEOUS.—This classification includes sockets having special forms of mechanism or of enclosing shells adapting them to particular forms of mounting, or special forms of fastenings between the various parts. Also such sockets with special bases which allow of adjustment for lamp focusing in headlights, signal lights, certain reflectors, etc. Other miscellaneous types not separately listed herewith are also included in this group.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. The Ajax No. 33 Triple socket is constructed of high heat-resisting moulded composition, similar to Ajax No 22, illustrated and described under Sockets, duplex and twin. Send for our complete catalog.—Adv.



Ajax Triple Socket

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (Marine). See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
DeForest, Inc., Lee, 451 3rd St., San Francisco, Cal.
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Circle F."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Schweitzer & Herz, 231 N. Wells St., Chicago, Ill.
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
Tremont Products Co., 216 High St., Boston, Mass. "Staylit," "Varylite."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

SOCKETS, TEMPORARY SERVICE.—A type of socket having special caps provided with metallic hooks used for supporting the sockets on span wires independently of the line connections in temporary service. Instead of hooks set screws with sharp points which make contact by piercing through the insulation are sometimes used. These sockets are used mostly for temporary outdoor display lighting.

Manufacturer:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18th St., New York, N. Y. (See display adv. page 1305.)

SOCKETS, TRANSFORMER.—When a lamp of lower than rated circuit voltage is to be used in a socket the voltage may be reduced by a special transformer socket. This socket has a small autotransformer mounted in the base of the socket. Such sockets are sometimes used in locations where a very small lamp is to burn all night, as in a hallway.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
PARKER & SON, INC., J. H., Parkersburg, W. Va. Porcelain primary transformer cut-outs, single pole, will operate with entire satisfaction under maximum load of 30 amperes on 250 volt circuits. Brown glaze.—Adv.

SOCKETS, VAPORPROOF.—These sockets, usually made with a porcelain body, are designed to be fastened to threaded conduit or hung on supply wires and provided with fittings for holding enclosing globes to exclude corrosive vapors or moisture. The socket usually has the leading-in wires permanently attached, the bushings being air-sealed where the wires enter.

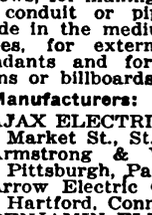
Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Circle F."
Paiste Co., H. T., Philadelphia, Pa. "Multipo," "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.

SOCKETS, WEATHERPROOF.—Lamp-holding devices of the keyless type with porcelain or molded composition bodies and permanently sealed-in connecting leads. They are sometimes provided with metal caps, which are attached to the body by screws, for making water-tight connections to conduit or pipe. These sockets are made in the medium-base and mogul-base types, for external use in fixtures or pendants and for illuminating buildings, signs or billboards and other displays.

Manufacturers:

AJAX ELECTRIC SPECIALTY CO., 1011 Market St., St. Louis, Mo. "Ajax."
Armstrong & White, Renshaw Bldg., Pittsburgh, Pa.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. The Benco weatherproof sockets are made in keyless and pull chain types and with aluminum, copper or brass shells. The caps are tapped ⅜ and ½ in. pipe thread. As shown in illustration, reflectors may be attached in a very substantial manner by the use of an ingenious threaded shade holder (also weatherproof), Benjamin Type "S."—Adv.



Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cole & Co., Henry, 54 Old Colony Ave., Boston, Mass.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J. "Circle F."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hubbell, Inc., Harvey, Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Mesa Co., Fernando C., Colt St. & Chancellor Ave., Irvington, N. J.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Paiste Co., H. T., Philadelphia, Pa. "Paiste," "Multipo." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PARKER & SON, INC., J. H., Parkersburg, W. Va. Porcelain weatherproof sockets.—Adv.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.
Union Electric Co., Inc., Hamilton & Clark Sts., Trenton, N. J.
WALSH ELECTRICAL SUPPLY CO., INC., 151 W. 18 St., New York, N. Y. These sockets are hot-molded under pressure, or a high heat resistant composition which is also impervious to water or weather. They have copper inside shells with porcelain bases and are fitted with 6-in. leads of No. 14 stranded rubber-covered wire. Also see display adv. page 1305.—Adv.



Walsh Weatherproof Sockets

WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SODIUM.—A very soft, light metal. Symbol Na; at. wt. 23.05; sp. gr. 0.97; m. p. 96° C.; b. p. 742° C. It is usually obtained by electrolysis of fused sodium hydrate, as by the Castner process, which see. It is used mainly as a reducing agent.

SODIUM AMALGAM.—An alloy of metallic sodium and mercury; it can be produced electrolytically by the electrolysis of a solution of a sodium salt with a mercury cathode.

SODIUM CHLORIDE.—NaCl; the raw material for the production in many different types of electrolytic process, of metallic sodium, sodium hydrate, sodium hypochlorite, sodium chlorate and chlorine. It is common table salt.

SODIUM HYDROXIDE.—NaOH; it is produced electrolytically in many different types of process. Commercially it is called "caustic soda." Among its numerous applications of special interest electrically is its use as the electrolyte for alkaline primary and storage batteries. Combined open and closed-circuit primary cells, such as the Edison-LaLande, and the nickel-iron storage cells, such as the Edison, use caustic soda in preference to the more expensive caustic potash (KOH).

Manufacturers:

Grasselli Chemical Co., The, Cleveland, Ohio.

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Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Hooker Electrochemical Co., 25 Pine St., New York, N. Y.
Mallinckrodt Chemical Works, St. Louis, Mo.

SODIUM NITRITE.—See Nitrites.

SOEDERBERG SELF-BAKING ELECTRODE.—An electric furnace electrode in which the soft carbon mixture is baked automatically by the heat received from the furnace while the electrode is in use. The electrode is enclosed in a sheet-iron casing into which the soft mixture is stamped at the top, the whole being gradually lowered as the electrode is consumed. New casing is joined on by welding. The electrode was developed recently in Norway, and the first American installation was made in 1920 at Anniston, Ala.

SOHM ELECTRIC CO.—841-49 Blue Island Ave., Chicago, Ill. Manufacturer of electric time systems. Business established 1915. President, A. L. Sohm; vice-president and general manager, G. G. Schoneberger; secretary and treasurer, H. J. Fiddelke; sales manager, A. T. Lyon.

SOLACE.—Trade name for X-ray interrupters and fluoroscopes manufactured by the Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

SOLAR.—Trade name for therapeutic lamp manufactured by the Sanitarium Equipment Co., Battle Creek, Mich.

SOLAR.—Trade name for commercial and industrial lighting fixtures manufactured by the Solar Illuminating Co., 54 W. Lake St., Chicago, Ill.

SOLAR ELECTRIC CO.—124 W. Lake St., Chicago, Ill. Manufacturer of sign flashers, receptacles and plugs. Business established 1905. President and general manager, John C. Smith; vice-president, Dr. A. M. Hewett; secretary and treasurer, Robert H. Rice.

SOLAR ILLUMINATING CO.—Chicago, Ill. Manufacturer of lighting fixtures. A. Lazerson, president. Main office, 54 W. Lake St., Chicago, Ill. Branch office, Wesley Roberts Bldg., Los Angeles, Cal.

SOLARAY.—Trade name for therapeutic lamps manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

SOLBAR.—Trade name for machinists' wrenches and screw drivers manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

SOL-LUX.—Trade name for ornamental post tops, brackets for trolley poles, street lighting fixtures and industrial lighting equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SOLDER, ALUMINUM.—An alloy of low melting point which will enable the making of a proper soldered joint in aluminum. It is usually an alloy of tin and zinc with a small amount of aluminum. The proportions are about 75.5 parts by weight of tin; 18 parts of zinc and 2.5 parts of aluminum. In using this solder it is advisable to heat the parts slightly before joining. No flux is required. Another aluminum solder is made of 80% tin and 20% zinc. This requires the use of stearic acid as a flux.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen."
Federal Mfg. Co., Inc., 27 Haymarket Sq., Boston, Mass. "Supreme Brand."
General Welding Co., 355-57 14th St., Hoboken, N. J. "Ideal."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa.
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass. "Mirete," "O C O."
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Soluminum Mfg. & Engineering Co., 1790 Broadway, New York, N. Y. "Soluminum."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Union Smelting & Refining Co., Inc., Pulitzer Bldg., New York, N. Y.
United Smelting & Aluminum Co., Inc., New Haven, Conn.
United States Reduction Co., East Chicago, Ind.

SOLDER, BAR.—An alloy usually consisting of lead and tin furnished in the form of bars for convenience in handling for making soldered joints in metals, such as lead piping systems and for cable splices and other heavy work. This is usually soft solder and for "common" solder contains two parts of lead to one part of tin. Other combinations are equal parts of lead and tin. The presence of aluminum and zinc, if in small quantities, causes the solder to be more sluggish or hard, while a small percentage of phosphorus renders it soft and causes it to run freely.

Manufacturers:

American Smelters Securities Co., Merchants Exchange Bldg., San Francisco,
Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
Eagle Smelting & Refining Works, Ltd., 41-45 Prince St., Montreal, Que., Can.
Follansbee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa. "Luco."
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
National Lead Co., 111 Broadway, New York, N. Y. "Dutch Boy."
North American Smelting Co., 9th & Thompson Sts., Philadelphia, Pa.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Pittsburgh White Metal Co., 3116 Penn Ave., Pittsburgh, Pa. "Rinehart."
Seaboard Metal Corp., North Arlington, N. J.
Shonberg, Inc., T., 122-126 Flushing Ave., Brooklyn, N. Y.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Standard Rolling Mills Co., 363-367 Hudson Ave., Brooklyn, N. Y. "Stromi."
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
Union Smelting & Refining Co., Inc., Pulitzer Bldg., New York, N. Y.
United Smelting & Aluminum Co., Inc., New Haven, Conn.

SOLDER, BRAZING.—See Brazing alloys.

SOLDER POTS.—Cast iron pots used for melting solder. They are used extensively in electrical construction work to melt solder used on spliced joints and terminal lugs in large wires and cables, and for wiping joints between lead-covered cables and sleeves. The pots are generally 5, 6 or 8 ins. in diameter and have a rim around the top that is used to support them in some cases. They may be set in the top of the firepot, or mounted on a small cast iron tripod and heated by a blow torch or in a gas oven.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. A self-regulating electric melting pot. Described under Melters. metal.—Adv.
Steam-Electric Products Co., The, 1250 W. 76th St., Cleveland, Ohio. "Sepco."

SOLDER, ROSIN-CORE AND OTHER SELF-FLUXING.—Solder consisting of lead and tin in various proportions used by electricians and manufacturers, and provided with a core of rosin or other suitable flux in proper proportion which melts on the application of heat and prevents the formation of oxides, thus permitting the making of a strong bond between the metals. It is a very convenient form of solder for joining small parts and for soldering wires to connections in rather inaccessible places. The rosin or other flux is placed in the solder in small pockets or merely inside of a tubing of solder. The composition of the solder varies from equal parts of lead and tin to two parts of lead and one of tin.

Manufacturers:

American Solder & Flux Co., 2910 N. 16th St., Philadelphia, Pa. "Tinol."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
CHICAGO SOLDER CO., Chicago, Ill. See description under "Soldering Compounds or Flux."—Adv.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
National Lead Co., 111 Broadway, New York, N. Y. "Dutch Boy."
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Union Smelting & Refining Co., Inc., Pulitzer Bldg., New York, N. Y.
United American Metals Corp., Brooklyn, N. Y.
United Smelting & Aluminum Co., Inc., New Haven, Conn.

SOLDER, SILVER.—Silver solder is a hard solder containing silver, copper and zinc or brass. It is employed for uniting comparatively small parts requiring a strong joint. The composition varies considerably, depending on the work. Some solder used contains 70 parts silver and 30 parts copper. Another composition used by some electrical companies is composed of 34.36% copper, 49.24% silver and 16.40% zinc. This solder requires the use of borax as a flux.

Manufacturers:

Baker & Co., Inc., 54 Austin St., Newark, N. J.
Canadian Seamless Wire Co., Ltd., 198 Clinton St., Toronto, Ont., Can.
Hagstoz & Son, T. B., 709 Sansom St., Philadelphia, Pa.
Handy & Harman, 59 Cedar St., New York, N. Y.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
Noble & Co., F. H., 59th & Wallace Sts., Chicago, Ill.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Tubular Products Co., Box 336, Southington, Conn.
Union Smelting & Refining Co., Inc., Pulitzer Bldg., New York, N. Y.
United Wire & Supply Co., 1497 Elmwood Ave., Auburn, R. I.

SOLDER, WIRE AND RIBBON.—A form of solder consisting of lead and tin in various proportions and furnished in the form of a thin wire or narrow ribbon for the convenience of wiremen and other electricians and mechanics in making small joints in conductors or other apparatus. The solder is usually soft solder, i. e., it runs freely when hot and does not require excessive heat to melt it. The ordinary composition varies from equal parts of lead and tin to two parts of lead and one of tin.

Manufacturers:

American Smelters Securities Co., Merchants Exchange Bldg., San Francisco, Cal. "Selby."
American Solder & Flux Co., 2910 N. 16th St., Philadelphia, Pa. "Tinol."
CHICAGO SOLDER CO., 4201 Wrightwood Ave., Chicago, Ill. "Kester."
Eagle Smelting & Refining Works, Ltd., 41-45 Prince St., Montreal, Que., Can.
Hagstoz & Son, T. B., 709 Sansom St., Philadelphia, Pa.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.
Mitchell-Rand Mfg. Co., 16 Vesey St., New York, N. Y.
More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.
National Lead Co., 111 Broadway, New York, N. Y. "Dutch Boy."
Noble & Co., F. H., 59th & Wallace Sts., Chicago, Ill.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Pittsburgh White Metal Co., 3116 Penn Ave., Pittsburgh, Pa. "Rinehart."
Seaboard Metal Corp., North Arlington, N. J.
Shonberg, Inc., T., 122-126 Flushing Ave., Brooklyn, N. Y.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Standard Rolling Mills Co., 363-367 Hudson Ave., Brooklyn, N. Y. "Stromi."
Union Smelting & Refining Co., Inc., York, N. Y.
United American Metals Corp., Brook-Pulitzer Bldg., New York, N. Y.
United Lead Co., 111 Broadway, New lyn, N. Y.
United Smelting & Aluminum Co., Inc., New Haven, Conn.
United Wire & Supply Co., 1497 Elmwood Ave., Auburn, R. I.

SOLDERALL CO., THE.—129 Sussex Ave., Newark, N. J. Manufacturer of soldering torches and flux. Business established 1910. President, A. G. Brach; secretary and treasurer, L. S. Brach; general manager and sales manager, F. Fitch.

SOLDERING COMPOUNDS OR FLUX.—Mixtures of chemical compounds in the form of fluids, paste, salts or sticks intended for use in soldering operations to prevent the formation of oxides on the

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surfaces of the work being soldered so as to insure a proper bond between the parts. They act by melting or forming a liquid that spreads over the surfaces being joined and dissolving any oxide that forms, thus keeping the surfaces clean. For soft solder, rosin and cloride of zinc are often used for making fluxes. For use with hard solders and in brazing, burnt or calcined borax, or boracic acid in powdered form is used. The material should be cleaned after the flux is applied as it sometimes causes subsequent corrosion. Other fluxes are made for special work, containing some stearin, tallow, ammonium chloride, hydrochloric acid, and cuprous oxide.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen Sodering Flux" is noted, both among large and small users of flux, for its superior qualities, proven by tests made by nationally known chemists and engineers. The following tests for tensile strength were made by Robert W. Hunt Co., Engineers, Chicago. Two pieces of rolled copper, ¼ by 1 by 3 ins., were butt-soldered together to form a test piece. The same solders were used and the same equipment in each test. The solder was a guaranteed 50-50. First table shows results of test with Allen flux:

Allen sodering stick, 16.228 lbs. per sq. in.
Allen sodering paste, 18.967 lbs. per sq. in.
Allen sodering liquid, 17.262 lbs. per sq. in.

Same test given to competitive fluxes:
Sodering stick, 7,182 lbs. per sq. in.
Sodering paste, 10,085 lbs. per sq. in.
Sodering rosin, 14,580 lbs. per sq. in.
Sodering muriatic acid, 6.036 lbs. per sq. in.

This comparative test indicates the quality of Allen flux. Tests made by



"Allen Sodering Fluxes."

the National Board of Underwriters, extending over a period of 18 months, proved that there was practically no corrosion where Allen flux was used and that soldered joints, mechanically and electrically secure, can be made between copper and brass conductors by using Allen flux. Speed: When Allen flux is used, a great number of joints, clean, strong, and connecting any metal to any other metal, can be quickly made. It is non-acid, non-corrosive, fumeless and leaves no stain. Allen flux comes in four convenient forms as shown in above illustration.—Adv.

American Solder & Flux Co., 2910 N. 16th St., Philadelphia, Pa. "Tinol."

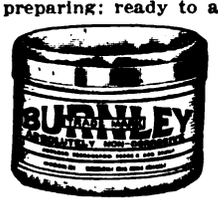
Benson Co., Alexander R., Hudson, N. Y. "Yager's."

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.

Blake Signal & Mfg. Co., 221 High St., Boston, Mass. "Blake."

Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "Peerless."

BURNLEY BATTERY & MFG. CO., THE, North East, Pa. Burnley soldering paste is so thoroughly mixed that every atom does its bit. It needs no preparing; ready to apply; doesn't flow from the soldering line, follows the heat, insuring a free, smooth, even flow of the solder. It is absolutely non-corrosive, and packed in handy form. Burnley soldering salts were extensively used by the American army in France. These salts are a combination of pure chemicals so proportioned as to give the best results as a flux for all kinds of soldering metals. Burnley soldering sticks are a substitute for acids, soldering salts and rosin, are easily applied and non-corrosive.—Adv.



Burnley Soldering Paste

CHICAGO SOLDER CO., 4201 Wrightwood Ave., Chicago, Ill., Sole manufacturers. Solder and Flux. A combination of these two items in one that makes a new soldering method possible. Flux is sealed in pockets in a hollow wire of solder. As the solder melts, flux flows on the job. Does away with time and trouble applying separate flux. Cuts one-third the work on all soldering. Trade name, Kester Rosin-Core Wire. Made especially for delicate electrical work.—Adv.



Kester Rosin-Core Wire

Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.

Dunton Co., The M. W., Providence, R. I. ("Nokorode" salts.)

Fres-Ko Chemical Co., Fort Wayne, Ind. "Fres-Ko."

Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.

Grasselli Chemical Co., The, Cleveland, Ohio. "Eureka," "Perfection," "Standard," "Snow Flake."

Hall-Thompson Co., The, Hartford, Conn. "Wonder Worker."

Highland Electro-Chemical Mfg. Co., Connellsville, Pa. "Highland" soldering paste, "Challenge" stick, "Snow Flake" salts.

Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."

International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

Lukens Metal Co., Thomas F., 238 N. 4th St., Philadelphia, Pa.

McGill Mfg. Co., Valparaiso, Ind. "Star," "Crescent."

Martindale Electric Co., The, 11737 Detroit Ave., Cleveland, Ohio. "Handyflux."

Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass. "Raylax."

Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."

Pacific Metal Works, 153-159 1st St., San Francisco, Cal.

Paragon Insulating Co., The, 5716 Euclid Ave., Cleveland, Ohio. "Paragon."

Reade Mfg. Co., 135 Hoboken St., Jersey City, N. J. "Incomparable" fluid, "Readeana" paste, "Readina" solution, "Crystalite" salts.

Ruby Chemical Co., The, 68-70 McDowell, Columbus, Ohio. "Rubyfluid."

Seidner & Enequist, Inc., 86-112 Hausman St., Brooklyn, N. Y.

Senga Chemical Co., The, 359 Pine St., Providence, R. I. "Senga."

Sieffert Electric Co., 210 Main St., Evansville, Ind. "Sterling."

SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

SNOW & CO., E. W., Rochester, N. Y. Snow's soldering paste, a self-adhesive, non-corrosive paste, high in quality and strong and rapid in action. Will solder any kind of work in any climate, does not spatter, and is very desirable for electrical work as it does not affect insulation. In convenient form; put up in 2-oz., ½, 1, 5, 10 and 25 lb. sizes. —Adv.

Solderall Co., The, 129 Sussex Ave., Newark, N. J. (Paste.)

Special Chemicals Co., Highland Park, Ill. "Speco."

Superior Chemical Products Co., Connellsville, Pa. "Superior."

Van Cleef Bros., 77th St. & Woodlawn Ave., Chicago, Ill. "Dutch Brand."

VULCAN CHEMICAL CO., 1940 W. Taylor St., Chicago, Ill. Vulcan soldering fluxes are made up in paste, salts, fluid, acid, and oil,—all quick acting, noninjurious, and economical. Make a clean smooth joint as strong as the metal itself. Carried in stock by electrical jobbers.—Adv.

Walsh Co., John F., 170 North St., Pittsfield, Mass. "Electric."

Weaver Specialty Co., 6344 Aurelia St., Pittsburgh, Pa. (Paste.) "Oakwood."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SOLDERING COPPERS.—See Coppers, soldering.

SOLDERING FURNACES.—See Fire pots, electricians'; Fire pots, electric.

SOLDERING IRONS.—See Irons, electric, soldering and tipping; Irons, soldering, miscellaneous and special.

SOLDERING OUTFITS, GAS OR OIL-BURNING.—These are outfits burning gas or oil and used in heating pots of solder or soldering irons. Where gas is used as fuel it is necessary to provide air, usually under pressure, to mix with it. In such cases the air may be supplied by a small manually operated or foot bellows and in some instances a small motor-driven blower is used. The outfits for use with oil as a fuel also require air under pressure and this is generally provided by means of a small pump which creates a pressure to force out the oil in a fine stream and mix it with the proper amount of air to vaporize it. The outfits are provided with stands on which the irons or solder pots may rest while being heated.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. The "Allen" combined soldering tool, blow torch and branding iron has a temperature range of 1290 to 1700 deg. F. It is used and indorsed by electricians for inside and outside work. Heat is projected into the opening inside the shank of the tip, thereby leaving the tips always clean, hot and ready for use. Handle is always cool. The "Allen" can be used either as a hand tool or attached to a holding post (as illustrated above) and can be raised or lowered to any angle or swung around for armature or commutator soldering. It is very practical, reasonably priced and reliable device, and comes in four sizes:



"Allen" Sodering Outfit.

No. 1 for light sodering	$6.00
No. 2 for heavy sodering	7.00
No. 3 Gas-Air Tool	8.00
No. 4 Gasoline-Air Tool	8.00

99% Pure Cast Copper Tips.

No. 1	$0.70	No. 6	3.00
No. 2	0.75	No. 7	3.00
No. 3	1.00	No. 8	5.50
No. 4	1.00	No. 9	5.50
No. 5	1.00		

Write for further particulars.—Adv.

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.

Clemens Electrical Corp., 725 Main St., Buffalo, N. Y. (electric).

International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa. (gas burning). "S. S. White."

SOLDERING TORCHES.—See Torches, acetylene, alcohol, and oxyacetylene; Torches, gasoline and kerosene.

SOLDERLESS WIRE CONNECTORS.—See Connectors, solderless.

SOLENOID.—A long coil of insulated wire. When a current of I amperes flows through N turns of a long solenoid, the magnetic intensity inside of the solenoid, but at points distant from the ends, is equal to $H=1.257NI$ gilberts. This is likewise the magnetomotive force of the solenoid. A more accurate expression for the magnetic intensity within a solenoid at a point x cm. from one end is the following: $H=1.257NI[1-r^2/4(l-x)^2-r_3/4x_3]$ gausses, where l is the length of the solenoid and r its radius; r, l and x must each be given in centimeters.

The magnetic field extends along the axis of the solenoid, and its direction or sense (if it is a direct-current solenoid) can be determined by the following rule: Grasp the solenoid with the right hand with the fingers curved in the direction of current flow; the thumb extended along

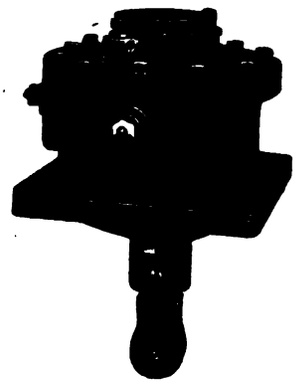
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the solenoid will point in the direction of the magnetic flux, or towards the north-seeking pole of the solenoid.

SOLENOIDS, MISCELLANEOUS.—Solenoids are the essential elements of many of the common forms of electro-magnetic devices. The solenoid consists of a winding of insulated conductor on a suitable nonmagnetic bobbin or spool, the winding being a series of superimposed layers of right and left pitch. Solenoids are used for a large number of purposes, especially in relays, usually having a suitable plunger operating within the bobbin. Special construction features are used to give a very strong sealing pull or to give a strong pull at the end of the stroke without excessive hammer action. The design and construction of solenoids is a highly specialized business. Many users of solenoids for special purposes do not construct their own coils, but find it advantageous to have them designed and made by manufacturers skilled in this work.

Manufacturers:

ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. (See display adv. page 1248.)
Automatic Switch Co., 154 Grand St., New York, N. Y.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Iron Clad Solenoids were designed primarily for use with hoist motor brakes, but are giving equally good service on other work where a smoothly operating and ruggedly constructed magnet with a high sealing pull is required. C-H Solenoids with floating plugs have a high sealing pull without objectionable hammer blow. The floating plug allows the plunger to overtravel its normal stroke slightly, carrying the plug with it. See display adv. pages 1225-1230.—Adv.



C-H Iron Clad Solenoid

Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, Ohio.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Scientific Co., 9 Barrow St., New York, N. Y.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

SOLEX CO., LTD., THE.—Montreal, Que., Can. Manufacturer of incandescent lamps. Business established 1912. President, Rolland Prefontaine; vice-president and treasurer, Albert Dupuis; secretary and general manager, J. E. Pelletier. Main office and factory, 1202 St. Lawrence Blvd., Montreal, Que., Can. Branch offices, 77 Bay St., Toronto, Ont., Can.; Galt Bldg., Winnipeg, Man., Can.

SOLID.—Trade name for telephone receivers manufactured by the William J. Murdock Co., Everett Ave. & Carter St., Chelsea, Mass.

SOLIDARCH ELECTRIC HOTPACK CO.—1225 Cottman St., Fox Chase, Philadelphia, Pa. Manufacturer of electrical surgical bakers and bath cabinets. Business established 1919. President and general manager, Henry Perlman; secretary and treasurer, S. T. Sterling.

SOLUMINUM MFG. & ENGINEERING CO., INC.—1790 Broadway, New York, N. Y. Manufacturer of brazing compounds. Business established 1915. President and general manager, George L. Upshur; secretary, M. Upshur; treasurer, Charles A. Sherman.

SOLSHANK.—Trade name for screw drivers manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

SOLVATE THEORY.—The idea that when a salt is dissolved in a solvent, the molecules of the salt unite chemically with the solvent to form compounds of the type $(MA)(Solvent)_z$, where z indicates the number of molecules of solvent united with one molecule of salt, MA; it also includes the conception that on dilution some of the molecules react with the solvent to form compounds of parts of the salt molecules, with the solvent, of the general type $M(Solvent)_x$ or $A(Solvent)_y$. These correspond to what are called in the ionization theory solvated ions, but they are here regarded as two new classes of chemical compounds, and not as dissociated fragments of salt molecules.

SOLVATED IONS.—See Solvate theory. Their conception marks the modernization of the ionization theory. They are in reality new classes of chemical compounds and not ions in any proper sense.

SOLVAY CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution. This cell uses a mercury cathode, producing a sodium amalgam which is then decomposed in a separate container with the formation of caustic soda.

SOMERVILLE RADIO LABORATORY.—102 Heath St., Somerville, Mass. Manufacturer of electrical indicating and radio instruments. Business established 1917. General manager, Francis R. Pray. Factory, West Somerville, Mass.

SONOSCOPE.—Trade name for automobile ignition tester manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

SOOT BLOWERS.—Where fuel is burned there is soot. As soot is a better heat insulator than asbestos, it is imperative, on the score of fuel economy and boiler capacity, to remove the soot from boiler heating surfaces. Soot can be removed by hand lance or mechanical soot blowers. The latter way is the modern way because men will not, nor can they, do a thorough job with the hand lance since boilers are now so large.

Mechanical soot blowers consist of a number of units installed within the boiler gas passages. Each unit consists of an element, sometimes rotating, comprising one or more steam jets so arranged and located that all parts of the boiler heating surface can be cleaned by the steam jet when it is turned on. Turning on the steam removes the soot; an entire boiler can be cleaned in less than ten minutes and while in service, whereas a boiler cleaned by hand lance would require several hours and then the job would not be done thoroughly. Mechanical soot blowers are necessary with the large modern boiler and the large amount of soot that forms with the high combustion rates in vogue. They are estimated to save anywhere from 4 to 10% of the fuel; they use about 25% less steam than the hand lance; they eliminate boiler shutdowns for cleaning and the accompanying labor.

Manufacturers:

Bayer Steam Soot Blower Co., 4057 Park Ave., St. Louis, Mo.
Diamond Power Specialty Co., Detroit, Mich. "Diamond."
Diamond Specialty Co., Windsor, Ont., Can. "Diamond."
Huyette Co., Inc., The Paul B., 5 S. 18th St., Philadelphia, Pa.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Marion Machine, Foundry & Supply Co., Marion, Ind. "Marion."
Monarch Soot Remover Co., Inc., Wollaston, Mass. "Monarch."
National Flue Cleaner Co., Inc., Groveville, N. J.
Sherwood Mfg. Co., 1702-1712 Elmwood Ave., Buffalo, N. Y. "Favorite."
Vulcan Soot Cleaner Co., Inc., The, 20 E. Long Ave., Du Bois, Pa. "Vulcan."

SOOTLESS.—Trade name for spark plugs manufactured by the Oakes & Dow Co., 311 Atlantic Ave., Boston, Mass.

SORALA.—Trade name for radio instruments manufactured by the Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.

SORENSEN CO., INC., C. M.—177 E. 87th St., New York, N. Y. Manufacturer of motor-driven air compressors. President and treasurer, C. M. Sorensen; vice-president, G. L. Sorensen; secretary, C. E. Sorensen.

SORGE-COCHRANE.—Trade name for water softening apparatus manufactured by the H. S. B. W.—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.

SORTING MACHINES, CARD, MOTOR-DRIVEN.—Office appliances consisting of apparatus for automatically sorting perforated cards into certain classifications determined by the relative location of the perforations. This is usually accomplished by mechanisms operated by electric motors. The cards are caused to move past a series of selectors containing pins which may be set to select all cards having a certain combination of perforations.

Manufacturers:

International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "Hollerith."
Powers Accounting Machine Co., Inc., 137 S. LaSalle St., Chicago, Ill.
Tabulating Machine Co., The, 50 Broad St., New York, N. Y.

S. O. S.—Trade name for storage batteries and parts manufactured by the Victor Storage Battery Co., Rock Island, Ill.

SOUND WAVES.—Sound travels through air by compressions and rarefactions like waves on water. One compression and rarefaction is called a sound wave. Loudness is fixed by the amplitude of the vibrations. Quality is fixed by the component frequencies or harmonies superposed on the main or fundamental wave and by the relative amplitude (loudness) of each.

SOUNDER, TELEGRAPH.—In telegraphy an instrument used for reading by sound signals received by the Morse telegraph system. Usually this instrument is operated by means of local battery controlled by the armature of a main line relay. Sounders are necessary because the ordinary line relay has insufficient power to make audible signals for reading. The sounders consist of a pair of coils, usually wound for 4 to 20 ohms resistance, with a rather heavy brass armature to which a steel strip is secured. The armature is normally held against its back (upper) contact by a spring and, when the coils are energized by an incoming signal, the steel strip, and hence the brass lever, is pulled down against the tension of the spring. The construction is such that when the limit of travel is reached an adjustable stop hits the brass anvil of the sounder and gives a clear distinct sound. As soon as the current ceases the spring pulls up the armature and gives another distinct sound, the two sounds forming a dot, if close together, or a dash if separated slightly.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Giant."
Manufacturers' & Inventors' Electric Co., 29 Gold St., New York, N. Y. "Morse-Watch."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."

SOUTH BEND CURRENT CONTROL CO.—112 E. Wayne St., South Bend, Ind. Manufacturer of remote control switches. Business established 1916. President and general manager, D. E. Wescott; secretary, R. E. Middelstadt.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION.—President J. A. Steninger, Parker, S. D.; secretary-treasurer, C. A. Sweet, Redfield, S. D.

SOUTHEASTERN GEOGRAPHIC DIVISION, N. E. L. A.—President, S. B. Irelan, Montgomery Light and Water Power Co., Montgomery, Ala.; secretary-treasurer, Charles A. Collier, Georgia Railway and Power Co., Atlanta, Ga.

SOUTHERN BELTING CO.—602-608 S. Peters St., New Orleans, La. Manufacturer of leather belting. Secretary and treasurer, G. W. Rowbotham.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS.—President, D. J. Butts, 603 S. Figueroa St., Los Angeles, Cal.; secretary-treasurer, B.

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E. Fanning, 628 Union Oil Bldg., Los Angeles, Cal.

SOUTHERN CREOSOTING CO.—Slidell, La. Producer of creosoted poles, posts and ties. President, H. P. Headley; vice-president, J. D. Grant; secretary, treasurer and general manager, W. J. Kelleher.

SOUTHERN DIMENSION OAK CO.—343 S. Dearborn St., Chicago, Ill. Producer of ties, piling and lumber. Alfred Bennett, manager. Yards, Brookport, Ill.

SOUTHERN ELECTRICAL EQUIPMENT CO.—Charlotte, N. C. Manufacturer of substation equipment, disconnecting switches, switchboards, lightning arresters, etc. President and general manager, L. H. Hardin; vice-president, Perry E. Lee; secretary and treasurer, D. E. Rohrer.

SOUTHERN ELECTRICAL PORCELAIN CO., INC.—Erwin, Tenn. Manufacturer of porcelain sockets, insulators, knobs, bushings, cleats and other electrical porcelain products. Business established 1920. President and sales manager, J. S. Thorp; vice-president and general manager, J. W. Owen; secretary and treasurer, C. D. Davis.

SOUTHERN PINE MFG. CO.—Paducah, Ky. Manufacturer of crossarms. John S. Black, sales manager. Main office, Paducah, Ky. Factory, Corinth, Miss. Warehouses, Paducah, Ky.; Metropolis, Ill.

SOUTHERN STATES INDEPENDENT TELEPHONE ASSOCIATION.—President, J. C. Duncan, Knoxville, Tenn.; secretary-treasurer, Minor Corman, Shelbyville, Ky.

SOUTHERN WOOD PRESERVING CO.—Atlanta, Ga. Manufacturer of wood underground conduit and crossarms. President, R. H. White; vice-president, W. C. Meredith; treasurer, R. H. White, Jr., secretary, W. E. White.

SOUTHINGTON HARDWARE CO., THE.—Southington, Conn. Manufacturer of wood screws. President, J. H. Pratt; secretary, William E. Smith; treasurer, Frances M. Girdley.

SOUTHWARK FOUNDRY & MACHINE CO.—Philadelphia, Pa. Manufacturer of hydraulic presses, steam pumps, etc.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.—President, A. Hardgrave, 1301 Southwestern Life Bldg., Dallas, Tex.; secretary, H. S. Cooper, 403-4 Sloughter Bldg., Dallas, Tex.

SOUTHWESTERN GEOGRAPHIC DIVISION, N. E. L. A.—President, A. Hardgrave, 1301 Southwestern Life Bldg., Dallas, Tex.; secretary, H. A. Lane, 1107 First National Bank Bldg., Oklahoma City, Okla.

SOVEREIGN.—Trade name for sheet packing manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

SP. GR. — Abbreviation for specific gravity.

SPACE TELEGRAPHY AND TELEPHONY.—A term sometimes applied to radio telegraphy and telephony because of the fact that the transmission of the signals is through free space rather than over a system of wires. See Radio communication, development and status of.

SPACING CURRENT.—In double-current telegraphy and in printing telegraphy, there are present in the line at successive intervals currents of opposite polarity, one of which is known as the marking current, the other as the spacing current. The marking current operates the recording instruments and the spacing current provides a space between these impulses to separate them and to restore the tongue of the relay to the spacing side, so that it may respond to the next impulse.

SPADES, POLE OR POST HOLE.—A style of spade having a long, sometimes curved, blade used for digging pole holes, etc.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Pittsburgh Shovel Co., Oliver Bldg., Pittsburgh, Pa.

SPAFFORD MACHINE SCREW WORKS, INC.—Morgan & Market Sts., Hartford, Conn. Manufacturer of screw machine products. President, treasurer and general manager, Frederick L. Spafford; vice-president, Claude Creighton; secretary, Earle E. Crommett.

SPALT & SONS, INC., GEORGE.—904 Broadway, Albany, N. Y. Manufacturer of electric refrigerating machines. Business established 1914. President, George Spalt, Sr.; vice-president, C. F. Spalt; secretary, Edward B. Spalt; treasurer, George Spalt, Jr.

SPANG & CO.—Butler, Pa. Manufacturers of gas engines. President, G. A. Spang; secretary, Verne Monroe, treasurer, F. J. Spang.

SPAR OAK.—Trade name for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

SPARE'S.—Trade name for brass and bronze products manufactured by the American Manganese Bronze Co., Holmesburg Junction, Philadelphia, Pa.

SPARK ARRESTERS.—See Arresters, spark.

SPARK COILS, IGNITION.—See Coils, ignition or spark.

SPARK COILS, RADIO. — Inductance coils operating on d-c. supply with a vibrator in the primary and especially designed for securing high secondary voltage for low-power damped-wave radio telegraph transmitting sets. The high-voltage secondary charges a condenser which discharges through an inductance and the spark gap to radiate the energy into space. Radio spark coils must be carefully insulated for high voltage.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Simon, Emil J., 217 Broadway, New York, N. Y.

SPARK GAPS, RADIO.—The spark gap is a device used for discharging a condenser through an inductance for the production of damped high-frequency alternating currents for radio communication. The simplest form is a plain gap consisting of two metal electrodes separated by a few millimeters. This gap is little used, because it causes the radiation of a broad wave-length band.

In the rotary gap a tooth wheel rotates past two stationary electrodes, the discharge occurring every time a tooth passes the stationary electrodes. The speed of rotation determines the number of discharges per second and also the duration of each discharge. Rapid quenching of each spark is necessary to prevent radiation of a broad wave-length band.

In the synchronous rotary gap the toothed wheel is directly connected to the alternator furnishing the power to the transformer and the discharges are made to occur at the time of maximum condenser voltage.

The quenched gap contains a number of plain gaps in series so arranged that the spark rapidly spreads out beyond the edge of the gap, due to skin effect. This produces rapid quenching.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass. "Cambridge."
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Mercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y.
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Murdock Co., William J., Everett Ave. & Carter St., Chelsea, Mass. "Murdock."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Parkin Mfg. Co., San Rafael, Cal.
Radio Corp. of America, 233 Broadway, New York, N. Y.
Radio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Simon, Emil J., 217 Broadway, New York, N. Y.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Wilcox Laboratories, Inc., The., 131 S. Fairview Ave., Lansing, Mich.
Wireless Mfg. Co., 619 4th St., N. W., Canton, Ohio. "Wimco."
Wireless Specialty Apparatus Co., C. & Fargo Sts., Boston, Mass.

SPARK GAPS, SAFETY AND TESTING.—Whenever it is desirable to protect inductive apparatus from very high voltages, especially high-voltage high-frequency surges, it is customary to connect a spark gap in parallel with the apparatus. Such surges find less impedance in jumping across the air gap than in the impedance of the apparatus. In modified form this is the principle of many lightning arresters. For testing purposes spark gaps are used to measure very high voltages. These are of two forms, needle-point and sphere spark gaps; the former use new sewing needles. The "Standardization Rules of the A. I. E. E." prescribe the use of needle-point spark gaps for voltages from 10 to 50 kv. and the sphere gap for voltages above 50 kv.; the latter are preferred, however, for voltages from 30 kv. up. The breakdown voltage of the spark gap depends upon many varying factors, such as density and humidity of the air, sharpness of the needle points, diameter of the spheres, distortion of the dielectric field by neighboring objects, etc. Skilled experimenters are necessary to obtain consistent and reliable results. See "Standardization Rules of the A. I. E. E." for detailed specifications for the use of both forms of gaps.

Manufacturers:

Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.

SPARK PLUGS.—See Plugs, spark.

SPARKO-GAP CO.—15 W. 37th St., New York N. Y. Manufacturer of spark intensifiers. Business established 1918. Factory, Floral Park, L. I., N. Y.

SPARK-O-METER OSCILLUM.—Trade name for spark intensifier manufactured by the Pro-Mo-Tor Fabricating Corp., 182 Locust Ave., New York, N. Y.

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SPARKS-WITHINGTON CO., THE.—Jackson, Mich. Manufacturer of motor-driven horns. President, P. H. Withington; vice-president and treasurer, William Sparks; secretary, David L. Johnson. Main office and factory, Jackson, Mich. Branch office, 622 Swetland Bldg., Cleveland, Ohio.

SPARTAN.—Trade name for receptacles manufactured by the Bryant Electric Co., Bridgeport, Conn.

SPARTAN.—Trade name for alcohol blow torches manufactured by the Carleton Co., 170 Summer St., Boston, Mass.

SPARTAN.—Trade name for leather belting manufactured by the Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.

SPARTAN.—Trade name for hacksaws and hacksaw blades manufactured by the Spartan Saw Works, 41 Taylor St., Springfield, Mass.

SPARTAN JUNIOR.—Trade name for outdoor wall lighting bracket manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SPARTAN SAW WORKS.—41 Taylor St., Springfield, Mass. Manufacturers of hacksaw blades.

SPARTON.—Trade name for motor-driven horns manufactured by the Sparks-Withington Co., Jackson, Mich.

SPAULDING & SONS CO., INC., J.—300 Wheeler St., Tonawanda, N. Y. Manufacturer of fiber sheets, rods, tubing, etc.

S-P-C.—Trade name for protective paints and varnishes made by the Ruberoid Co., 95 Madison Ave., New York, N. Y.

SPEAKING TUBE FITTINGS.—These are the various parts, such as tees, elbows, whistles, mouthpieces, etc., used for joining and terminating the various pieces of tubing used in a speaking-tube installation. Electricians often install speaking tubes in residences and apartment buildings in connection with the bell and other wiring.

Manufacturers:

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
Follansbee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa. "Follansbee Improved Electric," "Follansbee Special Dynamo," "Follansbee High Silicon Transformer."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.
Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SPEAKING TUBE, FLEXIBLE.—A flexible tube, two or three feet in length, with a mouthpiece on one end, arranged to be attached to the outlet of a speaking tube for greater convenience in talking; the mouthpiece may thus be held close to the lips.

Manufacturers:

Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
New York Gas Tubing Co., 806-810 Greenwich St., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.

SPEAKING TUBE, RIGID.—A light tin tube, about 1 inch in diameter, installed in many residences, apartment buildings and in other locations where conversation is desired with the entrance vestibule or from one floor to another. They are usually connected to the plate carrying the electric bell push button and the letter box, in the main entrance. They are being quite extensively replaced in the larger buildings by interior telephones.

Manufacturers:

Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
Follanshee Bros. Co., Liberty, 2nd, 3rd Aves. & Short St., Pittsburgh, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Ostrander & Co., W. R., 371 Broadway, New York, N. Y.

When writing to manufacturers please mention the

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Wheeler Condenser & Engineering Co., Carteret, N. J. (Brass.)

SPECIAL AUTO FLEXTUBE. — Trade name for nonmetallic conduit for automobile wiring manufactured by the National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.

SPECIAL CHEMICALS CO. — Highland Park, Ill. Manufacturer of soldering paste, fluid, compounds, etc. Business established 1918. President, Carl Pfanstiehl; vice-president and treasurer, George R. Jones; secretary, Caryl Cody Pfanstiehl; general manager, Edmund H. Eitel.

SPECIALTY DEVICE CO., THE.—106 W. 3rd St., Cincinnati, Ohio. Manufacturer of linemen's tools. Business established 1911. President, S. M. Newburgh; vice-president and general manager, S. J. Mack; secretary, F. N. Bierce; treasurer and general manager, Ralph Pappenheimer. Sales representative, C. H. Johnson, 301 Rialto Bldg., San Francisco, Cal.

SPECIALTY SHOE MACHINERY CO.—201 W. Colorado Ave., St. Joseph, Mo. Manufacturer of electric shoe nailing machines. President, James Bragg; general manager, J. R. Kathrens.

SPECIFIC CONDUCTANCE.—See Conductivity.

SPECIFIC GRAVITY.—The relative density of any substance as compared with that of water (in the case of liquids and solids) and of air (in the case of gases). The special gravity of water, which is the most used basis of comparison, is therefore, 1. The sp. gr. of air as compared with water, is 0.002 at ordinary atmospheric pressure and temperature. With water as the basis, the sp. gr. of gases is expressed as a very small number. For this reason atmospheric air is taken as the basis of comparison for gases, and its sp. gr. is then called 1.

SPECIFIC INDUCTIVE CAPACITY.—A term formerly used for what is now called the "dielectric constant," which see.

SPECIFIC RESISTANCE. — See Resistivity.

SPECO.—Trade name for soldering paste, flux, compounds, etc., manufactured by the Special Chemicals Co., Highland Park, Ill.

SPECTRO.—Trade name for photographic lighting equipment manufactured by the Joseph Gelb Co., 512 W. 36th St., New York, N. Y.

SPEED, ANSWERING, TELEPHONE.—The time from the lifting of the receiver from the hook to the answer by the operator in saying, "Number, please." Three seconds is excellent time; it is usually much more.

SPEED CONTROLLERS. — See Controllers, speed regulating.

SPEED COUNTERS.—See Counters, revolution and speed.

SPEED, CRITICAL.—The speed at which the rotating part of a machine vibrates much more than it does at other speeds above and below this critical value. It is the speed at which a force due to an unbalance of the rotating part has a period equal to the natural period of vibration of the shaft with its load.

SPEED INDICATORS.—See Tachometers.

SPEED-LIMITING SWITCH. — A safety device mounted on a synchronous converter to prevent excessive speed when it is operating "inverted" or from the d-c. end. At a speed above normal by a predetermined per cent, a centrifugal governor weight, revolving on the shaft, flies out and opens a switch mounted on the pillow block. This switch is in series with the low-voltage release coil of the d-c. circuit breaker, and its opening causes the latter to go out, thus shutting down the converter.

SPEEDOMETERS.—A small instrument employed principally on automobiles, electric venicles, electric railway test cars, etc., to indicate the speed in miles per hour. It is connected through gearing to one of the running wheels or axle and is usually operated by a small centrifugal device which moves a hand across a dial or rotates a drum. It differs from the tachometer in that the latter usually indicates the speed of a shaft in revolutions per minute.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
American Speed Indicator Co., The, New London, Conn. "Kenney." (Marine.)
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. (Speedometer parts.)
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Stewart-Warner Speedometer Corp., 1828 Diversey Pkwy., Chicago, Ill.

SPEER CARBON CO.—St. Marys, Pa. Manufacturer of carbons and carbon products. Business established 1899. President and general manager, J. S. Speer; vice-president, William Kaul; secretary and treasurer, G. P. Fryling; sales manager, J. Belmont Mosser. Branch office, 1270 Broadway, New York, N. Y.

SPEIDEL, J. G. — Reading, Pa. Manufacturer of electric elevators and dumbwaiters.

SPENCER.—Trade name for draft regulators manufactured by the Spencer Regulator Co., Salem, Mass.

SPENCER. — Trade name for motor-driven air compressors and vacuum cleaners manufactured by the Spencer Turbine Co., Hartford, Conn.

SPENCER GLOVE CO.—Waverly, N. Y. Manufacturer of linemen's and welders' gloves. Business established 1898. President and general manager, H. I. Seely; secretary, F. D. Dumbar.

SPENCER LENS CO.—442 Niagara St., Buffalo, N. Y. Manufacturer of lenses for projection lanterns. President, H. N. Ott; vice-president, L. M. Potter; secretary, A. O. Potter; treasurer, M. J. Ryan.

SPENCER MFG. CO. — Washington & Cornhill Sts., Boston, Mass. Manufacturer of meter seals and sealing tools and name plates for electrical machinery, etc. Business established 1872. S. M. Spencer and Richard E. Beckert, partners.

SPENCER REGULATOR CO. — Salem, Mass. Manufacturer of damper regulators. John E. Spencer, owner.

SPENCER TURBINE CO., THE—Hartford, Conn. Manufacturer of electric vacuum cleaners, blowers and air compressors. President, Ira H. Spencer; secretary, S. E. Phillips; treasurer, H. H. Richardson. Main office and factory, Hartford, Conn. Branch office, 64 E. Van Buren St., Chicago, Ill.

SPERMO. — Trade name for lubricating grease manufactured by the Warren Lubricant Co., 20-26 Maurice St., Buffalo, N. Y.

SPERRY. — Trade name for desk telephone bracket manufactured by the Kellogg Switchboard & Supply Co., Adams & Aberdeen Sts., Chicago, Ill.

SPERRY GYROSCOPE CO., THE.—Manhattan Bridge Plaza, New York, N. Y. Manufacturer of gyroscopes, gyroscopic compasses, searchlights, projector lamps and ship stabilizers. President, E. A. Sperry; vice-president, C. S. Doran; sales manager, T. A. Morgan.

SPIDERS, MOTOR AND GENERATOR.—Cast iron frames having spokes like those of a wheel on which the main portion of the rotating part of a large electrical machine is built. In small machines, the armature core is often keyed directly to the shaft; but in large machines, particularly those of low speed, the necessary radial depth of the core is such that a supporting structure is desirable and this often is given the form of a spider. Similar spiders are used for mounting the magnetic structure of a revolving field machine and for mounting large commutators.

SPIELMAN ELECTRIC CO.—1931 Broadway, New York, N. Y. Manufacturer of telephones, annunciators, cigar lighters and other electrical specialties. Max H. Spielman, owner.

SPIES ELECTRIC CO. — 564 W. Van Buren St., Chicago, Ill. Manufacturer of bells. Partnership, D. J. Spies and R. Spies.

SPIKES, MINE INSULATOR. — Mine spikes are long spikes having a serrated shank. They are intended for driving into walls of tunnels and other mine runways and rooms. The roughened portion tends to hold the spikes in place when strain is put on them. These spikes are generally used for mounting insulators.

Manufacturer:

Ames & Co., W., Jersey City, N. J.
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.

SPIKES, TRACK TIE.—The spike driven into a track tie to hold the rail in its proper position on the tie. There are a great variety of track spikes, many of which have certain patented features. Track tie spikes are of two general types, those that are driven into the tie and those that are turned or screwed into place. This latter type is known as a

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screw spike. It has the advantages that it does not split the tie and offers a much more secure hold; however, it requires holes to be bored in the ties and is therefore more expensive to install. The most common form of tie spike is the so-called "hook head" spike almost universally used on steam railroads and interurban electric lines.

Manufacturers:

Ames & Co., W., Jersey City, N. J.
Handlan-Buck Mfg. Co., 212 N. Third St., St. Louis, Mo.
Inland Steel Co., 1st National Bank Bldg., Chicago, Ill.
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."

SPILLWAY.—A spillway is that portion of a water-power, irrigation or other dam over which the excess water passes. It is of sufficient length and strength to pass over it all the water in the time of flood, without the water rising too high in passing over.

SPINNING LATHES, METAL, MOTOR-DRIVEN.—A class of lathe used to produce special forms of cups, cones, balls, etc., not readily made by dies without great expense, by bending the rapidly spinning sheet of metal to take the shape of a wooden form mounted on the head of the lathe. The process is used principally with the nonferrous metals, brass, silver, aluminum, copper, etc., although soft steel may be used on some machines.

Electric motor drive has the same advantages for this as for other lathes, namely, flexibility of control and ease of installation in isolated locations. The motor may be mounted on the machine or may drive a group of machines from a common shaft.

SPINNINGS, METAL, MISCELLANEOUS.—Miscellaneous metal spinnings are made by some manufacturers for use in making fixtures, etc. They include many of the thin brass parts that are used as acorns, balls, etc., and other decorative articles. Many of the smaller fixture manufacturers do not have the necessary spinning lathes to do this work and consequently have these parts made to their specifications.

Manufacturers:

Andresen Co., Jacob, 258 Third Ave., S., Minneapolis, Minn.
Brass Fixtures Co., The, Plantsville, Conn.
Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Edmunds Co., Ltd., J. H., 225 Richmond St., W., Toronto, Ont., Can.
Empire Stamping & Metal Spinning Co., Inc., 88-90 Walker St., New York, N. Y.
Frankel Light Co., 5016 Woodland Ave., Cleveland, Ohio.
Hyman & Co., Inc., Henry, 476 Broadway, New York, N. Y. "Hylite."
Mutual Metal Mfg. Co., 1948 N. Kedvale Ave., Chicago, Ill.
National Metal Spinning & Stamping Co., 176-180 Grand St., New York, N. Y.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Simplex Metal Spinning & Stamping Co., Inc., The, 24-34 New Chambers St., New York, N. Y.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Stelco."
Universal Metal Spinning & Stamping Co., Inc., 718 Atlantic Ave., Brooklyn, N. Y.

SPIRALITE.—Trade name for electric signs manufactured by the Commercial Utilities Mfg. Co., 160 N. Wells St., Chicago, Ill.

SPIRITTINE CHEMICAL CO.—Wilmington, N. C. Manufacturer of wood preservatives, etc.

SPIRO MFG. CO., THE C.—New York, N. Y. Manufacturer of portable lamps, lamp bases, fiber products, junction boxes, etc. Business established 1910. President, Charles Spiro; secretary and general manager, F. L. Spiro; treasurer, W. J. Spiro. Main office and factory, 68 E. 131st St., New York, N. Y. Branch office and factory, Senate Ave. & Georgia St., Indianapolis, Ind.

SPIT FIRE.—Trade name for spark plugs manufactured by A. R. Mosler & Co., Mt. Vernon, N. Y.

SPIZZERINKTUM.—Trade name for water treating compound manufactured by the Joseph W. Hays Corp., Michigan City, Ind.

SPLICE, SLEEVE.—A splice between ends of line wire which is made by slipping each end into one tube of a pair which are brazed together. The pair is then twisted together so as to make about three or four turns. It requires no solder.

SPLICE, TAP.—Any splice which attaches a branch to a main line without interfering with the continuity of the main line.

SPLICE, THREE-WIRE.—A splice for open wire line in which a separate piece of wire equal in length to the overlap of the line wires is laid into the splicing clamp with the ends of the line wires and twisted up very much like the so-called Western Union splice. It is very much stronger than the latter.

SPLICE, WESTERN UNION.—This is the usual method of splicing iron wire in an open wire line. The two ends are overlapped in a splicing clamp for several inches and the whole twisted into a distinct "neck" with a number of close turns at one end. The clamp is removed from the neck and applied to the one part while the other end is finished into close turns. It was known and used even before the days of the Western Union Telegraph Co.

SPLICERS, CORD, BELL, TROLLEY AND REGISTER.—Short metal tubular fittings into which the adjacent ends of a trolley cord or rope or round leather strap may be inserted and fastened together by crimping together. If tied by knotting, car bell and register cords often become too short. Hence these splicers are very useful in joining broken cords.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Inc., 212 King St., W., Toronto, Ont., Can.
Electric Materials Co., The, North East, Pa.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
Holland Trolley Supply Co., 1623 E. 43rd St., Cleveland, Ohio.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SPLICERS, TROLLEY WIRE.—Special forms of trolley ears arranged to splice broken trolley wire ends or to connect ends during erection. They take the place of splicing sleeves formerly much used. They grip the wire mechanically and securely without soldering, which is troublesome and anneals the trolley wire. The wired ends are passed through upward curving openings and clamped by set screws, clutches or other means. The preferred designs give an easy approach from the trolley wire to the body of the splicer with a smooth underrun, so that minimum wear and arcing results from passage of the trolley wheels.

Manufacturers:

American Mine Door Co., The, Canton, Ohio. "Canton."
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio. "K-I."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Holland Trolley Supply Co., 1623 E. 43rd St., Cleveland, Ohio.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SPLICES, CABLE.—See Joints, cable splicing.

SPLICING CLAMPS.—See Clamps, linemen's splicing.

SPLICING COMPOUNDS.—See Compounds, cable, junction box, pothead and transformer filling and sealing.

SPLICING GUM.—See Gum, insulating and splicing.

SPLICING LINKS.—See Links, pull chain, splicing.

SPLICING SLEEVES.—See Sleeves, cable splicing, lead; Sleeves, paper, for cable conductors; Sleeves, trolley wire splicing; Sleeves, wire splicing, miscellaneous.

SPLINTER, H.—3141 N. Clark St., Chicago, Ill. Manufacturer of electrically lighted signs. Proprietor, H. Splinter.

SPLIT KNOBS.—See Knobs, porcelain, split.

SPLIT TUBES.—See Tubes, split.

SPLITDORF ELECTRICAL CO.—Newark, N. J. Manufacturer of automobile ignition equipment. Business established 1858. President, R. W. Sutherland; secretary, C. Kratsch; treasurer, J. G. Sritz. Main office and factory, 98 Warren St., Newark, N. J. Branch offices, 68 Brookline Ave., Boston, Mass.; 5943 Ellsworth Ave., Pittsburgh, Pa.; 1215 S. Hope St., Los Angeles, Cal.; 1022 Geary St., San Francisco, Cal.; 1628 Broadway, Seattle, Wash.; 469 Yonge St., Toronto, Ont., Can.; Splitdorf Service & Sales Co., 2900 S. Michigan Ave., Chicago, Ill.; 403 S. Ervay St., Dallas, Tex.; 1295 Woodward Ave., Detroit, Mich.; 1621 Locust St., Kansas City, Mo.; 816 Hennepin Ave., Minneapolis, Minn. Sales office, 225 W. 57th St., New York, N. Y.

SPOKANE.—Trade name for motor-driven ice making and refrigerating machinery manufactured by the Armstrong Machinery Co., 3201-3219 E. Riverside Ave., Spokane, Wash.

SPOKANE CULVERT & TANK CO.—Spokane, Wash. Manufacturer of tanks.

SPOOLS FOR CORD AND WIRE, METAL.—These are usually made from a rolled tube of tin or other metal, with a disk or plate of the same metal riveted to each end. They are used largely for spooling wire in quantities up to 5 or 10 lbs. They can be readily imprinted during manufacturing and are low in cost. Also see Reels, wire, miscellaneous.

Manufacturer:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."

SPOOLS FOR CORD AND WIRE, WOOD.—Spools made from well seasoned wood, the smaller sizes being turned from a solid block, and used extensively for various kinds of wire. They are light, rigid and will not cut the insulation. Larger sizes of wood spools are built up rather than turned. Also see Reels, wire, miscellaneous.

Manufacturers:

Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
McGill Mfg. Co., Valparaiso, Ind. "Universal."
Stephenson Mfg. Co., South Bend, Ind.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
Wilmington Fibre Specialty Co., Wilmington, Del.
Wonder Spool Co., 13 Wormwood St., Boston, Mass.
Woodturning Products Co., Inc., Quincy, Mass.

SPOTLIGHT.—Trade name for flashlight manufactured by the American Ever Ready Works of the National Carbon Co., Long Island City, N. Y.

SPOTLIGHTS, AUTOMOBILE.—These are projecting lamps consisting of a small low-voltage incandescent lamp mounted in a reflector, usually nearly parabolic. The whole unit is mounted on an adjustable swivel joint and secured to a bracket which clamps onto the metal supports for the top or to the side of the windshield of an automobile. Its purpose is to provide a narrow intense beam of light of sufficient strength to pick out distant road signs and objects at night. They are also extensively used for illuminating the side of the road to avoid the possibility of going off the road into a ditch when other motorists' bright headlights are confusing. They have a small switch at the back of the reflector to turn the lamp on and off.

Manufacturers:

Anchor Electric Co., 557 W. Jackson Blvd., Chicago, Ill.

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ANDERSON ELECTRIC & EQUIPMENT CO., Chicago, Ill. AutoReelite is the trade name for a combined automobile windshield spotlight, and an extension trouble light. The AutoReelite is always electrically connected with the battery, there are no troublesome extension cords to find or connections to make. By loosening the nut, the lamp can be extended to any location of the car for inspection, there being 12 feet of cord. If desired, the lamp can be suspended or attached to any convenient support, so as to give a brilliant illumination over the area desired. The standard model B-6 is a suitable size for the average automobile. The lamp lens is 6 ins. in diameter, and 21 candle power. Sport model B-7, is a handsome and powerful searchlight for bigger cars. It provides a 27 candle power ray, and the lens is 7 ins. in diameter. These models are finished in black enamel, nickel trimmed, fitted with convex lens, equipped with a Mazda C, nitrogen lamp in a silvered parabolic reflector. The switch is conveniently located at the back of lamp, with or



The AutoReelite

without, 3½ in. rear mirror giving complete view of the road behind. The D luxe model, SB-7, is similar to model B-7, except for the finish, which is highly polished all-nickel that never wears off and cannot rust. The nonglare type, is a standard AutoReelite with a safety catch that prevents raising the lamp above the limit prescribed by law in many States, but when turned to the right or left, it can be raised as desired, to read road signs, etc. Adjustment is provided to allow for variation in slopes of windshield frames on different cars. Standard AutoReelites are provided with flat base brackets by means of which they can be attached to the frame of a closed car or to a truck cab. Model MB-7 is for use on motorboats. It is equipped complete ready for mounting, with deck mounting plate, 6 volt, 27 candle power, nitrogen Mazda C lamp, switch, and 5 feet of cord for connecting to battery. It can be extended to 12 feet if desired. Diameter of lamp lens is 7 ins., is finished in black enamel, nickel trimmed. See display advertisement on page 1294. —Adv.

BRENKERT LIGHT PROTECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."

Campbell Co., A. S. 161 Prescott St., East Boston, Mass. "Cello."

Fowler Lamp & Mfg. Co., 61 E. 24th St., Chicago, Ill.

Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.

Gilfillan Bros., Inc., Los Angeles, Cal.

Gray & Davis, Inc., Boston, Mass.

Howe Lamp & Mfg. Co., 115-123 E. Ontario St., Chicago, Ill.

Jaeger Co., H. J., 280 Park Ave., Weehawken, N. J.

K-D Lamp Co., The, 108-12 W. 3rd St., Cincinnati, Ohio. "K-D."

Kilborn-Sauer Co., Fairfield, Conn.

National Spot Light Co., 605 California Bldg., Los Angeles, Cal.

Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York. N. Y. "Pittsburgh."

Raydex Mfg. Co., Brackenridge, Pa. "Raydex."

Rose Mfg. Co., 910 Arch St., Philadelphia, Pa. "Neverout."

S & M Lamp Co., 118 W. 36th St., Los Angeles, Cal.

Standard Metal Mfg. Co., Chestnut Jefferson & Malvern Sts., Newark, N. J. "Standard."

Stewart-Warner Speedometer Corp., 1828 Diversey Pkwy., Chicago, Ill. "Stewart," "Van Sicklen."

Trolley Supply Co., The, Massillon, Ohio. "Flexolite."

WAKEFIELD BRASS CO., THE, F. W., Vermilion, Ohio. The "Red Spot" Searchlight is a thoroughly first class spot light containing, as a patented feature, a ruby glass cylinder which slides forward at a touch of a button and encircles the bulb, thus changing all the reflected light rays to brilliant red and serving as an emergency danger signal. To a car that has stalled



The "Red Spot"

or suffered accident or is held up for roadside repairs, this emergency signal provides protection and security which no other light can give. A simple yet positive focus adjuster, trouble-proof and rattle-proof switch, and facility for renewing the bulb from the rear, are other outstanding advantages of the "Red Spot."—Adv.

Williams Mfg. Co., Inc., 125 W. 35th St., Los Angeles, Cal.

SPOTLIGHTS, STAGE.—Stage spotlights are used to illuminate intensely a small portion of a stage or to single out one or more persons in a group. They are generally made in enclosed cabinets, consisting of an arc lamp, and lens with a shutter, rheostat and adjustable focusing arrangement to permit variation in the size of the spot, its intensity, etc. In addition, a holder for color screens is also provided so that the various colors may be thrown on the brightly lighted zone. Concentrated-filament incandescent lamps are being used in some theaters now in place of arcs for the spotlights because of their simplicity of control; the lamps used for this purpose are the same type of incandescents as for motion-picture projection.

Manufacturers:

Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y.

BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Crescent."

Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill. "Baby Spot."

Electrical Products Corp., 1128-34 W. 16th St., Los Angeles, Cal.

McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill.

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. "X-Ray." (See display adv. page 1405.)

Pennefather, James S., 358 W. 43rd St., New York, N. Y.

Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."

Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

SPRAGUE, FRANK JULIAN.—An American electrical engineer and inventor, born at Milford, Conn., 1857. He graduated at Annapolis Naval Academy in 1878, and entered active naval service. In 1882 he was appointed a member of the jury of awards at the Crystal Palace electrical exhibition, London, where he conducted all the tests on dynamoelectric machinery, electric lamps, and gas engines, his report being published in full by the Navy Department. He resigned from the Navy in 1883, and became assistant to Thomas A. Edison. A year later he founded the Sprague Electric Railway & Motor Co. and afterwards the Sprague Electric Elevator and the Sprague Electric Companies, the latter being now the Sprague Electric Works of the General Electric Co. He is recognized as one of the pioneers in electric railway work. In 1887, he installed in Richmond, Va., the first electric street railway that remained in continuous operation since it was placed in service. He introduced the high-speed electric elevator, and invented the multiple-unit system of electric train control and operation. He was a member of the electrical commission which had charge of the electrification of the New York Central Railroad terminal in New York City, and was co-inventor of its protected third rail. He was chairman of committees on electricity and ship construction of the United States Naval Consulting Board; and is president of the Sprague Development Corp. and the Sprague Safety Control & Signal Corp., which is introducing his system of automatic braking control of trains. Mr. Sprague was president of the American Institute of Electrical Engineers in 1892-93. In 1910 he received the Edison Medal, awarded by the Edison Medal Committee of the A. I. E. E.

SPRAGUE CANNING MACHINERY CO.—222 N. Wabash Ave., Chicago, Ill. Manufacturer of motor-driven parers, washing machines and other canning machinery. President, K. H. Addington; vice-president and secretary, L. A. Babcock; treasurer, E. R. King.

SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO.—New York, N. Y. Manufacturers of motors, controllers, generators, switchboards, panelboards, electric hoists, winches, exhaust fans, conduit and cable. General manager, S. W. Hall. Main office, 527-531 W. 34th St., New York, N Y. Factories, Bloomfield, N. J.; New Kensington, Pa.; Maspeth, L. I., N. Y. Branch offices, Fisher Bldg., Chicago, Ill.; Witherspoon Bldg., Philadelphia, Pa.; 84 State St., Boston, Mass.; American Bldg., Baltimore, Md.; Oliver Bldg., Pittsburgh, Pa.; Illuminating Bldg., Cleveland, Ohio; Traction Terminal Bldg., Indianapolis, Ind.; Provident Bank Bldg., Cincinnati, Ohio; Citizens & Southern Bank Bldg., Atlanta, Ga.; Pierce Bldg., St. Louis, Mo.; Public Service Bldg., Milwaukee, Wis.; Dwight Bldg., Kansas City, Mo; Rialto Bldg., San Francisco, Cal.; Colman Bldg., Seattle, Wash.; Electric Bldg., Portland, Ore.; Corporation Bldg., Los Angeles, Cal.

SPRAGUEDUCT.—Trade name for rigid, black enameled conduit manufactured by the Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York, N. Y.

SPRAGUELETS.—Trade name for conduit outlet boxes for exposed wiring manufactured by the Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York, N. Y.

SPRAGUNS.—Trade name for paint spraying outfits manufactured by W. N. Matthews & Brother, Inc., 2912 Easton Ave., St. Louis, Mo.

SPRAY ENGINEERING CO.—Boston, Mass. Manufacturer of cooling ponds, generator cooling equipment, air conditioning apparatus, etc. President, Lee H. Parker; secretary and treasurer, Main office, Boston, Mass. Branch office, 457 Peoples Gas Bldg., Chicago, Ill.

SPRECHER MFG. CO., INC., P. W.—Milwaukee, Wis. Manufacturer of fixture suspensions and joints.

SPRING CONNECTORS.—See Connectors, spring clip.

SPRING HAMMERS.—See Drills, hammer and spring.

SPRING STEEL.—See Steel for springs.

SPRINGFIELD.—Trade name for water-tube boilers manufactured by the Springfield Boiler Co., Springfield, Ohio.

SPRINGFIELD BOILER CO.—Springfield, Ill. Manufacturer of water-tube boilers. President, Owsley Brown; vice-president and sales manager, J. S. Hammerslough; secretary, H. H. Dickermann. Main office and factory, Springfield, Ill. Branch offices, 651 Marquette Bldg., Chicago, Ill.

SPRINGS, BRUSH-HOLDER. — Brush-holder springs, to be used with the large variety of brushes and brush holders, are made in a number of forms and styles. Small motors of the fractional-horsepower types and similar small generators generally have small carbon brushes with a helical spring, which in many cases acts as the connecting lead. This principle is also used on some larger motors, many automobile starting and lighting motors and generators being equipped in this way. In larger motors the tension is applied to the brush by means of a flat coiled spring. Other types have coiled wire springs which either exert pressure on the whole brush holder or on a separate arm which presses against the brush.

Mauufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and

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illustrations and descriptions of our products. We manufacture a complete line of springs for brush holders and other purposes.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Cuyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio.
Dunbar Bros. Co., The, Bristol, Conn.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Union Spring & Mfg. Co., 1207 Fulton Bldg., Pittsburgh, Pa.
Wickwire Spencer Steel Corp., Worcester, Mass.

SPRINGS, BURGLAR-ALARM CONTACT.—Circuit-closing devices consisting of contact springs of either the normally open or closed-circuit type and of special designs for mounting on doors, windows, etc., in such positions that the contacts will be operated by the movement of these respective parts.

Manufacturers.

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of springs.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Cuyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.

SPRINGS, CAR SEAT.—Spiral coil compression springs usually of conical shape used in the cushions and backs of car seats to make them more comfortable than plain nonspring seats.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We are the largest manufacturers of springs of this class.—Adv.
Brill Co., The, J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Union Spring & Mfg. Co., 1207 Fulton Bldg., Pittsburgh, Pa.

SPRINGS, DOOR OPENER OR PUSH-OUT.—A small spring operating a pin, used with some types of electric door openers to push the door ajar when the latch is released.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Cuyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
New York Wire & Spring Co., Hoboken, N. J.
Union Spring & Mfg. Co., 1207 Fulton Bldg., Pittsburgh, Pa.

SPRINGS, ELECTRIC VEHICLE AND TRUCK.—These springs are similar to those used on the gasoline automobile, except as they are affected in design by the relatively heavier load imposed by the storage batteries and by the usually lower speeds required of the electric vehicle. The customary range of operations keeps it on roads of a generally good class and the strain on the springs is therefore less.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of springs used in electric vehicles and trucks.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
New York Wire & Spring Co., Hoboken, N. J.

SPRINGS, ELECTRICAL INSTRUMENT.—In most electrical indicating instruments the deflecting torque is counterbalanced by the torsion of some spring. These springs may be helical or spiral. They are made of nonmagnetic, noncorrodible and nonoxidizable material, usually phosphor-bronze. In the case of most moving-coil indicating instruments a pair of springs is used that serve to conduct the current to and from the moving coil and also provide the restoring or counterbalancing torque.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of springs used in the manufacture of electrical instruments.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
Manross & Sons, F. N., Forestville, Conn.
New York Wire & Spring Co., Hoboken, N. J.

SPRINGS, MISCELLANEOUS CONTACT.—A very large variety of springs of various shapes and sizes is used in electrical devices for breaking temporary contacts. They are usually of brass, bronze or nickel silver, and generally have their contact points tipped with some metal which does not burn away readily, such as tungsten, silver, platinum, etc. For these points see Points, contact and sparking.

Contact springs are used very widely in the telephone operation and in printing telegraph and other communication circuits in connection with miscellaneous relays, keys and switches. Some of the more common types of springs for this service are described below.

Tension Spring. A spring which produces pressure but does not carry any electrical circuit. It is used in relays and keys.

Main Contact Spring. One of the contact springs of a relay which normally touches a back contact, but which touches the front contact instead when the relay is energized.

Make-Before-Break Spring. Abbreviated MBB. A set of springs whose main contact spring touches the front contact spring before it breaks away from the back contact. It is used to preserve continuity.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Cuyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio.
Eastern Parts Mfg. Co., Inc., 135 Spring St., New York, N. Y. "Pemko."
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
New York Wire & Spring Co., Hoboken, N. J.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

SPRINGS, TROLLEY BASE.—Helical coil tension springs used in trolley bases and acting through suitable leverage to provide substantially uniform upward pressure of the trolley wheel at all operating heights of the trolley wire. Trolley bases are usually provided with a number of like springs acting in multiple to produce the required effect.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of springs for trolley bases.—Adv.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
New York Wire & Spring Co., Hoboken, N. J.
Union Spring & Mfg. Co., 1207 Fulton Bldg., Pittsburgh, Pa.

SPRINGS, TRUCK, ELECTRIC RAILWAY CAR.—Spiral coil and leaf springs used in trucks of cars to absorb road shocks and vibration. The spring arrangement of nearly all types of trucks is so arranged and the springs are so placed that rapid shocks and vibrations will come on the coil springs, while the leaf springs take care of the slower movements of the truck with respect to the car body. Leaf springs consist of a number of tempered flat steel curved plates nested and held together by a suitable fitting called the spring band. Leaf springs are assembled in various ways and, according to the shape of the assembled complete spring, they are called full elliptic, semi-elliptic or three-quarter elliptic, and the number and dimensions of the leaves or plates in the spring is proportional to the load to be supported. In most types of trucks, both coil and leaf springs are arranged to act in compression. Also see Trucks, electric railway car.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of electric car springs.—Adv.
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Bemis Car Truck Co., 376 Birnie Ave., Springfield, Mass.
Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.
Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Farrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
Lee Spring Co., The, 347-51 Classon Ave., Brooklyn, N. Y. "Lee-Built."
New York Wire & Spring Co., Hoboken, N. J.
Union Spring & Mfg. Co., 1207 Fulton Bldg., Pittsburgh, Pa.

SPRINKLING CARS, ELECTRIC RAILWAY.—Special cars built for sprinkling the right-of-way and adjacent portions of the roadway with water. The essential features are water tank, regulating valves, filling and the spray devices or sprinkler heads, together with the necessary car frame, trucks and propulsion apparatus. The tanks may be of wood or steel, the latter type being used almost exclusively on modern equipment. Sprinklers may be of the gravity or pneumatic type. In the former the hydraulic head resulting from the location of the sprinkler heads with respect to the tank is relied upon to produce the pressure at the points of distribution. In the pneumatic type, compressed air is admitted to the air space in the tank above the water level, and aids the hydrostatic pressure in obtaining the pressure at the sprinkling heads required for covering the right-of-way and a considerable portion of the roadway. The requirements as to sprinkling thus determine in a large measure the type of sprinkler used.

The capacity of the sprinklers ranges from 1500 to 6000 gallons, the larger capacity sprinklers (4000 and 6000 gal.) being of the double-truck design. Sprinklers with

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special filling equipment consisting of a motor-driven centrifugal pump are needed where it is desired to fill the tank from a stream or other source of water located near the track. In most cases, however, sprinkler tanks are filled from the hydrants of the water mains by means of suitable filling hose.

Manufacturer:

Brill Co., The J. G., 62nd St. & Woodland Ave., Philadelphia, Pa.

SPRITE.—Trade name for oiling device manufactured by the Michigan Lubricator Co., 3643 Beaubien St., Detroit, Mich.

SPROCKETS.—A sprocket is a wheel having teeth so placed that a chain or other link device may be passed over it and have motion imparted to it by the turning wheel, or have it impart motion to the sprocket. They are used for various purposes wherever chain drive may be applied. Many motor-driven appliances and heavy machines have their motion transmitted from the motor by means of a chain and sprocket. These are sometimes made in quite large sizes, as in the case of sprockets over which the conveyors turn in the coal-handling system of a power plant.

Manufacturers:

Baldwin Chain & Mfg. Co., The, Worcester, Mass.
Bosworth-Ard Machine & Foundry Co., Anniston, Ala.
Diamond Chain & Mfg. Co., 502 Kentucky Ave., Indianapolis, Ind. "Diamond."

SPROUT, WALDRON & CO.—Muncy, Pa. Manufacturers of electric feed grinders. Business established 1880. President and general manager, F. M. Sprout; vice-president, N. L. Vredenburg; secretary and sales manager, J. Russell Smith; treasurer, S. Soars.

S.-P. STOVE CO.—Johnson Creek, Wis. Manufacturer of electric household ranges. Secretary, G. H. Trachte; treasurer and general manager, H. F. Prenzlow.

SPUDS, DIGGING.—This tool is used in loosening clay or hard soil in pole-hole digging for removal by the shovel or spoon. It consists of an iron bar sharpened somewhat for loosening the earth, and of suitable length.

Manufacturer:

OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)

SPURS, LINEMEN'S.—See Climbers, linemen's.

SQUARE D.—Trade name for safety switches, receptacles, meter protective trims and accessories manufactured by the Square D Co., 1400 Rivard St., Detroit, Mich.

SQUARE D CO.—Detroit, Mich. Manufacturer of safety switches, receptacles, meter protective trims and accessories. President, B. D. Horton; secretary, A. MacLachlan; treasurer and general manager, T. J. Kauffman; sales manager, E. A. Printz. Main office, 1400 Rivard St., Detroit, Mich. Factories, Detroit, Mich.; Peru, Ind.; Walkerville, Ont., Can. Branch offices, 1002 Singer Bldg., New York, N. Y.; First National Bank Bldg., Pittsburgh, Pa.; Atlanta, Ga.; 1002 Liberty Bldg.; Philadelphia, Pa.; San Francisco, Cal.; 3829 Minnesota Ave., St. Louis, Mo.; 1320 Majestic Bldg.; Milwaukee, Wis.; 431 S. Dearborn St., Chicago, Ill.; 416 Citizens Bldg., Cleveland, Ohio; 508 Lumsden Bldg., Toronto, Ont., Can.

SQUARE-END.—Trade name for pipe and conduit cutters manufactured by the Borden Co., Warren, Ohio.

SQUARE GEE.—Trade name for conduit fittings manufactured by the Grabler Mfg. Co., Cleveland, Ohio.

SQUARES, BEAM AND "T."—The beam or carpenter's square is frequently required by an electrician in laying out locations for cabinets and similar work. The T-square is a drafting instrument, consisting of a straight-edge section attached at right angles to the head or crossbar. It is used in drafting and engineering offices of manufacturers, electrical utility companies, consulting engineers, etc.

Manufacturers:

Acme Level & Mfg. Co., Toledo, Ohio. (Steel.) "Acme."
Cole Co., The H., Columbus, Ohio.
Peck, Stow & Wilcox Co., The, Southington, Conn. (Steel.) "Pexto."

SQUIBS, ELECTRIC, MINER'S BLASTING.—Squibs for use in igniting blasting charges, consisting of tubes containing powder charges which are set off by the heating of small ignition wires connected to a blasting machine or other source of electric energy. They are similar in appearance to blasting caps but have a paper instead of metal cap and do not detonate, merely shooting out a flame which ignites the charge.

SQUIRES CO., THE C. E.—E. 40th St. & Kelley Ave., Cleveland, Ohio. Manufacturer of steam specialties. President, treasurer and general manager, C. E. Squires; vice-president, A. L. Squires; secretary, T. W. Hill.

S R B.—Trade name for ball and roller bearings manufactured by the Standard Steel & Bearings, Inc., 5001 Lancaster Ave., Philadelphia, Pa.

S. S.—Abbreviation for steamship used before the vessel's name.

S-S.—Trade name for fiber products manufactured by the National Fibre & Insulation Co., Yorklyn, Del.

S. S. T.—Trade name for safety valves manufactured by the Ashton Valve Co., Boston, Mass.

S. S. WHITE.—Trade name for electric dental laboratory apparatus manufactured by the S. S. White Mfg. Co., 211 S. 12th St., Philadelphia, Pa.

STA-RITE.—Trade name for pull and push switches for automobile lighting manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

STA-RITE.—Trade name for electric car curtains manufactured by the Railway Supply & Curtain Co., 614-618 S. Canal St., Chicago, Ill.

STA-THERE.—Trade name for battery connector manufactured by the Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

STA-TITE.—Trade name for asbestos sheet packing for flange, cylinder head, manhole plates, hot water heaters, pumps, etc., manufactured by the Imperial Packing Corp., 191 Greenwich St., New York, N. Y.

STA-WARM.—Trade name for electric heating pads manufactured by F. H. Hainert & Son, Minneapolis, Minn.

STABILIZERS, AIRPLANE AND SHIP, MOTOR-DRIVEN GYROSCOPIC.—Gyroscopic stabilizers are used to neutralize the forces of waves or wind that cause a ship or airplane to roll. Following the development by E. A. Sperry of the gyroscopic compass he turned his attention to the gyroscopic stabilizer. Methods were long sought by early investigators to reduce or eliminate the rolling of ships. It is clear that many advantages must follow the riddance of a force so obstructive to rapid voyages and safe travel. The design of stabilizers for merchant vessels and yachts is very compact, light, and consumes but a fraction of the power saved. This latter will be recognized when it is remembered that the horsepower of propulsion is that required to continuously brush aside a mass of water equal to that displaced by the vessel. When the sea rolls and twists the loaded vessel this mass of water is an opposing dynamic force ever increasing the surface of the vessel immersed by the water. In the language of the naval architect the rolling of the ship increases the "wetted surface." This horsepower loss has been calculated to consume for a 15,000-ton vessel at a speed of 18 knots 1000 hp. There are many other advantages, but all calculated to increase the pleasure of sea travel, reduce its risk in all weather, and make financial returns to the owner in the form of reduced fuel and quicker voyages. The latter items are of great importance to the success of the new American merchant marine.

The operation of these stabilizers is determined by means of a small auxiliary gyroscope, which detects a roll of a fraction of a degree. This detector gets the main gyroscope under way to turn it to such an angle as to exactly balance and neutralize the disturbing forces causing the roll.

The gyroscopic stabilizers for airplanes operate on a different principle and do not directly stabilize the plane. They merely furnish a base line about which, when the plane banks or pitches, contacts are made bringing into play force from a motor to move the ailerons or elevators the proper direction and amount to correct the disturbance. Another gyroscopic device, known as the azimuth gyroscope, is also furnished to hold the plane in any desired straight-line course once it is set upon it.

Manufacturer:

Sperry Gyroscope Co., The, Manhattan Bridge Plaza, New York, N. Y.

STABILIZERS, VOLTAGE.—See Voltage stabilizers.

STACKERS, LUMBER, MOTOR-DRIVEN.—Portable trucks and hoists used for hauling and elevating lumber during stacking operations with hoisting mechanism operated by electric motor. The motor is driven by a storage battery mounted on the stacker truck. A machine of this sort greatly reduces the labor required in piling or unpiling lumber in storage yards.

Manufacturers:

Bradney Machine Co., Inc., Middletown, N. Y.
Leitelt Iron Works, 315 Mill Ave., Grand Rapids, Mich.
Seattle Machine Works, Lander St. & East Waterway, Seattle, Wash. "Hilke."

STACKPOLE CARBON CO.—St. Marys, Pa. Manufacturer of dry batteries, carbon and graphite brushes, electrodes and other carbon products. Business established 1907. President, H. C. Stackpole; vice-presidents, D. H. Miller, W. B. Hall; secretary and treasurer, L. G. Hall; factory manager, W. J. Mills; sales manager, H. W. Gudmens. Main office and factory, St. Marys, Pa. Branch offices, 47 W. 34th St., New York, N. Y.; 416 Blackstone Bldg., Pittsburgh, Pa.; 844 Book Bldg., Detroit, Mich.; 1218 Hamilton St., Philadelphia, Pa.

STACKS, POWER PLANT.—Smoke stacks or chimneys serve the three-fold purpose of creating "draft" by which air is furnished for the fuel in the furnace, of carrying away the gases of combustion, and of distributing the flue-gas dust and cinders over a wider territory than if there were no stack.

The smallest plants often use sheet-iron or steel stacks that are held in place by guy wires, the stacks not being self-sustaining. This type of stack is cheap but has not long life. Its use is usually confined to heights not exceeding 120 ft. and diameters around 5 to 6 ft.

The self-supporting steel stack, built up of riveted steel plates, the brick and the reinforced-concrete stack are used for the largest plants. Perhaps the majority of the larger central stations are using steel stacks, although the concrete stack is finding many applications. The reinforced concrete stack is about one-third the weight of the brick stack and occupies less space even than the steel stack; it costs more than the steel stack, but less than the brick. It is rapidly built and may be made any shape desired. It has long life, is well able to withstand wind pressure and corrosion. It is, however, more subject to damage from lightning.

In choosing a stack it should be borne in mind that the cost is a fixed charge. A steel stack may be taken down and put up elsewhere; the brick and concrete stacks have little salvage value.

Stacks should preferably be lined with brick as the lining tends to prevent corrosion (especially of steel stacks) due to the sulphur in the gases, which turns to sulphuric acid in the presence of moisture; a lining also lessens radiation and so improves the draft created by the stack. The lining, if not carried up to the top of the stack, should go at least half-way or three-quarters the way to the top.

In determining the size of stack to employ, it should be noted that the draft created for any given temperature depends upon the height of the stack. The cross-sectional area of the stack determines the volume of gases that can be handled. It seems to be current practice to design a stack for about 200 or 180% full-load operation, in this way allowing boilers to be operated at 200% rating during peak loads with natural draft and also allow sufficient draft even during adverse atmospheric conditions. Chain-grate stokers are operating in many plants at 200% rating under the above circumstances.

With natural draft, the air supply or "draft" is controlled by dampers installed

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in the individual boiler breechings or in the stack. One damper to each boiler is the best arrangement as it allows flexible control and ease of manipulation.

In deciding upon whether to adopt natural or mechanical draft the cost is not the only consideration; mechanical draft is always cheaper than natural draft. A stack once erected, unless of steel, cannot be used elsewhere, so that the money spent can never be collected should it be necessary to abandon the plant or move it. Moreover, a stack cannot have its volumetric capacity increased should plant additions require. For manufacturers see Chimneys, power plant; and Stacks, smoke, steel.

STACKS, SMOKE, STEEL.—Steel smoke stacks of the smaller sizes are made of sheet steel and are held in place by guy wires. They are not usually of large diameter, seldom exceeding 4 or 5 ft., and the height is limited to about 120 ft. These stacks are inexpensive but do not have a long life. For the larger sized stacks, riveted steel plate construction is used and the stacks are made self-supporting. These steel stacks are less expensive than reinforced concrete or brick stacks. They also have the advantage that they may be taken down and put up in another location, if necessary. Steel stacks are usually lined with brick as the sulphur in the flue gases corrodes steel quite rapidly.

Manufacturers:

Codd Co., E. J., 700-708 S. Caroline St., Baltimore, Md.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass.
Dover Boiler Works, Dover, N. J.
Downingtown Iron Works, Inc., Downingtown, Pa.
Freeman Mfg. Co., Racine, Wis.
Hamler Boiler & Tank Co., 39th & Halsted Sts., Chicago, Ill.
Heine Safety Boiler Co., 5316 Marcus Ave., St. Louis, Mo.
Keeler Co., E., Williamsport, Pa.
Lancaster Iron Works, Lancaster, Pa.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
Pittsburgh-Des Moines Steel Co., 404 Ross St., Pittsburgh, Pa.
Reeves Bros. Co., 338 Rush St., Alliance, Ohio.
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Riter-Conley Co., Pittsburgh, Pa.
Ruemmeli-Dawley Mfg. Co., 3911 Chouteau Ave., St. Louis, Mo.
Rust Engineering Co., Pittsburgh, Pa.
Scaife & Sons Co., William B., Pittsburgh, Pa.
Struthers-Wells Co., Warren, Pa.
Tide Water Iron Works, 725 Jefferson St., Hoboken, N. J.
Toledo Metal Manufactures Co., Toledo, Ohio.
Treadwell Construction Co., Midland, Pa.
Union Iron Works, Erie, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Weber Chimney Co., The, 1452-56 McCormick Bldg., Chicago, Ill.
Weiderholt Construction Co., Bank of Commerce, St. Louis, Mo.
Wickes Boiler Co., Saginaw, Mich.

STAGE CABLE.—See Cord, flexible, stage or theater.

STAGE CONNECTORS.—See Connectors, stage.

STAGE DIMMERS.—See Dimmers, theater or stage.

STAGE LAMPS.—See Spotlights, stage.

STAGE LIGHTS.—See Lights, stage, miscellaneous.

STAGE PLUGS.—See Plugs, stage.

STAGE POCKETS.—See Receptacles, stage.

STAGES, LINEMEN'S.—A small platform designed to be supported from the crossarms of a pole to give the lineman a better footing on which to work.

STAHL GEAR & MACHINE CO., THE.—1390 E. 40th St., Cleveland, Ohio. Manufacturer of gears. Business established 1917. President and general manager, George F. Stahl; secretary, treasurer and sales manager, Walter P. Stahl.

STAHL RECTIFIER CO.—1401-5 W. Jackson Blvd., Chicago, Ill. Manufacturer of rectifiers for charging of starting and lighting automobile batteries and magneto testers.

STAHOT.—Trade name for electric irons made by the Steatite Electric Products Corp., Yorktown Heights, N. Y.

STAIRWAYS OR ESCALATORS, MOVING, MOTOR-DRIVEN.—Stairways, consisting of pivoted treads and risers attached to endless bands or chains continuously propelled in one direction by electric motors. They are used in department stores, subway and elevated railway stations and such locations where large numbers of people pass from one floor level to another. They have a large capacity, but are slower than elevators.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Otis Elevator Co., 260 11th Ave., New York, N. Y.

STALACTITES, GLASS.—Incandescent lamp globes having a broad top or center and tapering to a pointed tip. They are usually either figured or made with many sides, as distinguished from the smooth round globe. Their name is derived from their resemblance to the stalactites found in caves.

Manufacturer:

Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

STAMPINGS, ARMATURE CORE.—Stampings of thin sheet steel, embracing the whole or a part of the armature circumference, from which the armature core is built up. For manufacturers see Armature punchings.

STAMPINGS, BRASS.—These include a very great variety of small brass parts, such as washers, fixture fittings and trimmings, clock-wheels, brackets, etc., which can be made by stamping from sheet brass. Brass-goods manufacturers prepare them in quantity to drawings or specifications.

Manufacturers:

Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.
American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Bridgeport Brass Co., Bridgeport, Conn.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Champion Hardware Co., Geneva, Ohio.
CRESCENT ELECTRIC CO., P. O. Box 178, Mountain Grove, Mo.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
Empire Stamping & Metal Spinning Co., Inc., 88-90 Walker St., New York, N. Y.
Faries Mfg. Co., Decatur, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Hyman & Co., Inc., Henry, 476 Broadway, New York, N. Y. "Hylite."
Illinois Stamping & Mfg. Co., 542 W. Jackson Blvd., Chicago, Ill.
Kales Stamping Co., 1657-87 Lafayette Blvd., Detroit, Mich.
Kensington Hardware & Tool Mfg. Co., 410-416 Mechanic St., Philadelphia, Pa.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Non-Twist Canopy Ring, Canada, Ltd., 58 Temperance St., Toronto, Ont., Can.
Parkin Mfg. Co., San Rafael, Cal.
PATTON-MAC GUYER CO., Providence, R. I. Our factory is equipped with modern machinery and tools especially adapted to manufacturing electrical component parts in brass, copper and steel. Our organization is trained to handle this work at minimum cost. We have tools already made for manufacturing innumerable electrical fittings.—Adv.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.
Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass.
Quadriga Mfg. & Specialty Co., 213 W. Grand Ave., Chicago, Ill.
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
Rieker Instrument Co., 1919-21 Fairmont Ave., Philadelphia, Pa.
Rome Mfg. Co., Rome, N. Y. "Rome."
Root Co., The C. J., Bristol, Conn.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
SHERMAN MFG. CO., H. B., Battle Creek, Mich. "Sherman." (See display adv. page 1323.)
Simplex Metal Spinning & Stamping Co., Inc., The, 24-34 New Chambers St., New York, N. Y.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.
STANDARD ELECTRIC & MFG. CO., 308 1st Ave., E., Cedar Rapids, Iowa. "Steico."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Tallman Brass & Metal, Ltd., Wilson. St, Hamilton, Ont., Can.
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Universal Chain Co., The, Stroudsburg, Pa.
Vester Sons, Inc., Alfred, 5 Mason St., Providence, R. I.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

STAMPINGS, FIBER.—Variously shaped pieces of fiber, used largely for insulation in electrical devices, and made by punching from sheet fiber.

Manufacturers:

Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Illinois Stamping & Mfg. Co., 542 W. Jackson Blvd., Chicago, Ill.
Kensington Hardware & Tool Mfg. Co., 410-416 Mechanic St., Philadelphia, Pa.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
National Fibre & Insulation Co., Yorklyn, Del. "Old Hickory," "Super Seasoned."
Quadriga Mfg. & Specialty Co., 213 W. Grand Ave., Chicago, Ill.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

STAMPINGS, SHEET IRON AND STEEL.—These may vary from extremely thin metal, such as used for armature punchings, to very much heavier, and

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from the size of a small washer to that of an automobile body, but the term stampings is usually applied to relatively small sized pieces, produced by punching from a sheet of the metal. For armature core stampings see Armature punchings. Also see Cores, electromagnet; Cores, field; Cores, transformer.

Manufacturers:

Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.
American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., 306 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Burgess-Norton Mfg. Co., Geneva, Ill.
Champion Hardware Co., Geneva, Ohio.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Detroit Pressed Steel Co., 6660 Mt. Elliott Ave., Detroit, Mich.
Faries Mfg. Co., Decatur, Ill.
Goshen Lightning Rod Co., Goshen, Ind.
Hale & Kilburn Corp., 1800 Lehigh Ave., Philadelphia, Pa.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Illinois Stamping & Mfg. Co., 542 W. Jackson Blvd., Chicago, Ill.
Kales Stamping Co., 1657-87 Lafayette Blvd., Detroit, Mich.
Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Kensington Hardware & Tool Mfg. Co., 410-416 Mechanic St., Philadelphia, Pa.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
PATTON-MAC GUYER CO., 31 Mathewson St., Providence, R. I.
Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass. "Universal."
Quadriga Mfg. & Specialty Co., 213 W. Grand Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
Reiter, G. C., Canton, Ohio.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
RISDON MFG. CO., Andrew Ave., Naugatuck, Conn.
Rome Mfg. Co., Rome, N. Y. "Rome."
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

STAMPINGS, SHEET METAL, MISCELLANEOUS.—Small metal parts of regular or irregular design which are stamped or punched out of sheets of the metal by dies set in punch presses. The great advantage of stampings lies in the fact that specially shaped parts can be produced in large quantities at low cost. The smaller manufacturers often find it cheaper to purchase such stampings than to install the necessary equipment for making them themselves.

Manufacturers:

Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.
American Brass Products Co., 105-15 S. Madison St., Pottstown, Pa.
American Nut & Bolt Fastener Co., The, Ontario & Doerr Sts., Pittsburgh, Pa.
Artcraft Metal Stamping Corp., 1022-24 Myrtle Ave., Brooklyn, N. Y.
Bay State Stamping Co., 380 Chandler St., Worcester, Mass.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. This company is prepared to furnish stampings, spinnings or drawings in any finish including porcelain enamel of the highest grade. No design is too large or too intricate for this modern fully equipped factory.—Adv.
Boesch Lamp Co., 960-62 Mission St., San Francisco, Cal. (Switch, heater and fixture specialties.)
Bossert Corp., The, Utica, N. Y.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."
Cambridge Brass Co., 815 Somerville Ave., Cambridge, Mass.
Champion Hardware Co., Geneva, Ohio.
Clark & Son, A. N., Plainville, Conn.
Clay Electric Co., 3398 N. 12th St., Philadelphia, Pa.
Cleveland Wrought Products Co., The, West 58th St., Cleveland, Ohio.
CRESCENT ELECTRIC CO., P. O. Box 178, Mountain Grove, Mo.
Crosby Co., The, Buffalo, N. Y.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Dominion Machine & Tool Co., Ltd., 77 Peter St., Toronto, Ont., Can.
Electric Box & Cover Co., Inc., 29 Ave. C, Newark, N. J.
Empire Stamping & Metal Spinning Co., Inc., 88-90 Walker St., New York, N. Y.
Gaynor Mfg. Co., The, Bridgeport, Conn.
Geuder, Paeschke & Frey Co., 1466-1476 St. Paul Ave., Milwaukee, Wis.
Hale & Kilburn Corp., 1800 Lehigh Ave., Philadelphia, Pa.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Hyman & Co., Inc., Henry, 476 Broadway, New York, N. Y. "Hylite."
Illinois Stamping & Mfg. Co., 542 W. Jackson Blvd., Chicago, Ill.
Kales Stamping Co., 1657-87 Lafayette Blvd., Detroit, Mich.
Keller Mechanical Engraving Co., 70 Washington St., Brooklyn, N. Y.
Kensington Hardware & Tool Mfg. Co., 410-416 Mechanic St., Philadelphia, Pa.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn.
Machen Electric Mfg. Co., 4639 E. Thompson St., Bridesburg, Philadelphia, Pa.
Mayer Co., George J., 4020 Guilford Ave., Indianapolis, Ind.
Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich.
Parkin Mfg. Co., San Rafael, Cal.
PATTON-MAC GUYER CO., 31 Mathewson St., Providence, R. I.
Pittsburgh Metal Spinning & Stamping Co., 821-823 Locust St., Pittsburgh, Pa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
Recording Devices Co., The, 5th & Norwood Sts., Dayton, Ohio.
Reiter, G. C., Canton, Ohio.
Reliance Metal Spinning & Stamping Co., Inc., 160 John St., Brooklyn, N. Y.
RISDON MFG. CO., Andrew Ave., Naugatuck, Conn.
Rome Mfg. Co., Rome, N. Y. "Rome."
Root Co., The C. J., Bristol, Conn.
SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327).
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Universal Chain Co., The, Stroudsburg, Pa.
Universal Metal Spinning & Stamping Co., Inc., 718 Atlantic Ave., Brooklyn, N. Y.
Vogel & Bros., Inc., William, 37 S. 9th St., Brooklyn, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Western Screw Products Co., 3221 S. Broadway, St. Louis, Mo.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
Worcester Pressed Steel Co., Worcester, Mass.
Worcester Stamped Metal Co., Worcester, Mass.

STAMPS, TIME, ELECTRIC.—Stamping devices equipped with inked ribbon and changeable numerals, type or other characters, indicating time, designed for use in punching the actual time on time cards of employees, letters received or cards indicating elapsed time for specific operations or jobs. The stamps are connected to electric circuits controlled by a contact-making clock which governs the electromagnetic mechanism of each device. They are very compact and quite simple in operation. One master clock can control a large number of time stamps and secondary clocks throughout a plant, large office or store.

Manufacturers:

Automatic Time Stamp Co., The, 160 Congress St., Boston, Mass. "Automatic."
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "International."
International Time Recording Co., 50 Broad St., New York, N. Y. "International."
Magnetic Clock Co., The, 37-39 E. 28th St., New York, N. Y. "Magnetograph."
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.
Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill.

STANDARD.—Trade name for track drills manufactured by the Aldon Co., 3338 Ravenswood Ave., Chicago, Ill.

STANDARD.—Trade name for electric vibrators and driers manufactured by the Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill.

STANDARD.—Trade name for condensers for telephone, telegraph, radio and all kinds of ignition and signaling service manufactured by the Electric Specialty Co., 233 N. Elm St., Cresco, Iowa.

STANDARD.—Trade name for attachment plugs and receptacles manufactured by the General Electric Co., Schenectady, N. Y.

STANDARD.—Trade name for soldering flux produced by the Grasselli Chemical Co., Cleveland, Ohio.

STANDARD.—Trade name for fire brick made by the A. P. Green Fire Brick Co., Mexico, Mo.

STANDARD.—Trade name for production counters manufactured by the R. A. Hart Mfg. Co., Battle Creek, Mich.

STANDARD.—Trade name for watchmen's electric time clocks manufactured by E. O. Hausberg, 49 Maiden Lane, New York, N. Y.

STANDARD.—Trade name for portable lamp guard manufactured by the McGill Mfg. Co., Valparaiso, Ind.

STANDARD.—Trade name for automobile jacks and railroad track tools manufactured by the National-Standard Co., Niles, Mich.

STANDARD.—Trade name for letter boxes manufactured by W. R. Ostrander & Co., 371 Broadway, New York, N. Y.

STANDARD.—Trade name for electric irons manufactured by the Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

STANDARD.—Trade name for lamp testing sets manufactured by the M. Propp Co., 108 Bowery, New York, N. Y.

STANDARD.—Trade name for power transmission belting manufactured by the Quaker City Rubber Co., 629 Market St., Philadelphia, Pa.

STANDARD.—Trade name for circuit breakers manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

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STANDARD.—Trade name for earth augers manufactured by the Specialty Device Co., 106 W. 3rd St., Cincinnati, Ohio.

STANDARD.—Trade name for storage batteries manufactured by the Standard Battery Mfg. Co., 1101-3-5 N. Main St., Fort Worth, Tex.

STANDARD.—Trade name for arc lamp carbons and carbon products, manufactured by the Standard Carbon Co., 488 Mills Bldg., San Francisco, Cal.

STANDARD.—Trade name for electric ranges, ovens and cooking compartments manufactured by the Standard Electric Stove Co., 1718-1720 N. 12th St., Toledo, Ohio.

STANDARD.—Trade name for fire alarms, electric clocks, signaling systems and accessories, made by the Standard Electric Time Co., 89 Logan St., Springfield, Mass.

STANDARD.—Trade name for portable electric tools manufactured by the Standard Electric Tool Co., Cincinnati, Ohio.

STANDARD.—Trade name for electric heating pads manufactured by the Standard Electrical Appliance Co., Beverly, N. J.

STANDARD.—Trade name for electric sealing machines manufactured by the Standard Envelope Sealer Mfg. Co., Everett, Mass.

STANDARD.—Trade name for Diesel engines manufactured by the Standard Fuel Oil Engine Co., Bucyrus, Ohio.

STANDARD.—Trade name for electricians' portable benches manufactured by the Standard Iron Works, Inc., 508-510 E. 74th St., New York, N. Y.

STANDARD.—Trade name for steel cabinets, switchboards, panelboards and theatrical lighting specialties manufactured by the Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex.

STANDARD.—Trade name for electrical automobile accessories manufactured by the Standard Metal Mfg. Co., Chestnut, Jefferson & Malvern Sts., Newark, N. J.

STANDARD.—Trade name for electric pumps manufactured by the Standard Pump & Engine Division, Adamson Machine Co., 730 Carroll St., Akron, Ohio.

STANDARD.—Trade name for portable electric and power sewing machines manufactured by the Standard Sewing Machine Co., Cedar Ave. & C. & P. Ry., Cleveland, Ohio.

STANDARD.—Trade name for steel forgings, malleable iron castings, wheels for electric cars, etc., made by the Standard Steel Works, 500 N. Broad St., Philadelphia, Pa.

STANDARD.—Trade name for thermostats, thermometers and other mechanical and recording instruments manufactured by the Standard Thermometer Co., 65 Shirley St., Boston, Mass.

STANDARD.—Trade name for bell-ringing transformers manufactured by the Standard Transformer Co., Dana Ave., Warren, Ohio.

STANDARD.—Trade name for wires and cables manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

STANDARD.—Trade name for incandescent lamp guard manufactured by the Standard Wire Co., New Castle, Pa.

STANDARD.—Trade name for solid-core commutators manufactured by the Toledo Standard Commutator Co., 2242 Smead Ave., Toledo, Ohio.

STANDARD ACCESSORY CORP.—355-357 E. Water St., Milwaukee, Wis. Manufacturer of phonograph lights.

STANDARD APPLIANCE CO. OF AMERICA.—380 Lafayette St., New York, N. Y. Manufacturer of telephone mufflers, etc.

STANDARD ART GLASS CO.—237 Lafayette St., New York, N. Y. Manufacturer of portable electric lamps and lighting fixtures. Business established 1908. Proprietor, Louis S. Richman.

STANDARD ASBESTOS CO.—69 Beekman St., New York, N. Y. Manufacturer of asbestos products.

STANDARD ASPHALT & REFINING CO.—Chicago, Ill. Manufacturer of waterproofing, insulating, battery sealing and impregnating compounds. Business established 1914. Vice-presidents, Frank W. Frueauf, W. A. Williams, P. M. Miskell, H. R. Straight; secretary, C. E. Murray; treasurer, R. C. Russum; manager, Charles R. Johnson. Main office, 208 S. LaSalle St., Chicago, Ill. Factories, Chicago, Ill., and Independence, Kans. Branch office, Insulite Products Co., Portland, Ore.

STANDARD ASPHALT & REFINING CO.—Bartlesville, Okla. Manufacturer of insulating oils, etc.

STANDARD-BALTIMORE.—Trade name for generators, motors, wiring devices, ovens, hoists, switches, winches, switchboards, controllers, air compressors and other electrical devices manufactured by the Standard Electric Machinery Co., 102 E. York St., Baltimore, Md.

STANDARD BATTERY MFG. CO.—Fort Worth, Tex. Manufacturer of storage batteries, storage battery parts and service station accessories. Business established 1918. President, Albert Kramer; vice-presidents, A. F. Hawkins, Max Rothman; secretary and treasurer, J. J. King; general manager, A. F. Hawkins; sales manager, Max Rothman. Main office and factory, 1101-3-5 N. Main St., Fort Worth, Tex. Branch offices and warehouses, Southwestern Battery Co., Dallas, Tex.; Standard Battery Sales Co., Houston and Waco, Tex.

STANDARD BRAZING CO.—45 Bromfield St., Boston, Mass. Manufacturer of brazing compounds.

STANDARD CARBON CO.—488 Mills Bldg., San Francisco, Cal. Manufacturer of projector carbons and carbon products. Factory, Richmond, Cal.

STANDARD CEDAR & LUMBER CO.—511 Lumber Exchange, Minneapolis, Minn. Producer of cedar poles.

STANDARD CELLS.—A standard cell is a voltaic cell which, when constructed according to certain specifications, maintains a constant voltage at a given temperature, and the voltage of individual cells so constructed differs by an extremely small fraction of a volt. The cell may, therefore, under proper conditions be used as a standard of e. m. f.

Three types of standard cell have been developed, the Clark, Carhart-Clark, and Weston cells. The standard cell in use at present is known as the Weston or cadmium standard cell. The electrodes of this cell are mercury covered by mercurous and cadmium sulphate paste for the positive pole, cadmium amalgam for the negative pole, and a saturated solution of cadmium sulphate for the electrolyte. The e. m. f. at 20° C. of the normal cadmium cell with saturated electrolyte is 1.01830 volts. Its e. m. f. at any temperature is:

$$E_t = E_{20} - 0.000406(t-20) - 0.00000095(t-20)^2 + 0.000000001(t-20)^3.$$

For most measurements the last two terms can be omitted.

A more recent form of the Weston cell is the unsaturated cell. The temperature coefficient of this cell is much smaller than that for the normal cell. It is especially well suited for potentiometer measurements. Its e. m. f. is very nearly 1.0186 volts and as constructed its resistance is about 200 ohms.

Manufacturer:

Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

STANDARD CINEMACHINERY.—Trade name for motion picture machinery manufactured by Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill.

STANDARD ELECTRIC & MFG. CO.—308 First Ave., E., Cedar Rapids, Iowa. Manufacturer of lighting fixtures and specialties. Business established 1917. President, A. J. Petersen; vice-president and general manager, A. C. Petersen; secretary and treasurer, H. A. Weyand.

STANDARD ELECTRIC MACHINERY CO.—102 E. York St., Baltimore, Md. Manufacturer of generators, motors, wiring devices, ovens, hoists, switches, winches, switchboards, controllers, air compressors and other electrical devices. Business established 1907. President, Guy K. Mitchell; vice-president, Frank Stark.

STANDARD ELECTRIC MFG. CO.—925-941 Wrightwood Ave., Chicago, Ill. Manufacturer of switches, electric whistles, and other electrical specialties. Business established 1911. President, L. E. Parker; vice-president, E. Parker; secretary and treasurer, T. L. Parker.

STANDARD ELECTRIC STOVE CO., THE.—1718-1720 N. 12th St., Toledo, Ohio. Manufacturer of electric ranges, ovens and cooking compartments.

STANDARD ELECTRIC TIME CO., THE.—Springfield, Mass. Manufacturer of electric time and signaling systems, fire alarms and accessories. Business established 1884. President and general manager, George L. Riggs; vice-president, J. J. Estabrook; secretary, C. M. Whiteford; treasurer, C. B. Fitts; sales manager, Charles F. Barrett. Main office and factory, 89 Logan St., Springfield, Mass. Branch offices, 261 Franklin St., Boston, Mass.; 50 Church St., New York, N. Y.; 1361 Monadnock Bldg., Chicago, Ill.; 421 New First National Bank Bldg., Columbus, Ohio; 461 Market St., San Francisco, Cal.; 5 Burrall Ct., Waterbury, Conn. Sales representatives, Langley & Ewart, 414 Essex Bldg., Minneapolis, Minn.; Haralson Sales Co., 752 Brown-Marx Bldg., Birmingham, Ala.; J. M. Fisher, 201 Oregon Bldg., Portland, Ore.; C. E. Brack, 901 Mutual Life Bldg., Buffalo, N. Y.; Oscar Sorenson, 161 S. Pearl St., Denver, Colo.

STANDARD ELECTRIC TOOL CO.—Cincinnati, Ohio. Manufacturer of portable electric tools. President, F. P. Hamilton; vice-president, E. E. Stevenson; secretary and treasurer, F. S. Baldwin.

STANDARD ELECTRICAL APPLIANCE CO.—Beverly, N. J. Manufacturer of electric heating pads. Business established 1916. President, J. H. Sinex; vice-president, Franklin P. Jones; secretary and treasurer, Franklin P. Jones, Jr.; general manager, George T. Newell, Jr.; sales manager, Earl R. Beyler.

STANDARD ELECTRICAL CONSTRUCTION CO.—San Francisco, Cal. Manufacturer of panelboards, switchboards, etc.

STANDARD ELECTRICAL MFG. CO.—220-22 High Ave., S. E., Cleveland, Ohio. Manufacturer of service entrance fittings, switch boxes, etc. Secretary and treasurer, George A. Streett.

STANDARD ELECTRODE.—See Normal electrode.

STANDARD ENVELOPE SEALER MFG. CO.—Everett, Mass. Manufacturer of electric sealing machines. President and treasurer, E. Charles Drouet; vice-president and general manager, F. W. Storck; secretary and sales manager, H. C. Hoskyns.

STANDARD FIBRE CO.—11 Miller St., Somerville, Mass. Manufacturer of fiber insulators, gears and other fiber products.

STANDARD, FLOOR LAMP.—The part of a floor lamp which supports the lamp proper and the lamp shade. It consists of a base or pedestal resting on the floor and an upright shaft or rod, supporting the lamp socket or sockets and shade at the desired height, which is usually 4 to 6½ ft. from the floor. While technically the standard would only consist of the upright shaft, common commercial usage includes the base as part of the standard as these parts are made and sold as a unit. The term pedestal is also widely used (although less correctly) instead of standard. See Bases and pedestals, floor lamp; also Lamps, floor.

STANDARD FORGINGS CO., THE.—Chicago, Ill. Manufacturer of axles for electric cars, etc., and electric railway forgings. President, George E. Van Hagen; vice-president, E. W. Richey; secretary, C. E. Jernberg; treasurer, L. C. Ryan. Main office, Railway Exchange Bldg., Chicago, Ill. Branch offices, 2040 Grand Central Terminal Bldg., New York, N. Y.; Merchants National Bank Bldg., St. Paul, Minn.

STANDARD FUEL OIL ENGINE CO., THE.—Bucyrus, Ohio. Manufacturer of Diesel engines.

STANDARD GAS PRODUCTS CO.—Atlanta, Ga. Manufacturer of oxyacetylene cutting and welding outfits. Business established 1913. President, treasurer and general manager, William Rawling; vice-president and secretary, P. W. Wilcox; sales manager, H. A. Dale. Main office, 216 Ivy St., Atlanta, Ga. Branch office, Chattanooga, Tenn.

STANDARD INSULATION CO.—Rutherford, N. J. Manufacturer of insulating materials. Business established 1918. President, G. J. Lange; vice-president and sales manager, F. P. Wilds; secretary, L. G. Lange; treasurer, D. B. Lange; general manager, Andrew Young.

STANDARD IRON WORKS, INC.—508-510 E. 74th St., New York, N. Y. Manufacturer of electricians' portable benches.

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STANDARD LAMP MFG. CO.—1323 S. Michigan Ave., Chicago, Ill. Manufacturer of floor lamps and lamp shades. President and general manager, L. A. Solomon; vice-president, H. L. Solomon; secretary, George Bruski; treasurer, H. Ostrowsky.

STANDARD LIGHT CO.—448 E. Water St., Milwaukee, Wis. Manufacturer of lighting fixtures. Business established 1920. President and general manager, Morris Tax; vice-president, D. Sigil; secretary, Morris Stern; treasurer, D. Stern.

STANDARD LOCK CO.—111-113 Himrod St., Brooklyn, N. Y. Manufacturer of electric door openers. Business established 1900. Frank D. Loch, sole owner. Sales representative, D. E. Distributing Co., 9 S. Clinton St, Chicago, Ill.

STANDARD MACHINERY CO.—Auburn, R. I. (P. O. address, Elmwood Station, Providence, R. I.) Manufacturer of bearings, armature disk notching and wire drawing machines. W. T. Murphy, general manager.

STANDARD MECHANICAL EQUIPMENT CO.—2020 Richardson Ave., Dallas, Tex. Manufacturer of steel cabinets, switchboards, panelboards and theatrical lighting specialties. President and general manager, W. H. Earl; vice-president, A. W. Earl; secretary, L. H. Hodge.

STANDARD METAL MFG. CO.—Chestnut, Jefferson & Malvern Sts., Newark, N. J. Manufacturer of electrical automobile accessories. President and treasurer, W. A. Lawrence; vice-president, Edward L. Lewis; secretary, C. S. Walling.

STANDARD OIL CO. OF CALIFORNIA.—200 Bush St., San Francisco, Cal. Manufacturer of transformer and lubricating oils.

STANDARD OIL CO. OF INDIANA.—910 S. Michigan Ave., Chicago, Ill. Manufacturer of lubricating oils and greases. President, W. M. Burton; vice-presidents, H. S. Morton, W. E. Warwick, B. Parks, Allen Jackson; vice-president, secretary and treasurer, E. G. Senbert.

STANDARD OIL CO. OF KENTUCKY.—Louisville, Ky. Manufacturer of lubricating oils.

STANDARD OIL CO. OF NEW YORK.—555 W. 25th St., New York, N. Y. Manufacturer of transformer and lubricating oils.

STANDARD OIL CO. OF OHIO.—E. Ohio Gas Bldg., Cleveland, Ohio. Manufacturer of lubricating oils.

STANDARD P. & S.—Trade name for boiler furnace regulators manufactured by the Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y.

STANDARD PLATE GLASS CO.—30 Sudbury St., Boston, Mass. Manufacturer of searchlight mirrors.

STANDARD PUMP & ENGINE DIVISION, ADAMSON MACHINE CO.—730 Carroll St., Akron, Ohio. Business established 1892. President, A. Adamson; vice-president, W. E. Slabaugh; secretary and treasurer, R. B. Kountz; sales manager, E. J. Green.

STANDARD RAILWAY SUPPLY CO.—Cincinnati, Ohio. Manufacturer of trolley wire splicing sleeves, etc.

STANDARD ROLLING MILLS CO.—363-367 Hudson Ave., Brooklyn, N. Y. Manufacturer of solder and tinfoil. I. I. Shonberg.

STANDARD SCIENTIFIC CO.—9 Barrow St., New York, N. Y. Manufacturer of electrical and other scientific instruments. Business established 1912. President, Newell D. Parker; secretary and treasurer, Henry C. Lomb.

STANDARD SEWING MACHINE CO., THE.—Cleveland, Ohio. Manufacturer of portable electric and power sewing machines. President and treasurer, Henry W. Corning; vice-president, Charles A. Otis; secretary, H. B. Knapp; general manager, O. J. Stewart. Main office, Cedar Ave. & C. & P. Ry., Cleveland, Ohio. Branch offices, Philadelphia, Pa.; Boston, Mass.; San Francisco, Cal.; St. Louis, Mo.; Cleveland, Ohio; 47 E. 19th St., New York, N. Y.; 210 W. Van Buren St., Chicago, Ill.

STANDARD SIGNS, INC.—428 6th Ave., S., Minneapolis, Minn. Manufacturer of electric signs and bulletin boards. Business established 1915. President and general manager, H. B. Green.

STANDARD SPECIALTY MFG. CO.—Cleveland, Ohio. Manufacturer of service entrance fittings and miscellaneous specialties.

STANDARD STAMPING CO., THE.—1st St. & 7th Ave., Huntington, W. Va. Manufacturer of household electric cooking appliances. Business established 1899. President, H. W. Morey; vice-president, W. T. Guy; secretary, D. G. Scott; treasurer and general manager, C. C. Armstrong; sales manager, H. M. Jones.

STANDARD STEEL & BEARINGS, INC.—Philadelphia, Pa. Manufacturer of ball and roller bearings. Business established 1903. President, A. F. Rockwell; vice-presidents, F. M. Germane, T. C. Fogel, G. H. Neilson; secretary, Ralph A. Gamble; treasurer, Harold C. Pryer; sales manager, F. M. Germane. Main office, 5001 Lancaster Ave., Philadelphia, Pa. Factories, Philadelphia, Pa., and Plainville, Conn. Branch offices, 1511 Kresge Bldg., Detroit, Mich.; 646 N. Meridian St., Indianapolis, Ind.; 1806 S. Michigan Ave., Chicago, Ill.; 251 Rialto Bldg., San Francisco, Cal.

STANDARD STEEL WORKS CO.—Philadelphia, Pa. Manufacturer of steel forgings, malleable iron castings, wheels for electric cars, etc. President, Samuel M. Gauclain; vice-presidents, William de Krasst, A. A. Stevenson; vice-president and sales manager, Richard Sanderson; secretary, Arthur L. Church; treasurer, A. B. Ehst. Main office, 500 N. Broad St., Philadelphia, Pa. Branch offices, 80 E. Jackson Blvd., Chicago, Ill.; St. Louis, Mo.; Richmond, Va.; San Francisco, Cal.; New York, N. Y.; Pittsburgh, Pa.; Houston, Tex.; St. Paul, Minn.

STANDARD SUPPLY & EQUIPMENT CO.—Cherry & 13th Sts., Philadelphia, Pa. Manufacturer of motor-driven fruit extractors. Branch offices, Trenton, N. J.; Altoona, Pa.; Pittsburgh, Pa.

STANDARD THERMOMETER CO.—65 Shirley St., Boston, Mass. Manufacturer of thermometers, thermostats and other mechanical and recording instruments. President and treasurer, Samuel C. Lord; secretary, Albert Shawcross.

STANDARD TRANSFORMER CO., THE.—Dana Ave., Warren, Ohio. Manufacturer of a-c. bells, push buttons and bell-ringing transformers. Business established 1919. President and general manager, W. F. Parker; secretary and treasurer, N. A. Wolcott.

STANDARD UNDERGROUND CABLE CO.—Pittsburgh, Pa. Manufacturer of wires, cables and underground construction specialties. Business established 1882. President and general manager, J. W. Marsh; vice-presidents, P. H. W. Smith, C. C. Baldwin, C. W. Davis and S. J. Marsh; secretary, J. W. Shibler; treasurer C. M. Hagen; sales manager, C. W. Davis. Main office, Westinghouse Bldg., Pittsburgh, Pa. Factories, Perth Amboy, N. J.; Pittsburgh, Pa.; Glenwillard, Pa.; Oakland, Cal. Branch offices and warehouses, St. Louis, Mo.; 111 W. Washington St., Chicago, Ill.; San Francisco, Cal.; Pittsburgh, Pa.; 50 Church St., New York, N. Y. District offices, Boston, Mass.; Philadelphia, Pa.; Washington, D. C.; Atlanta, Ga.; Detroit, Mich.; Seattle, Wash.; Los Angeles, Cal.; Minneapolis, Minn.; Salt Lake City, Utah.

STANDARD VARNISH WORKS.—New York, N. Y. Manufacturers of insulating paints and varnishes. Business established 1870. President, Arthur Davis; secretary, James Wolf; treasurer, S. H. King; general manager, J. William Rosenberg. Main office, 90 West St., New York, N. Y. Branch offices and warehouses, 506 Oakland Ave., S. W., Grand Rapids, Mich.; 55 Stevenson St., San Francisco, Cal.

STANDARD WASHING MACHINE CO.—1100 E. 55th St., Chicago, Ill. Manufacturer of electric vacuum type washing machines. Business established 1917. President and general manager, W. V. Rifle; secretary, Mrs. L. M. Koop; treasurer, Lawrence H. Whiting.

STANDARD WELDING CO., THE.—W. 73rd & L. S. & M. S. Railroad, Cleveland, Ohio. Manufacturer of welded steel and other tubing. President, J. O. Eaton; vice-presidents, John Younger and Dan C. Swander; secretary, P. A. Connolly; treasurer, T. E. Borton; general manager, W. L. Woodward.

STANDARD WIRE CO., THE.—New Castle, Pa. Manufacturer of incandescent lamp guards. Business established 1901. President and general manager, J. Kaufman; secretary and treasurer, J. L. Holsinger.

STANDARD WOOD TURNING CO.—1756 W. Austin Ave., Chicago, Ill. Manufacturer of portable electric lamps. Partnership, H. Klein and S. Renner.

STANDARD X-RAY CO.—1932-42 N. Burling St., Chicago, Ill. Manufacturer of X-ray apparatus. President and general manager, William J. Hettich; vice-president, Dr. C. F. Dick; secretary, C. O. Olson; treasurer, V. E. Hanson.

STANDARDIZATION RULES OF THE A. I. E. E.—As the result of many years' work by the Standards Committee of the A. I. E. E. with the co-operation of similar committees of ten other societies interested in electrical matters, there have been published as a book of 133 pp. the "Standardization Rules of the American Institute of Electrical Engineers." The chief purpose of these rules or standards has been to define the terms and conditions which characterize the rating and behavior of electrical apparatus, with special reference to the conditions of acceptance tests. These rules have been revised from time to time, the latest addition being that of 1918. Copies of this book can be obtained for 50 cents from the headquarters of the A. I. E. E., 33 W. 39th St., New York, N. Y.

STANDARDIZED.—Trade name for panelboards manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

STANDARDIZED.—Trade name for ash handling equipment manufactured by the Girtanner Engineering Corp., 1400 Broadway, New York, N. Y.

STANDCO.—Trade name for tachometers and rheostats manufactured by Herman H. Sticht & Co., 15 Park Row, New York, N. Y.

STANDPIPE.—A vertical pipe connected to the feeder pipe or penstock of a water-power plant, placed as close to the wheel as possible. Its diameter is from 30 to 50% of the penstock diameter, and (if not sealed) it must be as high as the head of water available at the plant. The purpose is to furnish a supply of energy to take care of sudden increases of load while the water is accelerating, and to serve as a relief valve in case of sudden excess pressures in the penstock. Standpipes are sometimes called surge tanks. (Also see Air chamber; also Water hammer.)

STANDS OR RESTS FOR ELECTRIC PRESSING IRONS.—These stands are metal devices either portable or attached to an ironing board, to permit an electric pressing iron to rest on them while heating or when not in use. They are usually made in several sections to prevent the radiation of heat and to keep the bottom of the stand cool. The fire hazard and danger of leaving an iron on the board with the current on while answering the telephone or doorbell is largely eliminated when the habit of resting the iron on its stand when not in use is established.

Manufacturers:

Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill. (Combined with ironing board.)

Wilson, Mrs. Catherine V., 541 Virginia Park, Detroit, Mich. "Wilson Iron Rest."

STANDS, PORTABLE, FOR ELECTRIC HAMMERS OR DRILLS.—These are rigid stands upon which heavy tools such as electric hammers or drills may be rested while in use in high or rather inaccessible places, such as near or in a ceiling. The workman on a ladder cannot successfully operate these heavy tools for any length of time, and the use of a rigid and movable stand is a decided advantage.

Manufacturer:

Grenzig, J. A., 359 Jay St., Brooklyn, N. Y.

STANITE.—Trade name for asbestos packing for flange joints manufactured by the Metallo Gasket Co., New Brunswick, N. J.

STANLEY.—Trade name for electric organ blower manufactured by the F. E. Whitney Co., 65 Sudbury St., Boston, Mass.

STANLEY, WILLIAM.—An American electrical inventor and engineer, born at Brooklyn, N. Y., in 1868. He was educated at the Williston Seminary at East Hampton, Mass., and at Yale University. In 1881 he became assistant to Edward Weston and in 1882 he was connected with

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the Swan Electric Light Co., where he invented and perfected a method of exhausting incandescent lamp bulbs. During 1883 and 1884 he conducted a private laboratory at Englewood, N. J. In 1884 he installed and equipped a lamp factory for the manufacture of incandescent lamps at Swissvale, Pa., and designed some d-c. machines adapted to operate incandescent lamps. The first a-c. system with transformers and parallel distribution built in this country was constructed in 1885 at Great Barrington, Mass., by Mr. Stanley. In 1890-91 he organized the Stanley Electric Mfg. Co. at Pittsfield, Mass. The first successful Stanley motors were completed in 1892 and in 1894 the company installed the polyphase transmission system at Housatonic, Mass. Later Mr. Stanley organized the Stanley Instrument Co. for the manufacture of a new form of wattmeter and for several years devoted his energies almost entirely to the development of this enterprise. In 1912 he was awarded the Edison medal by the American Institute of Electrical Engineers.

STANLEY & PATTERSON.—34 Hubert St., New York, N. Y. Manufacturer of telephone and electric signaling apparatus and electrical specialties. Business established 1884. President, George L. Patterson; vice-president, Arthur F. Stanley; secretary and sales manager, Albert S. DeVeau; treasurer, George B. Anthony. Sales representatives, J. A. Vaughan, Real Estate Trust Bldg., Philadelphia, Pa.; Doherty-Hafner Co., 618 W. Jackson Blvd., Chicago, Ill.; Heckert L. Parker, 111 New Montgomery St., San Francisco, Cal.; Clapp & LaMoree, San Fernando Bldg., Los Angeles, Cal.; P. L. Hoadley, Seaboard Bldg., Seattle, Wash.; Kemp Haythorne, 333 McKinley Ave., San Antonio, Tex.; H. B. Parke, Pittsburgh, Pa.; W H. Beaven, Jefferson County Bank Bldg., Birmingham, Ala.; Electrical Sales Co., Kenyon Bldg., Louisville, Ky.

STANLEY BELTING CORP.—32-40 S. Clinton St., Chicago, Ill. Manufacturer of cotton belting. Stanley Hathaway, sales manager.

STANLEY MFG. CO., THE.—50 Cannon St., Dayton, Ohio. Manufacturer of name plates for machinery, appliances, etc. President and sales manager, George F. Stanley; secretary and general manager, M. H. Stanley; treasurer and purchasing agent, H. R. Walker.

STANLEY WORKS, THE.—New Britain, Conn. Manufacturers of zigzag rules and insulated screw drivers. Main office and factories, New Britain, Conn. Branch offices, Bridgewater, Mass.; Niles, Ohio.

STANLICO.—Trade name for lighting fixtures made by the Standard Light Co., 448 E. Water St., Milwaukee, Wis.

STANNARDS MFG. CO.—379 Allen St., Springfield, Mass. Manufacturer of expansion sleeves. Business established 1902. President, C. S. Stannard; general manager, W. L. Stannard.

STANSICO.—Trade name for electrical and scientific instruments manufactured by the Standard Scientific Co., 9 Barrow St., New York, N. Y.

STANSICO-ALLEN.—Trade name for meter-testing rheostats manufactured by the Standard Scientific Co., 9 Barrow St., New York, N. Y.

STANWOOD.—Trade name for steps and treads made by the American Mason Safety Tread Co., 125 Perry St., Lowell, Mass.

STANWOOD EQUIPMENT CO.—Chicago, Ill. Manufacturer of safety treads. Main office, 308 N. Michigan Ave., Chicago, Ill. Branch offices, Boston, Mass.; San Francisco, Cal.

STAPLES, INSULATED.—Double-pointed staples provided with fiber insulation around the loop to prevent short-circuiting of wires secured by the staples. They are used for holding office buzzer, annunciator, telephone and other low-voltage wires.

Manufacturers:

Blake Signal & Mfg. Co., 221 High St., Boston, Mass. "Blake."

SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

STAR.—Trade name for grease and oil cups manufactured by the American Injector Co., 175 14th Ave., Detroit, Mich.

STAR.—Trade name for soldering furnaces manufactured by the Burgess Soldering Furnace Co., Columbus, Ohio.

STAR.—Trade name for ornamental street lighting posts manufactured by the Chicago Concrete Post Co., 608 S. Dearborn St., Chicago, Ill.

STAR.—Trade name for hacksaw blades manufactured by Clemson Bros., Inc., Middletown, N. Y.

STAR.—Trade name for insulated screw driver manufactured by the Cronk & Carrier Mfg. Co., 109 W. Water St., Elmira, N. Y.

STAR.—Trade name for spring and hammer drills manufactured by the Duffy Mfg. Co., 214 W. Grand Ave., Chicago, Ill.

STAR.—Trade name for electric fans, dishwashers and vibrators manufactured by the Fitzgerald Mfg. Co., Torrington, Conn.

STAR.—Trade name for ignition magneto generators manufactured by the Hercules Mfg. Co., 2122 Northwestern Ave., Indianapolis, Ind.

STAR.—Trade name for soldering pastes and sticks manufactured by the McGill Mfg. Co., Valparaiso, Ind.

STAR.—Trade name for leather belting manufactured by the F. Raniville Co., 241-247 Pearl St., Grand Rapids, Mich.

STAR.—Trade name for lighting fixtures manufactured by the Star Chandelier Co., Inc., 33 Bleecker St., New York, N. Y.

STAR.—Trade name for motors, generators and farm lighting plants manufactured by the Star Dynamo Co., Jefferson City, Mo.

STAR.—Trade name for electric fans and motors manufactured by the Star Electric Motor Co., Miller St. & N. J. R. R. Ave., Newark, N. J.

STAR.—Trade name for portable drills manufactured by the Star Expansion Bolt Co., 147-149 Cedar St., New York, N. Y.

STAR.—Trade name for renewable fuses manufactured by the Star Fuse Co., Inc., 168 Centre St., New York, N. Y.

STAR.—Trade name for electric headlights, automobile lamps and floodlight projectors manufactured by the Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y.

STAR.—Trade name for cutout boxes and sheet steel cabinets manufactured by the Star Metal Box Co., 507-509 W. 19th St., New York, N. Y.

STAR.—Trade name for storage batteries manufactured by the Star Storage Battery Co., 309-313 N. Jefferson St., Muncie, Ind.

STAR.—Trade name for fixture stems and conduit bushings manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

STAR.—Trade name for cotton insulating tape manufactured by the J. Sullivan & Sons Mfg. Co., 2224 N. 9th St., Philadelphia, Pa.

STAR AND STAR JUNIOR.—Trade names for electric cloth cutting machines manufactured by the Wolf Electric Promoting Co., 810 Main St., Cincinnati, Ohio.

STAR BRAND.—Trade name for rivets manufactured by the American Brass Co., 414 Meadow St., Waterbury, Conn.

STAR BRAND.—Trade name for brass, bronze and nickel silver rolls, sheets, wire, rods, etc., manufactured by the U. T. Hungerford Brass & Copper Co., 80 Lafayette St., New York, N. Y.

STAR BRASS MFG. CO.—Boston, Mass. Manufacturer of planimeters, etc. Main office, 53 Oliver St., Boston, Mass. Branch offices, New York, N. Y.; 6 E. Lake St., Chicago, Ill.; Pittsburgh, Pa.

STAR BRASS WORKS, THE.—Kalamazoo, Mich. Manufacturers of trolley harps and wheels.

STAR CHANDELIER CO., INC.—33 Bleecker St., New York, N. Y. Manufacturer of lighting fixtures.

STAR DYNAMO CO.—Jefferson City, Mo. Manufacturer of motors, generators and farm lighting plants. Business established 1894. President, B. J. Cooplidge; secretary and general manager, W. A. Nagle; sales manager, A. A. Allen.

STAR ELECTRIC MOTOR CO.—Miller St. & N. J. R. R. Ave., Newark, N. J. Manufacturer of motors, generators and fans. President, Emil E. Hollander; secretary and treasurer, C M. Petersen; general sales manager, E. B. Day.

STAR EXPANSION BOLT CO.—New York, N. Y. Manufacturer of cable and wire insulators and other circuit supporting devices. President, J. E. Ogden; vice-president, R. E. Ogden; treasurer, E. H. Clements; sales manager, Warren A. Peters. Main office, 147-149 Cedar St., New York, N. Y. Factory, Bayonne, N. J. Branch offices, 120 W. Lake St., Chicago, Ill.; 700 E. 3rd St., Los Angeles, Cal.

STAR FELT CUTTING CO., THE.—260 69th St., Brooklyn, N. Y. Manufacturer of felt gaskets, wicks, washers, etc.

STAR FUSE CO., INC., THE.—168 Centre St., New York, N. Y. Manufacturer of renewable fuses. President and general manager, M. Podell.

STAR GLASS CO.—Star City, W. Va. Manufacturer of illuminating glassware.

STAR HEADLIGHT & LANTERN CO.—294 Franklin St., Rochester, N. Y. Manufacturer of electric headlights, automobile lamps and lanterns. President and treasurer, Albert W. Jacobs.

STAR LUBRICATING OIL CO.—8714 Broadway, Cleveland, Ohio. Manufacturer of transformer and lubricating oils.

STAR METAL BOX CO.—507-509 W. 19th St., New York, N. Y. Manufacturer of cutout boxes and sheet steel cabinets.

STAR OR Y-CONNECTION.—The individual circuits of a polyphase system may be independent or interconnected. In a star connection one end of each phase circuit is connected to a common point called the neutral. In a three-phase system this type of connection is usually designated as a Y-connection.

STAR PORCELAIN CO., THE.—Trenton, N. J. Manufacturer of electrical porcelain. Herbert Sinclair, president.

STAR STORAGE BATTERY CO.—309-313 Jefferson St., Muncie, Ind. Manufacturer of automobile starting and lighting storage batteries. President, W. O. Haymond; vice-president, E. L. Haymond; secretary and treasurer, F. C. Haymond.

STAR WASHING MACHINE CO.—549 Quincy St., Chicago, Ill. Manufacturer of electric washing machines. President, treasurer and general manager, K. K. Schulz; vice-president, A. Hillstrom.

STARBUCK & SONS, R. M.—63 Asylum St., Hartford, Conn. Manufacturers of portable electric lamps. Business established 1897. Factory, Meridian, Conn.

STARK-INLAND MACHINE WORKS, INC.—St. Louis, Mo. Manufacturer of spark plugs, piston rings, etc. President and general manager, O. G. Stark; vice-president, L. J. Stark; secretary, Fred E. Moore; treasurer, Dan A. Ruebel. Main office, 1629 Locust St., St. Louis, Mo. Branch offices, New York, N. Y.; Chicago, Ill.

STARK ROLLING MILL CO., THE.—Canton, Ohio. Manufacturer of sheet iron and steel for electrical purposes. Main office, Canton, Ohio. Branch offices, 30 Church St., New York, N. Y.; Steger Bldg., Chicago, Ill.; Security Bldg., St. Louis, Mo.; First Wisconsin Bldg, Milwaukee, Wis.; First National Bldg., Cincinnati, Ohio.

STARLITE.—Trade name for luminous attachments manufactured by the Starlite Mfg. Co., 2 Columbus Circle, New York, N. Y.

STARLITE MFG. CO.—2 Columbus Circle, New York, N. Y. Manufacturer of luminous attachments. President and treasurer, Harry Cooper; vice-president and secretary, Cecil Anhalt.

STARRETT CO., THE L. S.—Athol, Mass. Manufacturer of tools for electricians, machinists, mechanics, etc. President, L. S. Starrett; vice-president, F. A. Ball; secretary and treasurer, F. E. Wing; sales manager, D. Findlay. Main office and factory, Athol, Mass. Branch offices, 90-92 West Broadway, New York, N. Y.; 17 N. Jefferson St., Chicago, Ill.

STARTER.—A starter is a device which brings about circuit changes or certain conditions which permit a safe current to flow through an electric motor and develop starting torque, and to bring the motor approximately up to speed. Several methods of starting are required because of the different types and sizes of motors and because of the different conditions under which they have to be started. The principal types are described below.

The term starter is also used to apply to starting devices for internal-combustion engines, as on automobiles and motorboats. These are also described below.

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STARTERS, "ACROSS THE LINE" TYPE.—Single-phase motors and squirrel-cage induction motors up to 5 hp. are usually connected directly to the line for starting. D-c. motors up to 1 hp. are also frequently started in this way.

STARTERS, AUTOMOBILE, ELECTRICAL, COMPLETE OUTFITS.—These electrical starters for automobiles comprise an electric starting motor, controlled by a foot pedal or foot-operated switch, connected to a storage battery and mounted on the automobile frame or on the engine structure. They are provided with a centrifugal or spiral device for temporarily engaging the driving pinion on the motor with the engine shaft through suitable gears during the starting operation. They are usually arranged so that the motor will just start to turn before the gear to turn over the engine is engaged. As soon as the engine starts, the motor is stopped and its driving pinion is disengaged.

Manufacturers:

American Bosch Magneto Corp., Springfield, Mass. "Bosch."
Bijur Motor Appliance Co., 15th & Garden Sts., Hoboken, N. J.
Dayton Engineering Laboratories, Dayton, Ohio. "Delco."
Electric Auto-Lite Corp., Toledo, Ohio.
Fisher Electrical Works, 1014 Lynn St., Detroit, Mich.
Gray & Davis, Boston, Mass.
Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."
Liberty Starter Co., 2281 W. Fort St., Detroit, Mich. "Liberty."
North East Electric Co., Rochester, N. Y. "North East."
Recording & Computing Machines Co., The, 1 Essex Ave., Dayton, Ohio. "Ohmer."
U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
Service Products Co, The, Greenawalt Bldg., Springfield, Ohio. "Heinze-Springfield."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STARTERS, MOTOR, AUTOMATIC.—An automatic starter is a starter designed to automatically control the acceleration of a motor. There are two types, time limit and current limit. Time-limit starters are those in which the motor accelerates in a fixed time regardless of the load. The timing is usually obtained by oil dashpot, air dashpot or by a pilot motor. Timing by dashpots is the cheaper and more common method and the oil dashpot is in general preferred to the air type. An automatic starter of the dashpot type usually consists of a solenoid with a plunger whose motion is retarded by a dashpot. The contact-making mechanism is connected to the plunger and as it moves forward resistance is cut out of the motor armature circuit either by (1) an arm sliding over segments, (2) a number of fingers making contact with buttons or (3) by the compression of a carbon pile rheostat.

Current-limit starters are those in which the rate of acceleration depends on the load. The acceleration is controlled either by current relays, series contactors, or counter-voltage relays or contactors. Current-limit starters have the disadvantage that the motor will not accelerate on heavy loads. Current-relay acceleration is the most complicated and is used principally where speed regulation is required. Acceleration by series or lockout contactors is commonly used for the larger sizes of automatic starters. Counter-voltage acceleration is used principally with small d-c. motors where only one or two accelerating contactors are required.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts, Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE. Milwaukee, Wis. C-H Automatic Controllers include practically every type that is required for motors driving machinery of every kind—as pumps, compressors, fans, machine tools, printing presses, freight and passenger elevators, hoisting machinery, cranes, etc. The characteristics of the various



C-H Automatic Starter

types of controllers depend largely upon the service in which they are to be used. Starters of the time-limit type are well adapted for the control of motors driving pumps, fans, compressors and other machinery where the load is likely to vary between wide limits. C-H Bulletin 6105 is typical of standard C-H Automatic Starters of the time-limit type. The time of acceleration is controlled by an oil-filled dashpot which can be adjusted to suit load conditions. After the dashpot is once set, the starter will always cut out the resistor in the same length of time. Bulletin 6105 provides low-voltage release when two-wire control is used and low-voltage protection when operated by a push-button master switch with three-wire control. C-H Magnetic Lockout Starters are designed especially for the automatic or remote control of motors driving heavy machinery and where the starting load is fairly constant. C-H Bulletin 6215 is an example of a stand-



C-H Automatic Starter

ard C-H Magnetic Lockout Starter. It consists of a series of very rugged clapper type contactors with series coils, so designed that each accelerating contactor is magnetically prevented from closing until the motor current has fallen to a predetermined value. A main contactor of the clapper type, equipped with a powerful magnetic blowout, is provided for opening the circuit. The use of automatic starters of the counter electromotive force type is confined to small motor service. Bulletin 6192 starter is built for motors up to 2 hp. In addition to the c. e. m. f. contactor, a main magnetic contactor is provided so that the motor may be controlled from a remote station by the use of a single-pole knife switch or a snap switch. A single step of resistor is cut out of circuit automatically when the motor has attained approximately one-half speed. In addition to the standard C-H Starters which are adapted for general use, the company manufactures a large number of special starters designed to meet special requirements. For certain conditions both time-limit and magnetic-lockout acceleration are used on the same controller. In mines special precautions are taken to insure long life and successful operation in spite of mine moisture and hard service. In steel mills where motor controllers receive exceptionally hard usage, special methods of construction are used. In elevator service unusual precautions are taken to insure dependable operation. For a-c. service C-H Starters include all types found in commercial service. C-H Bulletin 9602 is a simple across-the-line type of starter. It provides for low-voltage release with a two-wire remote control and furnishes low-voltage protection with three-wire control. Starters of this type are used to connect polyphase induction motors of the "internal starter" type directly to the line, providing the starting current inrush does not exceed three times the full-load current. They may also be used as main-line contactors for drum controllers, multiple-switch starters or other manual equipment where main-line contactors are desirable. Bulletin 9605 is an automatic



A-C. Automatic Starter

starter of the primary-resistor type. It is used with single-phase, self-starting or squirrel-cage motors, but only with the latter when driving a centrifugal pump or other machine with such load characteristics that the starting torque required does not exceed that corresponding to 60% of normal line voltage applied to the terminals. Bulletin 9605 is provided with two double-pole contactors and a solenoid-operated dashpot timing relay. One contactor connects the motor and starting resistor to the supply lines, the other short-circuits this resistor after a definite time interval determined by the setting of the relay. Transformer type starters are used with polyphase squirrel-cage motors which drive centrifugal pumps, ventilating fans, etc., where the starting characteristic is such that the motor can accelerate with a starting torque not exceeding that corresponding to 67% of normal voltage. Bulletin 9620 is used for motors up to 550 volts. Bul-



A-C. Automatic Starter

letin 9622 is used with 2200-volt motors and is equipped with oil-immersed magnetic contactors. The transformers in both starters are connected to impress 67% of normal line voltage upon the motor for starting. After a definite time interval, determined by the setting of the timing relay, the motor is connected directly to the supply lines. For extraordinary starting conditions, extra transformer taps are provided so that either 50 or 83% of normal line voltage may be impressed on the motor for starting. The motor and starting

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transformer are entirely disconnected from the line in the "off" position. Secondary-resistor-type starters are designed for use with polyphase slip-ring induction motors driving reciprocating pumps, air compressors, or other machines which require a starting torque equal to or greater than the full-load motor-torque. C-H Bulletin 9630 is characteristic of this type. Current-limit acceleration is used, the rate being governed by secondary current relays. Equal amounts of resistance are cut out in all phases of the resistor circuit in such a way that the rotor currents are balanced step by step. C-H Automatic Starters of the secondary-resistor type are made for both low-tension and high-tension motors. See display adv. pages 1225-1230.—Adv.



Bulletin 9622 Automatic Starter

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

Fort Wayne Engineering & Mfg Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

INDUSTRIAL CONTROLLER CO., Milwaukee, Wis.—A most complete line of automatic starters to meet the requirements for all electric motors. These include d-c. automatic motor starters, a-c. magnetic contactors, and enclosed panel-type automatic starters of the Class 8526, for induction motors under 5 hp., which provide protection in case of overload or undervoltage. Automatic compensators are also made for large induction motors.—Adv.

Jewell Electric Co., The, Munsey Bldg., Baltimore, Md.

Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. See "Control Systems. Newspaper Web Printing Presses. Sprague products" see display adv. pages 1306-7.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

Ward Leonard Electric Co., Mt. Vernon, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STARTERS, MOTOR, COMBINED REACTANCE AND RESISTANCE TYPE.—Single-phase induction motors are usually provided with a starting and a running winding. During starting, resistance is placed in series with one of these windings and an impedance coil of high reactance in the other. The currents are, therefore, out of phase and a rotating flux is produced similar to that of a polyphase machine. When the motor is up to speed, the starting winding is disconnected and the running winding connected directly to the line. Manual controllers of the face-plate type are used for this service.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

Automatic Switch Co., 154 Grand St., New York, N. Y. "Whittingham."

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "CC."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."

Radio Corp. of America, 233 Broadway, New York, N. Y.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

STARTERS, MOTOR, COMPENSATOR TYPE.—See Autostarters or autotransformer starters.

STARTERS, MOTOR, FUSE SHORT-CIRCUITING SWITCH TYPE.—See Switches, motor starting (fuse short-circuiting).

STARTERS, MOTOR, PLAIN RESISTANCE TYPE.—See Rheostats, motor starting.

STARTERS, MOTOR, SPECIAL AND MISCELLANEOUS.—The principal types of motor starters are defined and listed above and these various standard types meet practically all conditions encountered in general practice. There are special cases, however, where an unusual cycle in starting is necessary or for which exceptional protective features are required. Such cases may be taken care of by modified forms of standard starters or sometimes may necessitate a special design. A careful analysis of the proposed cycle and of all attendant conditions is necessary, but this study almost invariably permits working out a design that will serve the purpose. This classification covers such special designs and also miscellaneous types of motor starters not included in other subclassifications.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

Automatic Switch Co., 154 Grand St., New York, N. Y. "Whittingham."

Canadian Fairbanks-Morse Co., The, 84-98 St. Antoine St., Montreal, Que., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)

Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. "CC."

GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of motor controlling devices and also special equipments made up to perform particular service. See page 1211 for general information.—Adv.

INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."

Liberty Electric Corp., Port Chester, N. Y.

Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.

Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.

Motor Protector Mfg. Co., 47 Kearny St., San Francisco, Cal.

Radio Corp. of America, 233 Broadway, New York, N. Y.

Rowan Controller Co., 308 N. Holliday St., Baltimore, Md. "Rowan."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "Union."

Ward Leonard Electric Co., Mt. Vernon, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STARTERS, MOTOR, STAR-DELTA TYPE.—Star-delta starters are used in connection with special squirrel-cage induction motors for reducing the starting current. The starter is arranged to connect the motor windings in star for starting and delta for running. The starting voltage is therefore 57% of normal, and the starting current 3 to 4 times normal. This type of starter is used principally with motors from 5 to 30 hp. starting light. Above 30 hp. autotransformer starters are used because the line current is less for this type. Star-delta starters can only be used with a motor having 6 leads and are not common. Also see Switches, motor-starting (star-delta).

STARTERS, MULTIPLE-LEVER.—See Switches, motor-accelerating.

STARTERS, PRIMARY-RESISTANCE TYPE.—Primary-resistance starters are used in connection with squirrel-cage motors for reducing the inrush current at starting. Resistance is placed in both phases of a two-phase motor and two or three lines of a three-phase motor. The resistance is usually designed to limit the starting current to three times normal. This type of starter is used principally with motors from 5 to 30 hp. starting light. Above 30 hp. autotransformer starters are used, because the current drawn from the line is less for this type. Primary-resistance starters are simpler than autotransformer starters, but less efficient.

STARTING AND LIGHTING OUTFITS, AUTOMOBILE AND MOTORBOAT.—These are very complete equipments comprising starting motors which may have special windings and control apparatus permitting the motor to act as a generator when run above a predetermined speed to charge a storage battery which is used for supplying energy to lamps, spark-coils, and to the motor during the starting operations. This type is known as the "single unit" type. Other starting and lighting systems are provided which are of the two-unit type, comprising a starting motor and separate generator which charge the storage battery; for the starting part of the two-unit set see Starters, automobile, electric.

Manufacturers:

Gray & Davis, Inc., Boston, Mass. (automobile).

Liberty Electric Corp., Port Chester, N. Y.

Liberty Starter Co., 2281 W. Fort St., Detroit, Mich. "Liberty."

Remy Electric Co., Anderson, Ind.

Simms Magneto Corp., The, East Orange, N. J. "Simms."

U. S. Light & Heat Corp., Niagara Falls, N. Y. "USL."

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STARTING BOXES.—This term was formerly much used for motor starters of the plain resistance type. See Rheostats, motor starting.

STARTING PANELS.—See Panels, motor starting.

STARTING RHEOSTATS.—See Rheostats, motor starting.

STARTING SWITCHES.—See Switches, motor starting (fuse short-circuiting); switches, motor starting, (compensator); Switches, motor starting (star-delta); Switches, safety, motor.

STARTING TORQUE, MOTOR.—The torque or twisting effort exerted by the starting current in an electric motor. It is the moment of the twisting couple ordinarily exerted about the shaft axis. It acts to overcome the friction of the motor at rest. The customary unit in which torque is measured is the pound-perpendicular-foot or merely pound-foot. It means a force of one pound acting at right angles to a radius arm 1 foot in length. Single-phase induction motors, as such, have zero starting torque and must be started in some other way.

STASSANO FURNACE.—One of the earliest forms of electric steel furnaces, in which the bath was heated by an arc drawn between two electrodes immediately above the bath.

STATE ELECTRICAL RULES.—Statute requirements governing line construction exist in California, Montana, Nebraska, and Washington; and governing inside work in Oregon and Washington. The Montana law specifies that the National Electrical Safety Code shall be followed for points not specifically covered in the law. The Oregon requirements combine the rules of the National Electrical Code and the National Electrical Safety Code.

Orders have been issued by public service commissions to govern line construction in Arizona, Connecticut, Idaho, Illinois, Kansas, Nevada, New Jersey, North Dakota, Oregon, Utah, and Wisconsin; and especially covering crossing of one utility by another in California, Iowa, Michigan, Nebraska, and Pennsylvania. The more recent of these are either based on the

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National Electrical Safety Code (Conn., Ill., Kans., Neb.) or are identical with it (N. Dak., Utah, Wis..). The Arizona rules are based on the specifications of the National Electric Light Association. The Connecticut rules cover the joint use of poles by two utilities. California, Iowa, Nebraska and North Dakota have rules covering inductive interference. Committees are now working on new rules in California, Nevada, and Wisconsin. Many of the commissions have issued regulations for utility service.

Orders have been issued by industrial commissions to govern inside work (stations, wiring, and utilization equipment) in California, Pennsylvania, and Wisconsin. The two latter are identical with the National Electrical Safety Code, while the California rules involve minor variations. The fire marshals of Illinois and Ohio have issued orders requiring safety switches in those states. Orders covering fire-alarm systems have been issued in New Jersey and New York.

Orders regulating electric lighting have been issued in California, New Jersey, New York, Ohio, Oregon, Pennsylvania, and Wisconsin. These are all based on the Factory Lighting Code of the Illuminating Engineering Society.

STATES CO., THE.—72 Francis Ave., Hartford, Conn. Manufacturer of meter testing instruments and equipment, also specialties and supplies. Business established 1911. President, treasurer and general manager, H. A. Blakeslee; secretary, R. H. Blakeslee.

STATIC DISCHARGE.—A disruptive discharge of static electricity across a dielectric, such as air, when it gives way under the mechanical stress of the electrical forces present. The discharge takes the form of a spark, which punctures or jumps across the dielectric.

STATIC ELECTRICITY.—A term referring to electricity induced in a conductor or produced by friction, as rubbing together two dissimilar substances, such as glass and silk, etc. It is also that electricity or charge that remains upon the surface of a body or is contained in the plates of a condenser. It is also referred to as electricity at rest as distinguished from dynamic or current electricity or electricity in motion. Also see Electricity.

STATIC INTERFERENCE, RADIO.—See Radio communication interference.

STATIC MACHINES.—See Electrostatic machines.

STATIC NEUTRALIZERS.—See Neutralizers, static, electricity.

STATION CABLE.—See Wire, flameproof, or station cable.

STATIONS, HOSPITAL SIGNAL OR CALLING.—Apparatus used in hospital nurses' call systems consisting of a wall plate equipped with a detachable plug, cord and push button. Pressing the button causes a number of signal lamps mounted at various places in the building to be illuminated. For use in wards containing several patients, the calling stations are equipped with a small signal lamp. Each calling station is provided with an answering button operated by the nurse; this button extinguishes all lamps lighted by the calling button. Also see Signaling systems, hospital nurses' and doctors'.

Manufacturers:

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Stanley & Patterson, 34 Huber St., New York, N. Y. "DeVeau."

STATIONS, REMOTE MOTOR CONTROL.—Remote-control stations for motors are frequently of the push-button type. The push buttons in such stations are usually of the momentary-contact type; that is, if the button is normally open, it is returned to the open position by a spring as soon as it is released. The number of buttons in a station depends upon the service. A two-button station is used with an ordinary nonreverse automatic starter, one normally open button for starting and a normally closed button for stopping. For skip-hoist push-button service three buttons are common: up, down and stop. The push-button station in the car on an automatic elevator equipment has one button for each landing and a stop button. Large newspaper presses frequently have three or more buttons at each control station. Inching buttons are also frequently provided for certain machine drives. Instead of push buttons, snap switches which function in the same way as ordinary lighting switches, and control stations of the drum-switch type are also common.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STATIONS, TELEPHONE PAY.—See Coin collectors, telephone.

STATIONS, WATCHMEN'S TIME REPORTING.—Boxes consisting of circuit-closing contact mechanisms connected to a central recording apparatus and designed to be operated by watchmen during tours of inspection. This record shows at what hours each station was visited. One system in quite common use is connected to an outside common central station where fire alarms may be sent in and from which, if watchmen's signals are not received within a limited time after they are due, an investigator is sent out to learn whether there is trouble.

Manufacturers:

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
United Alloy Steel Corp., Canton, Ohio.

STATOR.—The stationary member of an electrical machine, commonly that of an induction machine. It contains a part of the iron of the magnetic circuits and one or more of the electric circuits, most frequently the primary windings.

STAY PUT.—Trade name for rail bonds manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

STAYLIT.—Trade name for special sockets and switches manufactured by the Tremont Products Co., 216 High St., Boston, Mass.

STAYSALITE.—Trade name for linemen's torch manufactured by Mathias Klein & Sons, 3200 Belmont Ave., Chicago, Ill.

STAZON.—Trade name for rust-preventing compound manufactured by the Conversion Products Corp., 149 Broadway, New York, N. Y.

STEAM CORP., THE.—215 N. Michigan Ave., Chicago, Ill. Manufacturer of electric oil heaters. President, Morgan J. Hammers.

STEAM-ELECTRIC PRODUCTS CO., THE.—1250 W. 76th St., Cleveland, Ohio. Manufacturer of electric heating devices. Business established 1919. President and general manager, A. F. Schroeder; vice-president, W. F. Clark; sales manager, C. L. Walters. Sales representative, Auto Manufacturers Service Co., 973 Woodward Ave., Detroit, Mich.

STEAM PRIME MOVERS.—Steam prime movers are classified according to whether they are of the piston or the revolving type; the former are reciprocating engines, the latter turbines. Both types are classified according to the mode of using the steam or controlling it and the number of cylinders or stages. The former gives noncondensing and condensing engines and turbines.

Reciprocating engines are used for low speeds, high starting torque and variable speeds. The turbine is used only for high speeds (or low speeds obtained through reducing gears) and constant speeds. The reciprocating engine costs less than the turbine up to 500 hp. and has a higher efficiency in smaller sizes. Reciprocating engines are being rapidly replaced by turbines for capacities above 500 hp. on account of their lower cost, greater compactness and adaptability to larger power capacities. On account of these advantages turbines are available in sizes ranging from 10 hp. up to 75,000 hp.

The small turbine finds particularly useful application for driving centrifugal pumps, exciters, condenser auxiliaries and similar apparatus where high-speed equipment is used and where space is cramped. The reciprocating engine is used largely for variable-speed work, such as driving blowers and stokers. There are other special cases where the small steam turbine should be used; but for capacities below 200 hp. economy and initial cost favor the reciprocating engine.

The large steam turbine is used almost exclusively for driving generators, rotary air compressors, centrifugal pumps, etc. Turbines are also used for direct or geared drive of ship propellers. Also see Engines, steam, simple; Engines, steam compound and triple-expansion; Turbines, steam, exhaust and low pressure; Turbines, steam, mixed and high pressure.

STEAM RAILROAD ELECTRIFICATION, DEVELOPMENT OF.—As a result of the growth in recent years of the traffic on the steam railroads of the country, the limitations of the steam locomotive have been evident under three principal conditions: first, in congested terminals; second, at important tunnels; and third, over the heavy grades encountered on mountain divisions.

Operation with electricity as the motive power has successfully overcome the above limitations of the steam locomotive by reason of the increase in track capacity, and the elimination of smoke and dangerous gases, which are the determining factors with respect to the first two conditions. Due to the inherent characteristics of the electric motor, electric locomotives are capable of exerting a greater continuous drawbar pull over a wider speed range than is possible with the steam locomotive, thus removing the limitation imposed under the third condition and making possible the handling of greater tonnage over existing tracks, which obviates the necessity of double tracking.

The initial electrification in this country of a section of a steam railway was brought about by the necessity of finding some means of hauling trains through tunnels which would eliminate the dangerous gases and the smoke incident to the operation of the steam locomotive. Experiments with various means of keeping tunnels free from gases had not proved successful and the choice fell upon electricity as the means of solving the problem. The first steam railway in the United States to employ this form of motive power was the Baltimore & Ohio R. R., which in 1895 equipped its tunnel at Baltimore with three 96-ton electric locomotives. The success of these locomotives in this initial installation of slow-speed service demonstrated the practicability of heavy electric traction.

Following this tunnel electrification little was accomplished in the application of electricity as a motive power on railroads until the Park Avenue tunnel disaster in New York City again focused attention on the hazards of steam-locomotive operation in long tunnels. From this developed the building of a magnificent new passenger terminal by the New York Central R. R. Co. in the heart of New York City and equipping it for electrical operation, which was inaugurated in October, 1906. This terminal provides not only for the large movement of New York Central suburban, local and through trains, but also accommodates all of the train service of the New York, New Haven & Hartford R. R., which enters New York City over the tracks of the New York Central R. R. The train movements in and out of this terminal are between 500 and 550 per day.

The Grand Trunk R. R. about this time equipped its tunnels between Sarnia and Port Huron, under the St. Clair River with electric locomotives, eliminating the gas hazard and increasing the track capacity.

Following in close order came the electrification of a tunnel on the Great Northern R. R.; the electrification of the Detroit River tunnel and the terminal of the Michigan Central R. R. at Detroit; the electrical operation of the Hoosac tunnel of the Boston & Maine R. R., and the electrification of the tunnel leading to the great terminal of the Pennsylvania R. R. in the heart of New York City, as well as the terminal itself, which was placed in service during the fall of 1910.

Since that time other projects involving electrification of steam railways have been carried out, both for the purpose of securing the economies and the increased capacities possible with electrical operation, as well as to overcome the hazards of tunnel operation with steam motive power. In 1913 the Butte, Anaconda & Pacific R. R., operating a heavy freight service and some passenger trains, electrified 30 route miles in mountainous country in Montana.

The Norfolk & Western R. R., handling a very heavy coal traffic and operating over mountain grades and through a long single-track tunnel, equipped approximately 30 route miles for electrical operation in order to increase track capacity and

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provide for safe and reliable tunnel operation.

The Canadian Northern R. R., in order to gain an entrance into Montreal, tunneled through a large mountain and equipped the tunnel and adjacent terminal for electrical operation.

The next and greatest example of electrical operation of a heavy trunk-line railroad is that of the Chicago, Milwaukee & St. Paul R. R., which in 1916 began the electric operation of 440 route miles on two mountain divisions. In 1920 this road put into operation 208 additional miles of electrification on the Cascade and Coast divisions, making a total of 648 route miles now operated by electric traction.

No statement of the development of electrification of steam railways would be complete without mention of the work done in connection with heavy suburban service on the Long Island R. R., which enters the Pennsylvania Terminal in New York City by means of tunnels from Long Island; also the West Jersey & Seashore R. R., operating between Camden and Atlantic City, N. J.; and the Pennsylvania R. R. electrification of that portion of the Broad Street terminal at Philadelphia which serves two of its important suburban branches, to Paoli and to Chestnut Hill.

Systems. The term "system of electrification" is used to define the kind of electric power used for the propulsion of the locomotives and motor cars. In the United States there are employed three principal systems of electrification, viz.: the direct-current, the single-phase, and the three-phase, the latter, however, having been employed in only one installation, that of the Great Northern R. R.

There are also subdivisions of these principal systems of electrification, such as high and low-voltage direct current, the straight single-phase, and one employing single-phase current on the working conductor and three-phase motors on the locomotives.

Each of the several electrification systems having been installed on important railroads and having proved successful through years of operation, and the results having been analyzed and studied, it has been demonstrated that each of these systems of electrification is practicable and reliable, and that a detailed study of the situation and an exhaustive analysis of all of the conditions surrounding any proposed electrification is necessary in order to arrive at the best solution of the problem. Therefore, today there are relatively few engineers who advocate but one particular system as being the only solution for any and every electrification project.

The flexibility of electrical equipment and the apparatus of electric locomotives permits in certain instances the interchange of locomotives or multiple-unit cars between roads using different systems. Thus the single-phase locomotives and cars of the New York, New Haven & Hartford R. R., taking current from a high-tension overhead contact system when on their own rails, also operate over the New York Central R. R. electrified tracks and take power from the low-tension direct-current underrunning protected third rail. Direct-current locomotives could operate over tracks having an overhead contact system carrying single-phase current, if such locomotives were provided with converters or motor-generator sets. The fact that a single-phase series commutator motor is also a good direct-current motor makes possible the operation of single-phase locomotives on direct-current systems where such operation is necessary.

Relative Status. The mileage of electrified steam railroads (heavy traction service) in the United States and Canada amounts to less than 1% of the total mileage of railroads of these two countries. As the greatest accomplishments in electrification have been made on this continent, it would appear that in the 26 years since its first establishment the electrification of steam railroads has made but slow progress. Yet, when the time of accomplishment is considered and compared to the much greater period during which steam operation has been in use, it is apparent that considerable advance has been made. In considering the general progress of electrification it must be remembered that the steam locomotive has been developed through generations of railroad experience and has reached comparatively high standards of mechanical design and operating efficiency; also to displace this familiar type of motive power it is necessary to overcome considerable "mental inertia" on the part of the steam railway men.

Electrification having proven itself successful under the most severe conditions of railroading, such as tunnels, terminals and mountain divisions, the considerations that now determine its further progress are mainly financial, especially the question of securing the capital necessary to effect the change.

Prospects. Due to the financial considerations referred to, it is not likely that wholesale electrification of steam railroads will be effected for many years. What may be expected first is the gradual electrification of more terminals, mountain divisions, heavy suburban lines, tunnels and other strategic sections where the advantages of electrification are most marked. With increasing cost of fuel and increased density of traffic electrification of intervening stretches of main line will probably come, especially in the western mountain states, in the Appalachian mountain sections and the congested divisions of the eastern states. An outcome of the present super-power survey of the metropolitan and industrial district between Boston and Washington may be the acceleration of railroad electrification in that district.

An encouraging feature is that steam railway operators now realize that electric locomotives are not simply replacing steam locomotives as a form of motive power, but that they provide a new tool capable of doing much more work in a given time, a tool which, where fully taken advantage of, will revolutionize the present practices and methods based on the steam locomotive as motive power.

Abroad, financial conditions are retarding electrification even more than in the United States and Canada, except in those countries where the fuel shortage is so serious as to amount to a national peril. This is true in Belgium, France, Switzerland and Italy, where extensive electrification projects are being considered. Several railroads in England, South Africa and South America are now actively engaged in the work of electrifying portions of their more important lines.

STEAM RAILROAD ELECTRIFICATION, ECONOMIES AND OTHER ADVANTAGES OF.—A. Economies. The economies to be obtained from the electric operation of steam railroads have been demonstrated to be substantial in amount and include savings in the following items:

(1) Fuel for power, due to the higher efficiency of combustion in large power stations, the reduction in standby losses, and to regenerative braking.

(2) Maintenance of electric locomotives and the use of multiple-unit passenger cars.

(3) Reduction in the number and size of repair shops and the accompanying reduction in labor, most evident where the electric operation covers one or more steam-locomotive divisions.

(4) Reduction in the cost of train crew service per ton-mile, due to higher average speeds and heavier trains.

(5) Reduction in the number and size of fuel and water stations. None are required for electric operation except on a very small scale to supply fuel-oil and water for heating through passenger cars in winter weather.

The published records of several electrifications of steam railroads have shown a saving in coal varying from 25% to 60%. If a saving of 50% were obtained by the substitution of electric locomotives for steam locomotives on all the railroads in the United States, it is estimated that it would amount to 12% of the total coal production of the country.

Tests have shown that from 3 to 7 lbs. of coal on the tender of a steam locomotive is equivalent to one kilowatt-hour measured at the high-tension side of the substation (thus including the transmission losses). A modern power station will produce one kilowatt-hour for less than 2½ lbs. of coal; hence from test data a fuel saving of more than 50% can be computed under conditions favorable to electric operation. However, a word of caution should be said against placing too much reliance upon results of tests, even if they fairly well represent actual conditions. To be of comparative value, service records should extend over several years, and the data should be carefully collected and averaged to give results which may be expected in every-day operation.

Regenerative braking results not only in considerable fuel economy but effects a saving in brake shoes and wheel tires. Tests have shown that a train on a 2% grade has regenerated 42% of the power required to pull the same train up the grade. The records for a month on the Rocky Mountain electrified division of the Chicago, Milwaukee & St. Paul R. R. for both freight and passenger trains indicate that the regeneration was equivalent to 11.3% of the total power used.

The maintenance of electric locomotives per mile is less than for steam locomotives. In one instance, that of a heavy freight road operating in a mountainous district of Montana, covering 30 route miles (122 miles on a single-track basis), and operating 28 80-ton electric locomotives, the average maintenance cost per locomotive over a period of six years was 6 cents per mile. This covered the years 1914 to 1919, both inclusive. The cost of maintenance of steam locomotives on this same road prior to electrification was, in 1909, 16 cents per mile. In general, taking prewar costs as a basis, the normal maintenance of steam locomotives ran from about 13 to 16 cents per locomotive-mile, while for electric locomotives during the same period it normally ran from 3 to 10 cents per locomotive-mile.

The reduction in number and magnitude of repair shops and necessary working force results from the greater mileage of electric locomotives, due to increased speed and less time out of service for cleaning, coal, water, inspection, repairs, overhauling and other causes peculiar to the steam locomotive. Electric locomotives are capable of performing from 400 to 500 miles per day for passenger service and about one-half these amounts in freight service. An authority on electrification recently stated that the electric locomotive is available for revenue work for 6000 out of the 8760 hours per annum, or 70% of the time, while the steam locomotive is available for revenue duty only 2500 hours, or only about 30% of the time. The repairs and overhauling on electric locomotives are comparatively simple matters, resulting in the requirement of only small maintenance forces and shop facilities. As an illustration, one armature winder and an assistant assures the operation of the 336 motors on the 42 electric locomotives on the Chicago, Milwaukee & St. Paul electrification, while the storage and repair facilities at the midpoint of the 440-mile initial installation formerly required for steam locomotives of 220 miles of route are sufficient for the storage and repair of all the electric locomotives required for the entire mileage. On this 440-mile electrification 42 electric locomotives replaced 112 steam locomotives.

Electrification has eliminated the necessity for shops and roundhouses at other points on the divisions. The only work done outside of the repair shops is light inspection.

The saving in cost per ton-mile and per train crew results from the greater locomotive capacity, the higher average speeds and the high availability-factor obtained with electric service as compared to steam operation.

The general results of the electrification on the St. Paul Railroad have been summed up by an official of the company by saying that it is quite within the facts to state that so far as that railroad is concerned it has forgotten that the continental divide exists. In other words, the electric locomotive, because of its almost unlimited tractive effort, has eliminated the ruling grades.

On the heavy Montana freight road first referred to, having 30 route miles electrified, the 17 electric locomotives first installed did the work of 28 steam locomotives. On this road, with few exceptions, the electric locomotives are operated in pairs, with one engine crew, resulting in a large reduction in expense for labor, yet handling greater tonnage than with steam locomotives. In the case of this road, it is stated that the annual net saving due to the economies of electric operation have exceeded 20% on the entire cost of electrification.

In the case of the Norfolk & Western R. R.—a heavy coal-carrying road operating through mountainous country including a long single-track tunnel—12 electric locomotives replaced 34 Mallet type steam locomotives. The tonnage per day in the direction of heavy traffic was increased from about 50,000 tons to about 65,000 tons. The resulting reduction in crew expense

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per ton-mile is very considerable. The operating speeds on 1% and 2% grades increased from 7 miles per hour to 14 miles per hour. The saving in round-trip running time is about 40%. On this road the single-track tunnel on a grade was the "neck of the bottle" with steam operation. Electrification has entirely removed this limitation and made possible a large increase in tonnage on the existing tracks. To obtain this increase with steam operation would have required additional tracks in the tunnel, as well as along the line, a very expensive undertaking in mountainous country. It has been stated that the cost of electric operation on this road is 12½% less than formerly, under steam operation, including all fixed and operating charges.

No coaling or watering stations are required in connection with electric traction; the expense of upkeep and operation of such facilities, which is a very considerable item with steam operation, is eliminated. For the heating of through passenger cars a small amount of fuel and water must be provided on electric locomotives during the winter months.

The running time between terminals with electric operation can be considerably reduced over that required when using steam locomotives. One instance has been referred to above. Another is that of the 30-mile electrification of the heavy freight road first referred to above. On this road, the average for three days of steam operation showed 1768 tons per train, time per trip 2 hours and 25 minutes. For electric operation one year later during three days of the same month of the year, there was handled 2122 tons per train, time per trip 1 hour and 25 minutes.

On the Chicago, Milwaukee & St. Paul electrification it has been found that the electric locomotives in passenger service can reduce the running time on long grades 30% or more. In the freight service it has been found that on one division where steam locomotives had required 10 to 12 hours to make 115 miles, electric locomotives can meet a schedule of from 7 to 8 hours for the same distance. Another instance on this road is that during the severe winter of 1917-18, it was quite customary to make up on the 440-mile electric run, fully 2 hours of the time lost by passenger trains on adjoining steam-locomotive divisions.

The greater part of the above discussion has related to the economies obtained in main-line electrification. Economies are also obtained in heavy suburban service, together with the absence of noise, smoke, gases, reduction in train delays and increase in station capacity. On the New York Central R. R. the multiple-unit electric cars in the suburban trains averaged 69,373 miles per detention during the year 1919, which may be considered a normal performance. The running time was also improved. The use of multiple-unit electric trains in suburban service reduces very much the switching at terminals, eliminates movement to and from round houses, and therefore, very materially reduces congestion at the terminal. Another instance of the advantages of the multiple-unit electric train operation in suburban service is that of the electrification of the Pennsylvania terminal in New York City and important suburban routes at Philadelphia. Here the capacity of the terminals, which was completely reached in steam operation, has been increased about 24% by the use of electric traction with multiple-unit trains.

With regard to switching service, especially in or near large cities, the elimination of smoke, gases and noise is a very important advantage of electric operation. The freight and passenger switching yards are often located in thickly populated sections and the undesirable characteristics of smoke and gas production, together with the noise of the exhaust and whistle, are intensified as compared with main-line operation. All of these undesirable features are eliminated with electric operation of switching service.

B. Other Advantages. The other advantages of electric operation, which do not of themselves result in a direct saving in train operation, but which accrue to the benefit of the railroad company or to the public, may be briefly enumerated below.

(1) Increase in track capacity, deferring the addition of tracks and the enlarging of terminals.

(2) Elimination of delays due to taking on coal and water, and from defective equipment; also from delays incident to steam-locomotive troubles in freezing weather.

(3) Reduced cost of painting structures due to the elimination of steam and smoke.

(4) Reduced cost of cleaning ballast due to the elimination of cinders and ashes.

(5) Conservation of coal, where water power is available for the generation of electricity, and a reduction in nonrevenue freight due to reducing the quantity of company coal consumed.

(6) Increased reliability of operation as evidenced by the greater train mileage per locomotive detention and a reduction in descending grade danger due to regenerative braking.

(7) Increase in property values adjoining city terminals and along the right-of-way because of the elimination of noise, smoke, steam and gases of the steam locomotives.

(8) The use of "air rights" over electrified terminals for the building of office and other buildings; also the possibility of two-deck terminals.

STEARNES CO.—133 W. Lake St., Chicago, Ill. Manufacturer of motor-driven fruit and vegetable peelers and parers and other hotel, kitchen and restaurant equipment.

STEARNS MOTOR MFG. CO.—Box 252, Ludington, Mich. Manufacturer of farm lighting and power plants. Business established 1909. President, J. S. Stearns; vice-president, R. L. Stearns; secretary and treasurer, E. E. Curtis; general manager, H. P. Wollensak.

STEATITE ELECTRIC PRODUCTS CORP.—Yorktown Heights, N. Y. Manufacturer of electric irons. Business established 1920. President and general manager, Samuel T. Moore; vice-president, Thomas D. Finizio, secretary, William J. Byrne; treasurer, James N. Strang; sales manager, Lester E. Moffatt. Main office, Yorktown Heights, N. Y. Factories, Yorktown Heights, Chester, Vt. Branch office, Chester, Vt.

STECHER CO., INC., THE CHARLES.—2301 Knox Ave., Chicago, Ill. Manufacturer of motor-driven machines, drills, etc. President and treasurer, Charles Stecher; vice-president, Emily Stecher; secretary, Charles F. Vogel.

STEEL.—Essentially an alloy of iron containing a small amount of carbon (usually not over 1.5%), capable of being cast directly in malleable form or of being hardened by sudden cooling. Small amounts of other elements may be present as impurities, and a definite amount of another element may be added to produce an "alloy steel" of a special property, as manganese steel, nickel steel, etc. Steel is usually manufactured from pig iron by oxidation and removal of the impurities contained therein, followed by readdition of carbon to the desire amount. The oxidation may be carried out in Bessemer converters, open-hearth furnaces, or electric furnaces. In the crucible steel process there is no oxidation, but materials of the desired composition are melted together in a crucible, yielding a high-grade product.

Electric steel can be made of equally high-grade, on account of the ease of control of the furnace atmosphere, temperature and other operating conditions. The electric furnace is especially well adapted for making alloy steels, since no difficulty need be encountered from oxidation of the alloying elements and the high temperatures necessary are readily attained. Of the steel produced in the United States in 1919, 77.7% was open-hearth steel, 21.0% Bessemer, 1.1% electric, and 0.2% crucible. The total production of steel ingots and castings was 34,671,232 long tons; that of electric steel 384,452 long tons. The United States production is roughly half of the world's production, Germany and Great Britain being the other two leading countries. The number of electric steel furnaces in the United States on Jan. 1, 1920, was 323, and in the world nearly 900.

STEEL, ALLOY, ELECTRIC FURNACE.—The electric furnace is very well suited to the production of alloy steel, because of the fact that the process may be carried on at high temperatures without the difficulty usually encountered from oxidation of the alloying elements. This permits the manufacture of alloys that were not possible before the introduction of the electric furnace and much progress has been made in recent years in this field. The steels produced have varying characteristics, depending upon the nature of the alloys. Such alloy steeels as manganese steel, chromium steel, vanadium steel, silicon steel, silicon-manganese steel, nickel steel, and combinations of the above, and others containing tungsten, molybdenum, titanium, aluminum, etc., are successfully made for use in high-speed tools, automobile axles, engines and other parts, large guns, airplane engines and many other machine parts, etc., where the metal is subjected to severe stresses and often also to high temperature.

Manufacturers:

Andrews Steel Co., The, Newport, Ky.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Hammond Steel Co., Inc., The, 2600 Milton Ave., Syracuse, N. Y.
Milton Mfg. Co., Milton, Pa.
Trojan Electric Steel Co., 3401 S. Hoyne Ave., Chicago, Ill.
United Alloy Steel Co., Canton, Ohio.

STEEL CABINETS.—See Cabinets, sheet steel, panelboard, switch, etc.

STEEL CASTINGS.—See Castings, electric steel; Castings, miscellaneous steel, for motors and other electrical machinery.

STEEL CITY.—Trade name for conduit boxes and other products manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

STEEL CITY ELECTRIC CO.—1221 Columbus Ave., Pittsburgh, Pa. Manufacturer of conduit fittings and wiring devices. Business established 1904. President and general manager, W. I. Patterson; vice-president, A. H. Trimble; secretary and treasurer, Charles P. Trimble; sales manager, V. G. Fullman. Sales representatives, E. R. Bryant, Boston, Mass.; A. J. Bressan Co., New York, N. Y.; D. B. Scarborough, Philadelphia, Pa.; G. V. Carpenter, Buffalo, N. Y.; W. P. Ambos Co., Cleveland, Ohio; J. T. Pearson Co., Detroit, Mich.; J. P. Lane, St. Louis, Mo.; Ohio Distributing Co, Chicago, Ill.; Foster Callaghan, Birmingham, Ala.; H. C. Moran, Pittsburgh, Pa.; Wesco Electrical Supply Co., Denver, Colo.; Allied Industries, San Francisco, Cal.; Walter Ehman, Kansas City, Mo.; Hatheway & Knott, New York, N. Y.; R. S. Wakefield, Dallas, Tex.

STEEL CROSSARMS.—See Crossarms, iron and steel.

STEEL, ELECTRIC FURNACE.—Steel made in electric furnaces, or electric steel as it is commonly called, is a very high-grade product. Where the induction type furnaces are used, a charge of pure steel scrap and pig iron may be made into a steel similar to crucible steel. Other high-grade steels are made in the arc type furnaces from charges of cold steel scrap covered with a slag containing a high percentage of lime, and brought to a high temperature. The reaction eliminates the impurities, such as phosphorous, sulphur, silicon, manganese and carbon, and the proper composition is obtained by the introduction of the necessary alloys. The physical properities of electric steel are usually superior to steels of similar composition made by other processes; this is due to its homogeneity and freedom from the traces of numerous impurities that weaken other steels. The electric steel output has rapidly risen during the last six years.

Manufacturers:

Bethlehem Steel Co., Bethlehem, Pa.
Canadian Brakeshoe Co., Ltd., 101 Belvidere St., Sherbrooke, Que., Can.
Carbon Steel Co., 32nd St., & A. V. Ry., Pittsburgh, Pa.
Chicago Steel Foundry Co., 3720 S. Kedzie Ave., Chicago, Ill.
Crowley Co., John A., 120 Liberty St., New York, N. Y.
Disston & Sons, Inc., Henry, Tacony, Philadelphia, Pa.
Hammond Steel Co., Inc., The, 2600 Milton Ave., Syracuse, N. Y. "Triton," "Taurus."
Ludlum Steel Co., Watervliet, N. Y.
Ryerson & Son, Joseph T., Corn Exchange National Bank Bldg., Chicago, Ill.
Trojan Electric Steel Co., 3401 S. Hoyne Ave., Chicago, Ill.
Union Drawn Steel Co., Beaver Falls, N. Y.
Union Electric Steel Co., Keystone Bldg., Reading, Pa.
United Alloy Steel Co., Canton, Ohio.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL FOR SPRINGS.—Steel for making springs is often an alloy steel. Some

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of the common alloys that have given good results are chromium-vanadium steel, vanadium steel, silicon-manganese steel, etc. Steel for making springs is not always an alloy steel, however, if about 1% of carbon is used and the steel is comparatively free from phosphorus and sulphur, ordinary spring steel is obtained. This is suitable for use in nearly all springs and its cost is less than some of the alloy steels, whose chief advantage is a greater elasticity.

Manufacturers:

Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Bethlehem Steel Co., Bethlehem, Pa.
Carbon Steel Co., 32nd St., & A. V. Ry., Pittsburgh, Pa.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Hammond Steel Co., Inc., The, 2600 Milton Ave., Syracuse, N. Y.
Laclede Steel Co., Arcade Bldg., St. Louis, Mo.
New York Wire & Spring Co., Hoboken, N. J.
Standard Steel Works Co., 500 N. Broad St., Philadelphia, Pa. "Standard."
Tacony Steel Co., 1417 Sansom St., Philadelphia, Pa.
United Alloy Steel Co., Canton, Ohio.
Woodward Iron Co., Woodward, Ala.

STEEL FURNACES.—See Furnaces, electric, steel.

STEEL GAINS.—See Gains, steel.

STEEL HANDLE.—Trade name for wrench manufactured by the Coes Wrench Co., 1 Coes Sq., Worcester, Mass.

STEEL, MAGNET.—The desirable qualities in steels for permanent magnets are: Ability to retain as much as possible of the magnetism it was capable of possessing while under the influence of the field of an electromagnet after that field is removed, and the retention of that residual magnetism at its full value for a long period of time. As to the physical properties of steel which give it these qualities little is known. Steels when heated above a temperature of about 750° C. become nonmagnetic. Some alloys of steel, while at ordinary temperatures nonmagnetic when cooled by liquid air become magnetic. It was thought that the harder the steel the better were its qualities but this was later known to be true of most, but not all, steels. However, it is known that certain steels if given the proper heat treatment will be highly satisfactory for permanent magnets. The most satisfactory steels used have contained a carbon content of about 1% and about 5% tungsten. These steels require a special heat treatment. This is ordinarily given by heating the steel to well above 750° C., then cooling it suddenly. The method of cooling may be to simply dip the metal in oil, water or brine solution, but the more satisfactory method seems to be to cool by a cold water spray.

The magnetic properties of various alloys of steel containing chromium, manganese, molybdenum, and tungsten have been tested. It was found that though carbon was beneficial to the steel it was possible to obtain highly satisfactory results by various combinations of the above four elements or by suitable additions of silicon or vanadium, the latter being very desirable. When carbon was not present it was found that quenching was unnecessary.

Manufacturers:

Bethlehem Steel Co., Bethlehem, Pa.
Carbon Steel Co., 32nd St. & A. V. Ry., Pittsburgh, Pa.
Hammond Steel Co., Inc., The, 2600 Milton Ave., Syracuse, N. Y.
Laclede Steel Co., Arcade Bldg., St. Louis, Mo.
Ludlum Steel Co., Watervliet, N. Y.
United Alloy Steel Co., Canton, Ohio.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL MILL PACKING CO.—238-42 W. Jefferson Ave., Detroit, Mich. Manufacturer of metallic packing. Secretary and treasurer, J. R. Beamer.

STEEL PINS.—See Pins, insulator, iron and steel.

STEEL PIVOTS.—See Pivots for meters and instruments.

STEEL POLES.—See Poles, steel, expanded and latticed; Poles, iron and steel, tubular.

STEEL POSTS.—See Posts, ornamental and plain street lamp, iron and steel.

STEEL REFLECTORS.—See Reflectors, iron and steel, painted, aluminized, etc.; Reflectors, steel, porcelain enameled.

STEEL ROPE.—See Rope, steel wire.

STEEL RULES.—See Rules, steel, straight, electricians' and mechanics'.

STEEL SHEET, FOR ELECTRICAL PURPOSES.—Steel used for electrical purposes generally contains a small amount of silicon. In amounts up to 4%, silicon increases the magnetic permeability and reduces the retentivity. Over 6% it renders steel exceedingly brittle. Silicon steel is rolled into sheets for use in making electromagnets and in the field cores and armatures of electric generators and motors, for the cores of transformers, etc. It has high permeability with high electrical resistance. Its use therefore results in low core losses.

Manufacturers:

American Rolling Mill Co., The, Middletown, Ohio. "Armco," "Muskingkum."
American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa. "Apollo Special," "Dynamo Special," "U. S.", "American Armature."
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Carbon Steel Co., 32nd St., & A. V. Ry., Pittsburgh, Pa.
Central Steel & Wire Co., 119-127 N. Peoria St., Chicago, Ill. "Cisco."
Columbia Steel Co., The, Elyria, Ohio. (for deep drawing in dies).
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Driver-Harris Co., Harrison, N. J.
Electric Steel Box Co., 541-46 W. Monroe St., Chicago, Ill.
Newport Rolling Mill Co., Newport, Ky.
Ryerson & Son, Joseph T., 16th & Rockwell Sts., Chicago, Ill.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Stark Rolling Mill Co., The, Canton, Ohio. "Stark."
West Penn Steel Co., Brackenridge, Pa.

STEEL STRAND.—See Strand, galvanized steel.

STEEL TAPES.—See tapes or wires, steel fish.

STEEL TOWERS.—See Towers, steel, radio antenna; Towers, steel, transmission line.

STEEL WIRE.—See Wire, copperclad steel.

STEELCLAD.—Trade name for electric heating devices manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

STEELDUCT CO., THE.—213-17 Dollar Bank Bldg., Youngstown, Ohio. Manufacturer of rigid metallic conduit. Business established 1919. President and treasurer, William B. Curtis; vice-president and secretary, John A. Logan. Sales representatives, Walker Bros. & Haviland, 112 S. 16th St., Philadelphia, Pa.; 120 Broadway, New York, N. Y.; H. C. Moran, 1111 Keystone Bldg., Pittsburgh, Pa.

STEER WARMS.—Trade name for steering wheel warmers manufactured by the Interstate Electric Co., 356 Baronne St., New Orleans, La.

STEERE, GEORGE.—434 S. Dearborn St., Chicago, Ill. Manufacturer of name plates for switchboards, etc. Business established 1882.

STEERING GEAR, MARINE, ELECTRICALLY OPERATED.—Electrically operated steering gears are used on some of the larger marine and naval vessels. These ships employ electricity for a number of power purposes. For operating the steering gear a motor operating the rudder directly by means of gearing is sometimes used. In other cases the motor is used to drive a hydraulic pump and the motion is transmitted to the rudder by means of a hydraulic piston. Very often electrical indicators are supplied to operate with this apparatus, indicating in the various navigating stations the position of the rudder. For manufacturers of the indicator, see Indicators, helm and other marine.

Manufacturer:

Maine Electric Co., Inc., The, 35 Commercial Sts., Portland, Me.

STEERING WHEEL WARMERS.—See Warmers, steering wheel.

STEIGERT CO., L.—Elder & Logan Sts., Cincinnati, Ohio. Manufacturer of boiler water level gages.

STEINER MFG. CO.—St. Louis, Mo. Manufacturer of electric grinders and meat choppers. President, J. Steiner; vice-president, D. Adelsdorf; secretary and treasurer, S. Koninski. Main office, 4100 N. 21st St., St. Louis, Mo. Branch office, 172 N. Dearborn St., Chicago, Ill.

STEINMETZ, CHARLES PROTEUS.—An American electrical engineer, born at Breslau, Germany, in 1865. He was educated at Breslau, Zurich and Berlin, specializing in mathematics, chemistry, electrical engineering and mechanical engineering. In 1889 he came to the United States. Through a letter of introduction he secured a position as draftsman in the electrical shops of Mr. Eickemeyer at Yonkers, N. Y. He was promoted rapidly and in a few years was chief designer and in full charge of all new and experimental work. In 1893, after the merging of a number of large electrical manufacturing concerns to form the General Electric Co., Dr. Steinmetz became consulting engineer of this newly established company, which has since become the largest electrical manufacturer in the world. As chief consulting engineer, he is particularly associated with its technical development and research work and has conducted a multitude of difficult investigations. He has been granted a large number of patents for his electrical and other inventions. Dr. Steinmetz has contributed many original papers to the proceedings of many engineering and scientific societies, notably the American Institute of Electrical Engineers, of which he was president in 1901-2. Since 1902 he has also held the chair of professor of electrophysics at Union College, Schenectady, N. Y. He has written several books which have become classics in electrical literature. Dr. Steinmetz is a gifted writer and lecturer and possesses an extraordinary power of direct analysis and clear presentation of any subject he deals with, whether it be in the realm of pure theory or applied science.

STEINMETZ ELECTRIC MOTOR CAR CORP.—Arlington, Baltimore, Md. Manufacturer of storage battery trucks. President, A. J. Norton; vice-president, E. J. Power; secretary and treasurer, W. R. Grant.

STELCO.—Trade name for lighting fixtures made by the Standard Electric & Mfg. Co., 308 1st Ave., E., Cedar Rapids, Iowa.

STELLITE.—An alloy manufactured in the electric furnace, composed basically of 75 to 90% cobalt and 25 to 10% chromium, with sometimes additions of molybdenum or tungsten, used chiefly as a substitute for high-speed tool steel, particularly for soft metals like brass or bronze.

STEMS, CANDLE.—Frequently electric lighting fixtures are designed to represent candles, with the incandescent lamp replacing the candle flame. Light porcelain tubes are used as the bodies of the candles and are called candle stems.

Manufacturers:

Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Faries Mfg. Co., Decatur, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

STEMS, FIXTURE.—Brass or other metal tubes used for supporting lighting fixtures from ceiling outlets. They are usually threaded at both ends and usually contain the wires. When gas also is used, the wires are run outside the gas pipe but inside a larger tube often called the casing. Stems and casings are sometimes square in shape.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto.
Butler Electric Co., 3531 Cottage Grove Ave., Chicago, Ill. "Beco," "Cisco."
Caldwell Electric Corp., 1002 N. Market St., Champaign, Ill.
Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
Electrical Dealers Supply House, 162 W. Randolph St., Chicago, Ill. "Edsh."

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Faries Mfg. Co., Decatur, Ill.
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.
POLACHECK & BRO. CO., CHARLES, 217 3rd St., Milwaukee, Wis.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. on page 1308.)
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.)
"Star" fixture stems are made of malleable iron, sherardized, with full, sharp threads. Two designs, hollow (hickey type) and solid, both furnished in ⅜ and ½-in. sizes. Arms are countersunk on both sides for use on outside of outlet box, if necessary.—Adv.



"Star" Stem

Virden Co., The, 6103 Longfellow Ave., Cleveland, Ohio. "V. M. C. Brass."
White Mfg. Co., J. H., 111 N. 3rd St., Brooklyn, N. Y.

STENMAN ELECTRIC VALVE GRINDER CO.—42 Southbridge St., Worcester, Mass. Manufacturer of electric portable drills and valve grinders. Business established 1917. President, A. G. Sandberg; treasurer, A. W. Larson; general manager, J. J. Kelleher.

STEP-CUT.—Trade name for piston rings manufactured by the McQuay-Norris Mfg. Co., St. Louis, Mo.

STEPHENS.—Trade name for linemen's pole climbers made by W. H. Buckingham, 8-10 Bronson St., Binghamton, N. Y.

STEPHENSON MFG. CO.—Albany, N. Y. Manufacturer of belting. President, E. L. Kellogg; vice-president, S. A. Kellogg.

STEPHENSON MFG. CO.—South Bend, Ind. Manufacturer of controller handles, washing machine tubs, bobbins for coils and other wood specialties for electrical purposes. Secretary and general manager, L. A. Walker.

STEPS, CAR.—Car steps may be fixed in position or of the folding type. Steps of the latter design are usually arranged to fold up when the doors leading to the car or vestibule are closed, and to fold down when these doors are open for taking on or discharging passengers. In this manner no foothold is available to those who may attempt to steal a ride. The steps may be wood or metal. Steps of wood consist of a board of proper width thickness and length, covered on its wearing surface with suitable antislip material or step-tread. Metal steps may be of flat plates covered on the wearing face with an antislip material or step-tread, or the metal step may be constructed so that the tread surface is formed by a number of comparatively thin metal strips set edgewise and connected so that there are small rectangular or diamond shaped openings between them. The edges of these metal strips form an antislip surface and the openings in the step make it self-cleaning.

Fixed steps are used on steam and interurban cars, while on street-railway cars the tendency is toward the use of folding steps. Due to the design of cars required on steam and most interurban roads, several steps are necessary to take care of the height from station platform to the car floor. The platform or vestibule floors of most street railway cars being at a lower level than the car floor, usually only one step is necessary. In some of the later designs of street-railway cars no steps are required as the vestibule or platform floor is carried at such a level that passenger may step directly from the street into or out of the car. The height of steps is an important factor in the time required for passengers to get on or off cars, and this is obviously important at transfer and terminal points at all times, and at all places during the hours of heavy or rush traffic. Low steps also promote safety.

Manufacturers:

American Mason Safety Tread Co., 125 Perry St., Lowell, Mass. "Stanwood."
Irving Iron Works Co., Long Island City, New York, N. Y.

STEPS, POLE, IRON.—The surface of wood poles is saved from damage by spurs and the work of linemen is facilitated if the pole is provided with steps. These consist usually of ⅝ in. iron rod about 9 ins. long screwed or driven into the pole after boring a ½ in. hole. The end is turned up to prevent the foot slipping off. They are not placed lower than about 8 ft. from the ground, as this would invite trespassers, and be an obstruction.

In the vicinity of schools and similar locations the pole may be equipped with step sockets set into the pole near the ground. The steps are put into the sockets by the lineman before he climbs and removed after he comes down.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of pole steps for use of electric light, street railway and telephone and telegraph companies.—Adv.
Bethlehem Steel Co., South Bethlehem, Pa.
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., Pittsburgh, Pa. Hubbard pole steps are made of open hearth steel and are hot galvanized. They are furnished with two styles of heads and are made for various styles and kinds of poles. See page 16 of Hubbard's catalog for details.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

STEPS, POLE, IRON, SPLIT OR COLLAR TYPE.—Heavy straps of iron, shaped to fit the pole, with ends projecting so as to form a step. They are used on steel tubular poles and the two halves are clamped together, about the pole, by bolts.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of iron pole steps, split or collar type.—Adv.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."

STEPS, POLE, WOOD.—Triangular pieces of hard wood, fastened by lag screws or spikes to wood poles to assist the lineman in climbing them without using climbers.

Manufacturers:

Cohn & Bock Co., The, Princess Ann, Md.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LACHUTE SHUTTLE CO., LTD., THE, Lachute Mills, Que., Can.
Locust Pin Co., Front Royal, Va.
McGlauflin Mfg. Co., Petaluma, Cal.
National Pin & Bracket Co., North Vernon, Ind.
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can. "Peirce."
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."

STEREOMOTORGRAPH.—Trade name for electric advertising novelties made by the Charles Beseler Co., 131-33 E. 23rd St., New York, N. Y.

STEREOPTICON LAMPS.—See Lamps, projecting and stereopticon.

STEREOPTICONS.—Projection apparatus for use with lantern slides equipped with suitable condensing and focusing lenses and a source of illumination consisting of a high-powered incandescent lamp or an arc lamp of suitable capacity with necessary control rheostat. For special lecture work these stereopticons have many refinements, such as for obtaining dissolving views.

Manufacturers:

Beseler Co., Charles, 131-33 E. 23rd St., New York, N. Y.
BRENKERT LIGHT PROJECTION CO., 49 Cortland Ave., Detroit, Mich. "Brenopticon."
Chicago Stage Lighting Co., 112 N. LaSalle St., Chicago, Ill.
Cosmograph Motion Picture Machine Co., Inc., Film Bldg., Cincinnati, Ohio. "Cosmograph."
De Vry Corp., 1250 Marianna St., Chicago, Ill. "De Vry."
Enterprise Optical Mfg. Co., 564 W. Randolph St., Chicago, Ill. "Double Dissolving."
McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill. "Triumph."
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Thompson & Co., A. T., 15 Tremont Pl., Boston, Mass. "Radioscope."
Underwood & Underwood, Inc., 417 5th Ave., New York, N. Y.
Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa. "Viopticon," "Victor Portable."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa. "Illustrator."

STERILIZERS, ELECTRIC, BACTERIOLOGICAL AND OTHER LABORATORY.—These sterilizers are electrically heated water baths enclosed in metal tanks for heating and sterilizing laboratory instruments, beakers, flasks, test tubes, etc., in which cultures are to be made or which are to be used for other purposes where the presence of active bacteria would be objectionable. They are used also in the sterilization of foodstuffs, milk and water on small quantities to prevent the reproduction of bacteria. Also see Sterilizers, electric, milk; Sterilizers, electric, water.

Manufacturers:

American Sterilizer Co., Erie, Pa "American."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Barnstead Still & Sterilizer Co., 2 Lanesville Terrace, Forest Hills, Boston, Mass.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Boekel & Co., William, 516-518 Vine St., Philadelphia, Pa.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Castle Co., Wilmot, 1155 University Ave., Rochester, N. Y. "Castle."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Heidbrink Co., The, 420 S. 6th St., Minneapolis, Minn. "Heidbrink."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
R. U. V. Co., Inc., The, 165 Broadway, New York, N. Y.
Santiseptic Mfg. Co., 26 Bay St., New Brighton, Staten Island, N. Y. "Pentz System."
Sterolectric Co., 117 W. Howard St., Muncie, Ind. "Steroclave."
Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Weeks Mfg. Co., H. G., Hamilton, Ohio.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

STERILIZERS, ELECTRIC, DENTAL AND SURGICAL.—These are electrically heated sterilizers for dental and surgical instruments. They consist usually of an enclosed rectangular vessel or tank into which a tray of water is placed and heated by an electric heating element. The instruments are placed in the pan and the boiling water and steam sterilize them. Some of these are made in a form resembling the muffle type furnaces. They are usually finished in white enamel to present a neat and sanitary appearance and to minimize radiation losses.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Barnstead Still & Sterilizer Co., 2 Lanesville Terrace, Forest Hills, Boston, Mass.

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Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Capital Novelty Co., 138 N. 12th St., Lincoln, Neb. "Marvel."
Castle Co., Wilmot, 1155 University Ave., Rochester, N. Y. "Castle."
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Halverson Co., The, Union Ave., at E. Oak St., Portland, Ore.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Majestic Electric Development Co., 656 Howard St., San Francisco, Cal. "Majestic."
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Santiseptic Mfg. Co., 26 Bay St., New Brighton, Staten Island, N. Y. "Pentz System."
Sterolectric Co., 117 W. Howard St., Muncie, Ind. "Steroclave."
Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md.
Wecks Mfg. Co., H. G., Hamilton, Ohio.
Wocher & Son Co., The Max. 23-29 W. 6th St., Cincinnati, Ohio.

STERILIZERS, ELECTRIC, MILK.—Electrically operated heating units designed particularly for use in raising the temperature of milk to certain values in approved sterilizing processes. The process most used is known as pasteurization. It raises the temperature of the milk to about 132 to 160° F. These sterilizers are especially suitable for hospitals, homes, etc.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American."
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.
Electropure Co., The, 53 W. Jackson Blvd., Chicago, Ill.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Babson," "Climax," "Arnold."
Weeks Mfg. Co., H. G., Hamilton, Ohio.

STERILIZERS, ELECTRIC, WATER, CIRCULATING.—Apparatus for treating water circulated in supply systems for sterilization purposes by the application of ultra-violet rays generated in quartz, mercury-vapor tubes around which the water is caused to flow in thin layers. Another type of sterilizer used has apparatus for generating ozone by means of high-tension electric discharges. The circulating water is subjected to the effects of the ozone. The treatment in each case is intended to kill all harmful bacteria or other noxious matter in the water. Such outfits have been applied both in small and large installations, such as swimming pools, bathing ponds and even for the entire water supplies of armies in the field and of municipalities.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American."
Barnstead Still & Sterilizer Co., 2 Lanesville Terrace, Forest Hills, Boston, Mass.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Electric Water Sterilizer & Ozone Co., Scottdale, Pa.
Electrozone Water Sterilizer Co., 431 S. Dearborn St., Chicago, Ill.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
R. U. V. Co., Inc., The, 165 Broadway, New York, N. Y.

STERILIZERS, ELECTRIC, WATER, NONCIRCULATING.—Apparatus provided with electrically operated heating units designed to raise the temperature of water for sterilizing purposes. They consist of one or more tanks to which the heating elements are applied. Some sterilizers, for use in hospitals, etc., also combine a still for producing distilled water. Sterilizers of this type are not used for as large quantities of water as are handled by the circulating type.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Barnstead Still & Sterilizer Co., 2 Lanesville Terrace, Forest Hills, Boston, Mass.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Castle Co., Wilmot, 1155 University Ave., Rochester, N. Y. "Castle."
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
R. U. V. Co., Inc., The, 165 Broadway, New York, N. Y.
Weeks Mfg. Co., H. G., Hamilton, Ohio.

STERITE.—Trade name for noncorrosive alloy castings manufactured by the Aterite Co., Inc., John & Williams Sts., New York, N. Y.

STERLING.—Trade name for labor-saving devices for hotels, restaurants, etc., manufactured by the Josiah Anstice & Co., Inc., Rochester, N. Y.

STERLING.—Trade name for rubber tape manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

STERLING.—Trade name for belting for motors and generators manufactured by the Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

STERLING.—Trade name for armored cables, interior flexible steel conduit, flexible armored cord and armored conduit cable and cord cutters manufactured by the Garland Mfg. Co., West Pittsburgh, Pa.

STERLING.—Trade name for electric sirens manufactured by the Interstate Machine Products Co., Rochester, N. Y.

STERLING.—Trade name for spark plugs manufactured by the Lockwood-Ash Motor Co., Jackson, Mich.

STERLING.—Trade name for therapeutic lamp manufactured by the Magic Pain Relieving Lamp Co., 544 Garfield Ave., Chicago, Ill.

STERLING.—Trade name for soldering paste manufactured by the Sieffert Electric Co., 210 Main St., Evansville, Ind.

STERLING.—Trade name for rubber-covered wire manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

STERLING.—Trade name for electric clocks manufactured by the Sterling Clock Co., Inc., 220 E. 42nd St., New York, N. Y.

STERLING.—Trade name for d-c. potential reducers manufactured by the Sterling Devices Co., 9 Lispenard St., New York, N. Y.

STERLING.—Trade name for incandescent lamps manufactured by the Sterling Electric Lamp Division, National Lamp Works of General Electric Co., Warren, Ohio.

STERLING.—Trade name for gasoline engine manufactured by the Sterling Engine Co., 1252-74 Niagara St., Buffalo, N. Y.

STERLING.—Trade name for therapeutic lamp manufactured by the Sterling Pain Relieving Lamp Co., 546 Garfield Ave., Chicago, Ill.

STERLING.—Trade name for insulating varnishes and compounds manufactured by the Sterling Varnish Co., 525-8 Fulton Bldg., Pittsburgh, Pa.

STERLING.—Trade name for electric washing machines manufactured by the Superior Machine Co., De Kalb, Ill.

STERLING.—Trade name for steam and vacuum traps manufactured by the Templeton Mfg. Co., Business St. & Glenwood Ave., Hyde Park, Mass.

STERLING BI-PLEX.—Trade name for armored cable outlet box manufactured by Clemence Bros., 164 Linden Ave., Irvington, N. J.

STERLING BRONZE CO.—201 E. 12th St., New York, N. Y. Manufacturer of portable electric lamps and lighting fixtures. President and treasurer, Charles F. Kinsman; vice-president, S. de Kosenko; secretary, L. D. Auchmoody.

STERLING CLOCK CO., INC.—220 E. 42nd St., New York, N. Y. Manufacturer of electric clocks and time switches. President, F. G. Almquist; vice-president, L. J. Stern; secretary and treasurer, Charles H. Topping.

STERLING DEVICES CO.—9 Lispenard St., New York, N. Y. Manufacturer of potential reducers.

STERLING ELECTRIC LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Shelby, Ohio. Manufacturer of incandescent lamps. William Coale, general manager.

STERLING ELECTRICAL CORP.—2711 Church Ave., Cleveland, Ohio. Manufacturer of generators, high-frequency apparatus; heating pads and transformers. Business established 1914. President, treasurer and general manager, Antonio Longoria; vice-president, Harry G. Welfare; secretary, S. J. Regan.

STERLING ENGINE CO.—1252-74 Niagara St., Buffalo, N. Y. Manufacturer of gasoline engines. President, Charles A. Criqui; vice-president, Orin E. Foster; secretary, Ulysses S. Thomas; treasurer, Harry T. Vars.

STERLING MFG. CO.—1014 Chestnut St., Erie, Pa. Manufacturer of ceiling outlet plates. Business established 1919. President, W. H. Pierson; treasurer and general manager, W. A. Curtze.

STERLING PAIN RELIEVING LAMP CO.—546 Garfield Ave., Chicago, Ill. Manufacturer of therapeutic lamps. Business established 1916. General manager, Dr. R. G. Schroth; sales manager, M. E. Baldauf.

STERLING STAMPING CO.—Sterling, Ill. Manufacturer of adjustable lighting fixtures, etc.

STERLING SWITCHBOARD CO.—537 S. 7th St., Camden, N. J. Manufacturer of switches and switchboards. Business established 1912. President, David Roberts; vice-president and treasurer, Herbert A. Roberts; secretary and general manager, J. W. Aschenbach; sales manager, E. H. Erdman. Sales representatives, Hildreth, Casey & Co., 50 Church St., New York, N. Y.; Parke, Jaques, 1503 First National Bank Bldg., Pittsburgh, Pa.; Perkins Le Noir Co., 113 E. Franklin St., Baltimore, Md.

STERLING VARNISH CO., THE.—Pittsburgh, Pa. Manufacturer of insulating varnishes and compounds. Business established 1894. President, James Todd; vice-presidents, C. H. Fink, John W. Thompson; secretary and treasurer, S. A. Peckstein; general manager, C. H. Fink; sales manager, J. A. Findley. Main office, 525-8 Fulton Bldg., Pittsburgh, Pa. Factory, Haysville, Pa. Branch offices, 23 W. 43rd St., New York, N. Y., 618 Monadnock Block, Chicago, Ill.

STERN, LOUIS.—120 N. 7th St., Philadelphia, Pa. Manufacturer of tank alarms.

STERNS.—Trade name for radio telephones manufactured by the Radioland Co., 209 Alsop St., Jamaica, N. Y.

STERO.—Trade name for electric fireless cookers manufactured by the Sterolectric Co., 117 W. Howard St., Muncie, Ind.

STEROCLAVE.—Trade name for electric sterilizers and ovens manufactured by the Sterolectric Co., 117 W. Howard St., Muncie, Ind.

STEROLECTRIC CO.—117 W. Howard St., Muncie, Ind. Manufacturer of electric fireless cookers, ovens and sterilizers. Business established 1919. President and general manager, J. H. Reichart; secretary and treasurer, J. L. Moore.

STETHOSCOPES, MICROPHONIC.—Microphonic or electrically operated stethoscopes for instruments for listening to the sounds produced in the body by the functioning of the heart and other organs. They differ from ordinary mechanical stethoscopes in that the vibrations produced are picked up by a sensitive diaphragm and converted into a varying electrical current, in a manner similar to that in the ordinary telephone. The electric current then operates a delicate receiver in accordance with the variations and produces a much clearer and louder sound than is obtained from the mechanical vibrations.

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The batteries, sound regulator, diaphragm and receiver are made up as a light portable set.

Manufacturer:

Globe Phone Mfg. Co., Reading, Mass. "Geophone," "Heartphone."

STETSON.—Trade name for drill chucks manufactured by the Morse Twist Drill & Machine Co., New Bedford, Mass.

STEUBEN GLASS WORKS.—Corning, N. Y. Manufacturers of illuminating glassware. President, Alexander D. Falck; vice-presidents, Arthur L. Day, George B. Hollister, Eugene C. Sullivan; secretary, William Sinclaire; treasurer, John L. Thomas; sales manager, G. B. Hollister. Main office and factory, Corning, N. Y. Branch office, 501 5th Ave., New York, N. Y.

STEVENS.—Trade name for continuous water stage recorders manufactured by Leupold, Voelpel & Co., 107 E. 70th St., N. Portland, Ore.

STEVENS & CO.—375 Broadway, New York, N. Y. Manufacturers of showcases, display boards, etc., for electrical stores.

STEVENS, WILL P.—1632-34 Long Beach Ave., Los Angeles, Cal. Manufacturer of motor-driven ice-making machines.

STEVENS PROCESS.—See Cadmium.

STEVENS TANK & TOWER CO.—9-23 Center St., Auburn, Me. Manufacturer of tanks and towers for power plants. Business established 1893. President, treasurer and general manager, A. H. Stevens; vice-president, D. B. Stevens, Jr.

STEWARD MFG. CO., D. M.—Chattanooga, Tenn. Manufacturer of lava products.

STEWART.—Trade name for horse and cow clipping machines and sheep shearing machines manufactured by the Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill.

STEWART.—Trade name for electric automobile horns, spotlights and speedometers manufactured by the Stewart-Warner Speedometer Corp., 1828 Diversey Pkwy., Chicago, Ill.

STEWART & CO., S. A.—85 Hall St., Boston, Mass. Manufacturer of fire and burglar alarms and switches. Business established 1893. President, S. A. Stewart; treasurer and sales manager, Chester E. Stewart.

STEWART ESTATE, WILLIAM E.—14th & Elm Sts., Flint, Mich. Manufacturer of separators for storage batteries. F. W. Springer, manager.

STEWART MFG. CORP.—4538 Fullerton Ave., Chicago, Ill. Manufacturer of die castings and bronze back bearings. President, L. A. LaChance; vice-president and treasurer, Leslie McArthur; vice-president, Sidney Hellings; secretary, J. R. Coster.

STEWART-WARNER SPEEDOMETER CORP.—1828 Diversey Pkwy., Chicago, Ill. Manufacturer of electric automobile spotlights, horns and speedometers. President, C. B. Smith; vice-president, Vail R. Bucklen; secretary, W. J. Zucker; treasurer, T. T. Sullivan.

STIC-LAC.—Trade name for insulating varnish manufactured by Emil Calman & Co., 100 William St., New York, N. Y.

STICHT & CO., HERMAN H.—15 Park Row, New York, N. Y. Manufacturers of tachometers, rheostats and other electrical instruments. Business established 1918. General manager, Herman H. Sticht. Sales representatives, Longstreth & Van Dyke, 1613 Chestnut St., Philadelphia, Pa.

STICKALITE.—Trade name for hand inspection lamp manufactured by the Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

STICKERS.—This term is applied to special varnishes or gummy compounds that may be classed as auxiliary insulating materials, since their chief function is not so much to produce a permanent insulating layer, as to hold other insulating substances in place. The stickers are not expected to remain permanently sticky, the material held being supported in some other manner within a short period after the sticker is applied. An example of this kind of work is the wrapping of varnished cloth on armature coils, where subsequent wrappings or compression within the slot holds the strip or tapes in place. Aside from the cementing in place of varnished cloth, varnished tape and mica tape, other uses for this class of compounds are pasting asbestos paper to iron or wood and felt gaskets to iron, the "sticker" being first painted or brushed onto the surface to be covered.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STILES & CO., H. A.—97 Oliver St., Boston, Mass. Manufacturer of grinding wheels, poles, crossarms, brackets, pins, lamp bases and other wood specialties for electrical purposes. Business established 1906. Partnership, H. A. Stiles and W. E. Stiles. Factories, Ellsworth, Me.; Niagara Falls, N. Y.; Gloucester, Mass.; Pittsfield, Me.

STILL SMALL VOICE.—Trade name for loud-speaking telephone manufactured by the Winkler-Reichmann Co., 4801 S. Morgan St., Chicago, Ill.

STILLS, ELECTRICALLY HEATED.—Apparatus comprising electrically heated boilers and condensers used for distillation of liquids. Such stills find application chiefly in bacteriological, pharmaceutical and chemical laboratories. In some cases of storage-battery service stations electric water stills are advantageous where other sources of heating are not available or not desired. The liquid is condensed by use of a large quantity of cool water passing through or around the condenser. Fractional distillation is often carried out by these stills, the regulation of electric control of the heating making it specially suitable.

Manufacturers:

American Sterilizer Co., Erie, Pa. "American."
Arthur & Fowler Co., 119½ N. Browne St., Spokane, Wash. "A. & F."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
Barnstead Still & Sterilizer Co., 2 Lanesville Terrace, Forest Hills, Boston, Mass.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Castle Co., Wilmot, 1155 University Ave., Rochester, N. Y. "Castle."
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Lalor Co., W. M., 208 S. La Salle St., Chicago, Ill. "Rochlitz."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

STILLS, WATER, STEAM OR FUEL-HEATED.—These stills are designed for use in electric garages and storage-battery rooms and stations. They provide a supply of pure distilled water that may be used in the electrolyte of the batteries. The stills consist of a coil of metal tubing through which the water flows while it is subjected to the heat of the fuel or steam. The water is changed into steam which rises and is passed through another coil of tubing which is subjected to cooling action. This condenses the steam and the distilled water may be collected.

Manufacturers:

BATTERY TOOLS CO., 29-A N. Willow St., Montclair, N. J.
General Scientific Equipment Co., North Philadelphia, Pa.
PRECISION SCIENTIFIC CO., 820-822 S. Tripp Ave., Chicago, Ill. "Sargent."
Stokes Machine Co., F. J. 17th & Cambria Sts., Philadelphia, Pa.

STIMPLE & WARD CO.—520 Sandusky St., Pittsburgh, Pa. Manufacturer of induction coils and commutator brush holders. Business established 1898. President, George L. Stimple; vice-president, W. S. Peters; secretary, George E. Stimple; treasurer, John C. L. Ward; general manager, William S. Peters.

STIMPSON CO., EDWIN B.—70 Franklin St., New York, N. Y. Manufacturer of nuts, nickel, rivets, etc. President, E. B. Stimpson; vice-president and general manager, H. V. Rau; secretary, William F. Kobilak; sales manager, Edwin Ball.

STIMPSON EQUIPMENT CO.—Salt Lake City, Utah. Manufacturer of electric vibrating screens and flotation machinery. Business established 1912. President, C. W. Stimpson; vice-president, E. Shores; secretary and treasurer, Clinton Clark. Main office, Felt Bldg., Salt Lake City, Utah. Branch office, 143 Liberty St., New York, N. Y.

STIMPSON SCALE & ELECTRIC CO.—Northville, Mich. Manufacturer of electric meat choppers and coffee grinders. President, James W. McMahan; vice-president, Martin B. Daly; secretary, Fred L. Newton; treasurer, Albert A. Martz; general manager, George B. Godfrey.

STINE SCREW HOLES CO., THE.—Waterbury, Conn. Manufacturer of screw holes. I. D. Stine, manager.

STIRLING.—Trade name for water-tube boilers manufactured by the Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.

STIRRERS, LABORATORY, MOTOR-DRIVEN.—Apparatus provided with fractional-horsepower motor drive for use in chemical and other laboratories for stirring liquids. This is required in some chemical reactions where slow and thorough action of the reagent is possible only by keeping the precipitate in the solution or other liquid from settling.

Manufacturer:

Wahmann Mfg. Co., George H., 520 W. Baltimore St., Baltimore, Md.

STIRRERS, MISCELLANEOUS, MOTOR-DRIVEN.—Small machines having fractional-horsepower motors direct-connected to the stirring rods and provided with flexible cord and attachment plug for connection to ordinary lighting circuits. Some of these are used in candy and pastry shops. Also see Mixers, drink.

Manufacturer:

Humboldt Mfg. Co., 2014 Nebraska Ave., Chicago, Ill.

STITCHING MACHINES, MOTOR-DRIVEN, MISCELLANEOUS.—Machines used for stitching operations, in binderies, shoe factories, canvas goods and other factories. They are a special form of sewing machine and are driven by electric motors, either individually or through group drive.

Manufacturer:

Progressive Shoe Machinery Co., 3116-36 Snelling Ave., Minneapolis, Minn. "Progressive."

STOCKS, DIE, CONDUIT AND PIPE THREADING.—Tools used for cutting threads on ends of pipe, consisting of a clamping holder in which are secured either one-piece or two-part adjustable cutting dies and suitable handles by which the tool may be rotated on the pipe during the cutting operation. This tool is used very extensively by electricians, when doing conduit wiring. Also by steam fitters and other mechanics when installing the piping for power houses, factory buildings, etc. For the dies used in these stocks, see Dies, pipe-thread cutting.

Manufacturers:

American Tap & Die Co., Greenfield, Mass. "Adamantine," "Eagle Brand," "Acme."
Armstrong Mfg. Co., The, Bridgeport, Conn.
BORDEN CO., THE, Warren, Ohio. Manufactures the well-known line of "Beaver" die stocks, in ⅛-in to 12-in. sizes. Smaller models are ideal for electrical work. The entire line is characterized by expert design, rugged construction and ease of manipulation. With a "Beaver," one man can readily cut an 8-in. pipe. The company issues a carefully compiled catalog describing each model in detail.—Adv.
Butterfield & Co. Division, Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass. "Paragon," "Favorite."
Carpenter Tap & Die Co., The J. M., Pawtucket, R. I. ("Little Wonder," "Nichols," wrench.)
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "O. K.," "Lightning," "Trio," "Duo."
Greenfield Tap & Die Corp. of Canada, Ltd., Front & York Pl., Galt, Ont., Can.
Keystone Die Stock Co., 652 W. 47th St., Chicago, Ill.
Landis Machine Co., Waynesboro, Pa.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Oster Mfg. Co., Cleveland, Ohio. "Bull-Dog."
Rapid Tool & Machine Co., Ltd., 174 St. Joseph St., Lachine, Que., Can.

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Toledo Pipe Threading Machine Co., The, Toledo, Ohio.
Winter Bros. Co., Wrentham, Mass. "Thistle Brand."

STODDARD TELEPHONE CONSTRUCTION CO., THE.—Monroe, Mich. Manufacturer of telephones and telephone construction material. Business established 1900.

STOKERS.—The purpose of stokers is to supply solid fuel to a furnace. They may be entirely mechanical or may be hand operated. The use of stokers tends to improve combustion efficiency, hence to save coal; to lessen smoke because of the more uniform motion of coal to and through the fire; to maintain steady steam pressure; to increase the amount of coal burned in a given time or upon a given grate area; to lessen the expansion and contraction that occur when fire doors are opened for hand firing. When entirely mechanical, stokers lower labor costs, provided coal is fed to the stokers mechanically.

Stokers may be classified as hand-operated, chain-grate, and other mechanical, which includes overfeed, underfeed, down draft and sprinkler type. The last two and the hand-operated stokers are not used for large boilers, above 500 hp.

STOKERS, CHAIN-GRATE.—The chain-grate stoker consists of an endless chain moving on rollers. The coal is carried into the combustion zone and finally falls as ash or unburned carbon into the ash pit. An arch is invariably installed above the stoker for absorbing and reflecting heat to the fuel bed and thus burning the volatile constituents and maintaining furnace temperature. This type of stoker utilizes natural draft, although many are converted to forced draft for high combustion rates. It is adapted to free-burning coals and small sizes of bituminous coals, coals high in ash and volatile, lignites, etc. The rate of combustion is controlled by the rate of chain speed, the draft and thickness of fuel bed. Combustion rates as high as 250 per cent are feasible on natural draft, where sufficient stack capacity exists.

Manufacturers:

Automatic Fuel Saving Co., 1061 Bulletin Bldg., Philadelphia, Pa.
Automatic Furnace Co., The, 1st & Harshman Sts., Dayton, Ohio. "Model Chicago."
Babcock & Wilcox Co., The, 85 Liberty St., New York, N. Y.
Burke Furnace Co., 320 E. North Water St., Chicago, Ill.
Combustion Engineering Corp., 43-47 Broad St., New York, N. Y. "Coxe."
Frederick Iron & Steel Co., Frederick, Md.
Illinois Stoker Co., 104 W. 7th St., Alton, Ill. "Illinois."
S & S Automatic Grate Co., 320 E. North Water St., Chicago, Ill. "Burke."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STOKERS, HAND-OPERATED.—The hand or manually operated stoker is a compromise between hand firing on an ordinary grate and the mechanically operated stoker. It consists of a shaking or moving grate manipulated by means of a hand lever operated by the fireman. Fires can be cleaned and fuel moved toward the bridge wall and ash pit, and the fire dumped entirely, by movement of the control lever. This type of stoker usually improves combustion efficiency, increases combustion rates and lessens smoke as compared with hand firing. Its use is indicated where boilers are too small for complete mechanical stokers, namely boilers below 400 to 500 hp., especially where there are but few boilers in the plant.

Manufacturers:

Automatic Fuel Saving Co., 1061 Bulletin Bldg., Philadelphia, Pa.
Cokal Stoker Co., 1029-31 N. Clark St., Chicago, Ill. "Cokal."
Files Engineering Co., The, 75 Westminster St., Providence, R. I.
Flynn & Emrich Co., Holliday & Saratoga Sts., Baltimore, Md. "Huber."
Hofft Co., The M. A., Lemcke Bldg., Indianapolis, Ind. "National."
Marion Machine Foundry & Supply Co., Marion, Ind. "Marion."
McClave-Brooks Co., Poplar St. & Park Pl., Scranton, Pa.
Simmons Hand Stoker Co., The, Wilmington, N. C. "Simmons."
Valley Iron Works, Williamsport, Pa.

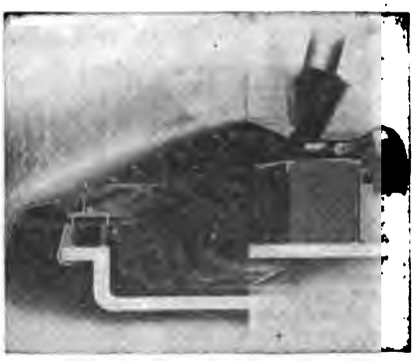
STOKERS, MECHANICAL, MISCELLANEOUS.—Mechanical stokers, excluding the chain-grate stokers which are listed above, are composed chiefly of overfeed, underfeed, down-draft and sprinkler type stokers, although a great number of different stokers may be made in each class. With the overfeed stoker, coal is pushed in at the top of the fuel bed, working downward over a movable grate by gravity. An arch above the fire helps burn the volatile and cake the coal. These stokers cannot be "forced" to any extent because of overheating the grate bars. A dump grate disposes of clinker and ash.

With the underfeed stoker, coal is forced up by a piston working in a retort through the incandescent fuel bed, working gradually over the sloping fuel bed to the clinker grinder, reciprocating grate or dump plates. This type of stoker is able to operate at as high as 400 per cent rating for several hours at a time with suitable coal. It is well adapted to coking bituminous coal and free-burning coals. It tends to produce clinker, more than any other type of stoker, so that the fusion temperature of the ash is an important factor in determining the suitability of this stoker. It also gets into trouble with high ash. Forced draft is necessary for all types of underfeed stokers.

The sprinkler stoker sprinkles or flips coal over the fuel bed, thus tending to lessen smoke by firing "little and often." It cannot handle large quantities of coal and so cannot be used for high combustion rates. The grates are not self-cleaning, ashes having to be removed and fires cleaned by hand.

Manufacturers:

American Engineering Co., Aramingo Ave. & Cumberland St., Philadelphia, Pa. "Taylor."
Automatic Fuel Saving Co., 1061 Bulletin Bldg., Philadelphia, Pa.
Automatic Furnace Co., The, 1st & Harshman Sts., Dayton, Ohio. "Dayton."
Brady Foundry Co., James A., 45th & Western Blvd., Chicago, Ill. "Harrington."
Combustion Engineering Corp., 43-47 Broad St., New York, N. Y.
Detroit Stoker Co., Woodward & Horton Aves., Detroit, Mich.
Domestic Stoker & Mfg. Co., 519 Atlas Bldg., Salt Lake City, Utah. "Garrison."
Files Engineering Co., Inc., The, 75 Westminster St., Providence, R. I.
Frederick Engineering Co., Frederick, Md. "Frederick."
McClave-Brooks Co., Poplar St. & Park Pl., Scranton, Pa.
RILEY STOKER CO., SANFORD, Worcester, Mass. The Riley stoker is a multiple retort, inclined, underfeed stoker, the fuel being forced up from beneath where the air is admitted, and is then burned on a series of inclined retorts. Distillation of the volatile gases takes place in the retorts, after which these gases, mixed with air, pass up through an active bed of burning coke and through the incandescent fire zone. Instead of stationary tuyeres it



Riley Stoker, Phantom View

has moving air supplying grate blocks, carried by the reciprocating sides of the retorts. These retort sides also move the overfeed grates which extend across the entire width of the stoker below the retorts. Beyond these are the rocker dump plates, which continuously agitate, crush and discharge the ash. The travel of these reciprocating parts is adjustable so as to control the movement of the fuel bed and dumping of refuse.—Adv.
Roach & Co., Inc., Joseph H., 221 S. 15th St., Philadelphia, Pa.
Stroud & Co., E. H., 928-934 Fullerton Ave., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STOKES MACHINE CO., F. J.—17th & Cambria Sts., Philadelphia, Pa. Manufacturer of impregnating apparatus, water stills, vacuum pumps, powder filling and other chemical and pharmaceutical machinery.

STOKES RUBBER CO., JOSEPH.—Trenton, N. J. Manufacturer of battery jar covers, rubber sheets, tubes and other hard rubber products.

STONE-DUCT.—Trade name for underground stone conduit manufactured by the Chicago Stone Conduit Co., Addison St. & Chicago River, Chicago, Ill.

STONE STRAW CO.—30-40 O St., N. E., Washington, D. C. Manufacturer of paper sleeves for cable conductors. Business established 1909. President, treasurer and sales manager, Carl Casey; vice-president, James B. Platt; secretary, Frank Casey; general manager and sales manager, Landra B. Platt. Factories, Washington, D. C.; Baltimore, Md.

STONERS, COFFEE, ELECTRIC.—Coffee stoners separate the coffee from stones or other foreign substances which are heavier than the coffee bean. The beans are comparatively light so the separation is quite complete.

Manufacturer:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich. "New Model."

STONERS, PEANUT, ELECTRIC.—Peanuts, after shelling still contain some chaff, stones and other foreign materials which must be removed before blanching or roasting. This is done by electrically driven machines called stoners. These machines separate the stones, regardless of their size or weight.

Manufacturer:

Lambert Machine Co., 311 S. Jefferson St., Marshall, Mich. "New Model."

STOP THIEF.—Trade name for automobile lock manufactured by the Long Distance Spark Plug Co., Birmingham, Ala.

STOPS, ENGINE, AUTOMATIC ELECTRIC.—These are electrically controlled devices to automatically stop an engine under certain predetermined conditions. They may be arranged for a number of conditions and will operate at the will of an operator, or when certain pressures are reached, or at a definite time, or in response to excessive variations in speed.

Manufacturers:

Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Strong, Carlisle & Hammond Co., Cleveland, Ohio.

STOPS, PHONOGRAPH, AUTOMATIC ELECTRIC.—These stops are used on electric phonographs and stop the driving motor automatically when the record has been played. They are usually set by hand when a record is put on, the setting being made to accommodate various sizes of records. When the tone arm has reached a certain position, at the end of the record, a switch is opened which stops the motor and applies a brake to the record disk.

Manufacturer:

Lakeside Supply Co., 426 S. Dearborn St., Chicago, Ill.

STORAGE.—In hydraulics, a term similar to "pondage," but having reference to the impounding of a large quantity of water during the flood season for future use. It may exist on streams or rivers naturally in the form of lakes or swamps, or it may be developed by damming up streams at favorable points, or in raising lakes already in existence. Its object is to keep up the flow of a river as well as possible during the dry season to give a high dependable power throughout the year.

STORAGE BATTERY & APPLIANCE CORP.—Philadelphia, Pa. Manufacturer of storage batteries. Factory, Reading, Pa.

STORAGE BATTERY BOXES.—See Boxes, battery.

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STORAGE BATTERY CARS.—See Cars, electric, street, battery.

STORAGE BATTERY CHARGING SETS.—See Battery charging sets.

STORAGE BATTERY ELECTROLYTE.—See Electrolyte, storage battery.

STORAGE BATTERY ENAMELS.—See Enamels, storage battery.

STORAGE BATTERY JARS.—See Jars, battery, glass; Jars, battery, rubber.

STORAGE-BATTERY LOCOMOTIVES.—See Locomotives, electric, mining, storage battery.

STORAGE BATTERY OR STORAGE CELL.—An electrochemical battery or individual cell which produces electrical energy as the result of a reversible chemical action in the cell. On sending a current through the cell from an outside source a chemical action is produced and the electrical energy converted into potential chemical energy; this is called "charging" the cell. When the charged cell is connected to an electrical conductor the chemical action reverses and the potential chemical energy is once more converted to electrical energy which produces a current in the conductor; this is called "discharging" the cell. Thus such a cell serves as a secondary source of e. m. f. and is therefore often called a secondary battery. Popularly it is believed that this type of cell stores electrical energy as such and it is therefore most commonly called a "storage" battery. See Batteries; also Batteries, storage.

STORAGE BATTERY PLATES. — See Plates, battery.

STORAGE BATTERY SEPARATORS.—See Separators, storage battery.

STORAGE BATTERY SUPPLY CO., THE.—239 E. 27th St., New York, N. Y. Manufacturer of storage batteries and battery repair shop equipment. Business established 1891. President and general manager, T. D. Bunce.

STORAGE BATTERY TRACTORS.—See Tractors, electric.

STORAGE BATTERY TRAYS. — See Trays, storage battery.

STORAGE BATTERY TRUCKS.—See Trucks, electric or storage battery, heavy duty; Trucks, storage battery, baggage and industrial.

STORAGE BATTERY VEHICLES.—See Vehicles, electric, commercial; Vehicles, electric, passenger.

STORE EQUIPMENT AND FURNITURE, MISCELLANEOUS.—This classification is intended for store equipment and furniture that is not otherwise listed, but is used in electric shops and by dealers in electrical appliances and supplies. Special effects and displays are often provided by building rooms or sections of a room, or by placing wooden panels and furniture, rugs, etc., to simulate part of a home. In addition to these there are special stands and novel forms or racks on which various electrical material may be displayed. Also see Counters and shelving, store; Display boards, fixtures, racks and stand; Showcases.

Manufacturers:

American Bolt & Screw Case Co., The, Davis Bldg., Dayton, Ohio.

Bradford & Co., I. L., 178 W. Jackson Blvd., Chicago, Ill.

Frankel Display Fixture Co., 177-179 Hudson St., New York, N. Y.

Sani Products Co., 209 W. Randolph St., Chicago, Ill.

Wilmarth Show Case Co., 1544 Jefferson Ave., Grand Rapids, Mich.

STORE LIGHTING FIXTURES. — See Fixtures, lighting, store; Fixtures, lighting, window and showcase; Lighting units, office and store.

STORM.—Trade name for electric dumbwaiters and elevators manufactured by the Storm Mfg. Co., 40-50 Vesey St., Newark, N. J.

STORM MFG. CO., THE.—40-50 Vesey St., Newark, N. J. Manufacturer of electric dumbwaiters and elevators. President, D. Minor Lake; secretary and treasurer, E. G. Broadwell.

STORRS MICA CO.—Owego, N. Y. Manufacturer of raw mica. Business established 1895. President, A. P. Storrs; vice-president, Charles F. Storrs. Main office, P. O. Box N (Tioga Co.), Owego, N. Y. Branch office and warehouse, 392 Canal St., New York, N. Y.

STORTZ & SON, JOHN.—210 Vine St., Philadelphia, Pa., Manufacturers of shave hooks and other tools.

STOVER.—Trade name for gasoline engine manufactured by the Stover Mfg. & Engine Co., Freeport, Ill.

STOVER & CO., S. H.—Chamber of Commerce Bldg., Pittsburgh, Pa. Manufacturers of solderless connectors.

STOVER MFG. & ENGINE CO.—Freeport, Ill. Manufacturer of gasoline engines and windmills. Business established 1862. Branch offices, Omaha, Neb.; Minneapolis, Minn.

STOVES, ELECTRIC COOKING. — See Ranges, electric, domestic or household; Ranges, electric, hotel, restaurant and institution.

STOVES, ELECTRIC DISK OR TABLE.—Heating devices of a portable nature usually limited in capacity to 660 watts for connection to ordinary lighting circuits and consisting of open coil or protected type electrically operated heating units. They are usually controlled by heater switches and are mounted in low frames for use on the table. The disk stoves have merely a flat disk and may have any kind of a utensil placed on it. The table stoves are usually provided with several pans to allow broiling, toasting, steaming and frying, etc.

Manufacturers:

AMERICAN ELECTRICAL HEATER Co., Detroit, Mich. "Rite-Heat" glower stove, an ideal small toaster stove



"Rite-Heat" Glower Stove

for light cooking operations. Glowing or open coil type, 5 ins. square, made throughout of sheet metal, finished in polished nickel. Furnished complete with 6-ft. cord with detachable plugs and attachment plug. "American Beauty" electric disc stove. These stoves have solid steel top plates that will attain a maximum temperature of 600° F. Heating element is attached to and in perfect contact with under side of plates and easily removable. For heating small quantities of water or for cooking in the home or apartment. Complete with 6-ft. cord, having detachable porcelain plugs and attachment plug.—Adv.

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Calorex Corp., The, 10 W. 23rd St., New York, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. The disc stove furnished is 4½ ins. in diameter.



"Hotpoint" Disc Stove

Other types manufactured in 6, 7, 8 and 9 in. sizes, and equipped with three-heat snap switches. Constructed with cast iron top and base of pressed steel, nickeled and polished. Fiber tipped feet. Seven, eight and nine in. sizes require special wiring. More elaborate are the twin and triple disc stoves. The discs on the twin stove are 7 and 9 ins. in diameter and 13x24 ins. in size over all. The triple disc stove has discs 7, 8 and 9 ins. in diameter and is 13x35 ins. in size. See also display adv. pages 1292-3.—Adv.

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

Glove Stove & Range Co., The, Kokomo, Ind. "Globe."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

Manning, Bowman & Co., Meriden, Conn.

National Electric Heating Co., The, 544 Queen St., Toronto, Ont., Can. "National."

Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

Perfection Electric Products Co., New Washington, Ohio. "Pepco," "Excelsior."

Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y.

Renfrew Electric Products, Ltd., Renfrew, Ont., Can. "Canadian Beauty."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill., "Hold-Heet."

Rutenber Electric Co., Marion, Ind. "Rutenber."

Security Electric Mfg. Co., 146B W. Ohio St., Chicago, Ill. "World's Best."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Standard Stamping Co., The, 1st St., and 7th Ave., Huntington, W. Va., "Armstrong."

S. U. E. Co., 89 Beach St., Boston, Mass. "Unitize."

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

WAAGE ELECTRIC CO., 12 S. Jefferson St., Chicago, Ill.

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STOVES, ELECTRIC, LABORATORY.—Laboratory stoves are heating devices of special design for use in laboratories in analytical or general utility work. They are operated by electrically heated open coil or protected type units and are generally made in the form of disk stoves. In this form they may be used to heat almost any kind of a container. They are useful in dental laboratories for gold annealing, packing plates, making bridges and baking investments. The stoves are supported on a metal stand. A push button or other heater switch is supplied to regulate the heat.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" electric disc stove for industrial use. Made in three sizes, 8, 10 and 12-in. diameters. For use in laboratories and for other industrial purposes. Surface temperature approximately 750° F.—Adv.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hughes."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hughes." (See display adv. pages 1292-1293.)

Electric Heating & Mfg. Co., Westlake and Republican Sts., Seattle, Wash. "Apfel's."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, One., Can. "National."

Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y.

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

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STOVES, ELECTRIC, TOY.—Miniature, electric ranges having concealed heating coils and designed for connection to ordinary lighting circuits by flexible cords and attachments plugs.

Manufacturers:

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Weeks Mfg. Co., H. G., Hamilton, Ohio.

STOW FLEXIBLE SHAFT CO.—3446-54 Ludlow St., Philadelphia, Pa. Manufacturer of portable electric tools. Business established 1876. H. K. Schoff, general manager.

STOW MFG. CO., INC.—443 State St., Binghamton, N. Y. Manufacturer of motors and portable electric tools. Business established 1875. President, Clarence F. Hotchkiss; vice-president, treasurer and general manager, D. Walker Wear; secretary, C. E. Hotchkiss.

STOWELL SCREW CO., LTD., THE.—290 St. Paul St., W., Montreal, Que., Can. Manufacturer of screws, nuts, bolts and rivets. Business established 1913. President and general manager, James S. Parkes; vice-president, Alexander Thurber; secretary and treasurer, J. M. Boulard. Factory, Longueuil, Que., Can.

STRACHAN, INC., R. & H.—395 Fulton St., Brooklyn, N. Y. Manufacturer of electric signs and stage lighting equipment. President, R. M. Strachan; vice-President, A. J. Strachan; secretary and treasurer, H. C. Strachan; general manager, John J. Holshuh.

STRAIGHT FILAMENT LAMP CO.—21 W. 37th St., New York, N. Y. Manufacturer of lighting reflectors, etc.

STRAIGHT PULL.—Trade name for socket attachments manufactured by the United Electric Supply Co., Boston, Mass.

STRAIGHTENING MACHINES, AXLE OR SHAFT.—Power-driven machine tools in which bent car axles, armature shafts, or other similar forgings may be placed, and straightened. These machines are provided with means for revolving the work and for bringing sufficient pressure against the bent portion to straighten it.

Manufacturers:

Columbia Machine Works and Malleable Iron Co., Atlantic Ave. and Chestnut St., Brooklyn, N. Y.
Medart Patent Pulley Co., Inc., Potomac and DeKalb Sts., St. Louis, Mo.

STRAIN CLAMPS.—See Clamps, strain.

STRAIN INSULATORS.—See Insulators, strain, high-tension; Insulators, strain, trolley; Insulators, strain, miscellaneous.

STRAIN-RELIEF GRIPS.—See Grips, plug, socket and rosette strain relief.

STRAIT & RICHARDS, INC.—Fabyan Place, Newark, N. J. Manufacturer of electric and gas fireplaces. President, Winfield S. Strait; secretary and treasurer, Victor I. Richards; general manager, V. I. Richards.

STRAITFLO.—Trade name for electric mine ventilating fans manufactured by the Jeffrey Mfg. Co., 1st Ave. and 4th St., Columbus, Ohio.

STRAND.—One of the fine wires or group of wires of any stranded conductor. A concentric strand is one composed of a central core surrounded by one or more layers of helically laid wires or groups of wires. The term strand is also applied specifically to a seven-strand steel wire, usually galvanized; used as a messenger wire for supporting overhead cables, trolley wires in catenary construction, etc. For this type see Strand, galvanized steel.

STRAND, GALVANIZED STEEL, FOR OVERHEAD CONSTRUCTION.—Strand is a term applied to steel cable composed of seven steel wires or strands twisted together and made in sizes of ⅛ to ⅝ in. in diameter. There are four grades of steel strand commonly used for overhead electrical construction: the "ordinary" or "regular" grade, the "Siemens-Martin" grade, the "high strength" grade, and the "extra high strength" grade. The ordinary grade is commonly used for cross-span wires, guys, pull-off work, etc., in city and light interurban trolley construction; also for light cable messengers and miscellaneous pole guys in telephone and other pole-line construction. The Siemens-Martin grade is used for heavier work, such as line anchors, short span catenary messengers, important pole guys, telegraph and telephone cable messengers, etc. High strength and extra high strength strands are used for very heavy construction work in steam railroad electrification, and for special work where unusually high strains are encountered, as in catenary construction with long spans. Another very important use of strand, especially the Siemens-Martin grade, is for the overhead ground wire strung at the highest point of the supporting towers or poles and connected to ground at frequent intervals to protect high-tension transmission lines from lightning. The difficulty in handling increases with the higher grades, the two highest grades of strand being quite difficult to cut and to handle as compared with the ordinary or Siemens-Martin grade. Consequently the use of the higher grades is restricted to those places where the others would not be able to stand the strain.

There are two grades of galvanizing in common use on strand, the "regular galvanized" and the "extra galvanized." In each case the strand is passed through a bath of molten zinc, but in the regular grade the strand is wiped after leaving the bath, thus giving a thinner but a smoother coating. The extra galvanized is unwiped after it leaves the bath, retaining all of the zinc which adheres to it. This gives a surface which is less smooth than the former grade, but one which has a heavier zinc coating and which will, therefore, withstand ordinary corrosion more successfully.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN INSULATED WIRE & CABLE CO., Chicago, Ill. Our strand is made in single and double galvanized grades and is used chiefly for guying smoke stacks and poles, and for overhead construction. The standard steel strand is made in sizes of 1/16, ¼, 5/16, ⅜ and ½-in. diameters. See page 1250. —Adv.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Copper Clad Steel Co., Rankin, Pa. "Copperweld."
Driver-Harris Co., Harrison, N. J.
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Indiana Steel & Wire Co., Muncie, Ind.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Leschen & Sons Rope Co., A., 5909 Kennerly Ave., St. Louis, Mo. "Hercules."
Moon Co., George C., Garwood, N. J.
Page Steel & Wire Co., 30 Church St., New York, N. Y. "Armco."
Roebling's Sons Co., John A., Trenton, N. J.
Ryerson & Son, Joseph T., 16th and Rockwell Sts., Chicago, Ill.

STRANDING MACHINES, WIRE.—Machines consisting of wire reel holders in one or more series and rotated-mechanically to wind or lay one or more layers of strands on a central core which is drawn through the axis of rotation of the machine. Each reel winds one layer, the layers being wound progressively as the core passes through the reels.

Manufacturer:

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West., Toronto, Ont., Can. "Canada."

STRANTON.—Trade name for steam separators manufactured by the Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y.

STRAPS, BEAM.—Straps formed in a U-shape to fit around a wooden block, laid against an I-beam and over the flange of the beam so that when two straps are screwed to both sides of the block it will be held in place against the beam. The block may be used to support insulators, conduit, etc.

Manufacturers:

Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Ryerson & Son, Joseph T., 16th and Rockwell sts., Chicago, Ill.

STRAPS, CABLE SAFETY.—Cable safety straps are steel straps mounted on poles to prevent heavy lead cable from falling to the ground, in case the cable hangers or cable rings should by accident be stripped off the strand supporting it. Great danger of injury to employees and to the public would result in such case, and is obviated by the use of these straps. They are made of steel strap shaped to pass around the cable and are provided with holes for bolting to the pole and crossarm.

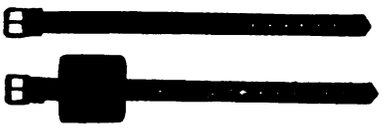
Manufacturer:

Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

STRAPS, CLIMBER.—These are leather straps used to fasten a lineman's pole climbers to his legs. The heel strap consists of a simple strap with a buckle, the calf strap being similar but provided with a protecting pad.

Manufacturers:

R. H. BUHRKE CO., THE, 1240 Fullerton Ave., Chicago, Ill. The Buhrke Eastern climber straps as shown below, are made of first-grade oak tanned steer hide harness leather with extra heavy Anchorite rust-proof finish



Buhrke Climber Straps

steel roller buckles tested to 750 lbs. The straps (over all) are 22 ins. long by 1¼ ins. wide; equipped with movable pads 4 ins. long by 4 ins. wide of plain, felt lined or sheep lined leather. There are two heel and two calf straps to a set.—Adv.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. See page 1259 for information; also send for complete descriptive catalog of construction tools.—Adv.
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa. "Tannate."

STRAPS, CONDUIT BOX.—These are metal straps formed and drilled for fastening to an outlet box or fixture stud in the box. They are used to fasten a receptacle to the box. For deep boxes or pancake boxes they are made in different forms to accommodate the different depths of the boxes.

Manufacturers:

Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Godfrey."
Faries Mfg. Co., Decatur, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."

STRAPS, CONDUIT OR PIPE.—U-shaped sheet steel clamps having perforations at each end for mounting pipe and rigid or flexible conduit on flat surfaces. Screws or nails are used for fastening the ends. Cast or malleable iron clamping or hanging devices for pipe or conduit are usually called hangers, which see.

Manufacturers:

Acme Pipe Strap Co., 944-50 Harper Ave., Detroit, Mich.
All-Steel-Equip Co., Aurora, Ill.
Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y.
Fee & Mason, 51 Beekman St., New York, N. Y.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Illinois Malleable Iron Co., 1801-1825 Diversey Pkwy., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
McAvity & Sons, Ltd., T., Kings St., St. John, N. B., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
North-Western Stamping Co., Burlington, Iowa.

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Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."
Yarnall-Waring Co., Mermaid Ave., Chestnut Hill, Philadelphia, Pa. "Yarway."

STRAPS, CROSSARM.—Where the tension of wires on a crossarm is not equally distributed on opposite sides of a pole, the arm is back-braced with iron straps. These are attached to the pole at the level of the arm so that they are put in tension by the tendency to twist the pole top. The straps are of galvanized iron about 26 ins. x 1 x ⅛ in.

Manufacturers:

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Slater Co., Ltd., N., 34 Sydney St., Hamilton, Ont., Can.

STRAPS, HAND, ELECTRIC RAILWAY CAR.—A strap of leather attached at one end to the ceiling or upper framework of the car and having a loop at the lower end which may be grasped by standing passengers. Hand straps are necessary, so that those who stand in the car where there are no seats or other means of holding on, may be prevented from falling when the car or train lurches due to curves or uneven track. Formerly hand straps were of leather throughout, but modern straps are provided with a readily cleanable white hand hold. These hand holds may be of metal enameled or of some hard material which will retain its shape and color and have the necessary wearing qualities. They are obviously more sanitary and easily cleaned than the all-leather type of hand strap.

Manufacturers:

Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave., Chicago, Ill.
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa. "Tannate."

STRAPS, JACKS OR VISE.—Adjustable length leather straps which fasten by means of a clevis or similar device to a wire grip used to take up slack in wire in overhead line construction.

Manufacturers:

BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.

STRAPS, LINEMEN'S SAFETY.—Heavy leather straps which are passed around the pole and fasten to rings in the lineman's tool belt so as to prevent his falling when working on the pole.

Manufacturers:

BUHRKE CO., THE R. H., 1240 Fullerton Ave., Chicago, Ill. Buhrke quality safety straps shown below, are made of heavy first-grade oak tanned steer hide harness leather, 6 ft. long by 1¾ ins. wide, having rust-proof snaps.



Buhrke Safety Strap

Can be furnished with plain, roller or swivel roller snaps, snaps tested to 1500 lbs. and buckles to 750 lbs. Strap is reinforced at both ends with metal clip to take wear where strap rubs against pole.—Adv.

Canadian Graton & Knight, Ltd., 84 St. Antoine St., Montreal, Que., Can.
Chicago Belting Co., 113-25 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., The, 1301 Elston Ave. Chicago, Ill.
Industrial Products Co., 1001 Chestnut St., Philadelphia, Pa. "Ipco."
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. See page 1259 for information; also send for complete descriptive catalog of construction tools.—Adv.
Rhoads & Sons, J. E., 12 N. 3rd St., Philadelphia, Pa. "Tannate."
SMITH & HEMENWAY CO., INC., Irvington, N. J. No. 349 safety strap is of extra heavy oak tanned leather, 6



"Red Devil" No. 349

ft. long. One snap is stationary and the roller snap is loose, so that strap can be adjusted to shorten or lengthen.—Adv.

STRAPS, WALL.—Wall straps are used in fastening guy wire or messenger strand to the wall of a building. They are widely used by telephone and telegraph companies and also in other electrical construction. They consist of a flat strap of steel usually about 2½ ins. wide and ¼ to ⅛ in. thick. The length is about 12 ins. and one end is forged into a round section and turned up into an eye. The flat part has three or four holes to permit the use of lag screws or expansion bolts in securing it to the wall.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

STRATTON.—Trade name for wood levels manufactured by the Goodell-Pratt Co., Greenfield, Mass.

STRAUS-HOHENSTEIN CO.—132-134 W. 21st St., New York, N. Y. Manufacturer of portable electric lamps, lamp shades, etc. Business established 1905. Markus Straus, owner. Sales representative, Harry T. Mitchell, 352 Pacific Electric Bldg., Los Angeles, Cal.

STRAUSS & BUEGELEISEN.—Brooklyn, N. Y. Manufacturers of goggles for all purposes. Main office, 16 Hanover Park, Brooklyn, N. Y. Factories, Brooklyn, N. Y.; Hamilton, Ont., Can. Branch office, 507 Mission St., San Francisco, Cal.

STRAY CURRENTS.—Currents induced in a conductor by being cut by a moving magnetic field or by moving in such a field. These currents circulate in the metal and cause heating. They are more commonly called eddy or Foucault current. See Eddy currents.

STREAM FLOW.—A term used to denote the quantity of water flowing in a stream at any time, usually expressed in cubic feet per second. It is also called run-off, which see.

STREATOR.—Trade name for electric washing machines manufactured by the Wells H. Press Co., Streator, Ill.

STREET & CO., F. G.—132 Nassau St., New York, N. Y. Manufacturers of electric dishwashers and meat cutting machines.

STREET CARS. — See Cars, electric, street, battery; Cars, electric, street and interurban, trolley.

STREET-LIGHTING BRACKETS. — See Brackets, street-lighting.

STREET LIGHTING, DEVELOPMENT AND METHODS OF.—The history of street lighting dates back to the beginning of community life. During the early stages of municipal enterprise, street lighting took the form of placing various illuminants at strategic positions along the highways—in reality, a form of beacon lighting. Naturally the first illuminant was the ordinary flame from resinous woods, oils, tars, pitch and similar substances. During the progress of street lighting, candles in lanterns were used, being then supplanted by kerosene lamps and later by gas, the culminating form of the gas lamp resulting in high and low-pressure Welsbach units whereby refractory light-producing metal salts were heated to incandescence by the gas flame, producing an intense greenish white light.

Electric Street Lamps.—In the last 50 years electrical street illumination has been gradually developed, resulting in some of the present magnificent systems which may be seen in various cities. The first electric lamps used were the arc lamps. By means of connecting two pieces of conducting material in an electrical circuit with their ends in contact, and then separating these ends slowly, an arc will be produced, providing the voltage of the circuit is sufficiently high. The arc thus formed will burn away portions of the terminals, forming between them a conducting vapor which will give off light rays. The ends of the conducting material will also be heated to incandescence with the result that the total illumination from such a source will be thereby greatly augmented. In earliest forms of arc lamp the electrodes consisted of plain carbon rods. In the direct-current open arc lamp the current required was about 10 amperes at 50 volts, giving a unit known as the "full arc" or 2000 nominal candlepower per lamp. The "half arc" or 1200 nominal candlepower lamp took about 6.6 amperes at the same voltage.

It has been determined that in any given type of arc lamp the total illumination and rate of consumption of the carbon depends upon the current density and size of carbon. The total light given off by such a unit is caused partly from incandescent vapor in the arc but mostly from the highly heated electrodes. In the direct-current open arc lamp in which most of the light was produced from a crater burned by the arc in the positive electrode, the lamps were so connected as to make the upper carbon positive so that most of the light would be thrown into the lower hemisphere. In the old open arc the carbons were rapidly burned away; the positive carbon being consumed approximately twice as fast as the negative carbon; from 1½ to 2 ins. of positive carbon was consumed per hour, necessitating the trimming of the lamps each day.

The considerations which were vital in the operation of the open arc led to the development of the enclosed arc lamps, which were made first in direct-current and later in alternating-current types. Owing to the fact that the burning up of the carbons is to a large extent due to their oxidation in the atmosphere, it was found that the life of the carbon could be greatly lengthened by inclosing the arc itself in a nearly air-tight inner globe which excluded the air and consequently retarded the rate of oxidation of the carbon. With most lamps of this kind an outer globe was also used. The addition of the inner globe increased the life of the carbon about 1000%, causing it to be necessary to trim enclosed arc lamps only about once every 100 hours.

In order to exclude the atmosphere from the arc as much as possible it was necessary that the inner globe be held tightly against a ground gas-cap at the top by a spring bail and hence it became necessary to use a much finer carbon on the inclosed arc due to the fact that these carbons had to fit closely into the gas-cap and still be freely fed by the mechanism. Devices were developed whereby enough oxygen could be introduced into the inner globe to consume all the carbon volatilized by the arc so that the carbon vapor would not be condensed on the inside of the inner globe, thus imprisoning the light and seriously affecting the efficiency of the lamp. The a-c. enclosed arc lamps were used with cored carbons which were necessary in order to provide sufficient conducting gases to carry the arc over the zero point of reversal of the current of alternating circuits.

As arc lamps were more extensively used, it was found that by the introduction of certain metallic salts into the material of the electrodes the light from the arc stream could be greatly increased and the color of the light itself changed appreciably. This development gave rise to the flame arc lamp which in its highest development has resulted in the magnetite or luminous arc in which iron from the magnetite electrode furnished the conducting vapor in the arc stream. Titanium is mixed with the magnetite, producing a large portion of the total light. The electrodes consist of iron tubes containing ground magnetite, salts of titanium, and chromite which absorbs the melted magnetite and causes the illumination from the arc to be more steady.

Usually carbon flame arc-lamp electrodes are consumed very rapidly, necessitating trimming of each lamp daily, whereas the magnetite arc electrode has a life from 75 to 200 hours, depending upon the current density and type of lamp used. Owing to the density of the vapor given off by a magnetite or carbon flame arc lamp, it was found impossible to use the tight inner globe and it became necessary to introduce a draft tube to carry away the products of combustion. In order to increase the life of flame carbon electrodes, the lamps were fitted with a loose inner globe and a condensing chamber which was supposed to

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take out much of the foreign material by means of condensation, giving the electrode a life of about 70 hours with the usual current and size of carbon.

One of the early forms of electric street illuminant was the incandescent carbon lamp in which a filament composed of carbon was heated to incandescence by the passage of the electric current, and later improvements consisted in making up lamp filaments of metalized carbon and of tantalum and tungsten, which is now used in the form of drawn wire, and will to a preponderant extent supplant all earlier forms of incandescent filaments. The development of the incandescent lamp resulted in the adaptation of these units for various candlepowers and voltages, both in the multiple and series types.

An arc lamp is inherently a unit which should be built in large sizes and consequently is to a certain extent inflexible in its application to ordinary street lighting. With the higher development of the incandescent lamp, involving the tungsten-filament gas-filled lamp in its later stages, it was found that these units could be built in many sizes, all of which would operate at the same voltage on multiple circuits or with the same current on series circuits. At present such lamps are constructed for straight series operation in sizes from 60 candlepower to 1000 candlepower and can be operated either on a straight series circuit or on suitable apparatus to supply higher currents, as in the case of the high-current, high-efficiency gas-filled lamps. The flexibility of the gas-filled incandescent lamps is aptly shown by the fact that on any one circuit carrying 6.6 amp. constant current, lamps of 60, 80, 100 and 250 candlepower burning at 6.6 amp. straight series, with lamps of 400 candlepower at 15 amp. and lamps of 600 and 1000 candlepower burning at 20 amp. on either compensators or series transformers can be used with equal success, thus taking care of almost every conceivable illuminating requirement within the limits named.

Street-Lighting Circuits. From inception of electric street lighting up to and including the present time, both series and multiple circuits have been and are in use. The direct-current system was first adopted, the circuit and generating equipment operating at a constant multiple potential of approximately 100 volts and having two arc lamps in series with obvious disadvantages. These were such that it became necessary to devise constant-current high-potential d-c. generators and circuits for the purpose of operating d-c. series arc lamps, many of which systems are still in use today. Later developments of the high-tension d-c. systems used in many modern installations comprised the operation of magnetite arc lamps in series on the d-c. side of high-tension mercury-arc rectifiers.

Owing to the greater flexibility and lower investment necessary in the operation of alternating-current street lighting equipment, various types of transformers and impedance regulators were developed for use in conjunction with the a-c. enclosed carbon series arc lamps.

The early troubles with multiple arc-lighting circuits led to the development of the present day standard 110-volt circuit with its accompanying multiple incandescent lamps and which is used almost entirely for interior lighting. Some installations of street lighting still use the multiple system of distribution which, however, is being rapidly supplanted by more flexible and efficient series system, both in alternating and direct current. The elimination of high-tension d-c. generators and the substitution therefore of the high-tension mercury-arc rectifier has resulted in the operation of magnetite lamps on d-c. circuits for many notable installations of "White Way" lighting, as well as ordinary street lighting, but the present general street lighting is almost invariably of the series type a-c. gas-filled incandescent-lamp system with the lamps operating either straight series or with compensators or series transformers for the purpose of stepping up the lamp current to a suitable value thus accommodating the high-current, high-efficiency incandescent lamp for general street illumination.

A development which has now come into general use is the series-series or group system combining a high-tension series primary, taking the high-tension side of a number of series-series transformers whose secondaries supply current at medium voltage to groups of incandescent lamps connected in series and placed at proper locations on the streets. A modification of this system comprises a multiple primary circuit, usually of 2300 volts single phase, 60 cycles, with multiple-multiple or multiple-series transformers supplying either individual lamps or medium-potential series groups.

On account of the wide diversity of local conditions which must necessarily be met in street lighting, it has been found that the selection of a suitable distribution system is affected by so many factors that it is impossible to give an opinion excepting in general as to the selection of a system for any particular locality. The selection of a specific system requires maturely developed judgment based upon local conditions and can only be done after a thorough engineering analysis of any proposition has been made, bearing in mind the various factors involved.

Illuminating Units. Using as source of light either arc lamps or incandescent lamps of any of the types described above, the earliest practice omitted glassware entirely. Later on, clear inner globes were used and occasionally the clear outer globe was added. Sand-blasted globes were also used during the earliest stages of development with the result that a very large percentage of the total light was absorbed in passing through the glassware. The enamel-top diffusing globe was used on pendent type units in order to reduce the amount of light escaping into the upper hemisphere but with indifferent results. Diffusing glass globes of various shapes were tried, the glass being of such a composition that visibly large particles were suspended in a matrix of transparent glass or by the admixture of particles of air distributed so as to cause proper diffusion with reasonable light absorption. The principal object achieved in this procedure has been the shielding of the eye from the direct rays of light sources having a highly intrinsic brilliancy.

At present such diffusing glassware is almost universally used, but in the last few years prismatic refractors, either open to the atmosphere or inclosed in clear outer globes, have proved a decided success. By use of this method the light is redirected from directions immediately below the source to points approximately half way between adjacent units, the result being to obtain much more even distribution. However, from the standpoint of maintenance expense the success of many plain refracting schemes is doubtful, inasmuch as the prismatic exterior or interior of the refractor acts in such a way as to accumulate dirt, smoke and fumes which when placed in the path of the light rays seriously lower the ultimate efficiency of the unit. In order to obviate this difficulty, two-piece refractors have been used, the corrugations of the outer sheet being on the concave side, and of the inner sheet on the convex side. The two pieces are then cemented together at top and bottom, forming a composite refracting unit, presenting smooth surfaces which are easily cleaned, on both the exterior and interior of the refractor. In order to use prismatic refractors successfully it is necessary that the light sources be fixed in position, which practice virtually confines the refractor to the incandescent lamp.

Many types and forms of glassware are now used, the field being now centered around the diffusing glass unit and the refracting unit. It is, of course, a waste of money to attempt to use refractors in conjunction with diffusing glassware, owing to the fact that by such means the redirecting effect of both is cancelled and the absorption greatly increased. Many systems now use the plain ball globe, but many highly ornamental systems are composed of diffusing glassware in various artistic forms which are more or less scientifically designed and will without doubt add greatly to both the daylight and operative appearance of any system. In an effort to eliminate as much absorption as possible, certain installations have been made using a unit of the globeless type, with a reflector, usually of the radial wave type, which excludes much of the light from the upper hemisphere.

A development which gives promise of great possibilities consists in making up refracting glassware in the form of an outer globe which not only properly redirects the light rays but also presents a very pleasing appearance. The chief objection to this type of unit is, as stated above, the lowering of efficiency by the accumulation of dirt on the prisms of the globe itself, unless it is of the two-piece type.

Street-Lighting Standards. In many localities, some of which are otherwise progressive, wood poles are still used to support street-lighting units. In some cases the lamp may be suspended in a harp at the top of the pole; in others the lamp is suspended by or supported from a bracket attached to the pole and in still others mastarms are used which may be either of the permanent or lowering type. In still other cases a span-wire center suspension is used to support a pendent type unit. These same types of lamp supports are also used with metal poles which may be either of cast iron, tubular steel, or structural type; a number of variations to these three types have also been designed and tried out in various localities. Some of these are still in service.

Some years ago the cluster type of ornamental street lighting was introduced into prominent so-called ornamental street-lighting systems, but due to the fact that much of the light in units of this nature is lost by direct and indirect interference and absorption, the cluster unit is rapidly being supplanted by single-light standards. The tendency at the present time is toward greater mounting heights, thus obtaining a much wider spread of light from each unit, but in cases where the foliage on the streets is very thick, and sometimes low, street lights will be found suspended over the centers of the streets or supported on standards of medium heights along the curb lines.

Due to the oxidation of the metal it has been found that both cast iron and tubular steel poles have in many locations been subjected to rapid deterioration, not only on account of the fact that oxidation takes place on the exterior of the standard but it is very difficult to reach the interior for painting. Various schemes have been devised to obviate this difficulty, such as galvanizing, plating with various metals and coating of the standard with various types of paints, all of which methods have had very indifferent success.

In the last 10 to 15 years the concrete lighting standard has been extensively developed with the result that many beautiful forms of such standards can now be obtained on the market. Because corrosion of concrete takes place very slowly, the maintenance cost and deterioration of such units is very small. The concrete standard, moreover, may be made in colors which harmonize with the surroundings and even if made of naturally colored concrete the tendency is to gradually accumulate enough dust, smoke and fumes to cause it to take on color which is in harmony with objects in its vicinity. Many concrete posts are made in the form of artificial granite, in which the sparkling effect is secured by means of mica flakes imbedded in the surface of the material of which the standard is composed. Such concrete standards, if properly built and well reinforced, will stand shock better than most metal standards, there being exceptions to this rule, of course. Concrete posts are now being used in many forms and sizes up to such types and heights as to mount the light center 30 ft. or more above the street level.

Both metal standards and concrete standards have their respective advantages and disadvantages, some of which have been named above. The chief objection to the cast-iron standard is its inability to resist shock and its tendency towards oxidation. The tubular or sheet-metal standard resist shock very well but in most cases it is subject to rapid deterioration through oxidation. The concrete standard is in many cases extremely heavy, although certain forms have a reasonable weight. Concrete has the disadvantage that when exposed iron is used in contact with cement, rust streaks from the iron fittings will develop and entirely spoil the appearance of the posts. In order to eliminate this undesirable feature it has been the practice to use fittings of heavily galvanized iron, brass or bronze on concrete posts, with a consequent increase in first cost.

Distribution Systems. The most extensive use was made of aerial wires on distribution systems for street lighting during the early period of the development of the art and many such systems are still in use today. As a rule, the conductors were weatherproof copper wires strung on glass or porcelain insulators supported by crossarms on wood poles. Virtually the

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same type of conductor was later used on steel-pole constructions, in which case the insulators were mounted on wood or steel pins supported by wood or malleable-iron crossarms, which were bolted to steel poles of the tubular or structural type and a large amount of this class of construction is operating satisfactorily today. Due not only to appearance, but also on account of the difficulty of running aerial wires through heavy foliage or congested districts, and also to the many troubles caused by lightning, contact with other circuits, breaking of wires by means of sleet, wind, etc., the underground system of distribution was developed.

At first cables were installed in conduits buried in the ground with suitable manholes at proper points for connection to the lighting standards. This was considered a very great improvement and operated in general almost entirely without the troubles common on aerial systems. However, new troubles were then encountered due to cable breakdowns and the various electrostatic effects which are inherent in an installation of lead-covered cables. Moreover, the expense of installing conduits was heavy and the actual installation was in many cases difficult and uneconomical. The first type installed was merely water pipe buried in the ground, followed later by pump log, sewer tile, multiple tile, concrete pipe and finally by fiber conduit. These types of conduit were used with varying degrees of success and even today many of the older installations are still performing their duties as well as ever. In cases where a large number of cables were to be installed on a system the conduit line was naturally the most economical equipment, but where single cables were to be run the expense of the installation of conduit was practically prohibitive.

This led to the development of the lead-covered, jute-protected, steel-taped or armored parkway cable of which many millions of feet are in successful service today. This type of construction has many admirable features, among which are the absence of conduit, extreme flexibility of installation, ease of installation and operating stability, the one disadvantage being, however, that in case of trouble it is necessary to dig up the cable in order to replace a defective length.

While the installation of armored cable has greatly decreased the necessary first cost on street-lighting distribution systems, thereby reducing the fixed charges on any installation, recent investigations have to a certain extent caused the arising of a question relative to the difference between fixed charges on conduit installations and power losses in armored-cable installations. This is due to the fact that a single-conductor cable entirely inclosed in steel will necessarily magnetize the armor, to a certain extent, thus causing increased line reactance, hysteresis losses and Foucault current losses which, taken in the aggregate and expressed in dollars, may possibly equal or exceed the excess fixed charges on a conduit installation. This matter is being given much attention by leading engineers at the present time.

As a general rule, it may be safely stated that in street-lighting installations where a number of leads of single or multiple-conductor cables are run in the same feeder line, it is preferable in such a case to use conduit and lead-covered cables, whereas in the case of single cables laid individually it is preferable to use armored parkway cable. Local conditions, however, may be taken into consideration in designing any street-lighting installation and no rule can be laid down which will cover the variety of conditions to be met with in various localities.

Methods of Connection. Arc lamps were and are connected usually in series with suitable devices for maintaining the arc while operating and with cutouts for maintaining the continuity of the circuit when certain lamps are not in operation for various reasons. Incandescent lamps are connected in various manners, the cheapest and most common method being that of the straight series circuit in which all current passes directly through all the lamps, and in case of a lamp being out, the circuit is closed by a film cutout consisting of a thin film shunted across the lamp terminals so that in case the lamp burns out the circuit voltage will puncture the film and maintain the continuity of the circuit.

A variation to this system consists in placing impedance coils connected in shunt across the terminals of the lamps so that in case of the lamp burning out its corresponding impedance coil will supply impedance in the circuit equivalent to the normal lamp voltage. A later development in use with gas-filled tungsten lamps consists of connecting each lamp across the secondary terminals of a suitable compensator or autotransformer whose primary is in series with the constant-current circuit. Such compensators may be built to supply normal line current to the lamps or may be of varying ratios in order to supply current to the high-efficiency and high-current incandescent lamp.

In order to secure protection from high voltage at the lamp terminals, the series-multiple transformer has been developed in recent years, and is constructed with the proper ratio to supply the required current to whatever lamp may be used as a secondary load. As mentioned above, a variation of the series-multiple scheme consists of the series-series or group system in which a group of lamps is connected in series on the low-tension side of transformers whose primaries are connected in series on the high-tension side of a constant-current circuit. In this case each lamp is protected by a film cutout of suitable characteristics and in certain installations the group system effects a substantial saving over the cost of other methods of installation.

Station Equipment. For modern street-lighting installations, the high-tension d-c. arc-lamp generator has long since become obsolete, although still used in many cases where modern practice has not been adopted. In the more recent installations series magnetite arc lamps are operated, as stated above, on the d-c. side of high-tension mercury-arc rectifiers. In a-c. installations employing either arc lamps or gas-filled incandescent lamps, the circuits are fed either from a constant-potential bus with induction regulators in series with the line, or from the secondary side of individual transformers also regulated by induction regulators. On some of the later types of series-multiple transformer installations the circuits are connected directly across the secondary terminals of constant-potential transformers which are built with a number of primary and secondary taps so that the line voltage may be adjusted to meet the requirements of any particular circuit.

The switchboard equipment is usually of very simple character, consisting merely of an oil switch for closing the line on the individual transformer primary, with vacuum-break stab switches for closing the series circuit. In conjunction with this apparatus there is usually a no-load relay connected in the secondary circuit and an overload relay connected in the primary circuit for the purpose of disconnecting the equipment from the line in case of trouble. In more complicated installations, however, transfer buses are installed to permit of cutting circuits from one panel to another, for the segregation of circuits, or the operation of a number of circuits in series. Many such installations are supplied with remotely controlled oil switches. As a variation to the transfer buses, the circuit terminals are occasionally supplied with disconnecting potheads whereby any desired combination of circuits may be obtained.

Methods of Financing. Street-lighting systems for municipalities may be financed in a number of ways, among which may be mentioned the following:

First—The payment of the installation costs, operating and maintenance charges, by means of direct taxes.

Second—Payment of installation costs by means of bond issues, in which case the operation and maintenance costs, as well as interest and sinking fund for the bonds, are taken care of through direct taxes.

Third—Payment of the installation costs by means of special assessment charges levied on a frontage basis, the operation and maintenance charges to be covered by appropriations from taxes.

Fourth—Payment of original construction costs by local public service companies; the cash costs and fixed charges of the systems to be paid by the municipalities, in which case provision is usually made for the acquirement of the property by the municipality at a given time on the basis of original cost less accrued depreciation at such date.

Fifth—Construction costs to be borne by some public body other than the municipality itself, in which case provision for payment is usually made on an installment basis, the deferred payments to bear interest and the expense of operation and maintenance to be paid from municipal taxes.

Sixth—Local street-lighting systems are occasionally constructed and operated by neighborhood commercial or business men's associations on various plans among which are the following:

(a)—Payment of cost of construction out of association funds, the operation and maintenance to be paid for by individual business men or property owners on a frontage basis; the construction work to be done by a contractor or by the local public service corporation, in which case a number of variations in the form of contract are possible.

(b)—Payment of construction and operating charges by means of individual subscriptions.

(c)—Payment of cost of installation by means of local assessment on a frontage basis; the system when completed to become the property of the municipality and to be operated as a part of the municipal system; the local association paying not only the cost of construction, but also for the excess illumination, whereas the municipality stands the cost of the normal illumination.

(d)—Payment of installation charges, maintenance and operating costs by means of general special assessment exactly as in the case of street and sidewalk improvements or on municipal utilities; the same conditions of ownership and contract applying as in item (c).

Conclusion. The many considerations involved in the selection, construction, operation, maintenance and financing of a street-lighting system are so complicated and interrelated that it is impossible to lay down any definite rules except in the most general form. It may safely be said, however, that any municipality or association contemplating the installation of a modern street-lighting system should first obtain a comprehensive engineering analysis of all factors involved, which analysis should cover the following points:

Intensities of illumination desired and type of unit or units proposed to give such illumination; type of standard or standards required to support the units; type of electrical system necessary to most economically supply power to the lamps; specifications covering all labor and material necessary on the work; estimate of costs of construction, operation and maintenance of proposed system and method of financing the above costs.

With this information in hand any municipality or association is then in a position to proceed with the financing and installation of a suitable street-lighting system and by this procedure the most economical and satisfactory conclusion may be reached.

STREET LIGHTING MASTARMS.—See Mastarms, street lighting.

STREET LIGHTING PENDANTS.—See Pendants, street lighting.

STREET LIGHTING POSTS.—See Posts, ornamental and plain street lamp, concrete; Posts, ornamental and plain street lamp, iron and steel.

STREET LIGHTING UNITS.—See Lighting units, ornamental street.

STREET PILLARS.—See Pillars, street, for underground cable, police and fire-alarm boxes.

STREET SERIES LAMPS.—See Lamps, incandescent, street series.

STREET SPRINKLING CARS. — See Sprinkling cars, electric railway.

STREET SWEEPERS. — See Sweepers, street, electric.

STREETHOOD BODIES. — Streethood bodies are provided for both series and multiple street lighting circuits. For use on the multiple circuits the body consists of a socket, usually mogul type, with a plain cast iron protecting cap, threaded to receive conduit, and a porcelain-enameled or painted steel reflector which is fastened to the cap. They are used for simple mul-

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tiple circuits for suburban and small town service. They are rather simple affairs and are also used in systems where compensators are used for each lamp.

Series street-lighting circuits sometimes provide a reactance coil or regulating coil at the lamp to keep the current in the circuit practically constant if one or more lamps burn out or are broken. The streethoods for this service, therefore, consist of a porcelain insulating head with a protecting cap or canopy, a mogul-base lamp socket with the reactance coil mounted above it, a cast iron reflector holder and steel reflector and sometimes diffusing glassware. When the film-cutout type of socket is used the streethood body is simpler and is made like the multiple-circuit bodies.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

STREETHOODS, COMPLETE, BRACKET TYPE.—This is a special type of street lighting unit provided with a flat cone reflector and a protective hood, usually made of cast iron and housing the socket and cutout. There are various styles, with or without enclosing glassware, and with either a glass or enameled metal reflector. The fixture fastens rigidly to the bracket arm.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Fletcher Mfg. Co., 302 E. Second St., Dayton, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Piper Co., Ltd., The Hiram L., 75 St. Remi St. Montreal, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Cutter." (See display adv. pages 1395-1402.)

STREETHOODS, COMPLETE, SUSPENSION TYPE.—Suspension type streethoods differ from the bracket type (which see) in that they are equipped with fittings for suspension from mastarms or span wires or cables instead of for attachment to a rigid bracket or other support. Being generally hung over the middle of the street, they are mostly arranged to be lowered.

Manufacturers:

A-A Electric Mfg. Co., The, 303 Center St., Bridgeport, Conn.
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Piper Co., Ltd., The Hiram L., 75 St. Remi St. Montreal, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Cutter." (See display adv. pages 1395-1402.)

STRETCHERS, WIRE.—See Grips, wire.

STRIEBY & FOOTE CO.—Newark, N. J. Manufacturer of pole bands, turnbuckles and electric railway forgings. President, W. H. Whittemore; vice-president and secretary, H. Karr; treasurer, C. D. Karr; sales manager, J. H. Lane, Jr.

STRINGING.—In pole line construction stringing is the process of running the wires from pole to pole after the erected poles have been equipped with crossarms and insulators.

STRIPPERS, CABLE.—See Knives, cable stripping and splitting.

STRIPS, RESISTANCE.—See Ribbon, resistance.

STRIPS, STAGE LIGHTING. — Stage lighting strips are long narrow pieces of metal containing several incandescent lamps. They are used for illuminating the stage and are of a portable nature, so may be moved wherever needed. Each lamp receptacle is mounted in a separate outlet box, or all of the lamps may be in one iron or steel box. The metal protecting casing, which is also finished and shaped to serve as a reflector, is protected against corrosion. They are provided with a special cable or reinforced cord.

Manufacturers:

NATIONAL X-RAY REFLECTOR CO., 235 W. Jackson Blvd., Chicago, Ill. Standard "X-Ray" proscenium strip contains 14 X-Ray units for 75 or 100-watt Mazda lamps. Color frames are supplied when specified. Fitted with an X-Ray mirror-glass reflector. Also see Borders, bunches, footlights, etc., and display adv. page 1405.—Adv.



Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.
Western Reflector Co., 1221 W. Madison St., Chicago, Ill. "Western."

STRITE AUTOMATIC TOASTER CO.—422 6th Ave., S., Minneapolis, Minn. Manufacturer of electric toasters. President, M. E. Simpson; vice-president, Fred Hansen; secretary, H. D. Lennon; treasurer, Glen M. Waters.

STROHMEYER & ARPE CO.—139-141 Franklin St., New York, N. Y. Manufacturer of insulating waxes. Business established 1882. President, F. G. Strohmeyer; vice-president and treasurer, G. Porges; secretary, F. E. Wolters; sales manager, A. H. Hoffman.

STROMBERG-CARLSON TELEPHONE MFG. CO.—Rochester, N. Y. Manufacturer of telephone apparatus, cables and supplies. Business established 1892. President, G. W. Todd; secretary, W. M. Angle; treasurer and general manager, W. Roy McCanne; sales manager, George S. Scovill. Main office and factory, 1050 University Ave., Rochester, N. Y. Branch offices and warehouses, 710 W. Jackson Blvd., Chicago, Ill.; Coca-Cola Bldg., Kansas City, Mo.; 35 McCaul St., Toronto, Ont., Can.

STROMBERG ELECTRIC CO.—Chicago, Ill. Manufacturer of electric time recording systems. President, C. M. Crook; vice-president and sales manager, E. E. Spencer; secretary, A. L. Denniston; treasurer, W. P. Martin, Jr. Main office and factory, 209 W. Jackson Blvd., Chicago, Ill. Branch offices, Boston, Mass.; New Haven, Conn.; Newark, N. J.; Philadelphia, Pa.; Baltimore, Md.; Pittsburgh, Pa.; Rochester, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Detroit, Mich.; Indianapolis, Ind.; Milwaukee, Wis.; Minneapolis, Minn.; Kansas City, Mo.; St. Louis, Mo.; 8 W 40th St., New York, N. Y. Sales representatives, Eicher & Bratt, Seattle, Wash.; Electric Sales Co., Los Angeles, Cal.; Richmond Machinery Co., Salt Lake City, Utah.

STROMI.—Trade name for solder and tinfoil manufactured by the Standard Rolling Mills Co., 363-367 Hudson Ave., Brooklyn, N. Y.

STRONG, CARLISLE & HAMMOND CO., THE.—Cleveland, Ohio. Manufacturer of electric furnaces and steam specialties. President, E. E. Strong; vice-president, R. H. Carlisle; secretary, H. W. Strong; treasurer, L. J. Hammond. Main office, Cleveland, Ohio. Branch office, 17 S. Desplaines St., Chicago, Ill.

STRONG MACHINERY & SUPPLY CO.—21 Walker St., New York, N. Y. Manufacturer of insulated screw drivers. Business established 1898. President, Charles E. Strong; vice-president, Louis E. Strong; secretary and treasurer, Louis Kiselka; general manager, C. E. Strong.

STRONG MFG. CO.—Sebring, Ohio. Manufacturer of lighting reflectors, etc.

STRONGHOLD.—Trade name for machinists' wrenches manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

STRONGHOLD.—Trade name for belting manufactured by J. E. Rhoads & Sons, 12 N. 3rd St., Philadelphia, Pa.

STROUD & CO., E. H.—928-934 Fullerton Ave., Chicago, Ill. Manufacturers of coal crushing, pulverizing and stoking machinery. Business established 1896. Sales representative, Matteson Co., Pioneer Bldg., Seattle, Wash.

STROWGER.—Trade name for automatic telephone switchboard apparatus manufactured by the Automatic Electric Co., 1001 W. Van Buren St., Chicago, Ill.

STRUCTURAL SLATE CO.—Pen Argyl, Pa. Manufacturer of slate for electrical purposes. Business established 1916. President, N. M. Male; vice-president, William Bray; secretary, M. L. Parsons; treasurer, William H. Smith; general manager, William A. Kitto. Main office, Pen Argyl, Pa. Branch offices, 313 Perry Bldg., Philadelphia, Pa.; 200 5th Ave., New York, N. Y.; 718 Crilly Bldg., Chicago, Ill.; 6353 Vinewood St., Detroit, Mich.; Waco, Tex.; 255 Frick Bldg. Annex, Pittsburgh, Pa.; 622 Old South Bldg., Boston, Mass.

STRUCTURAL STEEL FOR OUTDOOR SUBSTATIONS, ETC. — Structural steel used in the construction of outdoor substations, transformer platforms, special steel structures, etc., consists of angles, channels, I-beams, T-bars and T-rails, flats, etc. These forms do not differ any from other structural steel shapes, for use in buildings, etc., except that special attention must be given to prevent corrosion from the constant exposure to the elements. This means that the steel must be thoroughly cleaned and painted or galvanized, usually before being shipped out on the job.

Manufacturers:

Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont., Can.
Atlas Iron, Wire & General Metal Works, 815-817 Queen St., W., Toronto, Ont., Can.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Burke Furnace Co., 320 E. North Water St., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Coombs & Co., R. D., 30 Church St., New York, N. Y.
Erie Steel Construction Co., 615 Haybarger Lane, Erie, Pa.
Fabricated Steel Products Corp., Leetonia, Ohio.
Flour City Ornamental Iron Co., 27th St. and 28th Ave., S., Minneapolis, Minn.
International Steel Tie Co., The, 16702 Waterloo Road, Cleveland, Ohio.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.
Southern Electrical Equipment Co., Charlotte, N. C.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

STRUCTURES, STEEL, SPECIAL FOR TRANSMISSION LINES, ETC.—The interconnection of overhead transmission lines and the necessity of having facilities for switching the various sections of line in emergencies has resulted in the development of steel structures for outdoor use at such points. Where only two lines are involved it can be done on poles with special crossarms, but if there are lines in several directions a more elaborate structure is required. The structure must be of such size and shape as to support hand-operated disconnectives controlled from below, and the necessary insulators for bringing the connections to the switches. Ample clearance must be provided from ground and other phases, and with the higher voltage this requires a structure of considerable size.

Manufacturers:

Archbold-Brady Co., Syracuse, N. Y.
BATES EXPANDED STEEL TRUSS CO., 208 S. LaSalle St., Chicago, Ill. (See display adv. page 1258.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Coombs & Co., R. D., 30 Church St., New York, N. Y.
Erie Steel Construction Co., 615 Haybarger Lane, Erie, Pa.
Fabricated Steel Products Corp., Leetonia, Ohio.
Flour City Ornamental Iron Co., 27th St. and 28th Ave., S., Minneapolis, Minn.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
International Steel Tie Co., The, 16702 Waterloo Road, Cleveland, Ohio.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

STRUTHERS-WELLS CO.—Warren, Pa. Manufacturer of penstocks, storage tanks and other steel plate construction. Business established 1851. President, K. M. Andrews; vice-president, E. D. Wetmore; vice-president and sales manager, R. S. Hall; secretary, E. A. Arnold; treasurer, R. C. White; general manager, H. W. Co-

narro. Main office, Warren, Pa. Branch office, 50 Church St., New York, N. Y.

STUART.—Trade name for attachment plugs manufactured by the Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill.

STUART-HOWLAND CO.—Congress & Purchase Sts., Boston, Mass. Manufacturer of magnet wire. President and treasurer, Guilford M. Stuart.

STUART PRODUCTS CORP.—665 Washington Blvd., Chicago, Ill. Manufacturer of dry batteries and phonograph lights. President, M. H. Herskovitz; vice-president and general manager, William Herskovitz; secretary and treasurer, Abraham Herskovitz.

STUBS' IRON WIRE GAGE.—Another name for the Birmingham Wire Gage, which see.

STUCCO-APPLYING MACHINES, MOTOR-DRIVEN.—Machines consisting of mixing chambers together with suitable pumping mechanism for forcibly projecting thin mixtures of cement or stucco, through a hose and nozzle to coat surfaces of buildings, tunnels, etc.

Manufacturer:

Hodges Stucco Machine Co., The, 3618 Colerain Ave., Cincinnati, Ohio. "Hodges."

STUCKI CO., A.—419 Oliver Bldg., Pittsburgh, Pa. Manufacturer of side bearings. Business established 1908. A. Stucki, proprietor.

STUDIO LAMPS.—See Lamps, blueprinting, photoengraving and photographic.

STUDIO LITE.—Trade name for commercial lighting fixtures manufactured by the Lighting Studios Co., 220 W. 42nd St., New York, N. Y.

STUDS, FIXTURE.—Small metal fittings with a nipple for fastening a fixture stem to the stud and three or four slotted or drilled feet for attachment by bolts to an outlet box. The studs are made hollow, that is the hickey type, or solid for straight electric fixtures.

Manufacturers:

American Brass & Copper Co., 138 Lafayette St., New York, N. Y.
Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Godfrey."
Austin Co., The M. B., 108-16 S. Desplaines St., Chicago, Ill.
Frallck & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon"; "Kwikon Nobolt."
Grabler Mfg. Co., The, Cleveland, Ohio. "Square Gee."
Harvard Electric Co., 525 W. Van Buren St., Chicago ,Ill.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass. (insulated)
Michigan Stamping Co., Detroit, Mich.
M. S. W. Mfg. Co., Inc., 1527-1529 Niagara St., Buffalo, N. Y.
National Acme Co., The, E. 131st St., & Colt Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "National" fixture studs are stamped from a special highgrade steel—No. 11 B. & S. Gage—and while lighter, are stronger than any other fixture studs on the market. "National" fixture studs are sherardized, the only method through which they can be uniformly protected against corrosion. See display adv. pages 1302-4.—Adv.
Pratt-Chuck Co., The , Frankfort, N. Y.
RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. page 1308.)
Schwartz & Bro., S. Robert, 729-31 Broadway, New York, N. Y. "Esrobert."
STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa.
THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. "T. & B."

STUDY, DEVELOPMENT, FOR TELEPHONE SYSTEMS.—Any consideration of the amount and location of telephone business which may be expected in the future. Though based on many facts gathered, the findings are largely based on judgment and are full of error. Unforeseen factors arise which upset the most carefully made study, yet it pays to look ahead as far as can be seen.

STUPAKOFF LABORATORIES, THE.—6617-6627 Hamilton Ave., Pittsburgh, Pa. Manufacturer of pyrometers, Nernst lamps and high temperature porcelain insulators.

STURDY.—Trade name for ignition coils and heating device plugs manufactured by the Gray-Heath Co., 544 N. Parkside Ave., Chicago ,Ill.

STURTEVANT CO., B. F.—Boston, Mass. Manufacturer of motors, motor-generators, generators, electric fans, blowers, heaters and vacuum cleaners. Business established 1860. President, E. N. Foss; vice-president and general manager, E. B. Freeman; secretary, Noble Foss; treasurer, B. S. Foss; sales manager, H. W. Page. Main office, Damon St., Hyde Park, Boston, Mass. Factories, Hyde Park, Mass., and Galt, Ont., Can. Branch offices, 306 Walton Bldg., Atlanta, Ga.; 555 John Hancock Bldg., Boston, Mass.; 100 Bedford Ave., Buffalo, N. Y.; 530 S. Clinton St., Chicago, Ill.; 604 Provident Bank Bldg., Cincinnati, Ohio; 330 Guardian Bldg., Cleveland, Ohio; 3411 Knight St., Dallas, Tex.; 406 Marquette Bldg., Detroit, Mich.; 36 Pearl St., Hartford, Conn.; 412 Reliance Bldg., Kansas City, Mo.; 804 Metropolitan Life Bldg., Minneapolis, Minn.; 52 Vanderbilt Ave., New York, N. Y.; 135 N. 3rd St., Philadelphia, Pa.; 711 Parks Bldg., Pittsburgh, Pa.; 1024 Granite Bldg., Rochester, N. Y.; 2086 Railway Exchange Bldg., St. Louis, Mo.; 818 McIntyre Bldg., Salt Lake City, Utah; 1006 Loan & Trust Bldg., Washington, D. C.; 759 Monadnock Bldg., San Francisco, Cal.; 1105 White Bldg., Seattle, Wash.; 404 New Birks Bldg., Montreal, Que., 210 Lumsden Bldg., Toronto, Ont., 914 Somerset Block, Winnipeg, Man., Can.

SU-DIG.—Trade name for spark plugs manufactured by the Superior Motor Power Co., 75 Spring St., New York, N. Y.

SUBBASE.—The structure beneath the base of and supporting an electrical machine. Also a porcelain or other insulating part below the base of a switch.

SUBMARINE.—Trade name for electric washing machines manufactured by the Superior Machine Co., De Kalb, Ill.

SUBMARINE CABLE TELEGRAPHY.—Comparatively short lengths of submarine telegraph cable were laid as early as the year 1851. In 1856 a cable was laid between a point in Nova Scotia and a point in Newfoundland, 85 miles apart. Between 1857 and 1866 four attempts were made to connect America and Europe by submarine cable. Satisfactory communication was established on July 27, 1866. Additional cables were laid in 1873, 1874, 1880, 1894, 1900, 1901, 1905 and thereafter, until at the present time, there are submarine strands connecting points in the United States and Canada with points in Europe—England, Ireland, France and Germany. In 1903 the Pacific Ocean was spanned by a cable stretching from Bamfield Creek, British Columbia, to Australia, followed shortly afterwards by an American cable laid by the Commercial Pacific Cable Co., from San Francisco to Honolulu (Hawaii) the Philippines (with connections to Japan and China) and to Australia. Since 1866 there has been an American cable to Cuba, and since 1882 cable connection with points in South America.

At the present time there are about 300,000 miles of submarine cable in use, having been laid at a cost of approximately $350,000,000, and in the various waters of the globe more than fifty cableships are employed in maintaining and repairing these submarine lines. With the exception of the United States Signal Corps cable between Seattle, Wash., and Valdes, Alaska, (1,725 miles) practically all of the submarine cable in use was manufactured in England, and British companies own the only modern deep-sea cable-laying ships. Apparatus used in equipping cable terminal offices also has been manufactured mainly by British companies. However, developments to take place in the near future are likely to attract the attention of American manufacturers to this substantial and profitable field.

Since the advent of radio telegraphy there has been a tendency to weigh well all proposals for cable extension, but as radio has progressed it has become apparent that both of these methods of long-distance communication are to have distinctive fields of usefulness, as well as serving in a complementary sense. Since the close of the late war cable manufacturers have been supplied with orders for deep-sea cable which will keep their works going at full capacity for many years to come. Additional cable lines are being laid at the present time and many more are projected.

By means of improvements in cable terminal apparatus the speed at which a submarine cable may be operated has about doubled in the past twenty years. Originally, the mirror galvanometer was the only receiving instrument employed. This was supplanted by Kelvin's siphon recorder, by means of which the incoming signal impulses are marked on a moving paper tape in the form of left and right swings of an inking siphon, in response to positive and negative current applications at the sending end. The recorder is still widely used. During recent years a number of ingenious relays have been invented which may be connected directly into the cable circuit such as the Brown "drum" relay, the Gulstad vibrating-armature relay, the Bruce relay, the Muirhead goldwire relay, the Heurtley magnified, and the Dixon selenium-cell relay system. Practically all of the deep-sea cables are operated duplex, the number of words passed in each direction simultaneously ranging from 30 to 60 per minute.

The apparatus required at a cable terminal station, where the cable is duplexed, consists of: Terminal line-battery, total voltage 50; one set of sending condensers (line side 40 to 80 mf.); one set of sending condensers (artificial line 40 to 80 mf.); one apex resistance unit in tenths of an ohm; one signaling key; one automatic transmitter; one siphon recorder; one spare recorder suspension; one receiving condenser (40 to 80 mf.); one resistance shunt for receiving condenser, up to 10,000 ohms; one magnetic shunt of value to suit the cable; one rheostat for series resistance of magnetic shunt. One artificial cable representing electrical characteristics of the real cable as nearly as possible; one subdivided condenser, divisions as low as 0.01 mf.; one rheostat from 1 to 100 ohms; two rheostats from 1 to 500 ohms; one rheostat from 1,000 to 200,000 ohms; two rheostats from 1 to 10,000 ohms; one reliable set of lightning arresters.

SUBMARINE CABLES.—See Cables, light and power, submarine; Cables, telephone and telegraph, submarine.

SUBMARINES, SPECIAL ELECTRICAL EQUIPMENT FOR.—Submarine vessels have a great deal of electrical equipment and depend on this equipment entirely for all of their operations while submerged. The amount of air available is so limited that it cannot be utilized for any type of fuel-consuming engine equipment and therefore d-c. motors which operate from a storage battery are used for the propelling power, operating the raising and lowering devices, steering mechanisms, ventilating and other machines; electric power is also used for signals, lighting, etc.

While the submarine is operating on the surface a prime mover is operated which drives a generator supplying current for most of the operating mechanisms and for charging the storage battery. This requires a high class of equipment, as it must be very rugged and dependable. The equipment is very often special in its application and is always made to meet very exacting requirements of the naval authorities.

Manufacturers:

Diehl Mfg. Co., The, Trumbull St., Elizabethport, N. J.
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. ("Hughes", "Hotpoint", "Edison" electric cooking and heating.) (See display adv. pages 1292-1293.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUBSTATIONS, AUTOMATIC.—The desirability of placing substations at points where they will permit a saving in distributing feeder capacity without adding to labor costs for attendance has led to the development of control systems which make it possible to operate substations automatically. The use of automatic substations is of particular value in remote communities and at points on electric railways where it is difficult to maintain voltage at certain hours. In a-c. automatic stations the pressure regulators are automatic and the circuit breakers are arranged to be self-closing on out-going feeders. If a short-circuit occurs and holds on, the breaker remains open after opening the second time. In d-c. converter substations the converter is started whenever the pressure falls below a predetermined value, and stops when it goes above the maximum desire value. Also see Substations, railway, automatic.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. This Company can furnish from standard equipment all devices necessary for substations of any commercial capacities. With substations made automatic, advantage can be taken of more or less unreliable sources of power. The shorter line sections eliminate excessive line drop and a

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smaller part of the line is disabled at any one time, thus reducing the time of repair and, therefore, the duration of signal delays. Automatic substations require practically no attendance other than ordinary maintenance. See adv. pages 1203-1223.—Adv.

SUBSTATIONS, CONSUMERS'. — This applies to installations of high-tension converting equipment which are located on the premises of large consumers of energy. They are sometimes referred to as transformer rooms when the equipment consists chiefly of transformers. In the case of large industrial consumers supplied from overhead lines the service is most often supplied from an outdoor installation of transformers, with fuses, arresters and accessories, such as are described under Substations, outdoor. These will not be further discussed here.

The indoor substation contains transformers, high-tension control equipment and sometimes d-c. converting equipment. With transformers of over 100 kw. capacity there is an oil switch of the tank type with overload relay, disconnects to isolate the switch from the incoming line, and high-tension bus supports to carry the connection from the switch to the transformers. If the energy is sold as untransformed energy, there must be current and pressure transformers for the watt-hour meter, which is placed on the high-tension side of the transformer. In such substations the entire equipment (except metering) is installed at the consumer's expense and remains his property.

With very important service, where an interruption represents a serious loss because of the nature of the manufacturing process, it is usual to provide two sources of supply. In such cases there must be an oil switch on each incoming tap with bus connections so arranged that the transformers may be thrown to the other line in an emergency. This calls for interlocking arrangements in some cases to prevent the two lines being thrown in together.

With a loop connection each incoming line must be equipped with an oil switch capable of breaking the line current. There must be a high-tension bus into which each side of the loop is connected and from which a tap is taken to the transformers. The transformer tap must have a separate oil switch with overload relay. The line switches are equipped with reverse-power relays or some other protection which will cut out only one side of the loop in case of trouble. In such cases the line switches and protective relays are placed in a separate room and remain the property of the power company, while the transformer switch and equipment in the transformer room became the property of the consumer.

With very large consumers (2,000 to 5,000 kw.) the substation is sometimes equipped with compartment type switches and the construction is of the type used in generating stations. In such cases there are sometimes outgoing feeders at the transmission voltage going to other distributing centers on the property, or the distribution may be at 2,300 volts to other buildings. In such cases, regulators and the usual control boards of a distribution substation are provided, and there may be an operator in attendance.

SUBSTATIONS, OUTDOOR.—The use of outdoor substations has become increasingly common in recent years. The large clearance spaces required for bus connections at voltages above 50,000 necessitates buildings of unusual size for the housing of the transformers and switching equipment in high-tension substations. This suggested the desirability of installing the transformers and high-tension switches outdoors and saving the cost of the greater part of the building. Transformers were equipped with weatherproof types of porcelain bushings and oil switches were designed for outdoor service. The bus connections were supported by timbers and poles, and in later installations by steel skeleton framework. The lightning arresters, disconnecting switches, fuses and other auxiliary equipment were suitably modified and the outdoor substation became the usual thing.

With the extension of high-voltage distribution lines to towns and outlying industries, the outdoor installation of transformers and protective equipment followed as a matter of course. The equipment for a town requiring less than 100 kw. consists of a platform for the transformers, fuses, lightning arresters and in some cases a watt-hour meter to record the total energy delivered. The platform may be of timbers supported by two poles or a steel tower. Steel-tower installations have been worked out by several manufacturers to provide all the accessories in convenient form for rapid assembly on the site.

These usually contain fuses of the carbon tetrachloride or expulsion type on the primary side of the transformers. The fuses are arranged conveniently for replacement and for use at primary disconnectives in case it is necessary to work on the transformer.

Horn-gap lightning arresters are provided for the protection of the transformers, and these are accompanied by resistances in the ground circuit or choke coils in the line, or both. The use of horn-gap arresters without ground resistance is likely to cause interruptions by opening the circuit breaker at the point of supply. The flow of power following a discharge must therefore be limited by resistance or reactance.

If the substation supplies service at 2,300 volts to a town, a meter is provided by some companies on the 2,300-volt mains as a check on the distribution losses in the town. If to a mine or factory the voltage is usually 220 or 440 and the meter is located inside the first building. The current and potential transformers when required for such meters are housed from the weather in suitable boxes, as they are not suitable for outdoor work.

In larger installations the transformers are placed on the ground within a suitable fence or similar enclosure. Disconnective switches are provided on the pole top by which the connection can be "killed" if it is necessary to work on them. The fuses are omitted and an oil switch substituted instead. This increases the ground area and usually results in real estate being purchased for the purpose, or (in the case of an industry) set aside for the use of the substation.

If the regulation of the pressure on the transmission line is subject to considerable variation, and there is a further loss of voltage on the 2,300-volt lines, and the requirements of the service demand regulation within, say 5%, it is sometimes necessary to provide an outdoor type automatic potential regulator. This apparatus is made adjustable for different values of line drop and gives much more satisfactory service than is possible from the average high-voltage line without regulators. The regulator must be inspected periodically as it contains a small motor which runs continuously.

In systems having tie-line connections, switching stations are sometimes established at junctions of high-tension lines. These are generally used only for disconnective purposes and are therefore not intended to open any considerable amount of energy. Pole-top knife switches are arranged for this purpose with connecting rods to make the opening of the three poles simultaneous. These are then brought down to a handle which is accessible to the patrolman and can be locked to prevent unauthorized operation. Where switches of this type may be required to break a small current they are provided with arcing horns which take the arc as the switch opens and prevent damage to the switch contacts.

The outdoor substation reaches its most pretentious form in systems where high-voltage lines (above 50,000) are brought to a point where the pressure is reduced to a lower transmission voltage, such as 13,000, for distribution to neighboring towns and industries, or to substations within a large city. In such cases the higher line is of the suspension-insulator type and the line conductors are terminated on a dead-ending tower through strain insulators. These structures are placed over the stepdown transformers and oil switches which are of large capacity, and occupy a considerable ground area. The connections from the high line to switches and transformers are carried on insulators in the open and must be kept clear of the structure sufficiently to prevent an arc over. These requirements result in a steel truss structure with several members bridging the space occupied by the transformers and oil switches which becomes quite elaborate and not much less costly than an inside installation.

The installation includes space for a set of lightning arresters of the tank type, with disconnects and charging facilities. It is accompanied by the necessary switches and disconnects for the outgoing lines, if they are overhead.

Where the outgoing lines go to city substations by underground routes a building and the usual indoor type of oil circuit breakers are generally provided with a standard indoor type of construction.

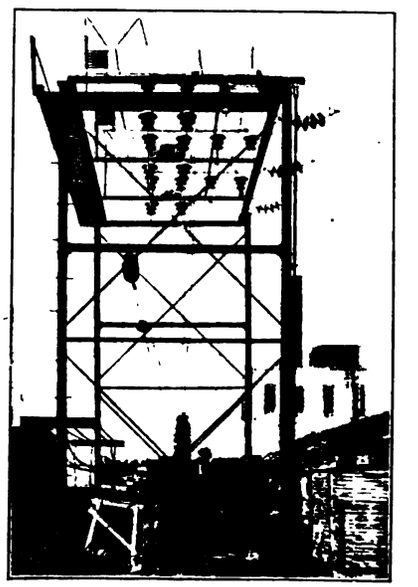
SUBSTATIONS, OUTDOOR, COMPLETE OR UNIT TYPE.—Complete or unit type outdoor substantions are made to provide a substantial and efficient equipment for supplying power and lighting current to small towns or to industrial customers. The substations are connected to the high-tension transmission lines of the power companies and operate without an attendant, requiring only periodic inspection. They consist essentially of a bank of stepdown transformers with complete protective fuses or oil circuit-breakers, arresters, choke coils, horn gaps and sometimes with switching equipment.

The unit type design has the important advantage that it is much lower in cost per kv-a. capacity than any indoor substation and than other outdoor substations constructed according to special designs. The equipment is standardized and may be used for varied distribution requirements at different voltages and power ratings by selecting the proper transforming, switching and protecting units. The complete outfit may usually be shipped and erected much more quickly than special equipment.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

DELTA-STAR ELECTRIC CO., 2433-2459 Fulton St., Chicago, Ill. The "Unit Type" construction which is standard with this company, makes it possible to construct a wide variety of designs of substations, example shown in cut below. When it becomes necessary to



Delta-Star Unit Type Outdoor Substation

add to the capacity of a substation built of these parts, it is only necessary to repeat orders for parts already in use. Damage is easily and quickly repaired. The appearance of the substation when complete is creditable, and does not detract from the value of neighboring properties.—Adv.

ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Substations equipped complete and specially fitted for every condition. See display advertisement on page 1261.—Adv.

GENERAL ELECTRIC CO., Schenectady, N. Y. Large or small outdoor transformer substations complete or any of the component apparatus for assembly by customer. The outdoor substation is a useful adjunct which enables the operating company to supply commercial power from any high-tension system and thus enlarges the field for service at a low initial cost and expense for maintenance. Transformers supplied with G-E substations give successful outdoor operation under greatly varied climatic conditions where a reliable weather-proof construction is essential. Standard sizes and voltage ratings have been established to cover all outdoor substation requirements. G-E outdoor substation apparatus is described in Bulletin 47706-A. Other G-E service in electric power transmission and distribution is portrayed on page 1205.—Adv.

Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUBSTATIONS, PORTABLE, COMPLETE.—Substations designed for ready transportation from place to place are found advantageous to take care of seasonal variations of load, chiefly in electric railway service. Where extra cars are put on for a few days to take care of a county fair or other public event at one season and traffic facilities are likewise increased at another point at some other season of the year, a portable substation serves a very useful function in keeping up schedule speed under abnormal traffic conditions. The portable substation consists of transformers, motor-generator or synchronous converter, and the necessary switching, control and protective equipment; all these are mounted on a car. The high-tension terminals of the transformers are connected to the transmission line; with a connection from the generator or converter to the trolley line, and a siding for the car, the substation can be brought into service in a few hours whenever needed. When not needed it is stored at a car barn where it is given such care as may be required.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
GENERAL ELECTRIC CO., Schenectady, N. Y. Portable substations, consisting of synchronous converter or motor generator, transformers, switchboard and accessories arranged ready for operation in a specially built car. Their use in some cases has saved the cost of a spare unit in several substations. See adv. pages 1203-1223.—Adv.
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. "Burke." (See display adv. pages 1395-1402.)

SUBSTATIONS, RAILWAY AUTOMATIC.—Automatic railway substations are sometimes used on electric interurban and city lines. They are being installed where the operating cost represents a large percentage of the yearly charge, and have proven successful for varied conditions of railway service. Automatic substations are also used for lighting and power service and for water power developments up to about 2,000 kw. The stations perform practically all of the functions usually delegated to an operator. In railway service they operate with either a sectionalized line or a continuous line. In the latter case, they shift load from one station to adjoining ones, thus equalizing the load demand and giving a higher load factor for the entire system. Sectionalized lines usually have one substation for each section which may be about 6 to 10 miles. They operate by starting or stopping the station in response to power demand, by the action of relays tending to keep the trolley potential at or near the normal operating value. They function only while this demand lasts.

As most of these stations are fed by a-c. transmission lines and use direct current for the car operation, the substation equipment must be very complete. Step-down transformers are used to supply alternating current at a suitable voltage to a synchronous converter or motor-generator set. Some means of automatically starting up the converter and bringing it into synchronism must be provided and the switches must all operate in a definite sequence. There is a little more equipment than is found in an ordinary substation to take care of additional functions not ordinarily provided in manually operated stations. Protective equipment is very important, as the stations may be subjected to heavy overloads at times and the service must not be interrupted. If the power supply should fail while a car is in the section the equipment must be arranged to start up under load.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. Automatic stations are now available for application as follows: Synchronous converters and synchronous motor-generators for railway, lighting, mining and industrial service; induction-motor generators for railway, mining and industrial service; synchronous condensers for transmission service; battery charging sets; hydro-electric generators; and alternating current feeder stations. Each equipment, excepting the feeder station is arranged to start under predetermined conditions and continue operating as long as these conditions exist. These may be demand for power, operation of a time switch, normal stream flow, etc. The equipments are arranged to shut down under certain other predetermined conditions. They are giving protection against overvoltage, or undervoltage, overload, overheating, polarity, reverse power, etc. (Bulletin 47730.) See adv. page 1206.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUBSTATIONS, TYPES AND USES.—The assembly of transformers, synchronous converter, switches and building required to convert energy as received from a transmission system to energy as required for distribution to consumers is referred to as a substation. If there is no equipment beyond a transformer and its protective devices and the energy is transformed to the voltage at which it is used in the immediate vicinity, it is properly not a substation but a transformer room or vault.

Substations are provided where the distance from the point of supply becomes too great for economy of investment and operation. They may be in charge of an attendant while in operation or automatic, requiring only occasional inspection.

Alternating-current substations are supplied by transformers, if the bulk supply is at 60 cycles, or by motor-generators if the frequency of the bulk supply is other than 60 cycles, unless the distribution frequency is to be the same as the transmission frequency when transformers are used.

Direct-current substations are supplied by synchronous converters or motor-generators, the converter being preferable as regards efficiency and first cost, but being more sensitive to system disturbances.

In general, substations include (a) oil switches and a high-tension bus for incoming lines, (b) converting equipment and (c) distributing feeder switches, regulators and the necessary control switchboards.

SUBURBAN LIGHTING CO.—Toledo, Ohio. Manufacturer of electric automobile heaters and headlight dimmers.

SUBWAY BOXES.—See Boxes, subway branch.

SUCCESS.—Trade name for electric perforating machines manufactured by the Capital Novelty Co., 138 N. 12th St., Lincoln, Neb.

SUCCESS.—Trade name for fire extinguishers manufactured by Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.

SUCCESS.—Trade name for electric washing machine manufactured by the Miller Mfg. Co., Meyersdale, Pa.

SUCCESS.—Trade name for boiler-tube cleaners manufactured by Charles Nuhring & Bro., 1212 Walnut St., Cincinnati, Ohio.

SUCCESS.—Trade name for electric dishwasher manufactured by the Success Dish Washing Machine Co., 640 Cushman St., Wooster, Ohio.

SUCCESS.—Trade name for electric milking machines manufactured by the Success Milking Machine Co., 1033 Winnebago St., Milwaukee, Wis.

SUCCESS.—Trade name for electric washing machines manufactured by the Superior Machine Co., De Kalb, Ill.

SUCCESS DISH WASHING MACHINE CO., THE.—640 Cushman St., Wooster, Ohio. Manufacturer of electric dish-washing machines. President, F. W. Blough; vice-president, Harry McClarran; secretary and general manager, H. S. Palmer.

SUCCESS MILKING MACHINE CO.—1033 Winnebago St., Milwaukee, Wis. Manufacturer of electric milking machines. Business established 1916. President, and general manager, George H. Barber; vice-president, J. C. Barber; secretary and treasurer, C. B. Harbaugh.

SUCTION CLEANERS.—See Vacuum cleaners, portable; Vacuum cleaners, semi-portable or heavy duty; Vacuum cleaners, stationary.

SUCTION SYSTEM CLEANING CO., THE.—Sidney, Ohio. Manufacturer of electric vacuum cleaners. President, G. E. Cyphers; secretary, Ruth J. Bennett; manager, H. E. Bennett.

SUDAN.—Trade name for heavy density Regent glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

S. U. E. CO.—89 Beach St., Boston, Mass. Manufacturer of electric heating devices. Business established 1919. Factory, Braintree, Mass. E. L. Emerson, proprietor.

SUESS GLASS CO.—8th and Virginia Sts., Seattle, Wash. Manufacturer of automobile lamp lenses. President and treasurer, John B. Suess; secretary, H. A. Hurlbert.

SULLIVAN & SONS MFG. CO., J.—2224 N. 9th St., Philadelphia, Pa. Manufacturer of electrical tapes. President and treasurer, J. Russell Sullivan; vice-president and general manager, J. R. Bux; secretary, Charles G. Frick.

SULLIVAN MACHINERY CO.—Chicago, Ill. Manufacturer of motor-driven air compressors and electric coal mining machines. Business established 1850. President, F. K. Copeland; vice-presidents, Howard T. Walsh and Arthur E. Blackwood; secretary, Thomas W. Fry; treasurer, J. Duncan Upham; sales manager, Howard T. Walsh. Main office, 122 S. Michigan Ave., Chicago, Ill. Factories, Chicago, Ill. and Claremont, N. H. Branch offices, Birmingham, Ala.; Boston, Mass.; Claremont, N. H.; Denver, Colo.; Duluth, Minn.; Cleveland, Ohio; Dallas, Tex.; Joplin, Mo.; Knoxville, Tenn.; New York, N. Y.; Pittsburgh, Pa.; Huntington, W. Va.; St. Louis, Mo.; Salt Lake City, Utah; San Francisco, Cal.; Spokane, Wash.; El Paso, Tex.

SULLIVAN OIL CO.—413 N. Wells St., Chicago, Ill. Manufacturer of lubricating oils and greases.

SULPHATE ION.—The SO_4 part of a sulphate salt which is set free at the anode during electrolysis.

SULPHURIC ACID.—Sulphuric acid is a heavy acid used in diluted form as an electrolyte in lead storage batteries, as a cleaning agent and acid in some other electrolytic processes and for many other purposes. Its chemical formula is H_2SO_4; specific gravity (concentrated) 1.835 at 60°F. It is usually supplied in large glass carboys in the concentrated form. In the electrical industry, it is nearly always diluted for use, especially when preparing the electrolyte for storage batteries. It should always be mixed in a glass or earthenware vessel or hard rubber jar, and the acid should always be added to the water and never the water to acid, as the heat formed in the latter case may cause an explosion.

Manufacturers:

Central Chemical Co., 4200 S. Marshfield Ave., Chicago, Ill.
COOPER & CO., CHARLES, 194 Worth St., New York, N. Y.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Eagle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
General Chemical Co., 25 Broad St., New York, N. Y.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Grasselli Chemical Co., The, Cleveland, Ohio.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Kalbfleisch Corp., The, 31 Union Sq., West, New York, N. Y.
Mallinckrodt Chemical Works, St. Louis, Mo.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
Merrimac Chemical Co., Boston, Mass.
Riverside Acid Works, Warren, Pa.

SUMMIT.—Trade name for copper asbestos gaskets made by Akron Metallic Gasket Co., 150 N. Union St., Akron, Ohio.

SUMTER.—Trade name for high-pressure piston packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

SUMTER.—Trade name for ignition magneto generators manufactured by the Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

SUN.—Trade name for oil and grease cups manufactured by the American Injector Co., 175-14th Ave., Detroit, Mich.

SUN.—Trade name for photoengraving lamps manufactured by the New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y.

SUN.—Trade name for lubricating oils manufactured by the Sun Co., 1428 S. Penn Sq., Philadelphia, Pa.

SUN CO.—Philadelphia, Pa. Manufacturer of lubricating oils. Business established 1901. President, J. Howard Pew;

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vice-presidents, Robert C. Pew, John G. Pew, J. Edgar Pew, F. S. McIlhenny, vice-president and sales manager, J. N. Pew; secretary and treasurer, Frank Cross. Main office, 1428 S. Penn Sq., Philadelphia, Pa. Factories, Marcus Hook, Pa.; Toledo, Ohio; Yale, Okla. Branch offices, Akron, Ohio; Atlanta, Ga.; Baltimore, Md.; Battle Creek, Mich.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Dallas, Tex.; Dayton, Ohio; Detroit, Mich.; Flint, Mich.; Grand Rapids, Mich.; Indianapolis, Ind.; Jackson, Mich.; Los Angeles, Cal.; Milwaukee, Wis.; Minneapolis, Minn.; Montreal, Que., Can.; New Orleans, La.; New York, N. Y.; Norfolk, Va.; Pittsburgh, Pa.; San Francisco, Cal.; St. Louis, Mo.; Syracuse, N. Y.; Toledo, Ohio; Toronto, Ont., Can.; Kansas City, Mo.

SUN-LIGHT ARC CORP.—New York, N. Y. Manufacturer of arc lamps for motion picture studios, textile mills, etc. President, J. Justice Harmer; vice presidents, J. Searle Dawley, Frank Elliott; vice-president and treasurer, Charles H. Banning; secretary, William Louis Payne. Main office, 1600 Broadway, New York, N. Y. Branch office, Hollywood, Cal.

SUN-RAY.—Trade name for electric heating pads manufactured by the Sun-Ray Mfg. Co., 720 S. Main St., Oshkosh, Wis.

SUN-RAY MFG. CO.—720 S. Main St., Oshkosh, Wis. Manufacturer of electric heating pads. Business established 1916. President, J. R. Mentzel; vice-president, Ira Hall; secretary, treasurer and general manager, A. W. Dunham. Sales representatives, A. Hall Berry, 71 Murray St., New York, N. Y.; A. E. Morrow, 9 S. Clinton St., Chicago, Ill.; Panama Lamp & Commercial Co., San Francisco, Cal.

SUN SHELL.—Trade name for illuminating glassware manufactured by Lorin W. Young, Inc., 214 E. 40th St., New York, N. Y.

SUNBEAM.—Trade name for electric iron manufactured by the Chicago Flexible Shaft Co., 5600 W. Roosevelt Rd., Chicago, Ill.

SUNBEAM.—Trade name for electric washing machines manufactured by the Silent Washer Co., Clintonville, Wis.

SUNBEAM.—Trade name for electric headlights and turbogenerators manufactured by the Sunbeam Electric Mfg. Co., Evansville, Ind.

SUNBEAM.—Trade name for incandescent lamps manufactured by the Sunbeam Incandescent Lamp Division, National Lamp Works of General Electric Co., 500 S. Clinton St., Chicago, Ill.

SUNBEAM DOMESTIC APPLIANCE CO.—Evansville, Ind. Manufacturer of electric washing machines. President, W. A. Carson; vice-president and general manager, O. F. Fischedick; secretary, E. D. Weymss. Business established as the Surf Mfg. Co., Milwaukee, Wis., in 1919.

SUNBEAM ELECTRIC MFG. CO.—Evansville, Ind. Manufacturer of electric headlights, turbogenerators and farm lighting and power plants. Business established 1883. President, W. H. McCurdy; vice-president, treasurer and general manager, W. A. Carson; secretary, J. D. Craft; sales manager (Headlight Division), J. Henry Schroeder; sales manager (Farm-Lite Division), E. W. Jones. Main office, Evansville, Ind. Branch offices, 52 Vanderbilt Ave., New York, N. Y.; 1051 McCormick Bldg., Chicago, Ill. Sales representatives: S. Herbert Lanyon, 507 New Call Bldg., San Francisco, Cal.; O'Fallon Railroad Supply Co., 214 N. 6th St., St. Louis, Mo.; Fleming & Cardozo, Broadway National Bank Bldg., Richmond, Va.

SUNBEAM FARM-LITE.—Trade name for farm lighting and power plant manufactured by the Sunbeam Electric Mfg. Co., Evansville, Ind.

SUNBEAM INCANDESCENT LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—500 S. Clinton St., Chicago, Ill. Manufacturer of incandescent lamps. H. B. Vanzwoll, general manager.

SUNBOWL.—Trade name for reflector radiator manufactured by the Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

SUNBURST.—Trade name for electric heaters manufactured by the Estate Stove Co., Hamilton, Ohio.

SUNDH ELECTRIC CO.—209 Parkhurst St., Newark, N. J. Manufacturer of electric control apparatus. Business established 1903. President and treasurer, W. E. Quimby; secretary, T. M. Belknap; general manager, Frank W. Smith; sales manager, L. Larsen. Sales representatives, H. J. Kaufman, Peoples Gas Bldg., Chicago, Ill.; V. W. Shear & Co., Akron, Youngstown, Cleveland, Ohio; Industrial Engineering Co., St. Louis, Mo.; Rutherford & Uptegraff, Pittsburgh, Pa.; Arthur H. Abbott, Boston, Mass.; Edgar S. Clark, Philadelphia, Pa.

SUNFLOWER.—Trade name for electric heater manufactured by Landers, Frary & Clark, New Britain, Conn.

SUNLIGHT.—Trade name for carbon lamps and motors manufactured by the Sunlight Electrical Mfg. Co., 523 Dana Ave., Warren, Ohio.

SUN-LIGHT ARC CO., INC.—218 W. 48th St., New York, N. Y. Manufacturer of arc lamps.

SUNLIGHT ELECTRICAL MFG. CO., THE.—523 Dana Ave., Warren, Ohio. Manufacturer of incandescent lamps and fractional horsepower motors. Business established 1917. President, R. B. Wick; vice-president, C. L. Wood; secretary, treasurer and general manager, J. B. Estabrook. Sales representatives, Electrical Machinery Sales Co., 327 S. LaSalle St., Chicago, Ill.; Garland-Affolter Engineering Co., 323 Rialto Bldg., San Francisco, Cal.; C. O. Hall, 147 W. 35th St., New York, N. Y.; L. M. Sperry, 917 Pine St., St. Louis, Mo.; C. A. Cotton, 92 Pearl St., Boston, Mass.

SUNLIGHT REFLECTOR CO.—226 Pacific St., Brooklyn, N. Y. Manufacturer of lighting reflectors. Business established 1898.

SUNNY LINE APPLIANCES, INC.—4058 Beaufait Ave., Detroit, Mich. Manufacturer of electric washing machines. Business established 1921. President and general manager, F. C. Sebulske, Jr.; vice-president, F. P. Goettman; secretary, H. P. Heaton; treasurer, W. C. Hegge.

SUNNYSUDS.—Trade name for electric washing machines manufactured by the Sunny Line Appliances, Inc., 4058 Beaufait Ave., Detroit, Mich.

SUNRAY.—Trade name for lighting reflector manufactured by the Sunlight Reflector Co., 226 Pacific St., Brooklyn, N. Y.

SUNSTRAND ADDING MACHINE CO.—Rockford, Ill. Manufacturer of motor-driven adding and calculating machines. President, W. A. Brolin; vice-president, G. D. Sundstrand; secretary and treasurer, H. L. Olson.

SUPEDO.—Trade name for electric hair wavers manufactured by the LeBijou Specialties, 186 N. LaSalle St., Chicago, Ill.

SUPER ENCO.—Trade name for flashlights and flashlight batteries manufactured by the Enterprise Electric Novelty Co., Inc., 603 W. 130th St., New York, N. Y.

SUPER-REFINED.—Trade name for silver for anodes produced by T. B. Hagstoz & Son, 709 Samson St., Philadelphia, Pa.

SUPER SEASONED.—Trade name for fiber sheets, rods, tubes, washers and specialties manufactured by the National Fibre & Insulation Co., Yorklyn, Del.

SUPER SIX.—Trade name for storage battery steam generator manufactured by S. R. M. Orum, North Philadelphia, Pa.

SUPERB.—Trade name for electric scales manufactured by the Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

SUPERBA.—Trade name for lighting reflectors manufactured by the Gilbert Electric Shade Co., 101 Warren St., New York, N. Y.

SUPERHEATER CO., THE.—New York, N. Y. Manufacturer of superheaters. Main office, 17 E. 42nd St., New York, N. Y. Vice-president and sales manager, G. E. Ryder. Main office, 17 E. 42nd St., New York, N. Y. Branch offices, Chicago, Ill.; Pittsburgh, Pa.

SUPERHEATERS, POWER-PLANT BOILER.—The superheater is a nest of tubes ordinarily installed in the gas passage of the boiler between the first and second pass. In some cases a separate source of heat than the boiler furnace is employed. The superheater is connected with the steam outlet of the boiler and the steam line or header, so that all steam passing out of the boiler (except that going through the safety valve) passes through the superheater.

The simplicity of the superheater and the ease with which it is installed are greatly in its favor for installation in existing plants. Once installed it requires far less attention than does boiler heating surface; it has long life and costs less than boiler heating surface.

The use of a superheater results in a fuel saving anywhere up to 25%. The efficiency of turbines is higher, the cost of maintenance much lower when superheated steam is used, because there is less erosion and corrosion with superheated steam than with saturated steam. Turbines can be kept in service longer with higher average efficiency.

Superheating results in lower heat losses in steam lines, likewise increased steam-carrying capacity. Condensation difficulties and complications are reduced. Superheating is often the only way to transmit dry steam outdoors and over long distances. As a working medium, steam is more efficient when superheated, in every form of engine and also in steam hammers, pumps, steam dryers, kettles, etc., because of the lower condensation loss.

The use of superheated instead of dry saturated steam is one of the most promising ways of improving power-plant economy and at the same time increasing power-plant capacity.

Manufacturers:

Babcock & Wilcox Co., The, 85 Liberty St., New York, N. Y.
Badenhausen, Phillips, 1425 Chestnut St., Philadelphia, Pa.
Decarie Boiler & Incinerator Co., 3324-30 St. Hubert St., Montreal, Que., Can.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Heine Safety Boiler Co., 5315 Marcus Ave., St. Louis, Mo. "Heine."
Locomotive Superheater Co., 30 Church St., New York, N. Y. "Elesco."
Pardel Corp., Bailey Bldg., Philadelphia, Pa. "Parker."
Power Specialty Co., 111 Broadway, New York, N. Y. "Foster."
Superheater Co., The, 17 E. 42nd St., New York, N. Y. "Elesco."
Vulcan Soot Cleaner Co., Inc., The, 20 E. Long Ave., Du Bois, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

SUPERIOR.—Trade name for die castings manufactured by Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill.

SUPERIOR.—Trade name for radio receivers manufactured by C. Brandes, Inc., 32 Union Sq., New York, N. Y.

SUPERIOR.—Trade name for resistance wire manufactured by the Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill.

SUPERIOR.—Trade name for spark plugs manufactured by A. R. Mosier & Co., Mt. Vernon, N. Y.

SUPERIOR.—Trade name for electric water heaters manufactured by the National Stamping & Electric Works, 410 S. Clinton St., Chicago, Ill.

SUPERIOR.—Trade name for conduit fishing wire manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

SUPERIOR.—Trade name for carbon and graphite brushes made by the Superior Carbon Products, Inc., Poughkeepsie, N. Y.

SUPERIOR.—Trade name for soldering paste manufactured by the Superior Chemical Products Co., Connellsville, Pa.

SUPERIOR.—Trade name for electric root cutters and motor-driven churns manufactured by the Superior Churn & Mfg. Co., Northville, Mich.

SUPERIOR.—Trade name for electric cooking and heating appliances manufactured by the Superior Electrics, Ltd., Pembroke, Ont., Can.

SUPERIOR.—Trade name for electric washing machines manufactured by the Superior Machine Co., De Kalb, Ill.

SUPERIOR.—Trade name for rail joints, derailers and rail benders manufactured by the Track Specialties Co., Inc., 29 Broadway, New York, N. Y.

SUPERIOR.—Trade name for motors and generators manufactured by the Wiley-Wray Electric Co., 118 W. 3rd St., Cincinnati, Ohio.

SUPERIOR CARBON PRODUCTS, INC.—Poughkeepsie, N. Y. Manufacturer of carbon and graphite brushes. Business established 1920. Sales manager, E. C. Hastings.

SUPERIOR CHEMICAL PRODUCTS CO.—Connellsville, Pa. Manufacturer of soldering paste. Charles F. Wood, manager.

SUPERIOR CHURN & MFG. CO.—Northville, Mich. Manufacturer of motor-driven churns and electric root cutters. President, R. C. Yerkes; vice-president, F. S. Harmon; secretary, treasurer and general manager, F. E. VanAtta. Sales representatives, J. S. Biesecker, 59 Murray St., New York, N. Y.; Joseph Breck & Sons, 51 N. Market St., Boston, Mass.; Philadelphia

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Farmers and Dairymen's Supply Co., Philadelphia, Pa.

SUPERIOR ELECTRICS, LTD.—Pembroke, Ont., Can. Manufacturer of electric cooking and heating appliances. Business established 1917. President, L. M. Chapman; vice-president, J. S. Fraser; secretary, A. E. Marcotte; general manager, C. L. Gulley. Sales representatives, Leo Lavigne, 26 Armstrong St., Ottawa, Ont., A. H. Fraser & Co., 501 Confederation Life Bldg., Winnipeg, Man.

SUPERIOR ENGINEERING CO., INC.—332 3rd Ave., Pittsburgh, Pa. Manufacturer of battery-charging equipment, farm lighting plants, panelboards and switchboards. Business established 1918. President, R. F. Clark; secretary and treasurer, J. M. Miller.

SUPERIOR GAS ENGINE CO.—Springfield, Ohio. Manufacturer of gas engines.

SUPERIOR LADDER CO., THE.—Goshen, Ind. Manufacturer of ladders. Business established 1910. President, William O. Vallette; vice-president, Vincent J. Vallette; secretary, treasurer and general manager, M. V. Starr.

SUPERIOR MACHINE CO.—De Kalb, Ill. Manufacturer of electric washing machines. Business established 1906. President, W. A. Cooling; vice-president and sales manager, D. W. Miller; secretary, treasurer and general manager, A. B. Cooling. Factories, Rock Falls, Ill.; DeKalb, Ill. Branch offices, Superior Sales Co., 2117 N. 2nd St., Harrisburg, Pa.

SUPERIOR MOTOR POWER CO.—75 Spring St., New York, N. Y. Manufacturer of spark plugs. President, Norman Leob; secretary, Bernard D. Cahn; treasurer, Louis D. Cahn; general manager, Max I. Kopelov.

SUPERIOR OXYACETYLENE MACHINE CO.—Hamilton, Ohio. Manufacturer of oxyacetylene welding outfits.

SUPERIOR PIERSEN.—Trade name for gasoline engines made by the Piersen Mfg. Co., 700 E. 8th St., Topeka, Kans.

SUPERLA.—Trade name for transformer and lubricating oils manufactured by the Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill.

SUPEROYL.—Trade name for piston rings manufactured by the McQuay-Norris Co., St. Louis, Mo.

SUPERPOSED CIRCUIT.—A superposed circuit is an additional circuit obtained from a circuit normally required for another service, and in such a manner that two services can be given simultaneously without mutual interference. Examples are phantom telephone circuits, composite telephone and telegraph circuits, multiplex telephony by means of carrier currents of different frequency traversing the same circuit, etc.

SUPERVISION, MANUAL TELEPHONE SYSTEM.—The attention given to a connection by an operator after one or more plugs are connected. Magneto (local battery) boards use a clearing-out drop on the cord circuit. Subscribers must ring off (by turning the crank of the magneto generator) to get attention. Uusually there is one drop or single supervision. It is possible to have two clearing-out drops on one cord circuit, so that the operator can tell which subscriber rang off (double supervision), but most such circuits cut down the voice transmission. Common-battery boards have double supervision, two supervisory lamps, one for the calling subscriber (answering supervisory lamp on the answering cord) and one for the called subscriber (calling supervisory lamp on the calling cord). When either party presses his hook down, his supervisory lamp lights. The clearing-out signal is thus automatic.

Where double supervision is desired provision is made on a manual switchboard whereby the operator gets a separate signal from each subscriber of two who are connected.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

SUPERVISOR, TELEPHONE.—A person who patrols several operators to assist or direct them.

SUPPLEE-BIDDLE HARDWARE CO.—507 Commerce St., Philadelphia, Pa. Manufacturer of nickel, nuts, etc. President and general manager, W. B. Monroe; secretary, Edward Knight; treasurer, George S. Spence.

SUPPLY JOBBING.—See Jobbing and jobbers of electrical supplies.

SUPPORTERS, POLE.—These supporters are used to hold a line pole in an inclined position when setting or erecting the pole. There are two patterns, a cross leg device, called the jenny pattern, and pike type, called a mule or dead-man pattern.

Manufacturers:

HERBST, PAUL W., Chicago, Ill. We make Jenney and Mule pattern pole supports in wood and iron. See display adv. page 1258.—Adv.

OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)

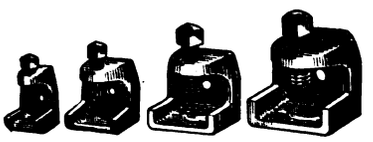
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUPPORTS, ADJUSTABLE OR CLAMPING, FOR CLEATS, KNOBS AND INSULATORS. — Malleable iron castings adapted to be clamped to the iron beams, columns, etc., of buildings and structures and to carry porcelain knobs, cleats or other insulators for wire and cables. They fit over the edge of the beam and are usually held in place by set screws.

Manufacturers:

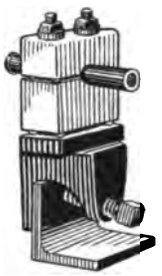
EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.

STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Universal" supports are malleable iron



Universal Supports

clamps for securing insulators to open steel framework for wiring mills bridges, elevated railways, subways, trainsheds and similar structures. They are easily attached and effect a big saving in labor and material. Universal supports can be used in any position on flanges of any standard cold-rolled steel structural shape or on gas and water pipes, edges of tanks, plates, etc. They require no drilling and simplify changes in wiring, it being only necessary to move support to new location.—Adv.



Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

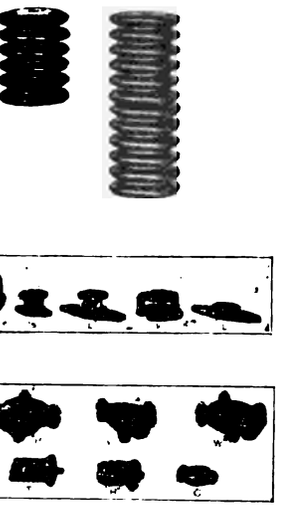
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUPPORTS, BUSBAR. — In making the connections to switches in high-tension switchboard work, the conductors are carried on busbar insulator supports which are bolted or clamped to a steel frame of angle iron or pipe. These supports are made for buses of insulated cable, copper tube, bare rod or flat bars, and consist of malleable iron bases with procelain supports for the conductor cemented to the iron base. Clamps of various types are provided to hold the conductor firmly. Busbar supports are made to fit into a large variety of situations such as arise in high-tension switchboard work.

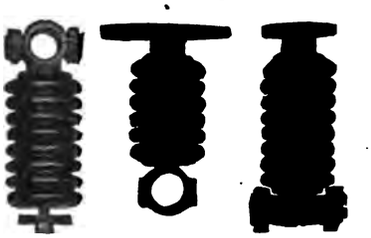
Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

DELTA-STAR ELECTRIC CO., 2433-2459 Fulton St., Chicago, Ill. The "Unit Type" busbar support, made by this company, consists essentially of three parts, an insulating unit (first illustration below), made in various lengths, a base, made in a great variety of styles (second illustration below), and a clamp, also made in many styles (third illustration below). By combining different lengths of insulating unit with different bases and clamps, about 7000 different busbar supports may be made from standard parts. Both bases and clamps are adjustable through 360°. Several specimen busbar supports made from these standard parts are shown in cut below. Insulating unit is high-



Parts of Delta-Star Busbar Supports



Insulating Units of Delta-Star Busbar Supports Equipped Bases and Clamps

grade, wet-process porcelain, finished in dark brown glaze. Metal parts are black enameled; combination harmonizes with fittings of any modern switchboard. "Unit Type" busbar supports already in use may be adapted to carry higher voltage by adding long or short insulating units to give required insulating surface. Two sizes of special clamps for fastening busbar supports to standard structural I beams are furnished; smaller size fits beams up to 8 in.; larger size fits all beams between 8

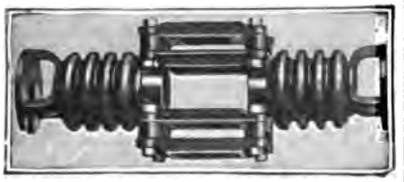


Extra Rigid Delta-Star Busbar Support

and 24 ins. Delta-Star busbar supports are tested as follows: Normal rated voltage 6600, test 30000; rated voltage 13200, test 54000; rated voltage 22000,

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test 75000; rated voltage 33000, test 100000; rated voltage 44000, test 125000. Six standard types of base are made; for 1¼-in. pipe clamp, 1¼-in. U bolt, flat base, long flat base, slotted base and I-beam base, for one, two, three or four bolt clamp for round or flat busbars or tongue for flat busbar. When desired, the Unit Type busbar support may be used without a base, and mounted directly on any flat surface such as walls, compartment floors, channel irons, steel plates, switchboard panels, etc. Cut next following shows application of "Unit Type" idea to heavy duty busbar support, to give extra rigidity to bus carrying heavy current. Built up of standard unit type parts. Prevents injurious vibration. Lessens danger of short circuit and heavy mechanical strains produced thereby. Where desired current capacity of bus makes still greater rigidity and cooling capacity necessary, a still heavier form of busbar support or spacer is built up as shown in cut below. Gives wid-



Special Type of Delta-Star Busbar Support

er spacing of bus elements with greater resistance to lateral flexure. Cut shows slotted bases and caps, but any form may be used, or any desired combination. This form of spacer has an ultimate strength of 60,000 lbs. Gives a wide spacing between phases, reducing induction, and increasing current carrying capacity by increasing heat radiating capacity.—Adv.

Electric Motor & Engineering Co., The, 2nd St., S. W. & B. O. R. R., Canton, Ohio.

ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Bus supports for indoor and outdoor service. Fitted with adjustable or fixed clamps, for rectangular vertical and horizontal, or round busses. See display advertisement on page 1261.—Adv.

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin", "Franklin Junior." (See display adv. page 1260.)

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio.

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.

PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.

Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.

ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill. Busbar supports



Sectional View Showing Mechanical Clamp

for tubular busbars from 0 to 3 ins. diameter, for voltages from 6600 to 22,000, in both 1¼-in. pipe mounting and flat base mounting; also for vertical, flat busbars, from 2 to 6 ins., in 1¼-in. pipe or flat surface mounting, for same voltages. Sectional view shows perfected mechanical clamp which eliminates use of cement in securing caps and nipples. (Insulating units more fully described under Switches, disconnecting, high tension.) Send for our catalog. It contains engineering data, illustrations and other interesting information of "Royal" products.—Adv.

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.

Southern Electrical Equipment Co., Charlotte, N. C.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUPPORTS, CABLE, FOR RISERS.—Where long vertical runs of cable are installed in conduit, as in office buildings, it is necessary to take the strain off from the insulation by supporting the cable at proper intervals. The maximum distances allowable between supports are as follows:

No. 14 to No. 0,	100 ft.
No. 00 to No. 000,	80 ft
212,000 to 350,000 c.m.,	60 ft.
351,000 to 500,000 c.m.,	50 ft.
501,000 to 750,000 c.m.,	40 ft.
Above 750,000 c.m.,	35 ft.

The supporting device may consist of approved insulating wedges driven into the upper ends of the conduit or of special fittings inserted into the conduit run. Or a junction box may be inserted, in which insulating supports of approved type are so mounted as to carry the weight of the cable. These are arranged to give the cable two or more 90° turns and to carry it out of the vertical line at least twice its diameter. The cable may also be secured to these insulators by tie wires.

Manufacturers:

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."

SUPPORTS, CRANE TROLLEY.—These supports are designed to be mounted on brackets from the side walls or framework upon which a crane is supported. They consist of a metal base, an insulating section or post and a metal cap at the other end, designed to either clamp on to the flange of a contact rail or to a trolley wire.

Manufacturer:

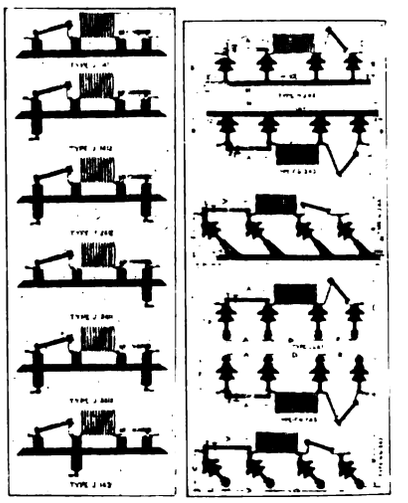
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

SUPPORTS, HIGH-TENSION, FOR ARRESTERS, CHOKE COILS, DISCONNECTS, ETC.—Oil switches, lightning arresters, and other high-tension equipments are often arranged to be cut out of the circuit by knife-switch disconnects. Such apparatus and the disconnecting switches must be mounted on insulating supports of a rugged nature to withstand the mechanical stress of opening and closing the switch or in large systems the magnetic stresses at time of short-circuits. The supports are of corrugated porcelain, with ample cross-section and height. Where disconnecting switches are back-connected the circuit connection is made by a rod through the center of the porcelain post.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

DELTA-STAR ELECTRIC CO., 2433-2459 Fulton St., Chicago, Ill. This company makes a very wide variety of high-tension mountings for different combinations of switches, fuses and choke coils, examples of which are shown in cut following. By using their "Unit Type" construction, about 1500 different ways of mounting various combinations are possible, without the use of special



Examples of Delta-Star Unit Type Mountings

material, thus meeting the needs of any ordinary commercial installation.—Adv.

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio.

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.

Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."

ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill. A large variety of high tension supports embodying this company's special standard insulating unit, for carrying fuses in all capacities, switch and fuse combinations, choke coil and fuse, switch and choke coil, or switch, choke coil and fuse. (Insulating units described more fully under Switches, disconnecting, high tension. Send for our catalog. It contains engineering data, illustrations and other interesting information of "Royal" products.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

STEEL CITY ELECTRIC CO., 1221 Columbus Ave., Pittsburgh, Pa. "Steel City."

SUPPORTS, PANEL.—Panel supports are steel or iron clamping members used on switchboard or isolated panels. They are made in special styles for mounting either one panel separately or two adjoining panels and for clamping on to one or two pipes. The clamps are either of the split type bolted together or have a single U-bolt strap for clamping over the pipe. The pipes and fittings used are sometimes called panel supports also.

Manufacturers:

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

SUPPORTS, TROLLEY WIRE.—The supports for trolley wires are more commonly referred to by other names, such as trolley hangers, ears, clamps and suspensions. See Catenary hangers; Clamps, trolley; Hangers, trolley; Ears, trolley; Suspensions, trolley wire, mine. For equipment used to support the entire overhead trolley system, see Brackets, trolley suspension; Catenary fittings, miscellaneous; Bridges, railway catenary and signal; Poles, iron and steel; Poles, wood.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

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SUPREME.—Trade name for electric radiators manufactured by Adon Products, Inc., 516 5th Ave., New York, N. Y.

SUPREME.—Trade name for alcohol blow torches manufactured by the Federal Mfg. Co., Inc., 27 Haymarket Sq., Boston, Mass.

SUPREME.—Trade name for electric hair cutters manufactured by the Supreme Electric Hair Cutter Corp., 56 Taylor St., Springfield, Mass.

SUPREME.—Trade name for electric washing machines manufactured by the Wenzelman Mfg. Co., Galesburg, Ill.

SUPREME BRAND.—Trade name for aluminum solder manufactured by the Federal Mfg. Co., Inc., 27 Haymarket Sq., Boston, Mass.

SUPREME ELECTRIC HAIR CUTTER CORP.—56 Taylor St., Springfield, Mass. Manufacturer of electric hair cutters. Business established 1920. President, Otto Herman; vice-president, Samuel Abrams; treasurer, Henry Lasker.

SURE GRIP.—Trade name for nail puller manufactured by the Bridgeport Hardware Mfg. Corp., Bridgeport, Conn.

SURE GRIP.—Trade name for trolley clamps manufactured by the Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.

SURETY.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

SUREX.—Trade name for X-ray machine manufactured by the Campbell Electric Co., Lynn, Mass.

SURF.—Trade name for electric washing machines manufactured by the Sunbeam Domestic Appliance Co., Evansville, Ind.

SURFACE COMBUSTION CO.—New York, N. Y. Manufacturer of boiler furnaces. President, Mr. Leslie; vice-president and secretary, Mr. Basquin; treasurer, Mr. Blagben. Main office, 368 Gerard Ave., New York, N. Y. Branch offices, 305 S. LaSalle St., Chicago, Ill.; Philadelphia, Pa.; Pittsburgh, Pa.

SURFACING MACHINES, FLOOR, MOTOR-DRIVEN.—These machines consist of an abrasive wheel rotated against the floor surface by an electric motor, the wheel being mounted directly on the armature shaft or driven by gears connecting the shaft and wheel. The motor and wheel are usually mounted on a small two-wheeled truck with a handle for pushing the machine over the floor. The machines are generally compactly built to allow of use in restricted space. Mosaic, tile, marble, granolithic or other composition floors are surfaced by these machines very effectively.

Manufacturers:

American Floor Surfacing Machine Co., 518 S. St. Clair St., Toledo, Ohio. "American."
Campbell Machine Co., Inc., Wollaston, Mass.
Cavicchi Polishing Machinery Co., 3-5 Woodworth St., Neponset (Boston), Mass.
Herr Mfg. Co., John, 44 N. 4th St., Philadelphia, Pa. "E-Z."
INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y. "International."
KELLEY ELECTRIC MACHINE CO., 111-119 Dearborn St., Buffalo, N. Y.
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Utility."
Northern Floor Surfacer Co., 307 Bellin Bldg., Green Bay, Wis.
Schlueter, M. L., 225 W. Illinois St., Chicago, Ill.
Wagner Machine Works, F., Laurel Hill, N. Y. "Wagner."

SURFEED.—Trade name for oil and grease cups manufactured by the American Injector Co., 175-14th Ave., Detroit, Mich.

SURGE TANK.—See Standpipe.

SURGES.—When an electrical overhead or underground transmission system becomes extensive, so as to include many miles of lines and cover much territory, it is subject to transient high voltages and currents, which tend to build themselves up by induction or reflection from sudden disturbances in the line conditions, such as breaking or grounding of a conductor, sudden opening of a heavily loaded switch, or unbalancing due to a violent lightning discharge near some part of the system. Such a disturbance is called a "surge" and may travel over the lines and be reflected in such a way that the voltage rises suddenly to a dangerous value so that an oscillating discharge takes place over the lightning arresters. If this discharge does not occur there is danger of the insulation being broken down at some point.

SURGICAL ENGINES, ELECTRICAL.—Electrical surgical engines are very similar to dental engines, electrical, which see. They are used to provide a rotary motion used in surgery for cutting and drilling. They consist of a fractional horsepower motor with a flexible shaft or arrangement of cords to transmit the motion to the instrument holder.

Manufacturer:

Mueller & Co., V., 1779 Ogden Ave., Chicago, Ill.

SURGICAL INSTRUMENTS, ELECTRICALLY HEATED.—Various surgical instruments are equipped with small heating elements. The elements are usually concealed within the instrument, electrical connection being made through flexible cord attached to a lighting socket.

Manufacturers:

American Surgical Specialty Co., 6 E. Lake St., Chicago, Ill. (electrically lighted). "Cameron."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Sharp & Smith, 65 E. Lake St., Chicago, Ill. "Sands."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.

SURGICAL TAPE.—See Tape, cotton, surgical web, stay binding and webbing.

SURTY GUARD CO.—Chicago, Ill. Manufacturer of machinery guards. Business established 1910. President and general manager, E. E. Jones; vice-president and sales manager, Roland Jones; secretary, A. F. Sharpe; treasurer, H. W. Beegle. Main office and factory, 4139 W. Kinzie St., Chicago Ill. Branch offices, St. Louis, Mo.; Cleveland, Ohio; Newark, N. J. Sales representative, Frontier Meter Works, Buffalo, N. Y.

SURVEY, ELECTROLYTIC.—This is a series of careful measurements of the electrical potentials existing in the earth all over an area, with a view to finding out what dangers of electrolysis exist. These potentials are taken as voltages above or below that of a fixed point, and are plotted on a map, after which equipotential lines are drawn. The whole survey includes finding out any facts, whatever, which bear on dangers of electrolysis to underground structures.

SUSCEPTANCE.—This is the factor by which the impressed e. m. f. of an a-c. circuit must be multiplied to give the component of current one-quarter of a period behind the e. m. f. Its symbol is b;

$$b=X/(R^2+X^2).$$

SUSCEPTIBILITY.—The ratio between the intensity of magnetization and the magnetic field intensity. It may also be defined as the coefficient which expresses the ability of a substance of acquiring the property of producing a magnetic field. Algebraically it is represented by $J/H=(\mu-1)/4\pi$. When μ is large, as in ferromagnetic substances, the susceptibility is practically equal to $\mu/4\pi$.

SUSPENSION BOLTS.—See Bolts, suspension.

SUSPENSION CLAMPS.—See Clamps, suspension.

SUSPENSION INSULATORS.—See Insulators, porcelain, suspension.

SUSPENSION STREETHOODS.—See Streethoods complete, suspension type.

SUSPENSIONS, LAMP AND LIGHTING UNIT.—A lamp suspension is a fixture fitting which allows the fixture to be easily detached, but does not provide a pulley or other means of lowering. The fitting is generally provided with an insulated terminal bushing for the fixture wires and a nipple threaded to fit the standard sizes of conduit. Devices that include a pulley for lowering are usually called lamp hangers; (for these see Hangers).

The term suspension is also applied to the equipment used for hanging various glass or other commercial and industrial lighting units. This suspension includes a chain, canopy, fitter, holder and socket. In some cases a special fitting is provided to assure vertical suspension of the fixture regardless of the unevenness of the outlet box or surface from which the unit is suspended.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. Benjamin fixture aliner causes fixture to hang in a perfectly vertical position, even when suspended from a surface that is not horizontal. Also protects fixture, causing it to "give" when struck by a ladder or other object carried high. Also furnished with shock absorber.—Adv.



Benjamin Fixture Aliner

Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
WAKEFIELD BRASS CO., THE, F. W., Vermilion, Ohio. The "Red Spot" suspensions are designed for hanging various high-candlepower commercial lighting units such as the "Ace", "Trojan", "11-8-12", etc. They consist of 4x6 in. canopy, chain suspension, fitter and receptacle, having overall length of 24 ins., and accommodating medium and mogul type sockets as desired. "Red Spot" suspensions are made of heavy metal carefully finished, and are packed in individual cartons for safe and easy handling and re-shipping. —Adv.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUSPENSIONS, TROLLEY WIRE, MINE.—A device used for supporting and insulating the trolley wire in mines. The common form consists of a malleable iron shell casting into which a threaded stud is molded, the stud being insulated from the hanger shell. The stud supports the trolley clamp or ear which in turn grips the trolley wire. The hanger shell may be provided with lugs through which lag screws pass supporting the device from the mine timbers. Another form is provided with a threaded boss for support by means of an expansion bolt which is installed directly in the mine roof. In some cases the boss is arranged to thread or otherwise engage the end of a supporting pipe which is installed vertically from the mine roof or with clamps for providing support from horizontal pipes in the wall.

Modified forms of mine hangers are used for supporting and insulating the feeder wires and are termed "feeder wire supports." The common form consists of a grooved porcelain spool supported by means of a barbed pin, which is driven into the mine roof. Another common feeder wire support is identical with the trolley support except that the trolley clamp is replaced by a sling which more suitably engages the feeder wire.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. Manufactures a complete line of insulated hangers and mechanical clamps for mines.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SUSPENSIONS, TROLLEY WIRE, STANDARD.—These are commonly called "trolley wire hangers." See Hangers, trolley wire.

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SUYDAM CO., M. B.—61st and Butler Sts., Pittsburgh, Pa. Manufacturer of insulating paints.

SWAGING TOOLS FOR LEAD SLEEVES.—A small swage which is used for tamping the lead sleeves of ring, expansion, eye and knob bolts. The tool fits over the shank of the bolt and is slightly offset to clear the head or eye.

Manufacturer:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."

SWAIN LUBRICATOR CO.—443 W. 37th St., Chicago, Ill. Manufacturer of cylinder lubricators. Proprietor, Thomas J. Holmes.

SWAN & FINCH CO.—New York, N. Y. Manufacturer of lubricating oils and greases. President, W. G. Moncrieff; vice-president and sales manager, H. C. Hutchins; vice-president and secretary, G. E. Brown; vice-president and treasurer, J. T. Lee. Main office, 522 5th Ave., New York, N. Y. Factories, Buffalo, N. Y.; Bayway, N. J.; Chicago, Ill.; Syracuse, N. Y. Branch offices, Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Detroit, Mich.; Cleveland, Ohio; Syracuse, N. Y.; Philadelphia, Pa.; New Orleans, La.; Pittsburgh, Pa.; San Francisco, Cal.

SWANOLEINE.—Trade name for lubricating oils manufactured by the Cook & Swan Co., Inc., 148 Front St., New York, N. Y.

SWANOVIA.—Trade name for lubricating greases manufactured by the Cook & Swan Co., Inc., 148 Front St., New York, N. Y.

SWARTZ ELECTRIC CO.—Indianapolis, Ind. Manufacturer of farm lighting plants. President and general manager, Ira T. Swartz; secretary, H. O. Votaw; treasurer, W. C. Osborne.

SWARTZ-LIGHT.—Trade name for generators and farm lighting plants manufactured by the Swartz Electric Co., Indianapolis, Ind.

SWEEPER-VAC.—Trade name for electric vacuum cleaners manufactured by the Pneuvac Co., 164 Fremont, St., Worcester, Mass.

SWEEPERS, STREET, ELECTRIC.—These machines are used to sweep city streets without raising clouds of dust or involving other such objectionable features. They are equipped with motor-driven brushes which sweep the dust, and vacuum apparatus which sucks it up as fast as it is swept. The power for the motors is supplied by a gasoline engine driving a generator, the generating and other apparatus being mounted on the sweeper. Straight electric sweepers deriving their power from trolley lines, like snow sweepers, have been proposed for vacuum sweeping of streets, but, as far as known, have not yet been tried out on a practical scale.

Manufacturers:

Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.
Smith Co., Clarence L., 52 Vanderbilt Ave., New York, N. Y.
Way Cleanser Co., The, Sandusky, Ohio.

SWEET.—Trade name for steam separators manufactured by the Direct Separator Co., Syracuse, N. Y.

SWENSON EVAPORATOR CO.—945 Monadnock Block, Chicago, Ill. Manufacturer of power plant evaporators. Business established 1889. President and general manager, F. M. deBeers; vice-president, P. B. Sadtler; secretary and treasurer, P. H. Appell.

SWETT IRON WORKS, A. L.—Medina, N. Y. Manufacturers of jacks, etc.

SWINBURNE - ASCHROFT PROCESS.—One of the early attempts at the electrolytic reduction of zinc, by the electrolysis of fused zinc chloride with carbon anodes and a fused zinc cathode.

SWINEHART TIRE & RUBBER CO.—Akron, Ohio. Manufacturer of tires and rubber rollers for electric washing machine wringers. President, T. F. Walsh; secretary, T. O. Baughmann. Main office, 21 W. North St., Akron, Ohio. Branch offices, New York, N. Y.; Boston, Mass.; 1328 S. Michigan Ave., Chicago, Ill.; Detroit, Mich.; Kansas City, Mo.; Philadelphia, Pa.

SWITCH.—A switch is a device for making, breaking or changing the connections in an electric circuit. A large number of types of switches are required to give the best results in the extremely large and varied classes of circuits found in the electrical field. As the industry has grown, each new class of service or important development necessitated a new or larger switch, until the number of distinct types of switches made now runs into hundreds. While one of the simplest and earliest forms of switches known the knife switch, is still used very extensively, the widespread adoption of alternating current for power work and the use of higher voltages has led to their replacement for this service by oil switches and oil circuit breakers. Numerous other special switches have been developed for particular service, such as burglar and fire alarms, telephone and telegraph, motor starting, lighting circuits, etc.

In addition to the function of operating directly in a circuit, switches are used to make the connection and changes through other apparatus. For this purpose there are three general classes of switches, master, control and auxiliary switches. A master switch is a device which serves to govern the operation of contactors and auxiliary devices of an electric controller. In this manner the master switch operates in a circuit of low current rating. A control switch is a switch for controlling electrically operated switches and circuit breakers. This also operates on low current to control circuits of large capacity. Auxiliary switches are those actuated by some main device for signaling, interlocking, etc.

The classification of the various types of switches below is mainly according to their particular uses, although where several types are used for rather similar purposes, the construction and outstanding differences of principle are used to classify them.

SWITCH ADAPTERS.—See Adapters, switch.

SWITCH AND BUS-CELL DOOR DEVICES AND HARDWARE.—The operating mechanism for high-tension oil switches and oil circuit breakers and their enclosing tanks are often contained in special cells or compartments. Busbars are also arranged in enclosed compartments and in both cases special doors are arranged to fly open in case of short-circuit, when enormous pressure is present. The doors are usually in the front of the compartment, often hinged at the top, and in some cases are provided with a small door in the larger one to open on slight pressures within that are not sufficient to operate the main door. The hardware for these doors includes the spring hinges, latches, handles, etc.

Manufacturers:

ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
National Co., Cambridge 39, Boston, Mass.

SWITCH ATTACHMENTS (LOCKING).—See Attachments, locking, for switches.

SWITCH BASES.—See Bases, snap switch.

SWITCH BLOCKS.—See Blocks, switch.

SWITCH BODIES, PULL, PUSH-BUTTON, KEY, ETC.—Several types of the smaller switch bodies are made in such a way as to provide a certain amount of flexibility, such as is given in interchangeable socket bodies. The principal switches of this type are ceiling, pendent and fixture types, which are made with porcelain bodies containing a switch mechanism and enclosed in a metal shell. The shell edge is corrugated or constructed so that it may have any form of cap or base mounted on it. These bodies may have either key, pull-chain or push-button mechanism and may be fitted with any standard size socket cap, pendent or fixture, or to certain kinds of a base, such as for cleat, metal or wooden raceway, conduit wiring, or for ceiling or wall mounting. The foregoing applies not to sockets or receptacles that may include a switch mechanism, but to devices used primarily for switching.

Manufacturers:

ANDERSON ELECTRIC & EQUIPMENT CO., 154-160 Whiting St., Chicago, Ill.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto" (push buttons).
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCH BOXES.—See Boxes, conduit, snap switch or wall, and Boxes, switch and cutout.

SWITCH BUTTONS AND PLATES, LUMINOUS.—Push buttons and flush mounting plates for snap switches having on them a small amount of luminous paint or compound to enable them to be easily located in the dark. Usually the button has a small circle painted on it which in the daytime merely shows up as a white center. The plates usually have rather small spots of the luminous compound near the buttons.

Manufacturers:

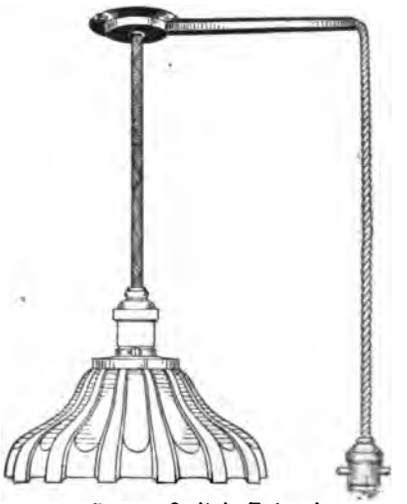
American Luminous Products Co., Huntington Park, Cal.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Best Electric Corp., 476 Broadway, New York, N. Y.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Lightninder Sales Corp., Inc., 14 W. 17th St., New York, N. Y. "Litenider."
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
Radium Luminous Material Corp., 58 Pine St., New York, N. Y. "Undark."
Smith & Co., T. C., 1531 Cherry St., Philadelphia, Pa. "Seelite."
Starlite Mfg. Co., 2 Columbus Circle, New York, N. Y. "Starlite."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

SWITCH COVERS.—See Covers, switch.

SWITCH EXTENSIONS.—These are devices designed to attach to a ceiling plate or outlet box or to a canopy, and extend out to the side to permit a switch to be mounted or to be suspended on a cord and be free from the bowl or reflector of a fixture. They are generally designed to be secured to the conduit or to the box itself and are so shaped as to remain rigid when the switch is operated.

Manufacturer:

LUMINOUS UNIT CO. DIV., ST. LOUIS BRASS MFG. CO., St. Louis, Mo. Brasco switch extensions are manufactured to attach to junction boxes or to screw to ceilings as indicated in



Brasco Switch Extension

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the illustration. Two types are made, one for pendant switch as shown and the other for pull switch. They are made of steel and zinc plated and are rust proof. For other Luminous Unit products see display advertisement pages 1276-7.—Adv.

SWITCH, FIELD-BREAKUP.—A multipole knife switch mounted upon the field frame of a synchronous converter. It is used to open the field circuit between the various poles during a-c. starting so as to prevent the production of excessive voltage at the terminals of the field winding. This voltage is due to stepup transformer action with the armature coils as primaries. After the converter has been brought up to speed this switch is closed and the d-c. excitation applied to the field winding.

SWITCH FITTINGS, BLADES, CLIPS, HINGES, ETC.—Switch fittings are often made up in large quantities and sold to be used either in the construction of standard or special switches or for repair work. The blades, clips or jaws and hinge parts for the smaller switches are often stamped and not all switch manufacturers are equipped for doing this work. This is also true of face plates for flush switches and covers for rotary switches. On some of the higher capacity and higher priced switches these parts are milled out of solid high-conductivity copper and are often supplied separately. The porcelain base and body parts are quite generally purchased from manufacturers of electrical porcelain.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
Barkelew Electric Mfg. Co., Middletown, Ohio.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Contacts.) (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Motor & Engineering Co., The, 2nd St., S. W., and B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
RISDON MFG. CO., THE., Andrew Ave., Naugatuck, Conn.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCH HANDLES. — See Handles, switch and circuit breaker.

SWITCH HOUSES, OUTDOOR.—Outdoor switch houses are used in connection with outdoor substations. Such a switch house is usually merely a small closed weatherproof steel housing placed within the station enclosure or underneath the platform on which transformers and other apparatus may be mounted. They are necessary for housing meters, instrument transformers and relays, sometimes also line sectionalizing or service switches or at least the control for such switches, and other equipment that is not built in weatherproof or exposed types. They are frequently made of sheet metal, galvanized and painted with special protective paint. For larger substations, where considerable equipment must be protected, a building generally made of concrete or brick is used.

Manufacturers:

Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
GENERAL ELECTRIC CO., Schenectady, N. Y. Three standard types. All are shipped completely assembled, wired and painted, so that by attaching the leads and filling circuit breaker tanks with oil—when breakers are included—the switch house is ready for service. Described with complete substation equipment in Bulletin 47706A. See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCH INDICATORS.—See Indicators, switch position, railway, electric.

SWITCH KEYS.—See Keys, socket and switch.

SWITCH LAMPS (RAILWAY). — See Lamps, railway signal and switch.

SWITCH OIL.—See Oil, transformer and switch.

SWITCH PLATES (ADAPTER AND ADJUSTER).—See Plates, switch adapter and adjuster.

SWITCH PLATES (FLUSH).—See Plates, flush switch.

SWITCH ROOM, TELEPHONE OFFICE.—A room which contains working automatic switches.

SWITCH, SPEED-LIMITING. — See Speed-limiting switch.

SWITCH STANDS, TRACK. — Track switch stands are extensively used on electric railway systems at switches, in yards, etc. A great variety of switch stands are made but in general they consist of a mechanism for operating the switch and at the same time causing an indicator to show the position of the switch, whether open or closed. The operating mechanism is usually installed in a heavy cast iron casing. The indication given usually consists of a target painted in different colors, that is turned when the switch is operated. For night service the target is replaced by a lamp with various colored lenses. Dwarf semaphores with colored roundels and a clear lamp with Fresnel lenses are also much used, especially by electric railways.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Cleveland Frog & Crossing Co., Cleveland, Ohio. "Lucas."
Ramapo Iron Works, Hillburn, N. Y.
St. Louis Frog & Switch Co., St. Louis, Mo.
Weir Frog Co., Station H, Cincinnati, Ohio.

SWITCH STICKS FOR DISCONNECTS, ETC.—High-tension disconnecting switches are arranged to be operated by insulated switch sticks. These are of hard wood impregnated with a moisture repellant and equipped with a suitable hook by which the switch blade may be opened or closed.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can.
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
Monarch Electric Co, Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCH TONGUE.—A switch tongue is that portion of an electric railway track switch which is moved from one position to another in order to control the direction of traffic. Its function is similar to that of the "switch rails" usually employed in the switches on steam railroad track.

SWITCHALL.—Trade name for heating device plug manufactured by the Union Electric Corp., 103 Mott St., New York, N. Y.

SWITCHBOARD BLANKS, MARBLE AND SLATE.—See Marble, finished, for switchboards, panels, etc.; also Slate, finished, for switchboards, panels, etc.

SWITCHBOARD BUSBARS.—See Busbars, copper, solid; Busbars, copper, tubular.

SWITCHBOARD CABLE. — See Cable, switchboard, flexible.

SWITCHBOARD FITTINGS, INSTRUMENT BRACKETS, LAMP BRACKETS, ETC.—There are a number of special fittings applied to switchboards to furnish illumination for important instruments or to provide for the mounting of certain instruments in the most convenient places, etc. Small details are also often added for decorative or designation purposes, such as fancy nuts and bolts, metal caps to cover holes drilled for future use, card holders for designating lines, machines or circuits, etc.

Instrument brackets which provide for mounting an instrument or groups of instruments on top of the switchboard or at one end are often used, especially the latter. They consist of iron brackets, one end of which is securely bolted to the switchboard frame. A clock is often mounted on top of the board, ornamental brackets being used. In one style for mounting a meter in upright position on top of the switchboard, the arm holding the instrument is attached to the stationary bracket arm by means of a swivel. The instrument may thereby be turned to any angle with the front of the board. A similar arrangement is also provided for end mounting where the instruments are normally flush with the board, but may be swung out at an angle so that they may be seen from any point along the board. They are used chiefly for voltmeters and synchroscopes. Lamp brackets, reflectors, etc., are given a finish to harmonize with the rest of the board. These brackets are arranged to mount over an instrument; they are rear-connected, projecting through a hole in the panel. Special sockets for rear connection are also provided for illuminated-dial instruments.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Brass Fixtures Co., The, Plantsville, Conn. (Lamp brackets.)
Buffalo Wire Works Co., 316-322 Terrace, Buffalo, N. Y. (Wire enclosures.) "Buffalo."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W. and B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. A broad and comprehensive line of fittings, devices, of all standard and

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special types. See display advertisement on page 1261.—Adv.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Erie Electrical Equipment Co., Johnstown, Pa. "Erie."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
Faries Mfg. Co., Decatur, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. (See display adv. page 1285.)
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Threadless Pipe Fittings Corp., Newark, N. J. (Exclusive distributors, Rubino & Liebstein, Newark, N. J.)
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARD FRAMING (PIPE, ANGLES, ETC.).—The standard types of frames for the usual panel switchboards are made either of pipe or structural angle construction. The cheaper and smaller panels are usually mounted on a framework of gas pipe. For small panels, not over 48 ins. high, this pipe may be of either ¾ or 1¼ in. diameter, depending on the class of apparatus used. For larger switchboards with panels 90 ins. high in two or three sections, pipe framing is also used. In these cases the pipe diameter is at least 1¼ in. Special fittings are provided to which the panel slabs may be bolted and these in turn are clamped to the pipes by J or U-bolts or some similar devices that obviate any necessity for drilling or threading the pipes. A full line of fittings has been developed so that various devices may be clamped to the pipe frame. With a multiple-panel switchboard one pipe upright forms the support for the two adjacent panels, so that the panels are usually shipped independently of their supporting frame unless temporary uprights are supplied for shipment.

Structural iron frames are usually made with two vertical angles of suitable size, such as 2x3x¼ in. with the 2-in. side next the panel. The vertical angles on adjacent panels are bolted together through the 3-in. web and are provided with corner angles for bolting at the bottom to a sill or channel iron, usually of 6x2 ins., and at the top to a flat iron running the length of the switchboard. This makes a very stiff construction and each panel is shipped bolted to its own pair of angle irons with all the panel sections completely wired up.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., and B. & O. R. R., Canton, Ohio.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Electrical Mfg. Co., The, 4140 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. (See display adv. page 1285.)
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARD INSTRUMENTS. — See Ammeters, switchboard or panel, a-c.; Ammeters, switchboard or panel, d-c.; Meters, watthour, switchboard and totalizing, d-c.; Meters, watt-hour, switchboard and totalizing, single-phase; Meters, watt-hour, switchboard and totalizing, polyphase; Power-factor meters; Synchroscopes; Voltmeters, switchboard or panel, a-c.; Voltmeters, switchboard or panel, d-c.; Wattmeters, switchboard, d-c. and single-phase; Wattmeters, switchboard, polyphase.

SWITCHBOARD INSULATORS. — See Insulators, switchboard.

SWITCHBOARD KEYS.—See Keys, telephone switchboard.

SWITCHBOARD MARBLE AND SLATE.—See Marble, finished, for switchboards, panels, bases, etc.; Marble, unfinished, for switchboards, panels, etc.; Slate, finished for switchboards, panels, bases, barriers, etc., Slate, unfinshed, for switchboards, panels, etc.

SWITCHBOARD TELEPHONE. — Abbreviated SwBd. Any device, made up chiefly of switches, for the purpose of connecting together telephone lines. It may be manual, semiautomatic, or automatic.

SWITCHBOARD WIRE AND CABLE.—See Wire, switchboard; also Cable, switchboard.

SWITCHBOARDS, BATTERY-CHARGING.—The main function of battery-charging switchboards is to provide the proper facilities for charging the batteries of electric vehicles and therefore they find their principal use in public or private garages. In most cases they are designed for the charging of 40 to 44 cells of lead battery or 60 to 62 cells of Edison battery. Different builders have their own types of construction, but the sectional design may be considered as fairly representative of the class.

With this construction each panel consists of three or more sections together with suitable charging rheostats comprising a resistor of cast iron grids supported back of the panel with the contact studs and arm of the face plate on the front of the panel. The usual panel comprises a power control section and two or more charging sections. Swinging brackets contain the meters and each battery circuit has a special switch with extra contacts so that the ammeter and voltmeter on the swinging bracket can be cut into service without opening the circuit to the battery that is being charged.

These various sections are usually made of slate slabs 1 in. thick, 24 ins. wide and in two heights, 14 ins. and 28 ins. Ampere-hour meter sections are sometimes provided with meters of the automobile type, having a zero-contact reset device that will automatically terminate the charge on a battery when a certain amount of energy has been fed into it. Suitable provision is usually made to prevent any possibility of the battery feeding back into the system by means of a reverse-current relay or the equivalent.

Where there is only one battery to be charged as in a private garage the generator is frequently used for light and power supply in addition to charging the battery, and for such service combination panels are provided. The usual battery can be charged through a resistance with all cells in series, but for 125-volt batteries fed from 125-volt generators provision is made for connecting the two halves of the battery in parallel for charging from the generator while it is carrying the usual lighting load, and the two halves of the battery can be connected in series when the battery is to operate in parallel with the generator or the generator is to be shut down.

Another common use of a battery is for the control circuits in a power plant using electrically operated switching devices. Such a battery is usually charged from a special motor-driven charging generator that has a high enough voltage range to permit periodically gassing the battery. At such a time the voltage is too high to be safely used on the control and indicating circuits and it is customary to furnish a switch for connecting such circuits at that time to a cell some distance in from the end of the series that will deliver the correct voltage when each cell is at its maximum voltage condition.

Where large batteries are used as a reserve source of power or excitation it is customary to have these float on the system with automatically operated end-cell switches or motor-driven boosters to maintain the desired voltage on the battery during operating conditions. Special switchboards are used designed to suit the exact conditions of each case.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio. "Dayton."
Acme Electric & Mfg. Co., 1444 Hamilton Ave., Cleveland, Ohio. "Acme."
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Autocall Co., The, Shelby, Ohio.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Automatic Transportation Co., 2933 Main St., Buffalo, N. Y.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Comet Electric Co., The, 1237-1241 St. Paul St., Indianapolis, Ind. "Comet."

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Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que. Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St. Chicago, Ill.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hobart Bros. Co., The, 113 Water St., Troy, N. Y. "HB."
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Kurz & Root, Appleton, Wis.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
MacRae, Hector C., 314 St. Paul St., Baltimore, Md. "Champion."
Main Electric Co., Cleveland, Ohio.
Mayhew Co., 867 Meinecke Ave., Milwaukee, Wis.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave., and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Pringle Electric Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk and Niagara Sts., Buffalo, N. Y.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Swartz Electric Co., Indianapolis, Ind.
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "USEM."
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARDS, BENCHBOARD TYPE.—In power plants using electrical operation for the switching equipment, the benchboard or control desk has many advantages where a very compact arrangement is desired, particularly where each generator normally feeds its own bank of transformers or group of feeders, as a miniature bus scheme can be worked out to show all of the connections made by the breakers in the different circuits. The extra space available on the desk over that which can be secured on a panel type of board is the real reason for this construction, which is used in nearly all large plants.

Various arrangements of benchboards or desks have been developed the main differences being in the arrangement of the portion of the desk devoted to the instruments. In certain cases the instruments are placed on an independent panel type board or on the station wall in front of the operator when he is standing at the desk. A modification of this scheme is to have the instruments on panels supported on a framework that is back of and above the desk which then faces towards the generator room so that the operator can look below the instrument frame and above the desk top to watch the machines he is controlling. This construction led to the "gallery type control desk" where the instrument frame is a vertical extension of the frame that carries the desk panels. This type of desk is particularly well adapted for locating on a gallery overlooking the generator room.

Where a large number of meters are required with each desk section and the desk is not in a position where the operator is to watch the generator room the instrument panels do not have any space between them and the slanting desk top. To provide still more instrument space it is customary with this type of desk to reserve the instrument sections for the indicating meters and to place all the recording meters, relays and similar devices on a separate panel type board set back to back on a self-supporting frame. Usually the two ends are closed in with grillwork and doors so as to make a little room back of the desk to facilitate getting at the wiring and connections.

With practically all desks, provision is made to use calibrating terminals that permit testing out the circuits or calibrating the meters and relays without removing them from the desk.

All of the main and exciter switches are usually made electrically operated with desk equipments, and the control switches and indicating lamps are so made that no live circuits, even of low voltage, are on the front of the desk.

An early variation of the desk arrangement was the use of control pedestals and instrument posts for the generator circuits, as these were self-contained devices and additional pedestals and posts could be added with additional machines without disturbing the symmetry of the arrangement or interfering with the apparatus already installed. The plant of the former Ontario Power Co., at Niagara Falls, Ont., is one of the best known examples of the pedestal and post arrangement of control, as there are 16 of these, each controlling a 12,000-volt generator and transformer bank of 7500 to 9000 kv-a. capacity each. The transmission line feeders are controlled from a panel switchboard.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave., and Montgomery St., Jersey City, N. J.
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
GENERAL ELECTRIC CO. Schenectady, N. Y. (See adv. pages 1203-1223.)
Liberty Electric Corp., Port Chester, N. Y.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHBOARDS, DEAD-FRONT OR SAFETY FIRST.—The "safety first" idea as applied to switchboards is carried out by having a "dead front" with no live apparatus on the face of the board and the rear so arranged that the operator does not have to get near the bus or live connections to renew fuses or to inspect apparatus.

This form of construction has been applied chiefly for lighting and for industrial power circuits where unskilled attendants are employed or where the utmost precautions have to be taken. Various arrangements have been adopted to carry out this idea. With panel type boards for lighting service, the handles of the switches are the only things exposed. The switches usually are interlocked with the doors of the fuse compartments, so that the fuses are only accessible for replacement when the switch is in the open position and the switch cannot be reclosed until the fuse compartment has been closed. A special design of switch is made with brush contacts that are pivoted at the center and connect the bus to the feeder circuit. These switches are removable from the board for inspection, cleaning or adjustment and can be replaced without danger to the operator.

For high-voltage a-c. service where oil circuit breakers are employed the safety first or dead-front board takes the form of the truck type switchboard where the entire breaker can be pulled out for inspection; see Switchboards, truck panel type.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electric Motor & Engineering Co., The, 2nd St., S. W., and B. & O. R. R., Canton, Ohio.
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. Standard unit, safety enclosed panels, made up with switches varying in capacities from 30 to 600 amp., 250 or 600 volts. Sheet steel door on the steel front of each switch unit directly behind the operating handle cannot be opened when the switch is closed. The switches can be locked open by a padlock. These panels may be combined into a switchboard which presents a pleasing appearance and offers all the advantages of dead-front safety operation. For lighting and small power service. (Bulletin 67110.) See adv. pages 1203-1223.—Adv.



Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., West, Detroit, Mich. The cut shows a dead-face, super-safety,

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"Bull Dog" theater board. There are no live metal parts on face of board. Switches are arranged with interlocking devices so that any group of switches may be operated by master levers. The switches are on the rear



"Bull Dog" Theatre Board

of the board and so arranged that the fuses and switches are dead when open. Some of these boards have been in operation for 10 years. "Bull Dog" super-safety industrial boards are built on the same general principle as theater boards, except they are not provided with interlocking mechanism; but switches are provided with means for locking them in "on" and "off" position. Also see display adv. page 1285. —Adv.

PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
SQUARE D CO. 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
WESTINGHOUSE ELECTRIC MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WESTERN ELECTRIC SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARDS, DENTISTS' AND ELECTROTHERAPEUTIC.—These switchboards are merely the larger and more intricate forms and groupings of control panels for dental and electrotherapeutic purposes. They provide not only the control apparatus but indicating instruments to show the operation of the various machines. For a more complete description of their functions see Panels, dentists' and electrotherapeutic control.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Liberty Electric Corp., Port Chester, N. Y.
Mevrowitz, Inc., E. B., 520 5th Ave., New York, N. Y.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane", "Pelton."
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y. "Ritter."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRIC CO., 300 5th St., Racine, Wis.

SWITCHBOARDS, D-C. RAILWAY.—Practically all American railway installations in the average city are run on 600-volt d-c. circuits by means of an overhead trolley wire with ground return. For this class of service the switchboards, whether controlling d-c. generators or synchronous converters, are arranged with only one polarity (positive) on the switchboard, the negative bus being run between machines and then taken to ground and the rail returns, while the equalizer bus runs between the machines. Each generator or converter is provided with an air-break circuit breaker mounted at the top of the panel, a switch in series with it, an ammeter, field rheostat and voltmeter switch or receptacle. Each feeder circuit has a circuit breaker, ammeter and switch.

For long interurban roads where heavy service has to be handled, 1200 to 1500 volts direct current is often utilized. The switching equipment for such service is very similar to that for 600 volts, except that the circuit breakers are located out of reach of the operator and are mechanically controlled by a handle on the switchboard panel. The usual knife switch in series with the circuit breaker is also made distant-control.

For heavy main-line electrification where 2400 to 3000 volts direct current is used, a high-speed breaker with magnetic blowout is employed and usually it is necessary to provide means for cutting in resistors in advance of the tripping out of the feeder breakers. Other precautions, such as the use of flash suppressors, have to be taken to insure satisfactory operation.

Most d-c. railways are now operated from a-c. generating stations by means of synchronous converters or motor-generator sets so that the panels for the converters or motors have to be considered as part of the railway switchboard in the plant. The high-tension side of the transformers for the converters, or the main circuits of the a-c. motor are controlled by oil circuit breakers that are usually distant-control and either manually or electrically controlled. Where converters are used these are almost invariably a-c. self-starting by means of low-voltage taps on the step-down transformers.

During the last few years a number of installations have been made of automatic substations, using synchronous converters or motor-generator sets. In these stations very ingenious combinations of relays, contactors and other devices insure the starting up of the units when their services are needed and their shutting down as soon as their services can be spared. In addition to the starting and stopping functions that are automatically taken care of by the equipment, there are many protective features introduced into the automatic stations that are not usually found in stations with operators.

These devices limit the overloads, limit the temperatures, and prevent the machine from attempting to start during low a-c. voltage or single-phase supply. They will shut down the machine when a-c. or continuous d-c. short-circuits occur; upon failure of alternating current; upon failure of any device; in case of excessive speed; upon reversal of direct current. Thermostat relays in the bearings lock the station out in case of bearing trouble, and similar thermostat relays enable the starting and running resistors to be utilized up to their maximum efficient temperature.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
ELECTRIC POWER EQUIPMENT CORP., N. E. Cor. 13th and Wood Sts., Philadelphia, Pa. "Elpeco." (See display adv. page 1261.)
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E panels for railroad service are standard manually operated switchboard units suitable for either main station or substation installation. Equipments for the a-c. side of synchronous converters and for other a-c. railway apparatus are available, together with auxiliary d-c. panels, such as exciter panels. Standard unit panels for railway service are designed to line up together, are made to control generators and converters, 100 to 2400 kw. up to 1500 volts, and for feeders up to 2000 amp. (Bulletin 47010.) Also G-E automatic switching equipment especially adapted to electric railway service. More than 100 complete equipments are now in successful operation. (Bulletin 47730.) See adv. pages 1203-1223.—Adv.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave., and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. on page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1096-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHBOARDS, FIRE ALARM.—The control boards upon which are mounted the switches, relays, fuses and other operating and protective apparatus used in large fire-alarm systems, including instruments and apparatus used for indicating circuit conditions, testing of circuits, and transmission of alarms. These are used on the larger fire-alarm systems only, such as for large cities, the smaller equipments being usually placed in cabinets or on panels. In large municipal systems the boards are often of marble with ornamental trimmings. Auxiliary boards and cabinets are used for recording registers and other special equipment.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Autocall Co., The, Shelby, Ohio.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Liberty Electric Corp., Port Chester, N. Y.
McFell Signal Co., 2857 S. Halsted St., Chicago, Ill.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Stanley & Patterson, 34 Hubert St., New York, N. Y.

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Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
U. S. E. M. Co., 505 W. 42nd St., New York, N. Y. "U S E M."

SWITCHBOARDS, GENERAL LIGHTING AND POWER.—For general light and power service, direct current is used where the amounts of power are small and the distance short. For larger amounts of power and longer distances higher voltages are necessary and alternating current is usually employed. Switchboards have been standardized by many builders that will take care of all the usual conditions to be met with in actual service.

For small industrial plants, etc., panels with slabs about 48 ins. high can take care of all the generator and feeder circuit conditions. For d-c. service 125 volts is customary for small lighting plants. Where the distances are too great or the amount of power too large for that voltage, 250 volts, two-wire or three-wire, can be used. For power service in mines 275 and in some cases up to 600 volts direct current is handled by these panels.

For small installations of one generator and several small d-c. feeders, combination panels are supplied, the generator being provided with ammeter, voltmeter, rheostat and main switch with either fuses or a circuit breaker to give automatic protection. Each feeder circuit up to about four is provided with a two-pole switch and fuses.

Where there are several d-c. generators operating in parallel, each has its own panel and separate panels are provided for the feeders. With these boards air-break circuit breakers or fuses in the generator or feeder circuits may be used for the purposes of automatic protection. Where the d-c. generators are three-wire machines circuit breakers are always used for their protection. In this case, with compound wound generators, the breakers can be either four-pole to open the positive, positive equalizer, negative and negative equalizer, or they may be two-pole with the breaker connected in the armature leads inside the series fields. The two-pole breaker is the cheaper arrangement as far as the switchboard is concerned, but usually involves a greater expense for cables between the board and the machine.

Small a-c. boards for 220 or 440 volts are usually provided with knife switches for the main circuits and fuses for the automatic protection of the feeders. For higher voltages as well as sometimes for these voltages, oil switches or circuit breakers are employed, nonautomatic for the generator circuit with automatic protection in the feeder circuits.

For d-c. machines of more than 600 amperes, and for a-c. plants with generators of more than a few hundred kv-a., it is customary to use 76 or 90-in. panels in two or three sections, the panels running all the way to the floor. The d-c. boards, whether for light, power, or railway, are almost invariably provided with air circuit breakers to secure automatic protection. For an industrial or railway plant fed through synchronous converters from a large system, the amount of short-circuit current to be handled practically necessitates mounting the breakers at the top of the panels with ample space for the arc to rise above the panels. The larger manufacturing companies have standardized their d-c. switchboards, based on this method of construction. For office buildings, stores or similar installation using a few engine-driven d-c. generators the short-circuit conditions are much less severe, and for such service it is safe to mount apparatus above the breakers and often a number of breakers may be mounted one above the other for the control of several feeders from a single panel. This type of construction is frequently specified by the architects of buildings containing isolated plants as it enables a large number of d-c. feeders with circuit-breaker protection to be controlled from a comparatively short switchboard.

For a-c. service at 2400 volts the panel construction using oil circuit breakers mounted on the rear of the panels or on the panel frames is used for capacities up to about 3000 kv-a. For higher voltages or for great amounts of power, the breakers are mounted apart from the switchboard and controlled manually or electrically. For a-c. boards it is customary to include the panels for the exciter control as part of the switchboard. Where these exciters are provided with a voltage regulator it can be mounted on a bracket or on a special panel. On brackets at the end of the board it is customary to mount a synchroscope with two synchronizing lamps and two a-c. voltmeters to provide ready means for connecting generators in parallel.

To the right of the exciter panels are placed the generator panels, usually arranged with panels for the smallest generator next to the exciter panels and that for the largest one farthest away as that facilitates tapering the a-c. bus to get the best copper distribution. The usual generator equipment comprises an a-c. ammeter with a three-way ammeter switch, a polyphase indicating wattmeter, a field ammeter, field-rheostat operating mechanism, field switch, voltmeter receptacle or switch, synchronizing receptacle or switch, and an oil switch, usually nonautomatic.

The feeder panels stand to the right of the generator panels, unless a totalizing load panel is supplied to come between the generator and feeder panels. The feeder panels usually have three ammeters to show whether the load is balanced and sometimes a watt-hour meter, an indicating wattmeter, or a power-factor meter. The breakers are usually automatic and can be made for instantaneous a-c. trip from current transformers, or can be provided with time-limit attachments or time-limit relays.

For the arrangement of the circuit breakers and the busbars, many conditions have to be considered in determining whether to mount the breakers directly back of the switchboard or to place them on a framework or in masonry compartments or to go to outdoor construction.

Manufacturers:

A-C Electrical Mfg. Co., The, 4th St., U. B. Bldg., Dayton, Ohio.
ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Barber Electric Mfg. Co., North Attleboro, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Switchboard Mfg. Co., 426 S. Clinton St., Chicago Ill.
Clay Electric Co., 3303 N. 12th St., Philadelphia, Pa.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Connecticut Dynamo & Motor Co., The, Lyons Ave. and Coit St., Irvington, N. J.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Apparatus Co., 127 S. Green St., Chicago, Ill.
Electric Motor & Engineering Co., The, 2nd St., S. W., and B. & O. R. R., Canton, Ohio.
Electric Panelboard Co., Rochester, N. Y.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. A.-c. and d.-c. switchboards, for special and ordinary requirements, fitted with high grade instruments, accurately rated. See display advertisement on page 1261.—Adv.
Electromechanical Co., The, 432-434 N. Calvert St., Baltimore, Md.
Empire Engineering & Supply Co., 1 Dominick St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of switchboards for all systems of electrical distribution. Standard Unit Panels have been developed to meet certain conditions which occur repeatedly. They are less expensive than the other classes, requiring less time to build and ship, though quality and workmanship are the same. They may be ordered simply by catalogue numbers, taken from descriptive bulletins, each of which is complete in itself and covers panels in a distinct class. The index to all of these, Bulletin 47001-A, can be obtained on request. These panels are so designed that they can be assembled in different combinations, to form a complete switchboard having a neat, uniform appearance. All apparatus is made by a single company, thus centralizing responsibility for the performance of the entire board. Industrial and consulting engineers are invited to confer with switchboard specialists in G-E sales offices on the adaptation of standard unit panels. See page 1223.—Adv.
Globe Electric Co., 368 Broadway, Milwaukee, Wis. "Globe."
Hatfield Electric Co., 102 S. Meridian St., Indianapolis, Ind.
Hub Electric Co., 2225 W. Grand Ave., Chicago, Ill.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display, adv. page 1327.)
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Kurz & Root, Appleton, Wis.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dall Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Liberty Electric Corp., Port Chester, N. Y.
Liberty Mfg. Co., Inc., 3201-41 Carrollton Ave., New Orleans, La.
Main Electric Co., Cleveland, Ohio.
Marquette Electric Engineering Co., 222 W. Austin Ave., Chicago, Ill.
Mendell Mfg. Co., Mattapoisett, Mass.
Metropolitan Electric Co., South Seattle, Wash.
METROPOLITAN ELECTRIC MFG. CO., Long Island City, N. Y. This company is prepared to design, manufacture and erect all kinds of switchboards for either direct or alternating current.—Adv.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
National Electric Co., 302 Kanawha National Bank Bldg., Charleston, W. Va. "National."
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
Nyelec Switchboard Co., 422 E. 53rd St., New York, N. Y.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Perfection Storage Battery Co., 500 E. 40th St., Chicago, Ill.
PETERSON CO., INC., CHARES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Post-Glover Electric Co., 308 W. 4th St., Cincinnati, Ohio.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk and Niagara Sts., Buffalo, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
Schmidt Electric Co., A. R., E. Water and Buffalo Sts., Milwaukee, Wis.
Southern Electrical Equipment Co., Charlotte, N. C.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Electrical Construction Co., San Francisco, Cal.
Standard Mechanical Equipment Co., 2020 Richardson Ave., Dallas, Tex. "Standard."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
Swartz Electric Co., Indianapolis, Ind.

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Tanner & Co., William F., Baltimore, Md.
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Western Electric Works, 213 6th St., Portland, Ore.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Burke." (See display adv. pages 1395-1402.)
Wisconsin Electrical & Mfg. Co., Milwaukee, Wis.
Worcester Electric Mfg. Co., Worcester, Mass.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARDS, MARINE AND NAVAL.—Switchboards for ship service are generally made of an impregnated composition or ebony asbestos lumber as this insures ability to stand internal and external shocks, such as are occasioned on naval vessels during battle. Slate is sometimes used on merchant vessels for mounting the various instruments and switching devices on smaller boards or isolated panels. Where the generators are located in two rooms switchboards are located nearby for their control, the two boards being interconnected. The switchboards are manually operated and the live parts are carefully guarded to protect the operators. There is no generally accepted limit set for the use of knife switches or circuit-breakers. In large plants, generally above 500 amperes, single-pole circuit-breakers on each leg of the circuit or independent arm multipole circuit-breakers are considered best practice. Usually the generating sets are connected for parallel operation, but in some small plants they are operated separately and so independent busbars with double-throw switches are arranged. On the smaller boards knife switches with fuses for the generator leads are considered amply safe. Enclosed cartridge fuses are employed except for instrument protection and they are always mounted on the face of the board.

SWITCHBOARDS, POLICE TELEPHONE AND SIGNAL.—The panels on which are mounted the relays and other operating and protective apparatus used in police telephone and signal circuits and including the transmitting, receiving and switching telephone apparatus, by which incoming calls are transferred to the proper officer and the regular reports of the patrolmen received. The newer systems often include a special signaling system, whereby the operator may call any patrolman. The switchboards also include the necessary apparatus for this.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Stanley & Patterson, 34 Hubert St., New York, N. Y.

SWITCHBOARDS, SERIES STREET LIGHTING.—While the development of the high-efficiency tungsten lamp has caused the practical abandonment of the series arc light systems for new installations, there are still a number of such systems in actual service. Some of the oldest of these systems are operated from d-c. series generators, usually motor-driven, and the switching equipment comprised panel switchboards equipped with air-break plug switches that permitted any circuit or combination of circuits to be operated in series from any generator or combination of generators. Provision was made for cutting ammeters into any circuit whose current was to be measured.

The d-c. series system was superseded by the constant-current a-c. system with the lamps operated from the constant-current transformers or "tubs," as they were called. These were repulsion-coil transformers with movable secondary coils and the switching equipment comprised switches of the plug or oil type with fuses in the primary or constant-potential circuit and plug or oil switches in the secondary or constant-current circuits. It was usually found advisable to short-circuit the constant-current circuit before opening up the primary so the secondary circuit was provided with three plugs, one to short-circuit the line and two to open-circuit it after the primary circuit had been cut off. A special oil switch with two handles was provided for the same service, one handle controlling a single-pole short-circuiting switch and the other controlling a two-pole switch for open-circuiting the line. A ten-ampere a-c. ammeter was usually provided for reading the current in the line.

By combining a mercury-arc rectifier with a constant-current regulator it was possible to operate the more efficient d-c. series magnetite arc lamps from a-c. distribution circuits without any moving machinery. The switchboards for this service provided a tilting mechanism or some similar device for starting the rectifier. Somewhat similar equipments were furnished for series tungsten lighting systems, except that they do not require any rectifier equipment.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. Series arc and incandescent panels for controlling constant-current transformers in plants of any size, 1,150 to 2,300 volts. Switch equipment consists of safe and convenient plug switches and tubular expulsion fuse combined in single unit. Panels are available provided with watt-hour meter sub-bases to check the general meters in the station. See adv. pages 1203-1223.—Adv.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SPRAGUE ELECTRIC WORKS OF GENERAL ELECTRIC CO., 527-531 W. 34th St., New York, N. Y. (See display adv. pages 1306-1307.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1305-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARDS, SPECIAL AND MISCELLANEOUS.—There are a number of switchboards built for special purposes and to meet requirements that are very different from those described here. Some examples of this are switchboards for mine service, to control the various feeder circuits, etc. These boards must be constructed so as to prevent injury from moisture or falling particles, etc. There are also special boards made to be moistureproof for use in tanneries or other installations where an excess of moisture is likely to be found. Various industrial processes also require switchboards that are distinctly special types, such as for the control of a battery of electric furnaces, etc. Large radio stations also have switchboards for controlling the high-frequency alternator, transformers and other main apparatus and circuits.

Manufacturers:

Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y. (Marine.)
Eureka Stone & Marble Co., 179 W. Maple St., Columbus, Ohio (Moistureproof.)
Flint Electric & Mfg. Co., The, 1412 Delgany St., Denver, Colo.
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague safety type switchboards are furnished with feeder switches of the brush contact type. Each switch is furnished with a separate door over the fuse compartment so arranged that access to the fuses can be had only with the switch in "off" position. The switch has a quick break action and is operated by a toggle mechanism. Sprague products, see display adv. pages 1306-7.—Adv.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEGRAPH.—Telegraph switchboards are simple boards on which are mounted jacks to permit the interconnection of various operating sets to lines running to different cities, etc. They are also made in a number of other forms for special purposes, the boards in these cases having mounted on them the necessary relays, rheostats, control apparatus and indicating instruments for balancing the lines, etc., in duplex and quadruplex operation, or for special testing and operating of printing telegraph systems.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch So., The, 414 Notre Dame St., W., Montreal, Que., Can.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Liberty Electric Corp., Port Chester, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See adv. page 1287.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE AUTOMATIC.—Telephone switchboards which make connections by means of automatic switches under the control of the calling subscriber without the aid of an operator. Automatic switchboards comprise a very complete and extensive arrangement of frames on which line switches, selectors, connectors, relays, etc., are mounted. One type of switchboard is known as the panel type and is coming into use in large cities. It derives its name from the vertical panel-like form of the apparatus. For the most important parts of automatic switchboards see the three types of switches described and listed under Switches, telephone, automatic.

Manufacturers:

AUTOMATIC ELECTRIC CO., Chicago, Ill., designers, manufacturers and installers of Strowger Automatic Telephone exchanges for public and private systems of any size. More than one thousand such exchanges have been installed in all parts of the world and have been in operation for over 20 years. This equipment has been recognized by engineers and officials of the largest operating organizations as thoroughly practical and reliable, and has been adopted by the governments of the leading foreign countries. Strowger equipment renders a superior type of telephone service, being uniformly rapid and accurate in setting up connections, and by eliminating the switchboard operators, reduces the cost of operation to a minimum. Conferences with interested organizations either for public or private exchanges are invited.—Adv.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.

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North Electric Mfg. Co., The, Galion, Ohio.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE, CENTRAL-BATTERY, MANUAL. — Central-battery switchboards are used in most of the large cities and many of the smaller cities on large systems. They are generally divided up into an "A" board and a "B" board, together with the toll boards, special test panels, etc.

The "A" board is the manual switchboard on which the subscriber lines terminate. It is handled by "A" operators who answer the calls of subscribers.

The "B" board is that part of a manual switchboard which receives the incoming calls from other offices and establishes final connection to the called line. Each "B" operator has within her reach a multiple jack of all the subscriber lines in the office.

A multiple switchboard is a manual switchboard so arranged that each operator can complete connections to all lines on it. The board is made in sections, three operator positions per section (sometimes two). Each operator has a number of answering jacks and line lamps on subscriber lines whose calls she answers. Each subscriber line is also multipled to a multiple jack in each section; through these calls are sent to the substations.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Burns Express."
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO. Adams and Aberdeen Sts., Chicago, Ill. "Service." (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE, CORDLESS.—See Switchboards, telephone, private branch exchange.

SWITCHBOARDS, TELEPHONE, MAGNETO MANUAL. — Manual switchboards with drops or (rarely) with relays and lamps, arranged so that the subscriber signals the operator by a magneto hand generator, which causes the shutter of a line drop to fall. Each cord circuit is equipped with one clearing-out drop (sometimes two) and the subscribers are supposed to ring off when through talking. Local-battery transmission of the voice is usually used. These boards are very little used in large cities or large systems at present.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Burns Express."
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
Federal Telephone & Telegraph Co., Buffalo, N. Y.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. "Service." (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE, MARINE.—Marine telephone switchboards are special boards built for use on large naval and marine vessels. They are usually constructed entirely of metal and fireproof insulating material. In design and operation they resemble private branch exchange boards.

Manufacturers:

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE, PRIVATE BRANCH EXCHANGE.—These are usually rather small boards, having but one position and operated by a single operator. They are used in offices, factories, etc., for the telephone system in the building or plant. One popular type that is largely used in small sizes is the cordless switchboard. This is a manual switchboard on which connections are made by keys instead of by plugs and cords. It is used for small private branch exchanges, the attendant's cabinet in connection with a private branch automatic exchange, and a few small private installations. It is not practical for large or even medium-sized boards; 12 or 15 lines are about the limit.

Many large switchboards also come under this classification as some large buildings, industrial plants and institutions require the service of several operators to handle all of the calls. In some cases these go from this large board to a small P. B. X. board in each of the principal buildings or departments of the plant.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill. "Burns Express."
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., Chicago, Ill. The P. A. X. (trade name for the Private Automatic Telephone Exchange Equipment) has been adopted by hundreds of the world's largest and most important commercial, financial and industrial organizations, as well as hospitals, hotels, clubs, private estates and Government buildings. Also aboard ships. Serves any number of stations and is capable of unlimited expansion. Requires only two wires to each telephone. Gives accurate instant, reliable service, 24 hours a day, without an operator or attendant. The P. A. X. also renders unexcelled code call, watchman, conference, credit and other specialized services. Conferences as to specific requirements invited. —Adv.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."
Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass.
Devoe Electric Switch Co., The, 414 Notre Dame St., W. Montreal, Que., Can.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. "Service." (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, TELEPHONE, SEMI-AUTOMATIC.—These are special telephone switchboards to provide a means for handling part of the calls automatically although from the subscribers' standpoint the operation is the same as in manual switchboards. When a call is sent to the operator, she answers and learns what number is wanted. This number is then dialed by the operator and at the proper exchange appears before another operator in visual form, and the call may then be completed. The switchboards are therefore a combination of automatic and manual boards with the addition of the call indicator. Modifications of this type permit other methods of transmitting the number by the operator and also eliminate the second operator to complete the call.

Manufacturers:

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
North Electric Mfg. Co., The, Galion, Ohio.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHBOARDS, THEATER.—The distinguishing features of theater switchboards are their compactness and safety features that make it possible for an operator to have complete control of the stage and other lights in a theater so that he can carry out the marvelous lighting effects that are incorporated in some of the elaborate scenic productions of modern times. This is accomplished by locating all of the switches for the white lights in a logical position, with those for the amber, the red, the blue, etc., so placed that the operator with his mind on the production and his eyes watching the lighting effects can manipulate the switches in entire safety and certainty by his knowledge of their location and relation to each other.

The typical switchboard of the dead-front design has a main double-throw switch at the lower left-hand corner that controls all of the stage lights. Directly above it at the left of the board are the double-throw main switches for the blue, amber, red and white lights. These main switches are made double-throw with fuses on each side so that the blowing of a fuse will mean the minimum interruption to the lighting service. To the right of the main switch in each row are the individual switches for the borders, the footlights, the proscenium, the stage pockets, etc., all of those for any one location, like the borders, being placed one above the other so that all of the lights of any one color can be operated by the switches in the same horizontal row and those for the same location by the switches in the same vertical row.

The individual circuits are controlled by dimmers or rheostats with a very large number of steps so that the lamps in any one circuit may be turned down from full brilliancy to absolute darkness in such fine steps that it is impossible to notice any difference in light on adjacent steps of the rheostat. In the same manner the lamps can be brought up from the dark condition to full brilliancy in a smooth and regular manner. These dimmers are operated by handles at the top of the board and provision can be made for locking together all of the dimmers for any one color or any one location and operating these as a single unit. In certain switchboards provision is made for throwing any particular circuit on the bus independently of the group switches so that the pulling of the group switch will shut down all of the circuits except the ones that have been placed on the emergency feed.

With the dead-front design there is no possibility of the operator getting a shock that might distract his attention from the stage, and the whole operation of the board can be carried out in a poorly lit location with very little chance of incorrect switching. The fuses and connections on the rear are made readily accessible to permit fuse replacement or changes in the circuits to be made with the minimum delay.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
BOUSTEAD ELECTRIC & MFG. CO., 16 E. Hennepin Ave., Minneapolis, Minn. (See display adv. page 1326.)
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Cleveland Switchboard Co., The., 2925 E. 79th St., Cleveland, Ohio.
Cregier Electrical Mfg. Co., 220 W. Ontario St., Chicago, Ill.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Hallberg, J. H., 25 W. 45th St., New York, N. Y.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
Louisiana Metal Cabinet Works, 1019 Bienville St., New Orleans, La.
Mendell Mfg. Co., Mattapoisett, Mass.

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METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N. Y. "Metco."
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
NePage-McKenny Co., Armour Bldg., Seattle, Wash.
NEWGARD & CO., HENRY, 947-955 Washington Blvd., Chicago, Ill. "Newgard." (See display adv. page 1287.)
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Robertson Electric Construction Co., Mohawk and Niagara Sts., Buffalo, N. Y.
Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."
SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague safety type theatre switchboards are furnished with feeder switches of the knife-blade type with quick make and quick break action. The switches and



Sprague Theatre Switchboard

fuses are located at the back of the board, the operating handles of interlocking type on the front. Each row of switches may be operated by a master lever and any or all rows of switches may be operated simultaneously by a grand master lever. Theatre switchboards can also be furnished with remote controlled switches. Sprague products, see display adv. pages 1306-7.—Adv.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Superior Engineering Co., Inc., 332 3rd Ave., Pittsburgh, Pa.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
U. S. E. M. CO., 505 W. 42nd St., New York, N. Y. "U S E M."
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Weste n Electric Works, 213 6th St., Portland, Ore
WESTINGHOUSE ELECTRIC & MFG. CO. East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHBOARDS, TRUCK PANEL TYPE.—With this type of construction, the usual slate panels of an a-c. switchboard are replaced by steel panels mounted on structural frames built in the form of a truck that can be rolled into and out of a compartment prepared for it, thus making a continuous steel switchboard.

The whole of the apparatus for each circuit equipment (including the oil circuit breaker, instruments and transformers) is mounted on the movable truck and is removed with it when the truck is withdrawn from the space allotted to it in the structure. It can be safely inspected while in front of the switchboard or it can be wheeled away for more thorough examination, adjustment or repair.

The truck carries contact jaws mounted on porcelain insulators which engage with contact blades mounted in the fixed portion of the structure. These contact blades are sunk into the porcelain insulators so as to obviate the danger of accidental contact or short-circuits when the truck is removed The same insulators also support the busbars in the busbar chamber and the cable terminals in the cable-box chamber.

Safety interlocks are fitted in such a way that it is impossible for any truck to be withdrawn from the cell unless the breaker is in the open position. Frequently provision is made for steel windows to automatically slide into position when the truck is withdrawn and these cover over the openings through which the contacts are made to the bus and the outgoing cables. This type of switchboard can be supplied in separate units or as a continuous board and one or more spare trucks can be kept available for replacing any equipment that may need overhauling.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E truck type panels are especially adapted to group mounting and make a most desirable switchboard from the standpoint of safety to life,



G. E. Truck Type Panel

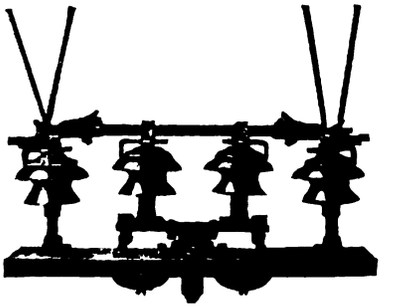
the elimination of fire risk and continuity of service. Described in Bulletin 47100. This Company manufactures also safety panels of the Dead-front and draw-out types, which see for description.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, AIR-BREAK, HIGH-TENSION, POLE-TOP AND OUTDOOR SUBSTATION.—High-tension switches of the air-break type are frequently used in outdoor substations and on overhead transmission lines of moderate capacity, as good practice dictates that such lines be sectionalized so that any section in trouble may be isolated and yet the whole line operated up to that section. These switches are also used on farm and other small-power lines where a medium or high-tension line is used to supply farms, irrigation pumps, small towns, etc., directly. They are less expensive than oil switches and meet the requirements of low-cost lines successfully.

The switches are usually mounted either on a steel framework, flat surface, or a pole top. The operating handle may be carried down within reach from the ground and locked so that it may be operated only by authorized persons. The switch itself in the common forms consists of a set of main contacts, one having a spring action and sometimes a leaf brush. A horn gap is generally provided above the main contacts and it remains closed after the main contacts are opened and finally opens the circuit there, thus breaking the arc on the diverging horns and preventing damage to the switch parts. One terminal of the switch is stationary and the other, which is the switch blade, usually has a rotary motion. Single-pole switches are much used and where more poles are required they are mechanically interconnected and all operated by the same handle. Switches are mounted so that the switch blade rotates in either a horizontal plane or a vertical plane. Protective features are sometimes provided and solenoid or motor operating mechanisms are also used, so that the switches may be of the remote-control type.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. and Montgomery St., Jersey City, N. J.
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. A new type of pole top switch for three phase, with laminated brush contacts, and having a vertical break. See display advertisement on page 1261.—Adv.
ELECTRIC SERVICE SUPPLIES CO., 17th and Cambria Sts., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electro Service Co., Marietta, Ga. ("Johnson.")
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type LG-7 Disconnect Switch for outdoor service up to 45,000 volts, or for higher voltage on application. For mounting on flat surfaces or pipe. Also the Type LG-20 disconnect switch for vertical mounting. The Type LG-119 disconnect switch can be secured in double, triple and 4-pole elements. It is made in combination with expulsion fuse where it is necessary to open the primary of a transformer bank and where no lightning arrester is required; with fuse and choke coil for use with a complete substation, having lightning arresters; or combined with choke coil when the fuse is replaced by an oil circuit breaker. (Bulletin 47706A.) See adv. pages 1203-1223.—Adv.
HI-VOLTAGE EQUIPMENT CO., Cleveland, Ohio. Manufacturers of air break switches, lightning arresters, choke coils, high voltage fuses, disconnecting switches, outdoor bus supports, steel sub-station structures, crossarms. The Hi-Voltage Switch is of a vertical break type, designed to open under heavy load. All parts of the switch and operating mechanism are protected against sleet and ice. All iron and steel parts are galvanized. Bearings are either brass bushed or babbitted. The main contact is of a self-adjusting type which insures good contact and free smooth operation under all conditions. Auxiliary arcing horns protect the main contact from all burning. All torsional strains on insulators are avoided. The strains on the porcelain are in compression. The insulators are secured to forged steel pins in a manner permitting their easy removal. The switch is easy to install and will not get out of adjustment in operation.—Adv.
Kelman Electric & Mfg. Co., 1650 Naud St , Los Angeles, Cal.
K-P-F Electric Co., 37 Stevenson St., San Francisco, Cal. "K-P-F."
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
PACIFIC ELECTRIC MFG. CO., 827-833 Folsom St., San Francisco, Cal. "Baum."
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill. "Royal" Type R. D. high-tension air break switches are made in a variety of forms. Il-



Type R. D.

lustration shows Type R. D. Form 1, 200 amps., 13,200 volts to 66,000 volts, or higher, if desired; a three-pole switch in which the rotating member is

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supported by two insulators and turns in an accurately machined bearing. Operating mechanism is a cable, always in proper tension. Insulators are of interchangeable type with non-cement attachments. Patented trolley contact insures positive operation, quick break and safety. All equipment is hot galvanized. Eight other forms embodying the same high standard of design and construction are supplied for 200-amp., 13,200 to 66,000-volt service, with or without choke coil, horn gap fuse, lightning arrester, tetra chloride fuse mountings, etc. Higher voltages, if specified. (Also see Switches, disconnecting, high-tension.) Send for our catalog. It contains engineering data, illustrations and other interesting information of "Royal" products.—Adv.

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."

Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

Western Electric Works, 213 6th St., Portland, Ore.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, AUTOMATIC. — See Contactors, magnetic; Switches, end cell (storage battery) automatic; Switches, pressure or vacuum-operated; Switches, remote control; Switches, time or clock-controlled; Switches, telephone, automatic connector; Switches, telephone, automatic line; Switches, telephone, automatic selector.

SWITCHES, AUTOMOBILE IGNITION. Control switches for automobile use intended to be connected in the main engine ignition circuit and designed with or without locking attachments. They are also made in special forms for manual operation or with projecting arms for foot operation; the latter are sometimes called the kick type. A good locking type switch is a safeguard against theft of the automobile.

Manufacturers:

American Bosch Magneto Corp., Springfield, Mass. "Bosch."

Apollo Magneto Corp., Kingston, N. Y.

Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Clum Mfg. Co., 421-437 National Ave., Milwaukee, Wis.

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Plug Switches No. 7171-61 and 7198-61 are designed to lock a motor car in order to prevent unauthorized operation. The switch is put in an out-of-the-way place known only to the owner of the car. C-H Switch No. 7171-61 is a plug switch for grounding the magneto. Removing the plug allows a contact to be



Switch No. 7198
Flush Plate No. 7161

made that grounds the magneto and is the reverse of the plug switch No. 7198-61 in which the plug is part of the circuit and removing it opens the circuit. These two switches are often made up in the same gang with the lighting switches. See display adv. pages 1225-1230.—Adv.

Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.

Eisemann Magneto Corp., 32 33rd St., Brooklyn, N. Y.

Hubbell, Inc., Harvey, Bridgeport, Conn.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)

Kent Mfg. Co., Atwater, 4937 Stenton Ave., Philadelphia, Pa. "Atwater Kent."

Liberty Electric Corp., Port Chester, N. Y.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Morse, Frank W., 289 Congress St., Boston, Mass. "Chapman", "Jost", "Purjtan."

Motor Specialties Co., Waltham, Mass.

Splitdorf Electrical Co., 98 Warren St., Newark, N. J.

Teagle Co., The, 1125 Oregon Ave., Cleveland, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, AUTOMOBILE LIGHTING. These are snap switches intended for the control of automobile lighting circuits and are usually designed for flush mounting on dashboards, steering columns, etc. They are furnished in various forms, including push and pull, push button, toggle, etc.

Manufacturers:

Accessories Mfg. Co., 2311-29 N. Crawford Ave., Chicago, Ill.

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.

Clum Mfg. Co., 421-437 National Ave., Milwaukee, Wis.

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

Cowles & Co., C., Water & Chestnut Sts., New Haven, Conn.

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Automobile Lighting Switches are operated by a single button with a very quick make-and-break mechanism. The mechanism is simple, and the push bar is unusually rugged in order to withstand the abuse that it is likely to receive. The Thermoplax insulating material used in the construction is both fireproof and waterproof and, unlike fiber, will not char or warp out of shape and thus in-



Switch No. 7160
Flush Plate No. 7161

terfere with the proper operation of the switch. In spite of the small size of C-H Automobile Lighting Switches they have the high rating of 10 amperes, 80 volts for single-pole and three-wire types, and 5 amperes, 80 volts for the automatic door switch. The three-way switch rating is 6 amperes, 40 volts or 3 amperes, 80 volts. Owing to the ample proportions of the switch parts,



Switch No. 7170 with
Flush Plate No. 7163

there is practically no voltage drop—an especially desirable feature on low-voltage systems. C-H Automobile Switches operate by means of a single pull-and-push button, the position of which indicates whether the circuit is open or closed. Pushing the button opens the circuit—pulling the button out closes the circuit. Switches are made up in gangs of two, three, four or more switches with flush plates. See display adv. pages 1225-1230.—Adv.

Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.

Gray & Davis, Inc., Boston, Mass.

Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."

Hubbell, Inc., Harvey, Bridgeport, Conn.

Liberty Electric Corp., Port Chester, N. Y.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Metal Specialties Mfg. Co., 3200-3208 Carroll Ave., Chicago, Ill. "Presto."

Morse, Frank W., 289 Congress St., Boston, Mass. "Pullrite", "Sta-Rite."

Motor Specialties Co., Waltham, Mass.

Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.

Seng Auto Device Co., 1452 Dayton St., Chicago, Ill. ("Seng" horn switch.)

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, AUTOMOBILE STARTING.—Switches for the starting circuits of automobiles having rugged contact members and a spring-controlled circuit-closing member intended for foot operation. They are made with very heavy contacts because the current required for turning the starting motor is often in excess of 50 amperes.

Manufacturers:

Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."

Bijur Motor Appliance Co., 15th & Garden Sts., Hoboken, N. J.

Briggs & Stratton Co., 1047 Louis Ave., Milwaukee, Wis. "Basco."

Cuno Enginering Corp., The, Meriden, Conn.

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)

Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.

Gray & Davis, Inc., Boston, Mass.

Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."

Motor Specialties Co., Waltham, Mass.

Niehoff & Co., Inc., Paul C., 232-242 E. Ohio St., Chicago, Ill.

Simms Magneto Corp., The, East Orange, N. J. "Simms."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, BABY KNIFE.—Miniature knife switches used in telephone, telegraph, fire and burglar-alarm and other low-voltage circuits of small capacity. They generally have a maximum current rating of 30 amperes and are made for both 125 or 250-volt service. Single, double and triple-pole switches mounted usually on porcelain or sometimes on slate bases are in this class and, although single-throw switches are generally used, they are also made as double-throw.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.

Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."

Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.

Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.

Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.

Liberty Electric Corp., Port Chester, N. Y.

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

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Paiste Co., H. T., Philadelphia, Pa. "Paiste." (Exclusive distributor, Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Peerless Light Co., 663 W. Washington Blvd., Chicago, Ill. "Peerless E-Z-Wire."
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Acme."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, BATTERY, KNIFE OR SLIDING.—These are small switches of small current capacity. They are made in two styles, either as a plain single-pole knife switch or arranged with a pivoted blade to slide in a horizontal plane over button contacts or between contact clips.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."
Canadian Coil Co., Ltd., Walkerville, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Detroit Coil Co., 439-447 Fort St., E., Detroit, Mich.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fahnestock Electric Co., East Ave. & 8th St., Long Island City, N. Y.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Morse, Frank W., 289 Congress St., Boston, Mass.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "BullDog." (See display adv. page 1285.)
Parkin Mfg. Co., San Rafael, Cal.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, BURGLAR ALARM, LOCK OR KEY CUTOUT.—Switches operated by keys and placed on the doors of stores, offices, residences, etc., connected with burglar alarm systems so that persons having the proper keys can go in or out of the building without ringing the alarm. Any attempt to open the lock without a proper key operates the switch and gives the alarm.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
KLAXON CO., Newark, N. J.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Stewart & Co., S. A., 85 Hall St., Boston, Mass.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, CEILING, PULL.—Snap switches mounted in insulating bodies with pull chains or cords and used chiefly for controlling individual ceiling lamps or fixtures, ceiling fans, etc. They are arranged for several kinds of mounting, either directly on the ceiling with screws, or for attaching to an outlet box or plate or fixture stud. The switches may be provided for a number of circuit conditions, such as single-pole, double-pole, three-point, four-point and two or three-circuit electrolier switches. The bodies are of porcelain and in the type for mounting on a flat surface have either solid or slotted bases for the wiring.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Pullite."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Ceiling Pull Switches, despite their large capacity (6 amp. 135 volts, 3 amp. 250 volts), are of small size, and neat design. The ingenious C-H mechanism employed has a quick snappy action. See display adv. pages 1225-1230.—Adv.



C-H 7320

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Pullite."
GENERAL ELECTRIC CO., Schenectady, N. Y. "G-E." (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hubbell, Inc., Harvey, Bridgeport, Conn. "Quick Catch," "Presturn."
Leveridge, Ins., Charles W., 133 Liberty St., New York, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

SWITCHES, CLOCK-CONTROLLED.—See Switches, time or clock-controlled.

SWITCHES, CORD.—See Switches, pendent and cord, also Switches, push-through.

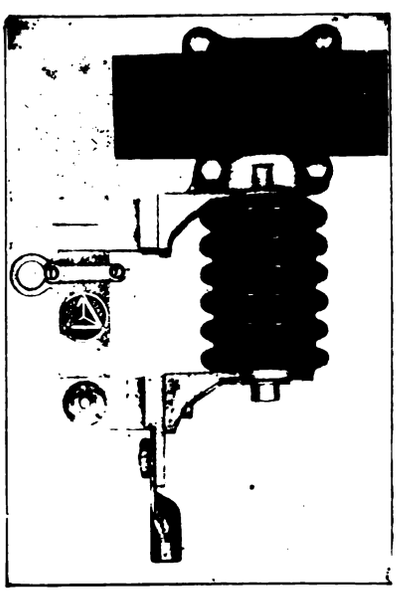
SWITCHES, DISCONNECTING, HIGH-TENSION.—The primary function of a disconnecting switch is to disconnect or isolate apparatus from the circuit for inspection and repair, and also to sectionalize feeders, busbars or other circuits. They are not designed for switching under load, and are usually operated manually by means of an insulated switch stick which has a hook that fits into a hole or eye in the extension of the switch blade, and permits opening the switch without danger to the operator. Disconnecting switches are of the knife blade type and are made in several forms and sizes, depending on the current rating, circuit voltage, method of mounting and location, whether indoor or outdoor. They are made for all circuit voltages and have current capacities as high as 4000 amperes.

Disconnecting switches are generally mounted either upright or horizontal on panels, walls, ceilings or pipe framework. If horizontal and arranged to open downward, locks or latches are provided to keep the blade from jarring loose. On account of the strong magnetic action tending to open the blade on short-circuit or heavy overload, this is also done on many vertical switches. The switch stick releases the latch when it is inserted. Single-throw switches are the most common and for very high voltages they are usually mounted on post type porcelain insulators, the length of which depends on the voltage. For lower voltage service a great many switches are mounted on slate or marble bases. Double-throw switches are sometimes used. For very heavy currents three or more switch blades are mounted in parallel.

Disconnecting switches are also used on distributing circuits; see Disconnectives, emergency, for distributing circuits.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Associated Engineers Co., 180 N. Dearborn St., Chicago, Ill.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
DELTA-STAR ELECTRIC CO., 2433-2459 Fulton St., Chicago, Ill. The "Unit Type" WC-14 bus switch, made by this company, and shown below, is an application of their standard insulating unit to a special purpose switch.



Delta-Star Unit Type High Tension Bus Switch

Cut shows blade in line with bus, but it may be at any angle. Switch clamps directly on busbar, which may be either round or flat, and of any capacity. Acts as disconnect between oil switch and bus, securing high space factor. Adjustable contact and holding clamps enable switch to be so located that a short run is secured to oil switch terminal.—Adv.

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Disconnecting switches for indoor and outdoor service. All types, voltages and capacities. See display advertisement on page 1261.—Adv.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa. "Garton-Daniels."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadel-

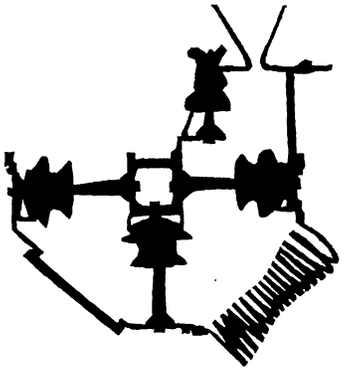
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phia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. "G-E." (See display adv. pages 1203-1223.)
Hi-Voltage Equipment Co., 3305 Groton Ave., Cleveland, Ohio.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PACIFIC ELECTRIC & MFG. CO., 827 Folsom St., San Francisco, Cal. "Baum."
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."
ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill. "Royal" switches and other apparatus are mounted on a special type of insulator, made of the best grade wet-process porcelain. A perfected mechanical clamp holds the cap and thimble to the insulator head and base, insuring rigidity. This clamp eliminates the use of all cement, projecting screws, pins, etc., presents an entirely smooth surface and removes all possibility of static discharge. It also makes insulators interchangeable and ready for instant assembly and use.



Royal High-Tension Disconnecting Switch with Interchangeable Insulators

Royal indoor disconnecting switches are furnished in numerous types, with connections arranged as desired, and with flat steel bases, 1¼-in. pipe mountings or flat surface mountings. Capacities range from 300 to 3,000 amps. at 6600 to 22,000 volts, with special models for higher ampere capacities and voltages. Choke coils are of the hour-glass type (see entry under Coils, choke, for description). Cylindrical coils, in place of hour-glass, are supplied when required. Standard fuse mountings are for S & C fuses; any other mounting, however, is available. A special adaption includes the bus-bar switch, furnished in four types—flat bus, either clamp or bolted; tubular bus, and rod bus. "Royal" outdoor equipment embodies all improvements noted above, with all parts, except copper, hot galvanized. Capacities range from 300 amps., upward, at 6600 to 70,000 volts in standard models. Second illustration an adaption of "Royal" crossarm equipment, which is noted for its ruggedness, dependability and simplicity of installation. The support castings facilitate detachment or addition of fuse mounting with switch blade. These models are furnished with any desired combination of equipment. Send for our catalog. It contains en-



Royal Outdoor Switching Equipment

gineering data, illustrations and other interesting information of "Royal" products.—Adv.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
Southern Electrical Equipment Co., Charlotte, N. C.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, DOOR, ELEVATOR.—Switches designed to be mounted so that elevator doors will cause a projecting movable member to open or close the contact mechanisms in the switch in such a manner that the elevator car cannot be started unless the door is closed. They are usually controlled by a small cam on the door or on the closing mechanism and are interlocked with the elevator controller.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Elevator Door Safety Switches are used to prevent starting the elevator car before all doors are closed. Type "A" is operated by a push button which engages the end of the sliding door; it is used generally where space limitations compel the use of a small switch. Type "B" is operated by a lever and roller which engages with a cam on the sliding door: it is used wherever space limitations will permit. Both types interpose a break in the control circuit of the magnetic main contactor when the door is open. See display adv. pages 1225-1230. —Adv.
Elevator Signal Co., 116 West St., New York, N. Y.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Knickerbocker Annunciator Co., 116 West St., New York, N. Y.
PITT ENGINEERING CO., 120 W. Kinzie St., Chicago, Ill.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Tecla Co., Inc., Detroit, Mich.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, DOOR, FLUSH.—Snap switches having narrow face plates intended for flush mounting in the side of a door frame on which the door is hung. They have a single projecting spring-controlled pin which is moved by the closing or opening of the door, thus operating the switch mechanism. The switches are generally used to control a light in a closet or telephone booth and are made so that the light will be on when the door is open (when used in a closet) or when it is closed (when used in a booth). They are generally single-pole switches and are rated at 6 amperes for 125 volts and 3 amperes for 250 volts.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Door Switches are made for installation in the hinge side of the door jamb. They have a capacity of 6 amp. Switches No. 7240 and 7245 are so designed that the light is switched on when the door is opened and is extinguished when the door is closed. This type of switch is suitable for installation in closets, pantries, entrance halls, and vaults. Switches No. 7241 and 7246 are designed to switch the light on when the door is closed and to extinguish it when the door is open. These switches are used in connection with telephone booths, toilets, etc. See display adv. pages 1225-1230.—Adv.



C-H 7240 Door Switch

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que.,
EDWARDS & CO., INC., 140th & Exterior Sts., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. "G-E." (See display adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Morse, Frank W., 289 Congress St., Boston, Mass.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, ELECTROLIER OR MULTICIRCUIT, SNAP.—Snap switches for surface or flush mounting provided with mechanism and contacts to control two or more circuits in various combinations. The switches are used chiefly with ceiling lighting fixtures, etc., where it is desired to control the illumination intensity by turning on one, two, three or more lamps by means of a single switch. When furnished for surface mounting they are made with porcelain bases, and metal covers with rubber or composition keys or buttons, or with porcelain covers and keys. The flush type switches are made to fit in a standard switch box. Some multicircuit switches are made in pendent form. In controlling two or three circuits, the switches which have four snaps or positions either close circuits one, two and three in turn, or circuits one, one and two, and one, two and three; the fourth snap nearly always disconnects or opens all circuits.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Little Twenty."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H.," "Hart."
Pneuvac Co., 164 Fremont St., Worcester, Mass.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

SWITCHES, ENCLOSED, MISCELLANEOUS.—Enclosed switches are made in several styles, and are adapted for the control of almost any power, heating or lighting circuits in which a heavy current is flowing. They are usually made to be used on conduit systems and are enclosed in either cast iron or sheet steel boxes. Enclosed switches are also made

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for open wiring systems having a number of porcelain insulating bushings to fit around the entering wires. The switches are made in several forms for the various purposes for which they may be used. Among these are their use as service switches, marine switches, railroad yard and roundhouse switches, light and power feeder switches, etc.

Some types of enclosed switches provide merely a box which may be locked, enclosing a knife switch or rotary snap switch, requiring the box to be opened to operate the switch. Others enclose a rotary switch and fuses, but have the handles projecting through the cover so the switch may be turned on or off. Other types are also used, but they differ from the so-called "safety" switches which have the operating handle extending through the side or cover of the box, which cannot be opened until the switch is first thrown to "off" position.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
AURORA STEEL PRODUCTS CO., Aurora, Ill.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Cherry Tree Machine Co., Cherry Tree, Pa.
COLUMBIA METAL BOX CO., 224-228 E. 144th St., New York, N. Y.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Lewis Electric Co., Inc., The, Canton, O.
METROPOLITAN ELECTRIC MFG CO., East Ave. & 14th St., Long Island City, N. Y.
Motor Protector Mfg. Co., 47 Kearny St., San Francisco, Cal. "Synthermal."
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PETTERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. (See display adv. pages 1282-1283.)
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, END-CELL, AUTOMATIC.—Automatic end-cell switches are used with large storage-battery installations to maintain a practically constant load or bus potential while the battery is discharging. They are of two general types, either the radial type, similar to the manually operated switch, or the sliding type. Motor operation is generally provided and the control is obtained by means of a contact-making voltmeter, which closes the motor circuit when the voltage drops and thus permits another cell to be added. When the battery is on charge the operation is reversed, cutting out the end cells in the inverse order of the way they were cut in. This gives the cell placed in the circuit last a small charge and as the terminal voltage rises, it is cut out, etc.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que
Electric Storage Battery Co., The, 19th St. & Allegheny Ave., Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."

SWITCHES, END-CELL, MANUALLY OPERATED.—These switches are used in connection with storage-battery installations to provide a means of connecting to a series of end-cell terminals each one of which may connect an additional cell in the circuit to increase the battery voltage as the terminal voltage per cell decreases. By using a manually operated switch an operator is required to move the switch to the next contact point when the voltage drops. These switches are usually made in the radial sliding type, having a contact arm which may carry a single contact or a double one, connected with a protective resistance, between the two, to prevent short-circuiting a cell in moving from one contact to another. The stationary contacts are broad and of heavy construction because the current capacity is generally large.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

SWITCHES, FAN MOTOR OR MULTI-SPEED, SNAP.—Snap switches designed particularly for the control of small motors, such as ceiling fans or bracket fans out of reach. They have multiple contacts which control combinations of motor windings or sections of speed control resistors. They are intended for mounting on fan motor frames or supports or for surface mounting on a wall or post. Sometimes they are made in pendent form. They may be arranged to give the same circuit combinations as electrolier or multicircuit switches and often are special forms thereof.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Devoe Electric Switch Co., 414 Notre Dame St., W., Montreal, Que., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

SWITCHES, FIELD DISCHARGE.—Switches so designed and operated that the energy in the magnetic field of a generator may be discharged without a dangerous rise in voltage when the field circuit is opened by the switch. A common type consists of a modified form of a double-pole, double-throw switch so arranged that a resistance is connected across the terminals of the field winding as the current to this winding is cut off. This is usually obtained by the addition of a short auxiliary blade attached to one of the blades of the switch. An auxiliary contact clip makes contact with this blade and connects the resistance in the circuit before the main contacts have opened.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, FIXTURE.—Snap switches designed for special use in fixture work and provided in various forms, such as key arm, canopy, and candelabra types with or without pigtails attached. Some of them may be made to give several circuit connections in a manner similar to the electrolier and multicircuit snap switches.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 626 N. 3rd St., Newark, N. J. "Noscru."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian Duplexalite Co., Ltd., 745 St. Catherine St., W., Montreal, Que., Can. "Pullite."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Candelabra Switches are very substantial in spite of their small size. The current carrying capacity is ½ amp., 125 volts. The design is readily adapted to almost any style of candle cup. The circuit is made and broken with a very quick snap. C-H Canopy Switches are of the push-and-pull type. Their small dimensions and comparatively high current-carrying capacity make them suitable for almost any installation.



C-H 7150.

The control of bracket lights by means of a C-H Canopy Switch saves reaching to the sockets and allows complete enclosure of the lamp socket by the husk when this is desirable. See display adv. pages 1225-1230. —Adv.

Duplex Lighting Works of General Electric Co., 6 W. 48th St., New York, N. Y. "Pullite."
LUMINOUS UNIT CO., DIVISION OF THE ST. LOUIS BRASS MFG. CO., 2615 Washington Ave., St. Louis, Mo. (See display adv. pages 1276-1277.)
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

SWITCHES, FOUR-WAY, SNAP.—Snap switches intended for flush or surface mounting having special contact mechanisms and designed to be connected at intermediate points in a circuit where it is desired to control a lamp or group of lamps from any one of three or more positions. Where the circuit is controlled from three points, two three-way switches and one four-way switch are required. Each additional four-way switch used is inserted between the three-way switches and provides another position for controlling the circuit. Switches for this purpose are used chiefly in a long hall or on a stairway of several flights. A four-way switch may also be used separately as a pole-changing switch.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

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GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

SWITCHES, FUSE.—Special switches having fuse clips mounted to hold standard cartridge enclosed fuses or other tubular fuses, through which the circuit is completed when the switch is closed, the fuse serving as a switch blade. They are usually made in the form of single-pole switches. They are made for both indoor and outdoor service and for the latter are usually enclosed in a cast iron or wooden box. They are made for voltages up to 13,200 volts and maximum current ratings of 100 amperes. They are used chiefly on the primaries of distribution circuits and serve the combined purpose of a compact fuse block and disconnecting switch, the circuit being killed automatically by the fuse action in case of short-circuits or trouble. In some types a ferrule contact cartridge fuse is secured by set screws in the hinge part of the switch, its other end engaging the upper switch and fuse clips. Expulsion fuses are used in other types in a similar manner. Knife-blade cartridge fuses are used in some cases as disconnectives, but unless provided with a hinge are not properly classed as switches.

These fuse switches should not be confused with ordinary fused knife switches which have a fuse separately mounted either above or below each blade.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHICAGO FUSE MFG. CO., Laflin & 15th Sts., Chicago, Ill. "Union."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
Liberty Electric Corp., Port Chester, N. Y.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Fu-switch."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, GAS-ENGINE OR ANGLE KNIFE BLADES.—Single or double-pole knife switches for use in gas-engine ignition circuits. They are designed with double sets of knife blades at angles to each other and are used for quickly changing from one set of ignition batteries to another or more commonly, from battery to magneto without the necessity of moving the handle through a half circle. Such switches are used chiefly with stationary engines.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Quick Action Ignition Co., South Bend, Ind. "Quick Action."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, HEATER OR SERIES-MULTIPLE.—Snap switches usually of the rotary type and designed for surface mounting having special contact members to connect two or more elements of electric heaters in series, singly or series-parallel, or parallel combinations to obtain varying degrees of heat, usually low, medium and high. They have a high current rating and are often insulated with mica. The most common form is a four-snap switch to be used with a heater having two equal element sections. These sections are connected in series, one section only, two in parallel, and both off, or the reverse, with successive snaps of the switch. They are always indicating to show whether low, medium or high heat is being obtained.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Consolidated Car Heating Co., Albany, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hart & Hegeman Mfg. Co., 340 Capitol Ave., Hartford, Conn. "H & H," "Hart."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.

SWITCHES, KNIFE, QUICK-BREAK.—Knife switches with smaller auxiliary blades under spring tension which are designed to be drawn from the contact clips after the main blades to break the circuit with a quick movement and reduce the destructive effects of arcing. They are used on inductive circuits and those of the higher voltages for which knife switches are permissible. Quick-break switches are made in nearly all standard ratings the same as standard knife switches, except in the largest capacities which are used only as disconnects, and also as single, double, three and four-pole switches with or without fuses. They are generally mounted on slate bases and are arranged for both front and rear connections. Both the single-throw and double-throw switches are made with or without fuse clips and, if fused, may be fused at one or both ends.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bryant Electric Co., The., 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electric Panelboard Co., Rochester, N. Y.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Western Electric Works, 213 6th St., Portland, Ore.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, KNIFE, SPECIAL.—Knife switches of nonstandard forms are sometimes designed for special purposes. One form provides one or more auxiliary clips to be engaged by the blade betwen the main contact clips, a longer blade being necessary; a special form of this type has four or five sets of clips superposed, the lengths of the clips increasing toward the hinge end of the blade so that the longest is engaged first and the others in succession, thus cutting out resistance step by step. Double-throw multipole switches are occasionally arranged to have all or part of the poles short-circuited in one position and independent in the other, a heavy cross bar being arranged between the short-circuited clips. Knife switches are also made up to give other special combinations of circuits. This classification includes all such special forms and types of knife switches as are not listed under other headings herewith.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumac St., Toronto, Ont., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Electrical Mfg. Co., The, 4149 E. 79th St., Cleveland, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Liberty Electric Corp., Port Chester, N. Y.

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Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MILLER & PARDEE, INC., 625 W. Jackson Blvd., Chicago, Ill.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. A variety of 25 ampere switches for use on telephone lines, gas engines, etc.



T. V. 25 Ampere Switch

Switches are for either front or back connections. Weatherproof switches with detachable handles for use on motor boats. All parts brass or copper; no iron.—Adv.
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Western Electric Works, 213 6th St., Portland, Ore.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, KNIFE, STANDARD.—Circuit-controlling switches consisting of copper blades hinged at one end and designed to enter spring contact clips when manually operated by attached insulated handles. Knife switches are furnished in single and multiple-pole types and arranged for single or double throw; and they may be provided for front or rear connections, with or without fuse connections above or below the switch and with either straight stem or spade handles. They are generally made for four standard voltage ratings: 125 volts d-c. or a-c., 250 volts d-c. or a-c., 500 volts a-c., and 600 volts d-c. or a-c. The standard current ratings range from 30 to 6000 amperes for d-c. circuits, the a-c. ratings generally being a little less. For the heavier currents the hinge is not depended on to carry the current, a separate set of contact clips being placed above it.

Knife switches are very widely used in all circuits of large current capacity and moderate voltages. They are commonly mounted on switchboards for low-tension circuits, on motor-control, battery-charging and other isolated panels, on distributing boards and for a large number of other miscellaneous uses. When knife switches are placed in a metal box or casing which must be opened to operate the switch they are called enclosed switches; see Switches, enclosed. When the enclosure is arranged so that the switches may be safely operated from the outside of the box they are called safety switches; see Switches, safety. For small or "baby" switches of the open type see Switches, baby knife.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barber Electric Mfg. Co., North Attleboro, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Clay Electric Co., 3303 N. 12th St., Philadelphia, Pa.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
Consolidated Electric Mfg. Co., Inc., 223-25 N. 13th St., Philadelphia, Pa. "Diamond C."
CROUSE-HINDS CO., Syracuse, N. Y. All current carrying parts of Crouse-Hinds switches are of hard drawn copper, 98% conductivity, with a current density rating of 1000 amp. per sq. in. of sectional area. Sliding contacts are rated at 75 amp. per sq. in. Blades are ground in contact. Parts cannot work loose. Copy of catalog sent upon request.—Adv.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electric Panelboard Co., Rochester, N. Y.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
Freeman Electric Co., E. H., 803 E. State St., Trenton, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Heineman Electric Co., 5th St. & Girard Ave., Philadelphia, Pa.
King-Craymer Electric Mfg. Co., 32 Haviland St., South Norwalk, Conn. "K-C."
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave., & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., West, Detroit, Mich. The



Type "A" Switch

"Bull Dog" line of knife switches, reputed for superior features of construction, embodying good materials, modern manufacturing methods and expert workmanship. Current carrying parts are amply proportioned, assuring capacity in excess of rating. Furnished in all standard voltages and capacities: one, two, three and four poles; front and back connected. Type "C"



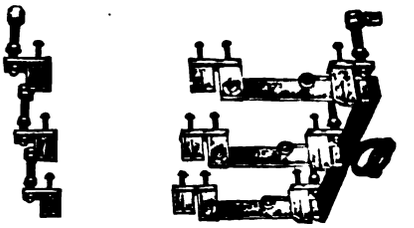
Type "C" Switch

Switches have these distinctive features: hinge jaw clips are interchangeable, permitting arrangement for fuses on either hinge or handle end. All types have Vandam bronze strong spring fuse clips with reinforced contacts: "cold flowed" terminal lugs: contact reinforcing spring and washer, insuring uniform contact pressure: hinge screws that cannot loosen: black oil finished (not painted) electrical slate base and extra heavy fibre cross bars. Write for descriptive catalog. Also see display adv. page 1285.—Adv.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. Circle T, Type A switches will carry 100% overload without burning. The National Code issues certain specifications as to break and separation and carrying capacity of copper on slided and bolted contacts. Nothing, however, is mentioned as to alignment, careful adjustment and machine work on which the efficiency of the switch depends. It is care in all such details that has made the Trumbull switch the leading line in the field. Circle T type A switches are furnished in 30-5000 amperes, 125-600 volts a-c. and d-c., front and back connection, single or double throw, fuse or no fuse, single, double, three and



Circle T, Type A Switch

four pole, straight or spade handles, plain polished, with or without quick break in most sizes. Circle T, type C "bent up" type have jaw posts and hinge posts of one-piece copper, bent to proper shape. The 100-200 ampere sizes have bent up fingers riveted to foot block of heavier material. Type C switches are made 30-200 ampere sizes, 250-600 volts, a-c. and d-c., front connection, plain finish. Circle T, Kappa switch, 30 amperes, 250 volt, front connection, plain finish, is designed for light service. See, also, display advertisement, pages 1282-3.—Adv.
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Manufactures a complete line of standard knife switches and special switch attachments. Trumbull - Vanderpoel switches are well made of high-grade



T. V. Knife Switch

material, and will stand up under very severe service. Our catalog describes type "A" and type "C" switches in detail. Battery switches designed to carry 25 amperes are manufactured for use on gas engines, telephones, etc.—Adv.
V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Western Electric Works, 213 6th St., Portland, Ore.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, LEVER.—A combination of a special operating lever or handle and a knife switch. The lever is usually mounted on the front of the panel and the knife switch and its contact clips on the back of the board. The lever and switch blades are connected by suitable operating links or other mechanism. This insures safety to the operator as there are absolutely no live parts on the front of the

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panel. If the switch is of the fused type, cartridge fuses are mounted in fuse clips arranged in a separate compartment between the front and rear of the board and accessible by means of a door in the front that can be opened only when the switch is in open position. This type of switch serves the same purpose as what are called safety switches, but does so in another manner. They are used chiefly in "dead-front" or "safety first" switchboards in industrial plants. Also see Switchboards, dead-front; and Panels, safety.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E lever switches meet all the requirements of the National Board of Fire Underwriters. Constructed to withstand severe usage with ratings based on maximum current which they will carry continuously. Made either single or double throw, 1 and 4 poles, spade handle on larger sizes.

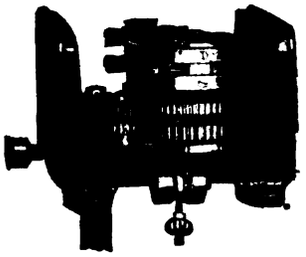


Also safety enclosed, externally operated lever switches, as shown, which give positive safety protection. These may be mounted in groups to control several circuits from a central point, or the back-of-board types may be mounted on a panel to form a thoroughly safe, dead-front switchboard. —See adv. pages 1203-1223.—Adv.

SWITCHES, LIMIT, ELEVATOR, CRANE AND HOIST.—Elevator limit switches are intended for mounting in elevator shafts in such positions that the elevator car in approaching the limit of travel in either direction will cause the power circuit to be opened, brakes to be set and thus prevent overtravel of the elevator. Limit switches are also furnished for similar purposes for use with electric cranes, hoists, etc. A small roller is placed on the switch lever and, in the case of an elevator, a cam is placed on the top and the bottom of the car which engages the roller and at the limiting point operates the switch. In the case of traveling cranes of any kind, monorail and traveling hoists, skip and nine hoists, etc., the limit switches are actuated either by the extreme safe positions of the trolley or skip or by a device on the hoisting rope near the hook. Limit switches are important safety devices to prevent serious damage to the apparatus or load in case the operator is inattentive to duty when approaching the end of the travel.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tactor." (See display adv. page 1286.)
Browning & Co., Victor R., 17701 Lake Shore Blvd., Cleveland, Ohio.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. For elevator service, C-H Bulletin 10310 (Type A) a rotating cam limit switch, is used with winding-drum type elevators operated by full magnetic controllers. C-H Bulletin 10310 (Type B) is used with either traction or drum type elevators, operated through full magnetic contactors. C-H Bulletin 10312, a traveling-cam elevator limit switch, is used with full magnetic elevator controllers on winding-drum type elevators and combines the functions of the ordinary traveling-nut device and a machine limit switch. C-H Bulletin 10316 is a hoistway limit switch for use on either winding-drum or track-type elevators. It provides automatic stopping at terminal landings and emergency overtravel protection. For crane and hoist work the Cutler-Hammer Mfg. Co. manufactures both the geared type and the direct-operated type of limit switch. C-H Bulletin 10110 is a safety limit stop of the direct-operated type. C-H Bulletin 10115 is an interrupted-gear-type geared limit switch. The reduction is secured through spur gears and an interrupted-gear mechanism. The excessive wear incident to worm-gear reduction is thus eliminated. See display adv. pages 1225-1230.—Adv.



Bulletin 10115 Limit Switch (Cover Removed)

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, LOCKING, FLUSH.—Flush snap switches having mechanisms designed to be operated by the insertion of special keys through slots of special shape in the face plates. As the key is inserted to the proper depth the switch mechanism operates in a similar manner to a push-button switch. Their use is confined principally to schools, halls, public buildings and institutions where it is desirable to have only authorized persons operate the switch. These switches are made in the same forms and have the same ratings as standard push-button switches.

Manufacturers:

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.

SWITCHES, LUMINOUS BUTTON OR KEY.—Snap switches with the operating buttons or keys coated with a luminous paint, enamel or similar compound enabling them to be readily located in the dark without groping around.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pioneer Corp., The, 1255 W. 63rd St., Chicago, Ill. "Eradium Luminous."
Smith & Co., T. C., 1531 Cherry St., Philadelphia, Pa. "Seelite."

SWITCHES, MAGNETIC OR CLAPPER TYPE.—See Contactors, magnetic.

SWITCHES, MARINE AND WATER-PROOF.—Snap switches mounted in watertight enclosures or compartments with gasketed joints and stuffing boxes for the operating spindles, shafts or handles. They are intended for use on shipboard and in moist locations, such as tanneries, laundries, refrigerating rooms, etc.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
BENJAMIN ELECTRIC MFG. CO., Chicago, New York, San Francisco, Toronto. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Conneaut Metal Works Co., The, Conneaut, Ohio. "Conneaut."
Cooley Electric Co., George R., 912 Western Ave., Seattle, Wash.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Liberty Electric Corp., Port Chester, N. Y.
Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."
Meyberg Co., The, 633 S. Grand Ave., Los Angeles, Cal.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

SWITCHES, MASTER, FOR REMOTE CONTROL.—A switching device which governs the operation of other switches, or the contactors or auxiliary devices of an electric controller, is called a master switch. It may be automatically operated, as a float switch or pressure regulator, or manually operated, as a drum, push-button, or knife switch. As the usual purpose of the remote-control system is to avoid the use of heavy wires running to a distant controlling switch, the controlled devices are designed to require little power and the master switch is consequently a small-capacity device.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Liberty Electric Corp., Port Chester, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, MOMENTARY CONTACT, FOR REMOTE CONTROL.—The switches in the main circuit of a remote-controlled system, when operated by solenoids or motors, require that these devices be energized only long enough to operate the switch. Consequently, the switches in the controlling circuit are frequently constructed to sustain the contact only so long as they are depressed, and, therefore, are designated as momentary-contact switches; they are a special type of master switch. The most common form is a push-button switch which remains closed when the button is held down, but springs open when the pressure is removed. The switch has two buttons; one to open, and one to close the remote-controlled switch. To indicate whether the circuit has been correspondingly opened or closed, a pilot lamp or other indicating device is often provided.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

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Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Liberty Electric Corp., Port Chester, N. Y.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Monitor Control'er Co., 500-16 E. Lombard St., Baltimore, Md.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.

SWITCHES, MOTOR-ACCELERATING.—A group of interlocked knife switches arranged to manually cut out (or short-circuit) motor-starting resistance step by step. The switches must be closed in proper sequence and each one, as it is closed, holds the preceding one but is itself released by a spring unless held in place; the final switch is held by a no-voltage release device so that failure of line voltage opens all the switches and again restores the resistance to the circuit. This outfit is used mostly with large d-c. motors where it is not desired to use magnetic contactor or clapper switches. It is often called a multiple-lever starter.

Another type of this switch consists of a long-bladed knife switch with three or more pairs of clips above each other and of decreasing length receding from the hinge end. In closing the blade the longest clips are engaged first, then successively shorter ones, the resistance being cut out step by step.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." See display adv. page 1286.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Barkelew Electric Mfg. Co., Middletown, Conn.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, MOTOR-REVERSING.—A motor-reversing switch is, in general, some form of double-pole, double-throw switch. On controllers where reversal is infrequent, a double-pole, double-throw knife switch is used. For freight elevator service, some machine tools, cranes, etc., drum type reversing switches are used. Magnetic reversing switches are usually made up of two double-pole contactors, mechanically interlocked so that both cannot be closed at the same time; for this type see Contactors, magnetic.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "UEMCO."
WADSWORTH ELECTRIC MFG. CO., INC., Covington, Ky. "Compro." (See display adv. page 1284.)
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, MOTOR-STARTING, COMPENSATOR TYPE.—This type of motor-starting switch is used with a starting compensator (autostarter or autotransformer) for starting medium or large a-c. motors. Frequently a combination of two autotransformers is used with the starting switch. The switch generally has three positions: off, start and run. The handle will remain in the off or running position, but must be held in the starting position against the force of a spring. In the larger size switches the contacts are usually broken under oil or in an asbestos-lined compartment with asbestos or other insulating barriers between poles. These switches may be furnished independently, although when mounted on the autostarter they are usually supplied with it.

In the starting position the switch throws the autotransformer onto the line and the motor onto its secondary terminals. The switch is then thrown to the running position, which places the motor directly on the line, cutting out the autotransformer. An overload or no-voltage release device, or both, may also be included. A suitable case generally incloses the autotransformer, switch and protective equipment. The switch may be designed so that it cannot be thrown to the running position until it has first been thrown to and held in the starting position.

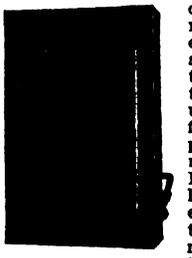
Manufacturers:

Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. Type CR1034 hand-operated compensator equipped with under-voltage release and overload relays. (Bulletin 68304.) Type CR7052 automatic starting compensator for automatic acceleration and overload and under-voltage protection. (Bulletin 68434.) See adv. pages 1203-1223.—Adv.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, MOTOR-STARTING (FUSE SHORT-CIRCUITING).—When an a-c. squirrel-cage induction motor is connected directly to the line, the inrush current is from 5 to 8 times normal. A fuse which would protect the motor against overload in normal running would be blown by this high inrush, and for this reason the fuses are usually short-circuited during starting. A double-throw knife switch is the simplest device used for this purpose. It connects the motor directly to the line for starting and, after full speed is attained, is thrown to the other side and connects the running fuses in circuit. Another device is arranged so that, when the starting lever is thrown forward, the motor is connected directly to the line and, when the lever is released, the fingers slide down to another set of contacts which connect the fuses in circuit.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
AJAX ELECTRIC CO., Baldwin Ave., & Montgomery St., Jersey City, N. J.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Bulletin 9116, a polyphase motor starter, is used for squirrel-cage induction motors which can be connected directly to the line. The design of the starter is such that the fuses are cut out of circuit while the motor is being accelerated. This type of starter provides protection to the operator and permits the use of fuses that furnish adequate protection to the motor while running. Bulletin 9118 is similar to Bulletin 9116 except for the addition of one step of resistor in each of the three phases for starting. The addition of this primary resistor permits the use of these starters for larger motors and cuts down the heavy starting current which is drawn from the line. See display adv. pages 1225-1230. —Adv.


Bulletin 9116

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Electrical Mfg. Co., 4149 E. 79th St., Cleveland, Ohio.
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.

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Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., Bantam, Conn. Similar to Mason line type with additional short circuiting cut-outs. Made two, three and four pole, 30 and 60 amp., 250 and 500 volts. Underwriters' classification "AA." Impossible to throw to running position without first passing through starting position. Also manufacture D. T. knife switch, fused on end for this purpose.—Adv.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "UEMCO."
WADSWORTH ELECTRIC MFG. CO., INC., Covington, Ky. "Compro." (See display adv. page 1284.)
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, MOTOR-STARTING (STAR-DELTA).—Star-delta starting switches are usually of the drum type, arranged to connect the motor windings in star when thrown to the starting position, and delta for running. A double-throw knife switch, which may be of the safety enclosed type, is sometimes used for this purpose. Also see Starters, motor, star-delta type.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
CUTLER-HAMMER MFG. CO., THE Milwaukee, Wis. C-H Bulletin 9401 is a star-delta switch of the drum type It is designed for use with three-phase squirrel-cage motors which have their winding so arranged that they may be connected in star for starting and delta for running. Bulletin 9401 is of the oil-immersed drum type and has three sets of fingers engaging with contacts upon the drum to effect the proper combination of connections. See display adv. pages 1225-1230.—Adv.
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Dominion Electric Switch Box Co., 60 Sumach St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis. "UEMCO."
WADSWORTH ELECTRIC MFG. CO., INC., Covington, Ky. "Compro." (See display adv. page 1284.)
Western Electric Works, 213 6th St., Portland, Ore.
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, OIL.—The fundamental feature of an oil switch is the interrupting or closing of the circuit under oil and there is no means known at present superior to the oil switch for controlling a-c. high-voltage circuits. Most of the best oil switches embody the following features: Open position maintained by gravity; rapid acceleration of the moving parts when opening; live parts immersed under deep head of oil; strong tanks properly vented and securely attached to the frame; high-pressure self-cleaning main contacts with suitable arcing contacts. For moderate capacities, all poles of the switch are placed in the same tank with insulating barriers between them; for the next larger size, independent tanks are used attached to a common frame; for still larger switches each pole is in a separate tank on a separate frame and is frequently arranged for mounting with each pole in a separate cell of masonry; while for higher voltages than about 25,000 the tanks are spaced a considerable distance apart without barriers and arranged for either indoor or outdoor service.

For moderate rupturing capacities oil switches are mounted on the switchboard panels, but for the larger sizes they are made for distant control and are operated manually or electrically. Where remote manual control is adopted it usually comprises bell cranks and rods and satisfactory operation is usually limited to a distance of about 50 ft.

Solenoid control is used for all of the oil switches of the leading manufacturers, with the exception of one line of switches which are compartment-type moderate-voltage switches for large rupturing capacity, for which motor operation has been adopted. The standard solenoid mechanism of any make employs a d-c. magnet for closing the switch, and a latch, trigger, or toggle holds the switch closed. A second solenoid upsets the toggle or releases the trigger or latch to trip the switch. The location of this mechanism varies with different designs; for outdoor service it is usually located in a weatherproof box. The motor mechanism of the line of oil switches referred to above is equipped with either a d-c. or a-c. motor mounted above the switch and provided with a torsion spring mechanism that make equally rapid motion for closing or for tripping. Compression springs throw the switch about 1 inch into contact on closing, and about 1½ ins. from full stroke when opening, both with a rapid movement, and the stroke is completed by the motor which then compresses the operating springs at the end of each stroke, preparing the switch for the next operation.

For high-voltage service steel tanks are used for the switches, each pole in a separate tank. Up to 50,000 volts the switches usually have their tanks on a pipe frame to facilitate dropping the tanks for inspecting the contacts. For 73,000 volts, or thereabouts a structural frame is used and for higher voltages the tanks are usually mounted on a platform or on the ground. These switches can readily be arranged for outdoor service.

Several manufacturers now designate all of their oil switches of the automatic type as oil circuit breakers, because they may be and commonly are used as much for circuit protection as for normal operating and closing of circuits. Also see Circuit breakers, oil.

SWITCHES, OIL, HIGH-TENSION, MOTOR-OPERATED. — High-tension oil switches of the motor-operated type are used in very large sizes on circuits of large capacity and are also applicable to other high-voltage circuits of smaller capacity. They may be arranged both for indoor and outdoor use and are generally floor-mounted, with each pole in a separate oil tank and separate switch cell if indoors. A small motor is mounted above the switch tank and is employed to wind up a spring. If the switch is open and it is desired to close it, the control switch on the board is closed and this operates a small solenoid, the plunger of which releases the stop on the operating spring, which quickly closes the circuit. The motor then operates to rewind the spring so that it will be ready for opening the switch. Most of these switches are three-pole with the poles interconnected so as to operate as a unit; a single motor may be used for the complete switch.

These switches are made for all voltages up to about 155 kv. Automatic tripping features are generally supplied by means of current transformers operating relays which in turn control the release mechanisms. The insulation of such switches is very important and the condenser type of terminal bushings is often used. Large expansion chambers are required to take care of the gases formed by rupturing under heavy load. Several forms of contacts are used; most of them are arranged for the final breaking of the circuit by auxiliary contacts which are replaceable if they should be burned.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St., & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. Type FH motor operated breakers of very high interrupting capacity. Very generally used in central stations, as they have proved unusually reliable. They have two breaks in series in each phase and easily removable oil vessels, and are characterized by high speed of operation, making a complete cycle—open and close—in two seconds. Designed for use up to 70,000 volts and 4,000 amp. Made also in removable truck form so that the entire breaker on any pole can be removed. (Bulletin 67495-6.) See adv. pages 1203-1223.—Adv.

SWITCHES, OIL, HIGH-TENSION, SOLENOID-OPERATED. — Solenoid-operated oil switches are made in about the same sizes and serve the same purposes as the motor-operated switches described above. They are also made for indoor and outdoor use and may be mounted on pipe framework up to about 75 kv. The solenoid principle makes use of a powerful d-c. magnet to close the switch. The open position is generally maintained by gravity, and on opening the switch a small solenoid releases a restraining latch and permits the contacts to separate. As this action should be very rapid, accelerating springs are provided which also prevent sticking or failure to operate when the mechanism is released.

The same principles are followed in both solenoid and motor-operated switches, as regards the isolation of poles, insulation of terminals, etc., and the selection of the proper switch oil, which is an important feature with all high-tension switches.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. Type FK36 large-capacity, high-voltage breakers, with ratings up to 220,000 volts, 3-pole, single throw. Bushings are interchangeable with those used in some G-E transformers and lightning arresters. Other parts are standardized so that different combinations make the breakers suitable for different conditions. Adapted for outdoor use. (Bulletin 47408.) See adv. pages 1203-1223.—Adv.
Kelman Electric & Mfg. Co., 1650 Naud St., Los Angeles, Cal.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, OIL, LOW AND MEDIUM-VOLTAGE, AUTOMATIC.—Oil switches with automatic tripping attachments are used on many low and medium-voltage circuits for controlling distributing lines, etc., and for many industrial purposes, especially for inductive loads, such as starting slip-ring or squirrel-cage induction motors. They are generally made for mounting on a wall or panel or on the rear of the switchboard. Some of the larger sizes are mounted on metal frames and are controlled from the switchboard either by a system of levers or electrically. Butt type contacts are used on nearly all switches of this type, and the final arc is broken on auxiliary contacts. In the smaller sizes all poles of the switch are in the same tank and the larger sizes have barriers which separate the main tank into a tank for each pole.

The automatic release features are provided for by attachments that may be mounted at the switchboard or mounted directly on the top of the switch in the larger capacities. Several forms of protection may be provided, such as overload, overvoltage, undervoltage and with inverse-time-element attachments. These forms may also be tripped from the switchboard, either mechanically or by means of a small solenoid on the switch. All of the automatic features are adjustable to

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change the values at which they will operate.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E oil circuit breakers for all medium voltages are either hand or solenoid operated. Very few hand operated breakers are non-automatic only, but all others can be obtained for both automatic and non-automatic service. Solenoid operated breakers can be equipped with standard coils for tripping at 125, 250 or 600 volts, direct current. Coils for tripping at other voltages can be furnished on request. These breakers can be equipped with circuit opening and circuit closing auxiliary switches for electrically interlocking, for indicating or for controlling an auxiliary circuit, or with bell alarm switches, under-voltage release for tripping breakers and with relays for every purpose. Standard unit construction is followed wherever possible. More complete information on the various breakers within this range of voltages can be secured from G-E sales offices. See page 1223.—Adv.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Motor Protector Mfg. Co., 47 Kearny St., San Francisco, Cal.
South Bend Current Control Co., 112 E. Wayne St., South Bend, Ind. "R-C-O-C."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, OIL, LOW AND MEDIUM-VOLTAGE, NONAUTOMATIC. — Oil switches are used for interrupting current or closing circuits at all voltages above 600. They are very widely used without any automatic features and manually operated for low and medium-voltage distribution circuits and substation switching, and also in the smaller sizes for industrial purposes, such as motor starting and reversing, and for many other special applications. They are arranged for panel or pipe-frame mounting and may be controlled from the front of the switchboard by a special switch handle or a system of levers where the switch is located some distance from the board. There are a number of other switches arranged for wall mounting and these are suitable for many purposes about an industrial plant. They are usually enclosed in dust and moistureproof cases and the contacts are generally of the butt type, with auxiliary arcing contacts for the medium-voltage type.

Manufacturers:

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GENERAL ELECTRIC CO., Schenectady, N. Y. See brief description of G-E Low and Medium Voltage, Oil Circuit Breakers under "Switches, oil, low and medium-voltage, automatic."—Adv.
Kelman Electric & Mfg. Co., 1650 Naud St., Los Angeles, Cal. "Kelman."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
SCHWEITZER & CONRAD, INC., 4431 Ravenswood Ave., Chicago, Ill. "S & C."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
WADSWORTH ELECTRIC MFG. CO., INC., Covington, Ky. "Compro." (See display adv. page 1284.)

SWITCHES, OIL, LOW-VOLTAGE HIGH-CURRENT.—The amount of arcing that results at the point of opening a circuit depends roughly on the power of the circuit and its inductance. Thus high-voltage circuits of moderate current rating and low-voltage circuits of high current rating may both cause severe arcing because both may be carrying much power. For breaking heavy low-voltage circuits special magnetic blowouts are often used to rupture the arc between the final contacts, if the switch is of the air-break type. Oil switches have also been developed for this special service, as the cooling action of the oil on the arc is as effective with high currents as with high voltages. The main contacts are very large and usually of the laminated brush type to give as perfect contact as possible; the secondary contacts, opening after the main ones, may also be of laminated type but of smaller area and of metal that does not arc as freely as pure copper. The design is such as to facilitate the free circulation of the oil between the contacts on opening, thus bringing into full play its cooling and arc-quenching action. Such oil switches find use for large electric furnaces, heavy electrochemical circuits and other low-voltage circuits carrying very large currents.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. Type FK25 oil circuit breaker for currents up to 5,000 amp. for use where the initial expense warrents it instead of air breakers. Recommended always when inflammable particles or gases are in the air or when there is insufficient head room for the air circuit breakers. The 3,000-amp. size, hand or solenoid operated, is of the brush-type contact construction. The 4,000 and 5,000-amp. sizes, furnished with solenoid operated mechanisms, have the main contacts open in air while the arc is actually broken under oil. (Bulletin 47471.) See adv. pages 1203-1223.—Adv.

SWITCHES, OIL, MEDIUM-VOLTAGE, POLE TYPE.—Medium-voltage oil switches for pole mounting are generally used with lighting circuits, such as series arc or series or multiple incandescent circuits, where remote control of the entire circuit is desired or where a section of the circuit is to be cut out at a definite time, as at midnight. They may be manually operated and nonautomatic or solenoid-operated switches and may be connected in the circuit in such a manner as to save running most of the controlled circuits back to the power house and also the space required for the installation of switches, etc., in the power plant. By using these switches several separate series circuits, which may be fed from different points on the general constant-potential distribution system, may be arranged in cascade and all the lights may be controlled by one switch in the power plant. The operating solenoid is connected in the series lighting circuit in this case and each circuit thus operates the oil switch controlling the next circuit to it. Only the first oil switch is operated from the power plant, requiring but two control wires, or one series circuit may be run from the plant and this controls the others. Other arrangements for motor control, sign lighting, bridge and tunnel lights, etc., may be operated in a similar manner. The switches are usually constructed very ruggedly and closely resemble a transformer in appearance, having the complete mechanism, except for an auxiliary hand-operating lever, inclosed in a cast iron tank which is filled with oil. The leads are brought through the tank in porcealin bushings similar to those used with transformers.

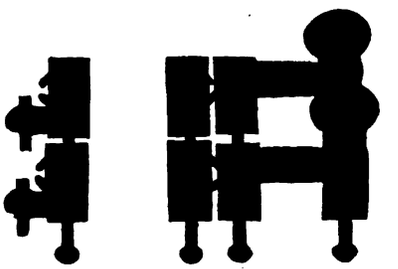
Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. Type FKO37 oil circuit breaker designed for 400-amp. capacity, 15,000 volts, and has provision for bushing transformers, bell alarm switch, transformer or shunt trip mechanism and emergency operating handle. A semaphore indicates the open or closed position and a lever and pipe mechanism makes the breaker operable from the ground. The G-E outdoor bushing used is not affected by weather, and all protective apparatus is enclosed. Eliminates difficulties and danger of replacing a pole-mounted fuse. See adv. page 1203-1223. —Adv.
High Tension Electrical Specialty Co., Newton, Mass.
South Bend Current Control Co., 112 E. Wayne St., South Bend, Ind. "R-C-O-C."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, PANEL, PANELBOARD, OR COMBINATION CUTOUT.—Switches designed for the control of branch circuits on panelboards and furnished in flush or surface snap switch types (push button or rotary) with or without means for mounting directly on busbar extensions, or as double-pole knife switches with or without fuse extensions. For so-called "safety" panels or panelboards they are usually of modified or special snap type construction.

Manufacturers:

AJAX ELECTRIC CO., Baldwin Ave. & Montgomery St., Jersey City, N. J.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
DANBURY ELECTRIC MFG. CO., Danbury, Conn.
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Electric Motor & Engineering Co., The, 2nd St., S. W., & B. & O. R. R., Canton, Ohio.
Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Large-Dail Mfg. Co., Inc., 606 Cherry St., Philadelphia, Pa.
Leonard Electric Mfg Co., The, 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Liberty Electric Corp., Port Chester, N. Y.
Mendell Mfg. Co., Mattapoisett, Mass.
Mesa Co., Fernando C., Coit St. & Chancellor Ave., Irvington, N. J.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J. "Tecco."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Knock-down panel switches are furnished for all types of standard lighting panels.—Adv.



T. V. Knock-down Panel Switch

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, PENDENT AND CORD, SNAP.—Pendent snap switches are enclosed in shells designed to be supported on the ends of flexible cords to control circuits of ceiling lights, fans, etc. Pendent switches are made in a number of forms, most of them operating by means of push buttons. Some are arranged with two

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buttons projecting from the bottom which are operated similarly to the ordinary push switch. Others have the two buttons projecting from the side, but one of the most common types has the buttons on opposite ends of an operating bar passing clear through the switch; this is known as the push-through type. Pendent switches are generally made as single-pole switches, although three and four-point and two or three-circuit electrolier switches are sometimes used.

Certain heater switches are a special application of these switches, in which the cord runs right through the switch, which is connected in series on one side of the cord. They are often used with heating pads or blankets and other heating appliances. Cord switches are also much used with toasters, percolators and other table heating devices.

The casing or shell in which these types of switches are mounted is often of brass, for which special finishes may be provided. The cap is arranged for supporting from several sizes of cord, in some cases the same cap being used for a larger cord by merely removing an inner bushing. Ornamental porcelain and molded insulating material are also used for the outer shells.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Push-Button Pendent Switches are made with three kinds of shells—porcelain, brass, and porcelain with brass cap. All have the same operating push buttons and simple mechanism which is characteristic of C-H Switches. A high-capacity pendent switch is thus available for



C-H 7007
Brass Shell



C-H 7000
All Porcelain

every use. The brass shell and all-porcelain switches are made for pendent use (cord suspension). The porcelain switches with brass caps are made for attachment directly to fixtures and other lighting units. When provided with composition bushings, they may also be used for cord suspension. See display adv. pages 1225-1230.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H," "Hart."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Penn Electric Machine Co., 114 8th St., Des Moines, Iowa. "Penn."
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, PLUG TYPE.—The earliest switches consisted of metal plates mounted on wooden blocks that were connected together by plugs inserted between the plates. This design still survives for laboratory resistance boxes, Wheatstone bridges and similar devices where there is no appreciable current to be opened. The design proved unsuitable for opening a circuit when carrying current as an arc was usually established when the plug was withdrawn.

The modern design of plug that is suitable for opening small currents at high voltage consists of a fiber tube with socket contacts at each end mounted on the rear of a switchboard panel with a plug in the form of a metal rod or tube with an insulating handle on the end that is inserted through a hole in the panel. This plug connects together the contracts at each end of the fiber tube. These plugs are used to a certain extent for arc-lamp service to handle 10 amperes at voltages up to about 5000, and for similar cases where a switch of small current rating is wanted.

Modifications of this design have been employed in some of the older installations as field switches for currents up to about 200 or 300 amperes and a further modification in the form of a plunger switch was used for a-c. service up to 2400 volts for 200 amperes.

SWITCHES, PRESSURE OR VACUUM-OPERATED.—These switches are in the form of special spring-controlled mechanisms operated by the movement of diaphragms or expansion chambers under the influence of changes in air or other fluid pressure. The relatively small diaphragm movement is multiplied through suitable levers or toggle mechanism to accomplish the desired result. They are frequently used to control air or vacuum pumps to automatically maintain a constant pressure or vacuum in any systm, and generally act only as a relay to close and open contacts that control another circuit, such as the circuit of the motor driving the pump.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Automatic Switch Co., 154 Grand St., New York, N. Y. "Sylphon."
Chicago Pump Co., 2320-36 Wolfram St., Chicago, Ill.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio.

SWITCHES, PULL, PLUG-SOCKET TYPE.—These are plug sockets with pull-chain switching mechanisms. They are provided with a medium screw base plug at one end to permit screwing into ordinary, medium base sockets or receptacles; the other end consists of a regular socket; the body contains the pull-chain mechanism. They are used to screw into a keyless socket whose lamp it is desired to control by means of the pull switch.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hubbell, Inc., Harvey, Bridgeport, Conn. "Presturn," "Lock Shell," "Quick Catch."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Majestic Electric Mfg. Co., 806 N. 12th St., St. Louis, Mo.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "Aladdin."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.

SWITCHES, PUSH-BUTTON, FLUSH AND SURFACE.—Snap switch mechanisms in insulating bodies or cups intended for mounting in switch boxes behind flush face plates in walls or on the surfaces of walls with or without subbases. These switches are very widely used and their design and construction is such as to give ample insulation and strong switch parts that can carry the current without heating and crystallizing as a result of the spring operation. The body or enclosing cup is generally made of porcelain and the switch mechanism secured in it by means of screws. In some cases this mechanism may be removed from the cup at any time without taking the cup from the switch box.

Push switches are generally made with two buttons, although a single button is employed in some switches. They are arranged to control a number of classes of circuits, the most common types being single or double-pole switches and three-point or three-way switches. Electrolier, four-way and heater switches are also made in this form. The standard rating for flush switches is 10 amperes at 125 volts or 5 amperes at 250 volts. Some other forms for panelboard or other mounting are also made with ratings of 10 and 20 amperes at 250 volts.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa.
Clay Electric Co., 3303 N. 12th St., Philadelphia, Pa.
Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn. "CemCo."
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
GORDON ELECTRIC MFG. CO., THE, Waterville, Conn. "Gordon."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
KLAXON CO., Newark, N. J.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Fewpart." (See display adv. pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, PUSH-THROUGH.—Snap switches of a special push-button type, designed either to be connected in cords of portable appliances or to be used as pendent switches. They have a double-ended button which extends through the switch. When pushed from one side it closes the circuit and then projects out on the other side of the switch shell, indicating the condition of the circuit. To open the circuit the button is pushed the other way. These switches are generally cylindrical or rectangular in form and are made as single-pole, three-point, electrolier and heater switches. They are enclosed in porcelain or molded composition or may have a brass shell and cap similar to a socket bushed for a pendent cord.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can

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CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. The C-H 7050 Switch is of the push-through type, its greatest use being on the cords of electrical appliances such as toasters, irons, grills, drink mixers, portable grinders, etc. It makes the control of these devices convenient, saving reaching for socket or wall switch. See display adv. pages 1225-1230.—Adv.



C-H 7050

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H."
Ideal Electric Mfg. Co., Inc., 718-720 Cherry St., Philadelphia, Pa.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
SEARS, HENRY D., 80 Boylston St., Boston, Mass.
UNION ELECTRIC CORP., 103 Mott St., New York, N. Y.

SWITCHES, RADIAL TYPE KNIFE.—Radial type knife switches are switches having a single knife blade pivoted at one end, with several contact clips arranged around the switch blade pivot as a center. The pivot is usually mounted on a swivel of some sort, and the blade may be turned through a complete circle and inserted in any of the contact clips. This permits the connection to a number of circuits to be controlled by one switch, and is useful in testing work or in connection with battery charging where each step between clips represents a certain amount of resistance added.

Manufacturers:

Brown Instrument Co., The, Philadelphia, Pa. "Brown."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)

SWITCHES, RADIO AND RADIO PANEL.—These switches are the special ones used on radio panels, and for changing over from sending to receiving connections in small stations, etc. They are often similar to other knife switches; where they are in the antenna circuit the current capacity does not need to be large, but the insulation should be good. Switches mounted on panels are sometimes of the radial type and in other cases are of the sliding contact type.

Manufacturers:

Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin St., Chicago, Ill.)
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Tresco, 1201 Kahl Bldg., Davenport, Iowa. "Perfection."
TRUMBULL ELECTRIC MFG. CO., THE., Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Radio antenna switches mounted on either slate or wood bases. Ground



T. V. Radio Antenna Switch

switches on slate or asbestos wood bases. The ground switch, 100-amp. capacity, is illustrated.—Adv.

Wireless Specialty Apparatus Co., C & Fargo Sts., Boston, Mass.

SWITCHES, REMOTE CONTROL.—Remote-control switches, consisting usually of solenoid or motor-operated contactors or other switching devices, are controlled from one or more remote points at which there are master switches or momentary-contact switches in the circuit of the controlling coil or relay of the contactors or switching devices. Remote-control switches are generally used in circuits carrying heavy currents and placed near the motor or other device controlled; their use avoids the expense and loss involved when heavy cables are carried to a distant point of control. They are also used to control high-voltage circuits or equipments, which for safety of operation are preferably controlled from a distant point. To prevent confusion regarding these switches, it should be noted that control switches are usually called master or momentary-contact switches, whereas what are generally called remote-control switches are really remote-controlled switches and would be more accurately designated as such.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Autocall Co., The, Shelby, Ohio.
Automatic Electric Mfg. Co., The, 126 E. Walnut St., Mankato, Minn.
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th & Wesley Aves., Columbus, Ohio.
Automatic Switch Co., 154 Grand St., New York, N. Y.
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Electric Control'er & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M.," "ZB."
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Manually operated disconnecting switches, designed to afford maximum safety to the operator. See display advertisement on page 1261.—Adv.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hi-Voltage Equipment Co., 3305 Croton Ave., Cleveland, Ohio.
Kelman Electric & Mfg. Co., 1650 Naud St., Los Angeles, Cal.
North Electric Mfg. Co., The, Galion, Ohio.
PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Protective Signal Mfg. Co., The, 1900 W. 32nd Ave., Denver, Colo.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
South Bend Current Control Co., 112 E. Wayne St., South Bend, Ind. "R-C-O-C."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Stewart & Co., S. A., 85 Hall St., Boston, Mass. (Alarm or emergency lighting)
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Tecla Co., Inc., Detroit, Mich.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, ROTARY. FLUSH AND SURFACE.—Snap switches having keys or handles attached to the operating spindles of rotary mechanisms enclosed in insulating bases designed for mounting in walls behind face plates or on surfaces with the bases designed for rear wiring connections or in special forms for open wiring, raceway work, etc. Rotary switches may be made to give a number of circuit combinations including three-way, four-way and electrolier types. They are made in various ratings and types of single and double-pole switches.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHELTEN ELECTRIC CO., THE, 4859 Stenton Ave., Philadelphia, Pa. "Chic."
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "Hart," "H & H."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y. "P. & S."
Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.

SWITCHES, SAFETY. — The knife switch is the oldest type of electric switch in general usage. It has been used for practically all kinds of circuits until its limitations of exposed current-carrying parts and arcing on heavy currents and high potentials led to the development of other types of switches. In dwellings, offices, public buildings, etc., it was early recognized that knife switches were unsuited for general use and they were therefore long ago replaced by surface and flush snap switches with all live parts enclosed. In factories, mills and shops of all kinds the knife switch has remained to this day in quite general use not only in the engine or generating room, where a trained engineer or electrician was the only person supposed to operate it, but also throughout the various workrooms and shops, chiefly as the main switch controlling any motor. As factories became more and more electrically operated non-electrically informed operatives were quite commonly entrusted with the starting and stopping of the motors driving their machines. The motors, starting boxes or controllers were commonly built without exposed live parts, but the main knife switch remained exposed, with the result that serious accidents happened from contact with the switches.

From this condition developed the completely enclosed and externally operated switch. In some cases a simple enclosed switch was an intermediate step; this provided a steel or other box in which the knife switch was mounted, a spring-hinged door keeping it guarded against accidental contact by any person near by or who might be carrying bars, pipes or other metal objects likely to strike the switch. It did not provide protection, however, to the uninformed operative that had to open the door of the box to open or close the switch. To provide this additional safeguard required a means of operating the switch from outside the box. Several types of switches that accomplish this have been placed on the market. They were at first known by various names, such as armored, ironclad or dead-front switches. Since their predominating feature is safeguarding the operative, they are now quite generally called "safety" switches.

Safety switches provide not only for operation of the switch without opening the box, but usually are also arranged so that the box can not be opened unless the switch is first opened, thus exposing no live switch blades or other parts. If fuses are to be replaced or the mechanism inspected, this may be done with perfect safety. This feature should be embodied in all safety switches. The enclosing case is usually of sheet steel, except for very large switches and those requiring special moistureproof or vaporproof boxes, for which cast iron is commonly used. The box may be self-locking by closure of the

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switch or also separately provided with a padlock. The switches are almost invariably of the spring-acting or quick-break type and while mostly double-pole, are also made with three or four poles and sometimes double-throw.

First used as motor switches, the safety type was soon developed for service switches and then for general use where protection is desired for the operator, the switch and the circuit. These are the three main classes of safety switches as to use.

SWITCHES, SAFETY, MISCELLANEOUS.—Safety switches are used for a large number of purposes. The two types listed below are for motor starting and service entrance, which are the most common applications. They are also used for a number of industrial purposes to provide safety to inexperienced operators controlling lights or lighting feeders, or various heating and other appliances. They are always of the full safety type and cannot be opened excxept when the circuit is dead.

Manufacturers:

Electric Panelboard Co., Rochester, N. Y.

Lewis Electric Co., The, 753 Paterson Ave., S. W., Canton, Ohio. "Kantshok."

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague brush contact switches are made up to 600-amp. 250-volt d-c., 500-volt a-c. and enclosed in sheet steel cabinets with an interlocking fuse compartment door so arranged that access to the fuses can be had only with the switch in "off" position. The switch has a quick break action and is operated by a toggle mechanism. Sprague products, see display adv. pages 1306-7.—Adv.

V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, SAFETY, MOTOR.—Safety switches for motor service are of several types, depending on the type and size of motor with which they are to be used. For small motors that may be thrown directly across the line, the switches are simply two or three-pole single-throw switches. This is also true where the safety switch is to serve merely as a main switch, accelerating being controlled by a separate starter or controller. In certain sizes of induction motors the motor may be started directly from the line, but because of the heavy starting current the fuses must be first cut out; in this case a double-throw safety switch is used in whose starting position the fuses are cut out or shunted, while in the running position the fuses are in circuit and protecting the motor. For still larger induction motors the safety switch may be of the star-delta type or the compensator type. The former first connects the motor windings in star or Y-connection for starting and then in the normal delta connection for running, a double-throw triple-pole switch being used. The compensator type switch first connects the motor to the motor compensator (or autostarter) giving reduced voltage for starting and then to the running position giving full line voltage and including the running fuses. For the star-delta and compensator combinations it is usual to provide a separate main switch by which the power may be completely cut off the motor and its auxiliary circuits. The fuses used with these switches are almost invariably of the N. E. C. standard cartridge type. For general remarks on the safety type of switch see Switches, safety.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."

Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.

Canadian Drill & Electric Box Co., 1402 Queen St., E., Toronto, Ont., Can. "C. D. & E. B."

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E," "U-Re-Lite."

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.

EFFICIENCY ELECTRIC CO., THE, East Palestine, Ohio.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

MUTUAL ELECTRIC & MACHINE CO., 858 Fort St., West, Detroit, Mich. "Bull Dog" safety switches represent the highest standard in safety switch construction. In them are combined all those superior features of construction that have always identified the "Bull Dog" line of knife switches and a design of enclosure and external operation that insures maximum safety and service. Yet they are moderately priced. Write for descriptive literature and discounts. Also see display adv. on page 1285.—Adv.

PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.

Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."

SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)

TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. The Trumbull safety switch is not only externally operated, but is a safety switch with interlocking attachment so arranged that, (1) it is imposible to open box until switch is in "off" position. (2) Switch cannot be closed until box cover is down. Interlocking catch, however, may be manipulated when necessary for expert to examine switch under load. (3) Fusible



Running Position

and motor starting switches can be equipped with 100% safety shield, making it impossible to touch live parts. The above illustration shows switch in running position. The operator cannot open box until switch is in "off" position. A shows impossibility of closing switch until cover is down, and B, the safety shield. In all



A B

Circle T safety switch boxes, the type A machine-made, built-up standard knife blade switch is installed, it being much stronger than the punched



Circle T Switches

clip switch (specified under Switches, knife, standard). Cut at left shows Circle T motor starting switch equipped with under voltage release coil. Cut at right illustrates complete line, no fuse, fusible, of quick make and break switches, with or without safety shield. The Circle T line of safety switches is complete and covers standard requirements, including fusible or no fuse 250-500 volt a-c., and 600 volt, motor starting, compensator and motor reversing. Catalog No. 12 gives complete layout of drilling dimensions and full description of the line. See, also, this company's advertisement on display pages 1282-3.—Adv.

TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE, Bantam, Conn. Manufactures safe switches—Underwriters' rating "AA"—under the Mason patents. One of the many desirable features of this switch is its compact-



Mason Enclosed Safety Switch

ness. The Mason switch requires less space than an open knife switch. Also manufactures complete line of enclosed knife, externally operated and cover interlocked, switches, both slate base and porcelain base.—Adv.

V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."

WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Krantz." (See display adv. pages 1395-1402.)

SWITCHES, SAFETY, SERVICE ENTRANCE AND COMBINED SERVICE AND METER PROTECTIVE.—Special types of safety switches have been developed for use at service entrances to buildings. These are sealable in most cases to permit control on the part of the central-station company. There are some types which have a separate fuse compartment to give access to fuses for replacement purposes without disturbing the seal. All are enclosed in a steel box with the operating handle extending outside, and are arranged to be sealed when the service has been disconnected.

Certain types of safety service entrance switches are arranged to be installed in conjunction with the meter installation. A special set of stamped steel housings is provided by which all connections from the service to meter are enclosed, thus affording protection against unauthorized use of electricity or other tampering with the service.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.

CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."

Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "U-Re-Lite."

Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.

Fralick & Co., S. R., 15 S. Clinton St., Chicago, Ill. "Kwikon."

Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.

Lewis Electric Co., The, 753 Patterson Ave., S. W., Canton, Ohio. "Kantshok."

Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.

MUTUAL ELECTRIC & MACHINE CO., 858 W. Fort St., Detroit, Mich. "Bull Dog." (See display adv. page 1285.)

PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.

Safety Electric Products Co., Inc., 1548 Central Ave., Los Angeles, Cal. "Safety Products."

SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)

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TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. Entrance switches, externally operated, for use with or without meter trims, of 30 ampere capacity, 125 volt, for plug fuses, fusible at top or bottom, for 2 or 3 pole. Suitable knockouts are provided in ends, sides, and rear. They are of the quick-break type, with ample room for running wire. These switches can be locked open, the 2 pole is made in two types, side or top hinged. The 3 pole, for use with meter trims, is hinged at top. Can furnish also a complete line of entrance switches with meter testing attachments. See also, this company's advertisements on pages 1282-3.—Adv.



Entrance Switch

V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa. "V. V."
WADSWORTH ELECTRIC MFG. CO., INC., Covington, Ky. "Compro." (See display adv. page 1284.)
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Krantz." (See display adv. pages 1395-1402.)

SWITCHES, SECTIONALIZING, FOR TROLLEY LINES.—Sectionalizing switches are used on trolley lines where it is desirable to maintain dead wires on branch sections or in mines, except at intervals when power is needed. They are generally single-pole single-throw quick-break knife switches mounted on a slate base and enclosed in a wooden or metallic box. The usual rating is for 750 volts and in capacities from 200 to 1200 amperes. Switches are also made for higher voltages up to about 1500 volts. In the larger sizes no handle is provided with the switch blade, which is arranged to be closed or opened by a switch stick. The stick is usually hung inside of the enclosing box in such cases.

Manufacturers:

Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. An automatic sectionalizing switch with a continuous capacity of 800 amp. and an overload adjustment of 600 to 1,200 amp. For connecting directly across the section insulators. All section feeders are thus put in multiple, which gives all the advantages of the non-sectionalized systems, but does not in consequence of automatic operation eliminate the benefits of a sectionalized system. Also a hand-operated switch for pole mounting. These, together with a complete line of railway line material, are described in Bulletin 44004-B. See adv. pages 1203-1223.—Adv.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Unit Electric Co., San Francisco, Cal. "Unit."
Wells-Morris Mfg. Co., 90 2nd St., San Francisco, Cal. "Wells."

SWITCHES, SOLENOID.—See Switches, magnetic; Switches, oil, high-tension, solenoid operated; Switches, remote control.

SWITCHES, SPECIAL AND MISCELLANEOUS.—There are listed herein under the heading of switches nearly 70 separate subclassifications. This miscellaneous classification is made to provide for such less commonly known types as are not listed under these classes, or for such modifications or combinations of the listed types as are so special that they cannot properly be listed under the regular headings.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Adams Morgan Co., Alvin Pl., Upper Montclair, N. J. "Paragon."
Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn. "Lite-A-While."
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
ANDERSON ELECTRIC & EQUIPMENT Co., 154-160 Whiting St., Chicago, Ill.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Barkelew Electric Mfg. Co., Middletown, Ohio.
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Clausen Engineering Office, Bisbee, Ariz. (For mine signaling.)
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "I-T-E."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Esler Electric Mfg. Co., 419 E. Lincoln St., Marion, Ind. "Moment."
GORDON ELECTRIC & MFG. CO., THE, Waterville, Conn. "Gordon."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H. & S."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Koenig-Keller Co., Lancaster, Pa. ("Kay-Kay Kontroller" for oven lights.)
Liberty Electric Corp., Port Chester, N. Y.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Maxwell Engineering & Mfg. Co., 61 Broadway, New York, N. Y. "Memco."
Mendell Mfg. Co., Mattapoisett, Mass.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Minnesota Electric Co., 309 2nd Ave., S., Minneapolis, Minn.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
North Electric Mfg. Co., The, Galion, Ohio.
Oliver Electric & Mfg. Co., 4221 Forest Park Blvd., St. Louis, Mo.
Pennefather, James S., 358 W. 43rd St., New York, N. Y. (Theater.)
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
PITTSBURGH ELECTRICAL & MACHINE WORKS, THE, 1-3 Barker Pl., Pittsburgh, Pa.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Pyle-National Co., The 1334 N. Kostner Ave., Chicago, Ill.
Robson & Co., Charles, N. W. Cor. 8th & Washington Ave., Philadelphia, Pa. (Oven door controller.)
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S & C."
Seligraph Co., The, Brooklyn, N. Y. (For motion-picture machines).
Southern Electrical Equipment Co., Kinney Bldg., Charlotte, N. C.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Standard Thermometer Co., 65 Shirley St., Boston, Mass. ("Standard" thermostatic.)
Stewart & Co., S. A., 85 Hall St., Boston, Mass. (Automatic emergency lighting).
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Tremont Products Co., 216 High St., Boston, Mass. "Staylit."
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display pages 1282-1283.)
TRUMBULL-VANDERPOEL ELECTRIC MFG. CO., THE. Bantam, Conn. Catalogs a number of special switches. Among these are radial switches (illustrated) cut-around meter-testing switches, motor control switches, field discharge switches, etc.—Adv.



T. V. Radial Switch

Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTERN SAFETY MFG. CO., 247 Minna St., San Francisco, Cal.
Wilcox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, SWITCHBOARD, CONTROL TYPE.—Switches of various types have been utilized for the control of electrically operated apparatus. At first small single-pole duoble-throw knife switches were used. The first modification of the ordinary knife type of switch was to use a spring return to the off position and to employ a little celluloid plunger colored red and green on opposite ends to indicate the last position to which the switch had been thrown.

To get the live contacts off the board and to take care of the arcing that sometimes occurred on opening the highly inductive circuits of the controlling solenoids, provision was made to put the switch on the back with the operating handle on the front. The push button design was tried out, but this had the disadvantage arising from the possibility of accidental closing so pull-button switches were substituted. The latest type of this design combines twin pull buttons with a red and green target device that shows the last pull button that has been operated. These pull buttons have a spring return to the off position and can embody auxiliary contacts when these are needed. Red and green indicating lamps with prismatic lenses are used as electrical indicators to signal back the actual operation of the device.

A special type of double-throw switch with handle on the front and switch on the back has been developed for switchboard service. This switch has a quick-make and quick-break arrangement and a target device to show the last position to which the switch has been thrown. Indicating lamps are used with this switch.

Another design of control switch is built along the lines of a drum controller, having an insulated square shaft for carrying the moving contacts and with special attention paid to the question of space economy with due regard for insulation clearances. This drum design can take care of the modifications needed for different types of apparatus using varying numbers of control wires. As an aid to the station operator in selecting the proper controller to use on the switchboard the handles are made distinctive. With the control switch used with electrically operated circuit breakers and employing signal lamps, provision is made for pulling out the handle of the controller after it has been turned to the off position. By so doing the signal lamps are all cut out of service and the breaker is locked open. The oval handle of the control switch will be turned at right angles to the normal position indicating that the circuit is out of commission intentionally.

SWITCHES, SWITCHBOARD INSTRUMENT (VOLTMETER, AMMETER, GROUND DETECTOR, ETC.) — Instrument switches of various types are available for connecting one ammeter, voltmeter or other similar device to various circuits. The two main types of instrument switches are the plug type and the drum type. The plug type has been used principally for ground detectors and voltmeters but is also used for transferring instruments, calibrating, etc. These are built with unit receptacles that are set into the switchboard panels. The conducting parts are recessed into insulating rings that make it difficult for accidental

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contact to be made by the switchboard operator. For ground-detector service some companies use the scheme of having 2, 3, 4 or 5 studs so spaced that the bridging contacts of the two-point plug will connect the central stud to any outside stud, forming the equivalent of a radial switch with 1, 2, 3 or 4 throws. For low-voltage service the outside studs are connected to the phase wires and the central stud conects through a series of lamps to ground. For higher voltages a transformer is connected in the circuit between the central stud and the ground. Two receptacles with a two-point plug are also used for voltage readings on d-c. railway switchboards that have only one polarity on the board. Where both polarities are on the switchboard or for a-c. service, the plug is made with four points and when used with a four-point receptacle it forms the equivalent of a two-pole single-throw switch. For two-phase service six-point reecptacles are used, forming with the four-point plug a two-pole double-throw switch. For three-phase work an eight-point receptacle is used and a special arrangement of connections enables the voltage to be read across all three phases. By using receptacles on various panels one voltmeter, preferably located on a bracket, can be connected by the removable plug across any phase of any desired circuit. As there is only one plug, there is no possibility of trouble from trying to connect two circuits to the voltmeter at the same time.

A modification of the plug type of switch, to get all of the live contacts off the board and to simplify the drilling, makes use of a tube mounted on the rear of the board with a series of contacts like the stops on a flute. The pushing in of a plug from the front of the board makes the contacts needed for voltage reading, etc. Plugs of this type are available for connecting in testing instruments for the purposes of calibrating the switchboard meters without removing them from the board.

Among the latest types of instrument switches are those built as drum controllers with movable contact members on a substantial insulating drum and the stationary contacts made in the form of stamped contact fingers mounted on the insulating tube that forms the outside of the switch. All desired combinations of contacts can be readily provided in this design. Certain switches for ammeter or similar service are provided with nonremovable handles, while for the voltmeter and synchronizing switches removable key type handles are furnished. By using pins in the shaft of the handle and slots in the escutcheon plates of the switches provision can be made for preventing the incorrect use of the plugs.

Manufacturers:

ADAM ELECTRIC CO., FRANK, 3650 Windsor Pl., St. Louis, Mo. "FA." (See display adv. pages 1262-1265.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
CROUSE-HINDS CO., Wolf & 7th North Sts., Syracuse, N. Y. "Condulet."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. Ammeter switches, ruggedly built, for either two or three-phase service. See display advertisement on page 1261.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Laganke Electrical Co., 6969 Aetna Rd., Cleveland, Ohio.
Leonard Electric Mfg. Co., The., 3907 Perkins Ave., Cleveland, Ohio. "Leonard."
Mendell Mfg. Co., Mattapoisett, Mass. (Ground detector.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PENN ELECTRICAL & MFG. CO., Irwin, Pa. "Penn."
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
WURDACK ELECTRIC MFG. CO., WILLIAM, 21 S. 11th St., St. Louis, Mo.

SWITCHES, SYNCHRONIZING.—These switches are very similar to switchboard instrument switches, which see, and are used for making the connections required for synchronizing two or more machines with a bus. There are two general types, the plug type and drum type. The former has been widely used, but the drum type is a later development and provides all desired combinations of contacts. Some synchronizing switches have, in addition to the contacts for making connection to the synchronizing instruments, a set of contacts for connecting the control circuit of the electrically operated generator oil switch so that the generator may be thrown on the bus only when synchronizing instruments are in circuit.

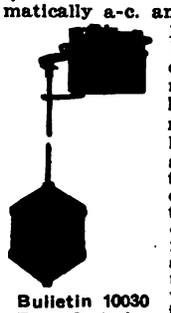
Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Cutter Electrical & Mfg. Co., 19th & Hamilton Sts., Philadelphia, Pa. "T-T-E."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
Drendell Electrical & Mfg. Co., 1345 Howard St., San Francisco, Cal. "Demco."
Eaton Electrical Mfg. Co., 555 W. Monroe St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, TANK OR FLOAT.—Switches for automatically controlling the circuit of motor-driven pumps used to supply a reservoir or pressure tank or for drainage purposes. The switch operates by the movement of a float in a small cylinder which is placed within the tank, sump or reservoir in which the proper level is to be maintained. Switches of this type frequently carry but a small current so that their motion and the closing and opening of the contacts merely controls another circuit which operates the motor-starting equipment. When used for supplying water to a reservoir or tank the motor is started when the level falls to a certain point and is stopped at the desired upper level. In sump or drainage service the motor is started at the maximum level and stopped at the minimum.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Automatic Switch Co., 2336 Wolfram St., Chicago, Ill.
CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Bulletin 10030 is a single-pole open type float switch designed for handling self-starter pilot circuits, in connection with d-c. or a-c. motors operating tank or sump pumps. Bulletin 10030 is a single-pole enclosed type float switch used to control automatically a-c. and d-c. motors driving pumps. This switch handles the pilot circuit only of an automatic motor starter having a main magnetic contactor. Bulletin 10031 is a float switch of the enclosed type, designed especially for use where the force available for operating the switch is small. This is usually the case where the motion of a float within a closed tank is transmitted to the switch by means of a shaft passing through a stuffing box. Bulletin 10035 is another enclosed type float switch designed with two, three, or four poles for small motor service. The contacts are of the knife-switch type and are operated with a quick make and break as the float rises and falls with the level of the water. See display adv. pages 1225-1230.—Adv.



Bulletin 10030 Float Switch

Decatur Pump & Mfg. Co., 634 E. Cerro Gordo St., Decatur, Ill.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Grindle Fuel Equipment Co., 1901-11 S. Rockwell St., Chicago, Ill. "Grindle System."
Hart Mfg. Co., 230 Hamilton St., Hartford, Conn. "Diamond H."
INDUSTRIAL CONTROLLER CO., 886 Greenbush St., Milwaukee, Wis. "I-C."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
Monitor Controller Co., 500-16 E. Lombard St., Baltimore, Md.
Pringle Electrical Mfg. Co., 1906-12 N. 6th St., Philadelphia, Pa.
Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, TELEGRAPH, BUTTON, TABLE JACK, ETC.—These switches are used on telegraph test tables and boards. They provide a means of cutting in new instruments in place of some other and greatly facilitate the changing of apparatus. They are also used as momentary-contact switches for testing purposes, such as to correct voltmeters and galvanometers in the circuit.

Manufacturers:

Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
WATERBURY BUTTON CO., 835 S. Main St., Waterbury, Conn. (See display adv. page 1328.)

SWITCHES, TELEPHONE, AUTOMATIC.—A remote-control switch for connecting telephone lines without an operator. It consists of a bank of contacts to which lines are attached, a set of springs (termed wipers or brushes) which may be moved into contact with any set of contacts in the bank, a set of electromagnets or motors for moving the wipers, and a set of relays to control the magnets and the circuits. There is a number of types of automatic switches, some of which are listed separately below. Other types are also used, such as a finder switch. This is an automatic switch attached to a trunk line and having subscriber lines on its bank. When a suscriber calls, the finder switch moves its wipers and connects the calling line to the trunk. It serves the same general purpose as a line-switch. Another type known as a reverting-call switch is an automatic switch used to ring back on a party line in the case of a reverting call. A special form of relay formerly used in the Strowger automatic system is also a form of automatic switch, called a sideswitch. It changed the circuits between pulls of the dial, so that different actions would result.

An automatic switch is tested by being operated under conditions more severe than any which will be found in practice. Strowger switches operate normally at 10 impulses per second over commercial subscriber lines. When being tested, they are operated at 14 impulses per second (1)

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on a 1200-ohm loop with no leak, and (2) on zero loop with 20,000 ohms leak across the line.

SWITCHES, TELEPHONE, AUTOMATIC CONNECTOR.—A connector, in telephony, is a special selector switch used in an automatic telephone system. Its function is generally to pick out the proper line from the tens and unit bank and to complete the connection to the "called party." Its duties are more complicated than other selector switches, because in addition to selecting the number it must make a busy test, ring the called station and furnish talking current to both telephones. The connector itself is complicated, consisting of several relays which govern the action of various magnets that rotate a shaft and wipers over the various contacts in the banks. There are a number of kinds of connectors used for different purposes. Some of these are mentioned below.

Party-Line Connector. A connector switch used to connect to selective party lines. One arrangement has as many groups of connectors as there are stations on a line, and each connector in a group has the kind of ringing current necessary to ring one station on the line. Another arrangement makes all connectors alike and in one group, but equips each connector with a frequency selector, a minor switch which selects the kind of ringing current indicated by the call number.

Toll Connector. A connector which may be used only by the toll operators.

Combined Toll and Regular Connector. A connector which may be used by toll operators or by local subscribers. When used by the latter, the connections are automatically changed to suit the local conditions, and it operates like the regular connectors. When seized by a toll operator it gives the proper conditions for efficient long-distance transmission. The local selectors choose these combination connectors only after all the regular connectors are busy.

Test Connector. A connector, usually one per 100 lines, which is arranged to be used by the wire chief or a tester for testing the subscriber line or its connections into the automatic switchboard. It often renders unnecessary a test at the main distributing frame.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
North Electric Mfg. Co., The, Galion, Ohio.
Scranton Button Co., The, 409 Cherry St., Scranton, Pa. "Lacanite."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHES, TELEPHONE, AUTOMATIC LINE.—An automatic switch attached to the subscriber line to enable a calling subscriber to be connected to an idle trunk line leading to switches. The line switch permits many subscribers to use few switches, because only a few subscribers will desire to call at the same time.

In order to increase the number of first selectors in a group, available to one group of subscribers, two orders of lineswitches are used. The primary lineswitches are attached to the subscriber lines. The secondary lineswitches are attached to the trunks which come from the banks of the primary lineswitches. The banks of the secondary lineswitches are run to first selectors. In this way one lot of subscribers may have access to 100 first selectors. These are called local secondary lineswitches.

Secondary lineswitches are also placed between selectors and interoffice trunks to increase the size of the group of trunks. Each selector bank contact is wired to a secondary lineswitch whose bank is connected to a group of outgoing trunk lines. These are called outgoing secondary lineswitches. There is another form of lineswitch known as a master switch. It is that part of a complete lineswitch unit of the Keith type which controls the plungers of the individual lineswitches, so as to keep them always pointing toward an idle trunk.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
North Electric Mfg. Co., The, Galion, Ohio.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHES, TELEPHONE, AUTOMATIC SELECTOR.—An automatic switch whose duty is to select a group of trunks (guided by the calling device) and to pick out an idle trunk in that group. The latter action is independent of the call number. The first selector selects the largest division into which the exchange is divided, the second selector selects the next smaller division, etc., and the final selector the called number; the latter is often known as the connector. There are several types of selectors depending on their use. Some of the most important are given below.

District Selector. An automatic switch of the panel type used to select trunks to a distant office or to the originating office.

Final Selector. An automatic switch of the panel type which performs most of the functions of a connector switch, and makes the final connection to the line called.

Office Selector. An automatic switch of the panel type which assists the district selector in selecting trunks to an office.

Toll Selectors. A system of selectors for the exclusive use of the toll operators whereby they can call any subscriber in the exchange.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Couch Co., Inc., S. H., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.
North Electric Mfg. Co., The, Galion, Ohio.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

SWITCHES, TELEPHONE, HOOK, ETC.—A telephone has two circuits, one for signaling and the other for talking. The signal circuit is normally in. The talking circuit must be switched into line when the telephone is used. This is done by the hookswitch, whose contacts are operated by a lever with a forked end in which the receiver is hung. When a microphone or hand telephone is used the switch is known as a cradle switch. It is merely a device for holding the telephone when it is not in use. It switches the circuits like a hookswitch. On a rural automatic party line it is necessary to prevent a subscriber from coming in on the line while some one else is dialing. A catch on the hook lever permits it to rise only far enough for the subscriber to listen and to find out if the line is in use. If free, he presses the "hook release" which permits the hook lever to rise the rest of its travel and to connect the circuits for dialing. The device is called a "hook-latch."

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Leich Electric Co., Genoa, Ill.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

SWITCHES, THREE-WAY, SNAP.—Snap switches intended for flush or surface mounting and designed to be used in controlling a lamp circuit from two locations. The mechanism of the switch is so constructed and connected that at all times one of two contact points is connected to a third contact, and operating the switch merely changes the connection to the other contact. Three-way switches are made as rotary switches, push-button switches, push-through and pendent switches. They are used principally to control lights for a stairway, hallway, basement, large room, etc., so that the lamps may be lighted from either end and extinguished from the same or opposite end; thus they save many steps and promote convenience of control. They have about the same ratings as other snap switches, 3 amperes at 125 volts or 1 amp., 250 volts, being the minimum and 30 amp., 125 volts, and 10 amp., 250 volts, the maximum. For electric railway and other special service switches rated at 5 and 10 amp., 600 volts are also used.

Manufacturers:

Arrow Electric Co., 103 Hawthorne St., Hartford, Conn. "Arrow."
Beaver Machine & Tool Co., Inc., 625 N. 3rd St., Newark, N. J. "Beaver."
Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "Hart," "H & H."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."
Paulding, Inc., J. I., New Bedford, Mass. "New England."
Sterling Switchboard Co., 537 S. 7th St., Camden, N. J.
TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn. "Circle T." (See display adv. pages 1282-1283.)
Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

SWITCHES, TIME OR CLOCK-CONTROLLED.—Switching devices mechanically controlled by the tripping action of a clock specially arranged for the purpose. The clock usually operates in a similar manner to an alarm clock and releases a spring which operates either a push or rotary snap switch to open or close a circuit. They are intended for the automatic control of the circuits of electric signs, window displays, exterior building lights, house hall lights, etc., to light or extinguish them at predetermined times. They are also sometimes used to control storage-battery charging equipment, also in connection with signaling and alarm systems, and for many other similar purposes. The clock is usually an eight-day hand-wound movement, although electrically wound clocks are being introduced to make the entire device completely automatic.

Manufacturers:

A & W Electric Sign Co., The, Cleveland, Ohio.
ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv. page 1286.)
Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass. "Anderson."
Automatic Electric Mfg. Co., The, 126 E. Walnut St., Mankato, Minn.
CAMPBELL ELECTRIC CO., Lynn, Mass. Campbell switches have been on the market for 20 years and all types have the full indorsement of the Underwriters' Laboratories. One-day and eight-day models are made for every conceivable purpose. Each type is marked by simplicity of mechanical detail and positive reliability in operation. Illustration at left shows 250-volt model. Top arrow shows where clock is removable from frame to wind and set. Second arrow shows how supports allow space back of switch for wires. Center arrow (at left) indicates where switch may be manually operated independent of time switch mechanism. Fourth arrow shows where switch is set by used for all manner of industrial purposes and for automatic control of lights in store windows, signs, stairways, alleyways, clocks, entrances, whiteways, poultry houses, etc.—Catalog and price list on request.—Adv.



Campbell Time Switch

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can. "Venner."
Devoe Electric Switch Co., The, 414 Notre Dame St., W., Montreal, Que., Can.
HARTFORD TIME SWITCH CO., 71-73 Murray St., New York. The "Hartford" time switch is a device by which electric current is automatically turned on and off at such time as the user de-

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sires, with no attention other than the weekly winding. It embodies the finest of marine clock movements, and a standard switch so arranged that in operation each is independent of the other. This permits perfect regulation of the clock and assures accuracy of operation, as the clock has no work to perform except its proper function of keeping time. The mechanism is inclosed in a dust proof and weather proof case of cast iron, finished in hard baked black japan, with rubber gasketted door, locking with a subtreasury lock. Operation is such that it is impossible for the switch to stop except at the extreme "off" or "on" point, either through disarrangement of the mechanism or failure to wind. Easy to set as a house clock. Quick, positive switch action. The switch is made in five types: Type B throws current on and off once daily at the hours for which set—sizes, single or double pole or triple pole, 10, 20, 35, 50, 100, 200 amps.; Type C is so constructed that



Hartford Time Switch

clock and switch are automatically disconnected one day in each week (while designed to omit operation of switch on Sunday, can be set to disconnect on any day); sizes single or double pole or triple pole 10, 20, or 35 amps. single or double pole only, 50 amps.; Type D similar to type B but arranged to switch on and off for two periods each day—sizes single or double pole or triple pole 10, 20, or 35 amps. single or double pole only, 50 amps.; Type E designed for use in connection with two rate meter service, automatically cutting from one meter to another and vice versa at hours desired—sizes 10, 20, or 35 amps.; Type G to control apartment house hall lighting and arranged to throw on full number of lights in the early evening and later throw these off, at the same time throwing on a series of few night lights, throwing this second series off at dawn —sizes, single or double pole, 10 or 35 amps. All the above are for circuits up to 250 volts a. c. or d. c. Special switches furnished for unusual requirements.—Adv.

MERCURY TIME SWITCH CO., 2230 E. Canfield Ave., Detroit, Mich. "Mercury."

MINERALLAC ELECTRIC CO., 1045 Washington Blvd., Chicago, Ill. (See display adv. page 1310.)

PALMER ELECTRIC & MFG. CO., THE, 175 5th St., Cambridge, Mass.

PARAGON ELECTRIC CO., Old Colony



Paragon Time Switch

Bldg., Chicago, Ill. The Paragon time switch will automatically turn on and off, with unfailing regularity, show window lights, electric signs, apartment house lights, street lights, etc. It will perform as many as four operations a day, from one weekly winding. The indoor types have open faces, and can be used as clocks. The outdoor types can be supplied with automatic thermostat and heat coil to prevent lubricant freezing in cold weather. Furnished with jeweled-bearing clock movement, housed in strong, cast iron casing, neatly japanned.—Adv.



RELIANCE AUTOMATIC LIGHTING CO., 510 College Ave., Racine, Wis. Manufacturers for the past 12 years of "Reliance" automatic time switches in eleven different types, for turning "on" and "off" electric circuits such as signs, window lights, hall lights, etc., up to 30 amp., 250 volts or less, either a-c. or d-c.



Reliance Automatic Time Switch

The "Reliance" embodies a sturdy, reliable, 8-day clock movement operating a snap switch enclosed in a black japanned cast-iron case with open face for indoor installation, as shown in cut, or with solid iron door for outside use. All types approved by the National Board of Underwriters.—Adv.

Sohm Electric Co., 841-49 Blue Island Ave., Chicago, Ill.

Sterling Clock Co., Inc., 220 E. 42nd St., New York, N. Y.

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

Takamine Commercial Corp., 120 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

SWITCHES, TOGGLE OR TUMBLER SNAP.—Snap switches in which the quick-make-and-break mechanism is operated through a toggle action by an external lever or handle pivoted to permit its being moved to the "on" and "off" positions. This type of switch is not much used in this country for lighting circuits, although extensively used abroad. Some electrical appliances, such as electric flatirons, have toggle switches placed on the cord terminal receptacle that completes the connection at the iron. Toggle switches are also used on automobile circuits. They are very easily operated, a slight touch with the back of the hand, with the elbow or foot, serving as well as use of the fingers.

Manufacturers:

BENJAMIN ELECTRIC MFG. CO., 806 W. Washington Blvd., Chicago, Ill. (See display adv. pages 1231-1234.)

Bryant Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."

Cleveland Switchboard Co., The, 2925 E. 79th St., Cleveland, Ohio.

Connecticut Electric Mfg. Co., Connecticut & Florence Ave., Bridgeport, Conn "CemCo."

Duncan Electrical Co., Ltd., 2 Inspector St., Montreal, Que., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. The G-E Tumbler Switch





is an ideal switch for all classes of building. It combines the usual two push buttons into a single sturdy lever that operates (up and down) at the slightest touch. Since the button is in one position for "off" and the other for "on", this switch is self-indicating. G-E Flush Tumbler Switches are made in the usual types. The surface switch is made in two sizes—"pony" and medium—in single-pole and three-way types. See adv. pages 1203-1223.—Adv.

Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "Hart." "H & H."

Hubbell, Inc., Harvey, Bridgeport, Conn.

METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.

Pneuvac Co., Worcester, Mass.

Sundh Electric Co., 209 Parkhurst St., Newark, N. J.

SWITCHES, TOOL HANDLE.—These are snap switches having push-button operated mechanism inclosed in tubular castings and intended for mounting in the handles of small portable appliances, such as hair driers, vibrators, drills, grinders, vacuum cleaners, etc. They are used with such appliances as may be switched on the circuit without a starter and are usually rated at 110 volts, 6 amperes.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis. C-H Push-Button Switches are especially adapted for insertion in handles of vacuum cleaners, electric tools, etc., because of their compact design and large current-carrying capacity. It allows convenient starting and stopping of the tool. It is unnecessary to turn to the socket or attachment plug in order to have complete control over the tool. The switch is enclosed in a fiber tube. A special type has removable push buttons to facilitate installation in tool handles. C-H Tool-handle Switches are of the single-pole type and have a capacity of 660 watts, 250 volts. See display adv. pages 1225-1230.—Adv.



C-H 7033

Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn. "H & H," "Hart."

SWITCHES, TRACK, ELECTRICALLY OPERATED.—A track switch is a device for moving a small section of track so that a car can be run from one track to another or to a bypass or siding. In electrically operated track switches the switch is operated by an electric device for moving the switch tongue. This device is located in a box on the ground adjacent to the switch and is connected with a contact on the trolley wire. This contact may be so arranged that when the trolley passes it with current on the car the circuit is completed to the electrical device which moves the switch tongue. When the trolley passes the contact with no current on the car the circuit is not completed and in consequence the switch tongue is not moved. The contact may also be so arranged that when the trolley passes over it with the current off, the switch will always be set for one direction, as, for instance, straight track, while when the trolley passes over it with the current on, the switch will always be set for the other direction, as, for instance, the curve.

Manufacturers:

Buda Co., The, Harvey, Ill.

St. Louis Frog & Switch Co., 6500 Easton Ave., St. Louis, Mo.

SWITCHES, TRACK, MANUALLY OPERATED. — Manually operated track switches are almost always operated by some application of the lever principle. These vary from a bar with a flattened end which is thrust between the switch

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tongue and the body of the switch to pry the switch tongue over, to quite complicated systems of levers and weights for moving the heavier switches.

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Buda Co., The, Harvey, Ill.
Canadian Steel Foundries, Ltd., Montreal, Que., Can.
Cleveland Frog & Crossing Co., Cleveland, Ohio. "Lucas."
Conley Frog & Switch Co., Bodley Ave., Memphis, Tenn.
Easton Car & Construction Co., Easton, Pa.
Kilby Frog & Switch Co., Birmingham, Ala.
Lakewood Engineering Co., Cleveland, Ohio.
St. Louis Frog & Switch Co., 6500 Easton Ave., St. Louis, Mo.
Track Specialties Co., Inc., 29 Broadway, New York, N. Y. "Trasco."
Weir Frog Co., Station H, Cincinnati, Ohio.

SWITCHES, TRAIN DISPATCHING, SELECTOR.—Selector switches are used on telephone train dispatching systems to enable the dispatcher to call any station he desires. The calling signals are sent out in the form of impulses with short intervals between certain groups. The selector switches are located at each station and are so arranged that a certain combination of impulses, with intermediate intervals, will rotate a wheel and at certain points in its travel close a local bell circuit. This bell may operate from the main line or from local battery. An answer back arrangement is provided so that the dispatcher can hear the impulses and knows positively that the bell is ringing.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
ELECTRIC SERVICE SUPPLIES CO., 17th & Cambria Sts., Philadelphia, Pa.

SWITCHES, TROLLEY. — Trolley switches are more commonly called "trolley frogs." See Frogs, trolley.

SWITCHES, X-RAY. — See X-ray switches.

SWITCHMAN, TELEPHONE.—A man who maintains automatic switches.

SYCO-LIGHT.—Trade name for farm lighting plant manufactured by the Beaudette & Graham Co., Boston, Mass.

SYLPHON.—Trade name for pressure and vacuum regulating switches manufactured by the Automatic Switch Co., 154 Grand St., New York, N. Y.

SYMONS CLAMP CO.—2116 S. Sawyer Ave., Chicago, Ill. Manufacturer of column clamps. President, A. H. Symons; vice-president, N. A. Lampert; secretary and treasurer, L. Lampert.

SYNCHRONATOR.—Trade name for pulverized coal equipment manufactured by the Powdered Coal Engineering & Equipment Co., 2401 W. Washington Blvd., Chicago, Ill.

SYNCHRONISM.—The condition of having the same period or frequency. Before two alternating-current generators are connected in parallel they must be in synchronism.

SYNCHRONIZE.—To bring to the same frequency; as to synchronize one a-c. generator with another. This is done by adjustment of the speed through hand or automatic control, and the condition of synchronism is indicated by lamps or by instruments called synchronoscopes or synchroscopes. The instruments also show whether the machine being synchronized is running too fast or too slow, and, if at synchronous speed, the phase relation of its voltage to that with which it is being synchronized.

SYNCHRONIZED CLOCK SYSTEMS.—See Clock systems, synchronized.

SYNCHRONIZER, AUTOMATIC.—A machine so controlled that it will close a line switch putting one a-c. generator in parallel with others when this generator has its frequency and the magnitude and phase of its voltage within certain predetermined limits.

SYNCHRONIZING CURRENT.—A current in the armature windings of a-c. generators in parallel due to differences in phase of their general voltages which tends to keep them running in synchronism. It gives power to the slow machines and takes it from the fast ones, thus acting to maintain the speeds equal.

SYNCHRONIZING POWER.—The power which acts to hold a-c. generators in synchronism when they are operating in parallel. It is produced when there are phase differences among the generated voltages, these phase differences being due to momentary but slight changes in speed. The synchronizing power, being the action of the synchronizing currents with the generated voltages, increases the load on the faster machines and lightens the load on the slower machines, thus tending to equalize the speeds.

The synchronizing power depends in magnitude not only on the phase displacements among the generated voltages but also upon the resistance and the reactance of the load and the several armatures and the lines connecting them.

SYNCHRONOSCOPE.—The correct technical name for the instrument more commonly called the synchroscope, which see.

SYNCHRONOUS.—Having the same frequency, as when two a-c. generators are operating in parallel. The word is also used to designate a-c. machines in which the frequency of the generated voltage is fixed by the speed and the number of poles, as synchronous generators, to distinguish them from the asynchronous type whose frequency is dependent on conditions external to the machine. For example, the frequency of an induction motor is fixed by the source of power supply; its speed is not synchronous with that source, but changes with the load, applied voltage, etc. The principal classes of synchronous machines are synchronous generators, synchronous motors, synchronous converters, synchronous condensers.

SYNCHRONOUS CONDENSERS. — See Condensers, synchronous.

SYNCHRONOUS CONVERTER. — See Converter, synchronous.

SYNCHRONOUS MOTOR.—See Motors, a-c., synchronous.

SYNCHROSCOPES.—These are instruments for indicating whether two alternating-current machines are operating at the same frequency. They are essential in all stations where two or more a-c. machines are to be operated in parallel. The common term synchroscope is a contraction of the correct name—synchronoscope, or synchronism indicator.

The principles of operation of synchroscopes are the same as those of power-factor meters. Perhaps the simplest method of determining whether two machines are in synchronism is to connect lamps or a voltmeter in series with the opposing secondaries of two transformers, the primaries of which are connected, one to each, to the generators to be synchronized. When the machines are in synchonism and the same polarity at the busbars, the secondary voltages neutralize each other and the lamps are "dark." By cross-connecting the secondaries so that the two secondary e.m.f.'s are in series the lamps will burn the brightest at the instant of synchronism.

A type of synchroscope much used in practice is an electrodynamometer with spring control. The fixed coils are connected through a resistor directly across the station busbars and the movable coil is connected in series with a condenser and across the terminals of the machine to be synchronized. If the machine is in synchronism and in phase or 180° out of phase, the currents in the two coils will be in quadrature and hence they will exert no torque on the movable element and the pointer will stand at zero. Any change in this phase relation of the currents will produce a torque on the movable element, deflecting it to one side or the other and indicating whether the machine is running too fast or too slow. The proper phase relation is indicated by a lamp as explained above.

Another type of synchroscope is practically a combination of three interconnected reed-type frequency meters. One set of reeds indicates the frequency at the busbars, the other the frequency of the incoming machine and the third the resultant frequency. The synchroscopes are so connected that when the incoming machine is in synchronism and opposite phase the reed that shows the resultant frequency indicates the normal frequency of the system.

A third type of synchroscope consists of a pivoted soft iron core with projecting vanes surrounded by three coils, whose axes are at right angles to each other. The pivoted armature is magnetized by a current in phase with the e.m.f. of the incoming machine. The other two coils are actuated by currents from the busbars, but as one is connected through an inductance, these currents are one-quarter of a period out of phase and hence produce a rotating magnetic field. If the frequency at the busbars and that of the incoming machine is the same, the pointer will take a position determined by the phase difference between the two e.m.f.'s. If the frequencies are not the same, the pointer will rotate. The direction of rotation will indicate which machine has the higher frequency.

An efficient synchroscope should indicate the difference in frequencies, which machine has the higher frequency, and the phase difference when the frequencies are equal.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Roller-Smith Co., 233 Broadway, New York, N. Y.
SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill. "S. & C."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

SYNTHERMAL.—Trade name for fuses and switches manufactured by the Motor Protector Mfg. Co., 47 Kearney St., San Francisco, Cal.

SYRACUSE TWIST DRILL CO.—Syracuse, N. Y. Manufacturer of twist drills.

SYRACUSE WASHING MACHINE CORP.—507 E. Water St., Syracuse, N. Y. Manufacturer of electric washing machines. President, J. N. Derschug; vice-president and general manager, G. C. Wilkinson; secretary, William A. MacKenzie; treasurer, H. L. Babcock; sales manager, Raymond Marsh.

SYRINGES, ACID, BATTERY OR BULB.—Acid syringes are used chiefly in adding and removing the electrolyte in storage batteries. They consist of a soft rubber bulb with a short stem of hard rubber or a glass stem at the open end. When the bulb is compressed the air is forced out and the acid drawn up into the bulb. Compressing it again causes the acid to be discharged. Aside from their use for acid, they are employed for adding distilled water to the cells.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
General Scientific Equipment Co., North Philadelphia, Pa.
Luthy Products Corp., 1170 Broadway, New York, N. Y. "Automatic."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Storage Battery Supply Co., The, 239 E. 27th St., New York, N. Y.

SYRINGES, HYDROMETER.—A glass syringe in which a hydrometer may be floated. For manufacturers and details, see Hydrometer syringes.

SYSTEMS OF DISTRIBUTION, DEVELOPMENT OF.—Distribution of electricity for general lighting and power purposes has had a very interesting development. Starting on a small scale with direct-current arc lighting systems, it soon developed into direct-current incandescent lighting on the multiple system. Through the development of alternating-current generation and distribution it was possible to greatly extend the service both for lighting and power and to make possible the utilization of electricity on an economical basis for heating, electrochemical and other numerous uses.

Series Lighting Systems. Brush installed the first electric lighting system in America in Cleveland, Ohio, in 1876. It was a direct-current series system operating at a constant current of about ten amperes, and being a high-tension system found its main field of usefulness in street and outdoor display lighting. This system which required a special generator was followed by those of Thomson and Houston, Wood and others in the following decade.

About 1895 the enclosed arc was introduced, making a great saving in lamp trimming cost, since the lamp would burn with the arc enclosed for about 70 hours instead of 12, thus saving both in carbons and labor. The enclosed arc soon displaced the ten-ampere open arc and, by increasing the voltage at the arc from 50 to 70, reduced the line current to seven amperes. Circuit loads were reduced somewhat by this change as experience had indicated that 7,500 volts was as high

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as the voltage of the arc generator could be made.

The alternating-current arc lamp was developed for enclosed operation and rapidly took a place, since it permitted the use of energy taken from the general power supply. As a result many d-c. arc machines were scrapped and considerable savings were effected in the cost of plant operation.

The advent of the tungsten lamp about 1908 and its subsequent improvement in the gas-filled type provided a lamp which equaled arc lamps in efficiency and gave a more satisfactory light. The enclosed arcs and the flaming arcs which had been later introduced shortly became obsolescent and are rapidly disappearing.

The use of alternating-current circuits for series lighting affords a means of isolating the lamp and its fittings from the high voltage of the main circuit, by the use of a series transformer. With 300-watt units or larger a separate transformer is provided for each lamp or cluster of lamps. With units of 60 to 200 watts, which are used for lighting in residence districts, a group of lamps in one or two city blocks is carried on a secondary series circuit, the voltage of which may be kept below 150. This greatly reduces the hazard of working series circuits and the cost of the fittings. Such series of series systems are being installed in several of the larger cities for street lighting in residence sections.

Multiple Systems. The glare of the arc lamp makes it useless as an illuminant for residences, offices and most other interiors. The "subdivision" of the electric lamp engaged the attention of Edison. He undertook to produce a lamp which would give light from an incandescent filament, operating on a multiple circuit at low voltage. After many experiments he made a lamp with a carbon filament which would last reasonably well, and proceeded to develop the necessary conductors, junction boxes, sockets, fuses and fittings needed to install the complete system.

In September, 1882, the first commercial central-station plant was put into operation in the downtown district of New York City and this was followed a few weeks later by a plant at Appleton, Wis. Edison systems were installed in nearly all the larger cities in the succeeding years, and were extended rapidly each year as additional machinery could be installed.

The first installations were designed to operate at 110 volts, two-wire. It was seen very soon that this would require much copper and Edison devised the three-wire system by putting two generators at 110 volts in series and bringing a neutral wire from the junction point. With the load balanced this greatly increased the range of the feeder system and the capacity of feeders, since the main part of the load was carried at 220 volts.

In 1897 the larger companies began the practice of providing storage-battery protection against service interruption. This greatly enhanced the character of the service rendered and has given the d-c. system a distinct advantage. This advantage is further strengthened by the greater usefulness of the d-c. motor in variable-speed work, such as elevators, printing presses, etc.

In the year 1897 the synchronous converter was introduced as a source of direct current from an alternating-current supply. This permitted the smaller plants to be shut down during lightly loaded periods, thus saving fuel and labor. This development proved to be the means by which the great power supply systems of the present day were made possible. The original Edison d-c. generating plants were thereafter replaced by a-c. machines of much larger sizes driven by direct-connected prime movers of much better efficiency than the older and smaller units.

Alternating-Current Systems. The high copper cost of the d-c. system when applied to outlying sections of the large cities greatly restricted the extension of service to these districts and created a demand for a cheaper system. This led George Westinghouse to become interested in the alternating-current system. By this system the main distribution was made at 1100 volts, 133 cycles and transformers were located near the consumer's premises to provide pressure suitable for the lamps and wiring. This pressure was made 55 volts in the earlier installations because of the better life of lamps. However, it required a transformer for each building, since at this pressure the regulation was too poor to supply service over 100 ft. from the transformer. This system was put into service for the first time in 1886, at Greensburg, Pa.

Thomson and Houston shortly developed a similar system which was operated at 125 cycles and other systems followed.

In 1888 Tesla devised a polyphase system which was shortly thereafter introduced in America by Westinghouse. His company adopted the two-phase system for distribution purposes because of the greater ease of balancing the load between phases. The polyphase system had an advantage over single-phase distribution in that motors of the induction type could be made self-starting without the complicated starting coils required for single-phase motors. This made the system readily applicable to industrial operations and made it a competitor of direct-current systems, motors for which had been well developed.

Three-phase lines were used for transmission purposes since the copper required was but 75% of that required for single phase at the same voltage, and balancing was not difficult with the larger loads carried. This led Chas. F. Scott, then of the Westinghouse company, to devise the well-known Scott connection for transforming from two-phase to three-phase supply, or the reverse, by the use of two transformers of the proper ratio.

Within ten years the original voltage of 1100 had become inadequate and 2200-volt systems began to supplant the 1100-volt systems. Likewise, it had been found that 133 cycles was too high a frequency for good motor designs and for line drop and 60-cycle system came into use. The replacement came in most cases as the natural growth of load which made the old plants too small and inefficient to make it pay to continue them.

The expiration of the Edison three-wire patent permitted the use of the three-wire system for secondary mains. This led to the replacement of many small inefficient transformers with larger ones, and a change from 55 to 110-220 volts.

In the year 1900 the first large four-wire three-phase station was started at Chicago. This supplied a rebuilt system at 2300 volts from phase to neutral and 4000 volts from phase to phase. This system had the great advantage of utilizing the standard 2200-volt transformers on the distributing mains and yet having the advantage of 4000-volt distribution on the feeder system. Two single-phase feeders, having as such a combined load capacity of 600 kw. had a capacity of 900 kw. when combined as a four-wire three-phase feeder with only 75% as great loss of energy. This system has been adopted in many of the larger cities instead of the original single-phase or two-phase systems.

At present 60-cycle systems are almost universal for general distribution purposes in America, and alternating current is distributed in all parts of cities and towns except those larger cities in which Edison d-c. systems were originally started in the more built up portions where the load is very concentrated.

Single-phase mains are used where lighting is the chief load and three-phase mains where there is power as well as light. Three wire delta-connected systems are used in smaller cities where distances do not exceed the range of 2300-volt distribution and the capacity of three-wire feeders is ample to carry the load without undue multiplication of feeders. Three-wire mains are cheaper than four-wire since the minimum size of wire is determined by mechanical requirements and is amply large for electrical requirements at 2300 volts.

In economy of operation the a-c. systems are not far different from the Edison d-c. system. The losses at maximum load are higher in the d-c. system and the copper losses during a year are about double those of a well planned a-c. system. However, the continuous losses in the cores of the transformers of a-c. systems are sufficient to approximately make up the difference. The annual efficiency of a large city system is from 75 to 80% between the power-station bus and consumers' meters.

T

T.—The letter T is used as a symbol for temperature. The form t is also used as an abbreviation and symbol for time, usually measured in seconds.

T. & B.—Trade name for flexible conduit and conduit fittings manufactured by the Thomas & Betts Co., 63 Vesey St., New York, N. Y.

T. & W.—Trade name for heating device plug manufactured by the T. & W. Electrical Mfg. Co., Inc., Register Bldg., Santa Ana, Cal.

T. & W. ELECTRICAL MFG. CO., INC.—Santa Ana, Cal. Manufacturer of heating device plugs. President, C. E. Treat; secretary, Miss M. Walkinshaw. Main office, Register Bldg., Santa Ana, Cal. Branch office, 4503 Ravenswood Ave., Chicago, Ill.

TA.—The form Ta is the chemical symbol for the metallic element tantalum.

TABER PUMP CO.—Buffalo, N. Y. Manufacturer of electric pumps and groomers. Business established 1859. President, B. C. Taber; vice-president, William F. Traudt; secretary and treasurer, P. E. Wurst.

TABLE CLAMPS.—See Clamps, table (push-button).

TABLE LAMPS.—See Lamps, table and reading.

TABLE STOVES.—See Stoves, electric, disk or table.

TABLES, CHOCOLATE DIPPING, ELECTRICALLY HEATED. — Chocolate and bonbon coatings must be maintained at a very close and uniform temperature. This can be accomplished best by electrically heated dipping and coating pans which can be maintained at the desired temperature without heating the adjacent atmosphere which is objectionable in the dipping room which must be moderately cool so that the coatings will set quickly and properly. The tables are ordinary wood tables of suitable construction containing one or more dipping and coating pans.

Manufacturers:

CUTLER-HAMMER MFG. CO., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "C-H." (See display adv. pages 1225-1230.)

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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INTERNATIONAL ELECTRIC CO., 218-222 S. McCrea St., Indianapolis, Ind.



International Chocolate Heater

Chocolate heaters and dipping tables, complete; four styles, two sizes. Write for bulletin.—Adv.

Mabey Electric & Mfg. Co., 968 Ft. Wayne Ave., Indianapolis, Ind.

TABLES, DISPLAY, STATIONARY AND REVOLVING.—To attractively display a number of products such products are sometimes mounted on specially constructed racks or tables which may be placed in the aisles or windows of the electrical store. Some of these have plate glass or mirrored glass tops. To more easily attract attention, or to display a greater variety of goods such stands and tables are frequently revolved by belting the central standard or shaft to an electric motor, usually concealed beneath the base of the stand.

Manufacturer:

Smith, Winfield H., 10-16 Lock St., Buffalo, N. Y.

TABLES DRAFTING.—Tables designed especially for mechanical or architectural drawing, and used largely in engineering, manufacturing and utility drafting rooms. Some styles are built with adjustable tops that can be tilted at an angle to suit the convenience of the draftsman. For very large boards they are sometimes equipped with an exactly horizontal straight edge that travels over the board in place of the commonly used T-square.

Manufacturers:

American Drafting Furniture Co., Inc., 103 Mill St., Rochester, N. Y.
Cole Co., The H., Columbus, Ohio.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Economy Drawing Table & Mfg. Co., S. Center St., Adrian, Mich. "Economy."
Pease Co., The C. F., 829 N. Franklin St., Chicago, Ill.
Post Co., The Frederick, 319 S. Wabash Ave., Chicago, Ill.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Washburn Shops, The, Worcester, Mass. "Worcester."

TABLES, KITCHEN POWER.—See Kitchen power units or power tables

TABLES, SEWING-MACHINE POWER.—See Sewing-machine power tables.

TABLES, TRANSFER, ELECTRICALLY OPERATED.—In railway car houses, car construction shops and many other similar locations, it is necessary to transfer cars or special trucks from one storage or work track to another without the inconvenience of switches and curves, which occupy much ground space. A transfer table or platform is built, having a pair of rails matching those of the storage tracks, and shifting past them on a lower set of rails laid at right angles to them. By means of an electric motor and controller mounted on the transfer table, it is brought opposite any one of the storage tracks and the car it is desired to move, run out onto it. After shifting to a point opposite the proper track the car is moved off into the new location. These transfer tables are equipped with a traction motor, a controller in an operator's cab at one end and a trolley pole extending up from the cab to an overhead trolley wire.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Nichols & Brother, George P., 2139 Fulton St., Chicago, Ill.
Whiting Corporation, Harvey, Ill.

TABLES, TURN, LOCOMOTIVE.—See Turntables, locomotive.

TABULATING MACHINE CO.—50 Broad St., New York, N. Y. Manufacturer of motor-driven tabulating and sorting machines. Subsidiary of Computing-Tabulating-Recording Co., 50 Broad St., New York, N. Y. President and general manager, Thomas J. Watson; vice-president, George W. Fairchild; secretary and treasurer, James S. Ogsbury. Factories, Endicott, N. Y.; Washington, D. C.

TABULATING MACHINES, MOTOR-DRIVEN.—These are machines used to tabulate results obtained in the analysis of certain business conditions, surveys, reports, etc. They are driven by small fractional-horsepower motors. The machines may also be used to separate perforated cards according to any desired system, to select cards representing certain articles or classes of items or certain conditions, and tabulate these results.

Manufacturers:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Jagabi."
International Business Machines Co., Ltd., Royce St. & Campbell Ave., West Toronto, Ont., Can. "Hollerith."
Powers Accounting Machine Co., Inc., 137 S. LaSalle St., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y.
Tabulating Machine Co., The, 50 Broad St., New York, N. Y. "Hollerith."

TACHOMETERS.—These are instruments for showing the speed of a rotating body. Classified according to operation they are of three types, centrifugal, vibrating reed and electrical. Classified according to the character of their readings, they are either indicating or recording; the former show the speed at any instant; the latter make a graphic record of the speed. Tachometers of all types almost invariably read in revolutions per minute

TACHOMETERS, CENTRIFUGAL.—The centrifugal type is of two forms, one consisting of revolving weights on the ends of levers, as in Watt's governor. The movement of the weights is transmitted to a pointer which moves over a scale graduated in speed. In the other or liquid form a small centrifugal pump, operated from the shaft whose speed is desired, discharges a liquid into a vertical tube, the height of the column of liquid indicating the speed. The centrifugal weight type is the oldest type of tachometer and is still widely used, although not as accurate as the reed or electric types.

Manufacturers:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Jagabi" Type C hand tachometers with 3-in. dials; operating on the centrifugal principle. Accurate. Dead-beat action. Convenient to use. Each instrument has three ranges, the change from one to another being made by a special gear shifting device. Standard ranges up to 12,000 r. p. m.—Adv.



"Jagabi" Type C Tachometer

Bowsher Co., The N. P., South Bend, Ind.
Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y. "Victometer."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McDonnell Odometer Co., 3501-03 S. Kedzie Ave., Chicago, Ill. "Lightning." "Precision."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y.
Sticht & Co., Herman H., 15 Park Row, New York, N. Y. "Standco."
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "T-L Co." (See display adv. page 1286.)
Veeder Mfg. Co., Sargeant & Garden Sts., Hartford, Conn.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Zernickow, O., 15 Park Row, New York, N. Y. "O-Z."

TACHOMETERS, ELECTRIC, INDICATING.—The simplest form of an electric tachometer is a direct-driven magneto generator connected to a voltmeter which indicates the speed instead of volts. Instead of a voltmeter, a reed frequency meter may be operated by the magneto or other small alternator which is driven by the shaft whose speed is desired. The scale of the magneto-voltmeter type is very uniform throughout its normal range.

Manufacturers:

Adsit Laboratories, The, 825 Hennepin Ave., Minneapolis, Minn.
BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Frahm."
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
Foxboro Co., Inc., The, Foxboro, Mass.
HOLTZER-CABOT ELECTRIC CO., 125 Amory St., Boston, Mass.
Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y. "Victometer."
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

TACHOMETERS, ELECTRIC, RECORDING.—The voltmeter type of electric tachometer may be made recording by attaching to the pointer some marking device and a clock-operated strip of paper, thus giving a graphic record of the speed in the same way as other graphic instruments record the current, voltage, power, etc.

Manufacturers:

Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Electric Tachometer Corp., The, 310 N. 11th St., Philadelphia, Pa. "Tetco."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
Nicholas Power Co, Inc., 90 Gold St., New York, N. Y.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

TACHOMETERS, VIBRATING-REED.—The reed type of tachometer is essentially the same as the reed type of frequency meter, which can be used on a-c. generators directly since the speed and frequency are connected by the relation $n=f/p$, where n is the speed in revolutions per second, f the frequency in cycles per second, and p the number of pairs of poles. For other machines the reed tachometers are belted to the shaft and the reed is set in vibration by some mechanical device.

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Manufacturer:

BIDDLE, JAMES G., 1211-13 Arch St., Philadelphia, Pa. "Frahm" vibrating-reed tachometers for speeds between 800 and 12,500 r. p. m. No belt, gears or electrical connections. Simply at-



"Frahm" Tachometer

tach instrument to machine, and that is all there is to it. Less likely to need repairs than any other type. Especially suited for steam turbines.—Adv.

TACKS, INSULATED.—Double or single-pointed tacks provided with sleeves, washers or caps of fiber or other insulating material for use in supporting the wires of bell, annunciator or other low-tension signal circuits on walls or other surfaces. Their insulation is not designed for voltages above about 15, therefore, these tacks should not be used for lighting or other circuits exceeding this value.

Manufacturer:

Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

TACOMA.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TACONY STEEL CO.—Philadelphia, Pa. Manufacturer of steel for springs, etc. President, J. B. Warren; vice-president, and treasurer, George Satterthwaite; secretary, Henry T. Stetson. Main office, 1417 Sansom St., Philadelphia, Pa. Branch offices, Boston, Mass.; New York, N. Y.; Cleveland, Ohio.

TAFT-PIERCE MFG. CO., THE.—Woonsocket, R. I. Manufacturer of magnetic chucks.

TAGLIABUE MFG. CO., C. J.—New York, N. Y. Manufacturer of indicating and recording thermometers. Main office, 18-88 33rd St., New York, N. Y. Branch offices, Boston, Mass.; Chicago, Ill.; Pittsburgh, Pa.; San Francisco, Cal.; Tulsa, Okla.

TAGS, CABLE, CIRCUIT, POLE AND WIRE.—In large systems and on long lines it is desirable to number the poles and circuits. On long lines it is usual to number every fifth or tenth pole, thus making it easy to identify any pole in the line by stating its position with regard to the nearest numbered pole. Circuit numbers placed on crossarms are of value where men are shifted from time to time and the system is too large to be familiar to all the men.

Painted stencil numbers or separate tags are used. The tags are made in various forms, brass and enameled steel being the most common. They are also fastened to cables in manholes.

Manufacturers:

Benedict Mfg. Co., East Syracuse, N. Y.
Dennison Mfg. Co., Framingham, Mass.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Moise-Klinkner Co., 369 Market St., San Francisco, Cal.
Railroad Supply Co., The, 203 S. Dearborn St., Chicago, Ill.

TAGS. SHIPPING, FACTORY, ETC.—These tags are used in enormous numbers for price tags, shipping tags, etc. They are usually made of heavy paper or bristol board on which is printed a form for filling in the information the tag is to convey and are attached to the article by a string or wire through a hole in the tag, though some tags such as shipping tags, attached to boxes, are usually tacked on.

Manufacturers:

American Tag Co., 6143 S. State St., Chicago, Ill.
Dennison Mfg. Co., Framingham, Mass.
International Tag Co., 319-329 N. Whipple St., Chicago, Ill. "I-T," "Duo Safety."

TAILORS' IRONS.—See Irons, electric pressing, tailors'.

TAILORS' SEWING MACHINES.—See Sewing machines, motor-driven, tailors', shoemakers', hatters', etc.

TAILRACE.—A canal or tunnel for conducting water from the turbines or downstream ports of a water-power plant to the point where it is discharged back into the stream. Tailraces are carefully designed in order that this may be accomplished with a minimum sacrifice of head.

TAKAMINE COMMERCIAL CORP.—120 Broadway, New York, N. Y. Manufacturer of electric control equipment, elevator safety and signaling devices, etc. President, Eben T. Takamine; secretary and treasurer, Sydney B. Carragan.

TAKEUP REELS.—See Reels, payout and takeup.

TALC.—Talc is a hydrous magnesium silicate, containing in its pure state about 63% of silica, 32% of magnesia, 5% of combined water. Soapstone, French chalk and lava are all forms of talc. It is used occasionally for electrical insulation, in the form of barriers for switches, or in slabs for switch cells and bus compartments. Talc will withstand very high temperatures; it is not affected by acids, oils or alkalies, and is easily machined or drilled.

TALC PRODUCTS CO.—7 Hanover St., New York, N. Y. Manufacturer of powdered soapstone, etc. President and general manager, H. B. Barling. Factory, Glendon, N. C.

TALLMAN BRASS & METAL, LTD.—Wilson St., Hamilton, Ont., Can. Manufacturer of lighting fixtures, fixture fittings and parts, metal stampings, etc. President, J. N. Tallman; vice-president, W. N. Tallman; secretary, treasurer and general manager, A. H. Tallman; sales manager, G. McKnight.

TAMARACK.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TAMPING BARS.—See Bars, pole or post hole, digging and tamping; Bars, tie tamping.

TAN.—Contraction of tangent, a trigonometric function, when referring to the tangent of a particular angle, as tan θ, tan 15°.

TANDEM.—A term used to designate connection of one winding of one machine to a different winding of another. With two induction motors, for example, the secondary of one motor is connected to the primary of a second motor, the object being to obtain a lower speed than that given by one alone. This is also called a cascade or a concatenated connection.

TANDEM.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TANGENT.—(1) A straight line that just touches the circumference of a circle and is, therefore, at right angles to the radius at the point of contact. (2) One of the three most used trigonometric functions. In a right-angled triangle the tangent of one of the acute angles is the ratio of the distant leg (side opposite the the angle considered) to the adjacent leg (side between this angle and the right angle). When referring to a particular angle the contracted form tan is almost invariably used, as tan 45°=1.

TANGENT GALVANOMETER.—See Galvanometer.

TANGENT TRACK.—Straight track or track assumed to be tangent to a circle or curve.

TANK ALARMS.—See Alarms, tank, high and low water.

TANK SWITCHES.—See Switches, tank or float.

TANKLESS.—Trade name for motor-driven air compressors manufactured by the C. M. Sorensen Co., Inc., 177 E. 87th St., New York, N. Y.

TANKS, ELECTROPLATERS'—These are the tanks used to contain the electroplating solution, in which the objects to be plated are hung. For small work they may be of various materials, as required, and are usually made in a single piece, but for large work they are usually made from wood, lead-lined for certain acid solutions, or coated inside with prepared asphaltum for alkaline solutions. The walls of large tanks are usually 2 to 3 ins. thick, made from selected, kiln-dried lumber, often treated, and carefully jointed and held together by iron bolts.

Manufacturers:

Alberene Stone Co., 228 E. 23rd St., New York, N. Y. (Soapstone.)
Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.
Canadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Littleford Bros, 453 E. Pearl St., Cincinnati, Ohio.
Munning & Co. A. P., Church St., Matawan, N. J. "Optimus."
National Tank & Pipe Co., 275 Oak St., Portland, Ore. "National Quality."
U. S. Electro Galvanizing Co., 28-34 Stockton St., Brooklyn, N. Y.

TANKS FOR ELECTROPNEUMATIC WATER SYSTEMS.—Hermetically sealed metal enclosures having suitable piping connections for use with automatically controlled motor-driven water service pumps. The tanks are designed to trap a certain amount of air which is compressed by the confined water, giving rise to pressure which will force the stored water through the systems.

Manufacturers:

Fabricated Steel Products Corp., Leetonia, Ohio. "Treat 'Em Rough."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Graver Corp., East Chicago, Ind.
Hanson & Van Winkle, Newark, N. J.
Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Koven & Bro., L. O., 154 Ogden Ave., Jersey City, N. J.
Littleford Bros., 453 E Pearl St., Cincinnati, Ohio.
Stevens Tank & Tower Co., 9-23 Center St., Auburn, Me. "Dirigo."

TANKS LEAD-LINED, FOR LARGE STORAGE BATTERIES, ETC.—Most materials are quickly affected by the sulphuric acid solution used in the common storage battery. Small battery cells are made from glass or hard rubber, but neither of these materials is suitable, on account of their brittleness, for the cells or tanks required for large batteries. These tanks are strongly built from treated wood and lined with heavy sheet lead, bent and burned together to fit. Lead is the only cheap and common metal suited to this purpose. It is also widely used in other tanks containing weak acids for electrolytic or other manufacturing purposes.

Manufacturers:

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Munning & Co., A. P., Church St., Matawan, N. J.

TANKS, MISCELLANEOUS, POWER HOUSE.—A variety of tanks are required in connection with the ordinary power plant. These are generally made of steel and are used for storage purposes and in connection with various circulating systems. Where compressed air is used, riveted or welded tanks are used for storage. Poor water supply in some localities makes it necessary to have tanks for the storage and treatment of the water to remove the impurities by filtering, distilling or by various chemical treatments. Lubricating and insulating oils are ordinarily kept in sheet steel tanks, both for storage purposes and for filtering and dehydrating for reuse.

Manufacturers:

American Welding Co., Carbondale, Pa. (High pressure.)
Biggs Boiler Works Co., Akron, Ohio. "Biggs."
Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Bowser & Co., Inc., S. F., Creighton & Bowser Aves., Fort Wayne, Ind. (Oil.)
Chicago Tile Arch Furnace Co, 321 W. Austin Ave., Chicago, Ill.
Coatesville Boiler Works, Coatesville, Pa.
Codd Co., E. J., 700-708 S. Caroline St., Baltimore, Md.
Cole Mfg. Co., R. D., Newnan, Ga.
Continental-Pipe Mfg. Co., Seattle, Wash.

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Dillon Steam Boiler Works, D. M., Fitchburg, Mass.
Dover Boiler Works, Dover, N. J.
Downingtown Iron Works, Inc., Downingtown, Pa.
Fabricated Steel Products Corp., Leetonia, Ohio. "Treat 'Em Rough."
Freeman Mfg. Co., Racine, Wis.
Furman-Fisher Corp., 30 Church St., New York, N. Y.
Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.
Graver Corp., East Chicago, Ind.
Green Engineering Co., East Chicago, Ind.
Hamler Boiler & Tank Co., 39th & Halsted Sts., Chicago, Ill.
Heine Safety Boiler Co., 5315 Marcus Ave., St. Louis, Mo. "Heine."
H. S. B. W.—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
International Engineering Works, Inc., Waverly St., Framingham, Mass.
Koven & Bro., L. O., 154 Ogden Ave., Jersey City, N. J.
Lancaster Iron Works, Lancaster, Pa.
Littleford Bros., 453 E. Pearl St., Cincinnati, Ohio.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
National Tank & Pipe Co., 275 Oak St., Portland, Ore. "National Quality."
Nugent & Co., Inc., William W., 146 W. Superior St., Chicago, Ill.
O'Brien Boiler Works Co., John, 1601 N. 11th St., St. Louis, Mo.
Ormsby Co., Ltd., The A. B., 48 Abell St., Toronto, Ont., Can. (Transformer.)
Petroleum Iron Works Co., The, Drawer 539, Sharon, Pa.
Pittsburgh-DesMoines Steel Co., 404 Ross St., Pittsburgh, Pa.
Reeves Bros. Co., 338 Rush St., Alliance, Ohio.
Ruemmeli-Dawley Mfg. Co., The, 3911 Chouteau Ave., St. Louis, Mo.
Spokane Culvert & Tank Co., Spokane, Wash.
Stevens Tank & Tower Co., 9-23 Center St., Auburn, Me. "Dirigo."
Struthers-Wells Co., Warren, Pa.
Tide Water Iron Works, 725 Jefferson St., Hoboken, N. J.
Treadwell Construction Co., Midland, Pa.
United Conveyor Corp., Old Colony Bldg., Chicago, Ill. "De Luxe."
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Wendnagel & Co., 600 W. 22nd St., Chicago, Ill.

TANNATE.—Trade name for leather belting, straps and washers manufactured by J. E. Rhoads & Sons, 12 N. 3rd St., Philadelphia, Pa.

TANNER & CO., WILLIAM F.—Baltimore, Md. Manufacturers of panelboards, switchboards, etc.

TANNEWITZ WORKS, THE.—Grand Rapids, Mich. Manufacturers of motor-driven wood saws.

TANTALUM LAMPS.—See Lamps, incandescent, tantalum.

TAPALOG.—Trade name for pyrometer recorders manufactured by the Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

TAPE, ASBESTOS.—A tape having a base of asbestos fiber, which for heat-resisting qualities is much superior to paper and cloth tapes. Various impregnating and cementing compounds are used with the woven base, some being applied after the tape is in place on an armature, magnet coil or heating unit or wherever it is to be used.

Manufacturers:

American Insulation Co., Roberts Ave. & Stokley St., Philadelphia, Pa.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Dagnall Asbestos & Insulation Co., 316 Lagauchetiere St., W., Montreal, Que., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. "Deltatape" is a heat-resisting insulating material having asbestos fiber as a base. Through special treatment a very high temperature is required to destroy this tape. It can be furnished in any desired thickness from 10 to 25 mils. Its thinness and flexibility make it an admirable material for insulating the covers and terminals of all types of coils, and for insulating between turns on flat wound motor coils. Deltatape can be furnished in widths ranging from ¾ in. to 1½ in. Prices on special widths quoted on application.—Adv.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Kramig & Co., R. E., 8th St. & Eggleston Ave., Cincinnati, Ohio.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Vulcan Asbestos Mfg. Co., 95 Broad St., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TAPE, COTTON (SURGICAL WEB, STAY BINDING, WEBBING.)—The various forms of cotton insulating tapes are classified according to the weave, and the threads are usually arranged in three different ways, straight, biased or webbed. When untreated, these tapes are hygroscopic and therefore are not entirely satisfactory unless impregnated or protected from moisture. Their main use is for binding field and armature coils and for mechanical protection. Surgical tape or web is closely woven tape of the herringbone pattern. Webbing is the strongest form of woven tape and does not stretch readily. This is used considerably for binding transformer coils, or in other places where there are large mechanical stresses. Stay binding is another form of webbing, but usually is not as closely woven.

Manufacturers:

Adamson & Co., Joseph, Columbia & Germantown Ave., Philadelphia, Pa.
ANCHOR WEBBING CO., Pawtucket, R. I. Awebco (Blue Label) tapes, and webbings made to specifications of some of the largest electrical concerns. Their



Awebco (Blue Label) Tapes

factory numbers are known everywhere and are recognized as being standard.—Adv.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barton, F. C., 65 Worth St., New York, N. Y. "Lily Brand."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldentape."
Boston Armature Works, 77 Washington St., N., Boston, Mass.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Empire Mfg. Co., Lockport, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa. "Lion."
Hope Webbing Co., Providence, R. I. "Hope."
Lambeth Rope Corp., New Bedford, Mass.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Pearce Co., Inc., The R. T., 12-16 E. Pike St., Covington, Ky. "Pearce."
Preston Mica Co, Robert K., 804 Monadnock Block, Chicago, Ill.
Schlegel Mfg. Co., The, College & Goodman Sts., Rochester, N. Y.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Sidebotham, Inc., John, 4317 Griscom St., Frankford, Philadelphia, Pa.
Sullivan & Sons Mfg. Co., J., 2224 N. 9th St., Philadelphia, Pa. "Star."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Windsor Webbing Co., Beverage Hill Ave., Pawtucket, R. I.

TAPE, FRICTION.—Cloth fabric in narrow tape form saturated with an insulating adhesive compound and used in wrapping joints made in electric conductors. The tape is applied to cover the splice with an insulation practically equal to that on the remainder of the conductor. Friction tape is not designed for high-voltage wires, nor for wires exposed to much moisture.

Manufacturers:

Ackurate Rubber Co., Inc., 253 Broadway, New York, N. Y. "Ackerman."
Adamson & Co., Joseph, Columbia & Germantown Aves., Philadelphia, Pa.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass. "Armature," "Bull Dog," "Magnet," "Service."
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "Newark."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Clifton Mfg. Co., 65 Brookside Ave., Boston, Mass.
Commercial Electrical Supply Co., Broadway & Spruce Sts., St. Louis, Mo. "Crown."
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Elkhart Rubber Works, Elkhart, Ind. "Apex."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.
Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa. "Lion."
Hope Webbing Co., Providence, R. I. "Hope."
Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Grimshaw."
Okonite Co., The, Canal St., Passaic, N. J.
Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."
Roebling's Sons Co., John A., Trenton, N. J.
St. Louis Rubber Cement Co., St. Louis, Mo. "C. G."
Schlegel Mfg. Co., The, College & Goodman Sts., Rochester, N. Y.
Standard Insulation Co., Rutherford, N. J. "Sico."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

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UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. U. S. friction tapes, "Holdtite" (black), "Utility" (black), "Grey Perfection" and "Armature" (white), for outside or inside general electrical work. These tapes are readily adhesive, they have the proper insulating qualities and contain no free sulphur. They will not corrode copper wire. Standard width ¾ in. Any width furnished on order.—Adv.



"Holdtite" Friction Tape

Van Cleef Bros., 77th St. & Woodlawn Ave., Chicago, Ill. "Dutch Brand."

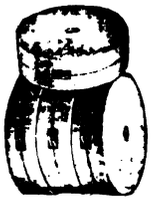
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "DXL." (See display adv. pages 1395-1402.)

TAPE, LINEN.—Linen tapes, or linen-finished tapes as they are sometimes called, are used principally for coil windings as binders, merely because of their mechanical strength and depending for insulating qualities upon the varnish or compound with which they are impregnated. These tapes, although called linen, are often made of cotton and are now being listed as such by some manufacturers.

Manufacturers:

Adamson & Co., Joseph, Columbia & Germantown Aves., Philadelphia, Pa.

ANCHOR WEBBING CO., Pawtucket R. I. Awebco (Blue Label). The term standard applied to electrical tapes used by the electrical trade, means a tape


Awebco (Blue Label) Linen Tape

manufactured under the specifications of some of the largest manufacturers of electrical machinery.—Adv.

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Barton, F. C., 65 Worth St., New York, N. Y. "Lily Brand."

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Boston Armature Works, 77 Washington St., N., Boston, Mass.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Hoffman-Corr Mfg. Co., 312 Market St., Philadelphia, Pa. "Lion."

Pearce Co., Inc., The R. T., 12-16 E. Pike St., Covington, Ky. "Pearce."

Schlegel Mfg. Co., The, College & Goodman Sts., Rochester, N. Y.

Sidebotham, Inc., John, 4317 Griscom St., Frankford, Philadelphia, Pa.

TAPE, MISCELLANEOUS INSULATING—Insulating tapes are frequently cut from various impregnated or built-up cloths and papers other than those listed herewith and are manufactured under numerous trade names. Paper and cloth mica-coated or combined with asbestos, or mica and asbestos combined with fabrics and cemented together by numerous compounds are among the special tapes made for specific purposes.

Manufacturers:

Adamson & Co., Joseph, Columbia & Germantown Aves., Philadelphia, Pa.

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind., "Champion." (See display adv. page 1320.)

Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

DOWNEY CO., GILBERT H., 7 S. 17th St, Philadelphia, Pa.

Dunton Co., The M. W., Providence, R. I. "Black Diamond," "Gibraltar," "Verifax," "23."

Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.

Elkhart Rubber Works, Elkhart, Ind. "Hydro-Proof."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Hoffman-Corr Mfg Co., 312 Market St., Philadelphia, Pa. "Lion."

Hope Webbing Co., Providence, R. I. "Hope."

Hyfield Mfg. Co., The, 21 Walker St., New York, N. Y.

INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

Mica Insulator Co., 68 Church St., New York, N. Y.

Mica Insulator Co., Victoriaville, Que., Can.

Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Grimshaw."

Okonite Co., The, Canal St., Passaic, N. J. "Manson."

Res-Pro Insulating Co., Inc., Boston, Mass. "Voltape."

Roebling's Sons Co., John A., Trenton, N. J.

Ruberoid Co., 95 Madison Ave., New York, N. Y. "P & B."

Schlegel Mfg. Co., The, College & Goodman Sts., Rochester, N. Y.

Standard Insulation Co., Rutherford, N. J. "Sico."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. U. S. splicing compounds, "Rello" and "Usco," for outside and inside work. These tapes are scientifically compounded to provide permanent di-electric and mechanical strength. They are adhesive, waterproof and easy to handle. Can be applied without heating. Standard width ¾ in. Any width furnished on order. Tapes manufactured to meet specifications if desired.—Adv.



"Rello" Splicing Compound

TAPE, PAPER.—See Paper tape.

TAPE, RUBBER.—Insulating compound containing a certain amount of unvulcanized rubber or material of equivalent elasticity, and furnished in rolls of narrow tape intended for insulating joints or splices in electric conductors. Rubber tape is used in place of ordinary friction tape for wires exposed to moisture or carrying voltages above those suited for friction tape. After rubber tape is applied it is often further protected from mechanical injury by a wrapping of friction tape.

Manufacturers:

Ackurate Rubber Co., Inc., 253 Broadway, New York, N. Y. "Candee."

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass. "Alexall," "Sterling."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)

Clifton Mfg. Co., 65 Brookside Ave., Boston, Mass.

Dominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

Elkhart Rubber Works, Elkhart, Ind. "Hydro-Proof."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Goodall Rubber Co., Inc., 11th & Race Sts., Philadelphia, Pa.

Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.

New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Grimshaw."

Okonite Co., The, Canal St., Passaic, N. J. "Okonite Tape."

Philadelphia Electrical & Mfg. Co., 1228-36 N. 31st St., Philadelphia, Pa. "Pemco."

Roebling's Sons Co., John A., Trenton, N. J.

St. Louis Rubber Cement Co., St. Louis, Mo.

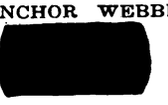
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. U. S. cable tape, made from highest grade cotton fabric thoroughly impregnated with rubber compound. Furnished by the square yard or cut in suitable widths for cable work. Tapes manufactured to meet specifications if desired.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TAPE, SILK.—A tape woven from pure silk thread and treated with oil or some other impregnating compound to make it nonhygroscopic and increase its insulating properties. It gives a very thin and flexible tape with fairly high dielectric strength.

Manufacturers:

ANCHOR WEBBING CO., Pawtucket. R. I. Awebco (Blue Label) gives users the benefit of experience that the largest electrical concerns have paid thousands of dollars to obtain.—Adv.


Awebco (Blue Label) Silk Tape

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.

Barton, F. C., 65 Worth St., New York, N. Y. "Lily Brand."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.

CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)

Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.

DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.

Hope Webbing Co., Providence, R. I. "Hope."

IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. See "Silk, Varnished," also display adv. page 1319 for all Irvington electrical products.—Adv.

Mica Insulator Co., 68 Church St., New York, N. Y.

Mica Insulator Co., Victoriaville, Que., Can.

Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

Schlegel Mfg Co., The, College & Goodman Sts., Rochester, N. Y.

Sidebotham, Inc., John, 4317 Griscom St., Frankford, Philadelphia, Pa.

Standard Insulation Co., Rutherford, N. J. "Sico."

TAPE, VARNISHED OR OILED.—Varnished or oiled tapes are used for taping windings that cannot readily be impregnated and for busbar and switchboard-cable protection, etc. They are usually cut from sheets of oiled or varnished paper and fabrics or other insulating cloths, such as varnished cambric, and may be cut straight or on the bias, the latter permitting a neater application to uneven surfaces. For their insulating properties see Fabrics, oiled insulating;

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Cloth, insulating, and Paper, oiled and paraffined.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Boston Armature Works, 77 Washington St., N., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Fillion, Inc., S. O., 68 Murray St., New York. N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. See "Silk, Varnished" and "Paper, Special and Miscellaneous Insulating"; also see display adv. page 1319 for all Irvington electrical products.—Adv.
Mcirowsky Bros., 11 McPherson Pl., Jersey City, N. J.
Mica Insulator Co., 68 Church St., New York, N. Y. "Empire." "Linotape."
Mica Insulator Co., Victoriaville, Que., Can.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.
Schoonmaker Co., A. O., 88 Park Pl., New York, N. Y. "Aosco."
Standard Insulation Co, Rutherford, N. J. "Sico."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TAPES, MEASURING.—Metallic or fabric tapes marked with linear divisions, such as inches and feet. They are usually rolled up in a pocket-size case or miniature reel with a folding winding device at one side.

Manufacturers:

Good Mfg. Co., The, 160 N. Wells St., Chicago, Ill.
Lufkin Rule Co., The, Saginaw, Mich. "Reliable." "Challenge," "Rival," "Banner," "Universal."
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

TAPES OR WIRES, STEEL FISH.—Flexible steel tapes or wires used for fishing conductors through flexible or rigid interior conduit. In the trade parlance of electricians they are often called fish or fishing "snakes." Flat steel wire or narrow tape is favored over round steel wire.

Manufacturers:

RATTAN MFG. CO., THE, 552 State St., New Haven, Conn. (See display adv. on page 1308.)
STEEL CITY ELECTRIC CO., Pittsburgh, Pa. (Write for Catalog 33.) "Superior" fish wire is a specially prepared, flat, tempered, spring wire. It is very tough, flexible, and particularly suited for long runs through conduit having several bends.—Adv.

TAPING MACHINES.—See Armature taping machines; Coil taping machines.

TAPON.—Trade name for wire connectors manufactured by Jordan Bros., Inc., 74 Beekman St., New York, N. Y.

TAPPERS, FIRE-ALARM.—Signal devices used in fire-alarm circuits to indicate the location of fire-alarm calls by tapping or striking code signals on gongs. The tapper usually has a single-stroke bell mechanism and is actuated either through relays or by direct connection in the alarm box circuit. The number of the box is the signal most commonly tapped.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
Gamewell Fire Alarm Telegraph Co., The, Newton Upper Falls, Mass.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

TAPPERS, LINE OR WIRE, HIGH-TENSION.—To tap branch lines onto main lines the power is usually shut off, if the voltage is high, on account of the danger to the linemen. Customers naturally object to this, and sometimes insulated stagings are used. Tappers have also been devised which consist of long insulating handles at the upper ends of which is a winding device. After the branch line has been completed and is ready for connection to the main line, a piece of soft copper is spliced to the branch circuit wire, then inserted in the mechanism of the tapper, which is lifted against the live wire and the branch wire wound around it by means of the handle, the operator being at a safe distance away.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
Hickey & Schneider, Inc., 434-43 E. Jersey St., Elizabeth, N. J. "H & S."

TAPPERS, WINDOW.—Advertising devices consisting of electromagnetic vibrators having armatures operating rubber-tipped hammers intended to tap or strike store windows and thus attract the attention of passers-by. Such tappers usually operate on one or two dry cells.

TAPPING MACHINES.—Bench, portable and stationary machine tools having cutting equipment for forming internal threads in pipe or conduit couplings, locknuts, holes in cast or sheet metal boxes, etc. The machines are either motor or belt-driven. They are also used to tap or thread holes in angle irons, channels, I-beams, columns, and other structural materials in order to mount insulators, etc.

Manufacturers:

Bicknell-Thomas Co., Greenfield, Mass.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "Boyer."
Garvin Machine Co., The, Spring & Varick Sts., New York, N. Y.
Langeller Mfg. Co., Arlington, Cranston, R. I.
Mueller Mfg. Co., H., Decatur, Ill.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Pipe Machinery Co., The, 930 E. 70th St., Cleveland, Ohio.

TAPS, CABLE.—Low-tension cables may be tapped by special mechanical joints which hook over the conductor after it has been bared, and are securely held by a threaded sleeve. When a high-tension line cannot be shut down to cut in new taps, special devices are available by which the work can be done with the line alive. These consist of long-handled tools by which the tap can be attached securely For this type see Tappers, line or wire, high-tension.

Manufacturer:

Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)

TAPS, CURRENT.—See Current taps, multiple type; Current taps, series type.

TAPS, THREADING OR PIPE.—Portable tools used for cutting internal threads in the ends of pipe or conduit or fittings therefor, also in holes that have been cut in metal cutout or switch boxes, etc. These taps may be used in tap holders, die stocks or in tapping machines.

Manufacturers:

American Tap & Die Co., Greenfield, Mass. "Eagle."
Armstrong Mfg. Co., The, Bridgeport, Conn.
Butterfield & Co. Division, Union Twist Drill Co., Derby Line, Vt.
Carpenter Tap & Die Co., The J. M., Pawtucket, R. I.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "Gun."
Greenfield Tap & Die Corp., of Canada, Ltd., Front & York Pl., Galt, Ont., Can. "Gun."
Morse Twist Drill & Machine Co., New Bedford, Mass.
Winter Bros. Co., Wrentham, Mass. "Thistle Brand."

TAR HEEL MICA CO., THE.—Plumtree, N. C. Manufacturer of mica and mica products. President, D. T. Vance.

TARPON.—Trade name for belting manufactured by the Page Belting Co., E. Penacook St., Concord, N. H.

TARRANT.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TAUNTON-NEW BEDFORD COPPER CO.—Taunton, Mass. Manufacturer of copper and brass bars, rods and sheets and other copper products. Business established 1831. President and general manager, Henry F. Bassett; vice-president, E. H. R. Revere; secretary, Francis J. Bassett; treasurer, John H. Barrows. Mills, Taunton and New Bedford, Mass.

TAURUS.—Trade name for electric furnace steel manufactured by the Hammond Steel Co., 2600 Milton Ave., Syracuse, N. Y.

TAYLOR.—Trade name for automatic stokers manufactured by the American Engineering Co., Aramingo Ave., & Cumberland St., Philadelphia, Pa.

TAYLOR. DR. W. D.—Mechanic Falls, Me. Manufacturer of dental lamps. Business established 1917.

TAYLOR BROS. CHURN & MFG. CO.—2951 N. Market St., St. Louis, Mo. Manufacturer of motor-driven churns and ice-cream freezers. Business established 1910. President, J. E. Taylor; vice-president, W. P. Taylor; secretary, L. E. Soudan.

TAYLOR-CAMPBELL ELECTRIC CO.—237 Dundas St., London, Ont., Can. Manufacturer of service boxes, steel cabinets, conduit couplings, unions, etc.

TAYLOR CO., H. D.—101 Oak St., Buffalo, N. Y. Manufacturer of electric cigar lighters.

TAYLOR ELECTRIC TRUCK CO.—Troy, N. Y. Manufacturer of electric car trucks, axles, etc.

TAYLOR FURNACE.—A shaft furnace for the electrothermic production of carbon bisulphide (CS_2).

TAYLOR INSTRUMENT COMPANIES.—Rochester, N. Y. Manufacturers of electrical and other indicating, recording and temperature controlling instruments. Business established 1851. President and treasurer, Herbert J. Winn; vice-presidents, James Ely, Henry W. Maurer; secretary, Henry W. Kimmel; sales manager, James Ely. Main office and factory, 95 Ames St., Rochester, N. Y. Branch offices, Boston, Mass.; Philadelphia, Pa.; St. Louis, Mo.; San Francisco, Cal.; Atlanta, Ga.; Pittsburgh, Pa; Baltimore, Md.; 29 E. Madison St., Chicago, Ill.; 31 Union Sq., New York, N. Y.; Toronto, Ont., Can.

TAYLOR MACHINE CO.—116 W. Van Buren St., Chicago, Ill. Manufacturer of oil engines.

TAYLOR WELDER CO., THE.—Warren, Ohio. Manufacturer of electric spot welders. President, G. P. Gillmer; vice-president, A. C. Taylor; treasurer, J. H. Ewalt; secretary, A. E. Hackett. Main office and factory, Warren, Ohio. Branch offices, 50 Church St., New York, N. Y.; 1017 Engineers Bldg., Cleveland, Ohio; 1217 Dime Bank Bldg., Detroit, Mich.; 1150 Peoples Gas Bldg., Chicago, Ill.

TE-TAP.—Trade name for current taps manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

TEA KETTLES, ELECTRIC.—Household size vessels for heating water and provided with electrically operated heating units with or without automatic temperature cutouts. Also provided with flexible cord and attachment plug for ready connection to supply circuit. Large stationary kettles or outfits for restaurants, etc., are usually called "urns," which see.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Manning, Bowman & Co., Meriden, Conn.

TEA POTS AND URNS, ELECTRIC.—Vessels of household size for heating water for brewing of tea and furnished in special forms with electrically operated heating units, with or without automatic temperature cutouts and with flexible cords

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and attachment plugs for connection to supply circuits. If the tea pot has a tea ball arrangement, it is often called a "samovar," which see.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
EDISON ELECTRIC APPLIANCE CO., 5600 W. Taylor St., Chicago, Ill. See display adv. pages, 1292, 1293.
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Manning, Bowman & Co., Meriden, Conn.
Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."
Van Briggle Tile & Pottery Co., The, Colorado Springs, Colo.

TEAGLE CO., THE.—1125 Oregon Ave., Cleveland, Ohio. Manufacturer of ignition magnetos and parts. President and treasurer, F. H. Teagle; sales manager, George Bell.

TEC.—Trade name for electric trucks manufactured by the Terminal Engineering Co., 17 W. 44th St. New York, N. Y.

TECCO.—Trade name for plug fuses and cutouts, panel switches, cleat rosettes and ground clamps manufactured by the Trenton Electric & Conduit Co., Tyler & Canal Sts., Trenton, N. J.

TECHNICAL AND TRADE JOURNALS OR PAPERS, ELECTRICAL.—See Periodicals, electrical, for a complete list of American and Canadian electrical journals having a national or international circulation.

TECHNICAL COLOR & CHEMICAL WORKS.—382 Hudson St., New York, N. Y. Manufacturers of lamp coloring compound, insulating paints and varnishes. Sales representatives, Myers & Schwartz, 75 N. Montgomery St., San Francisco, 1119 S. Los Angeles St., Los Angeles, Cal., 303 Maritime Bldg., Seattle, Wash.

TECHNICAL PRODUCTS CO., INC.—New York, N. Y. Manufacturer of motor-driven refrigerating and ice making machinery. President and general manager, Richard D. Kehoe; vice-president, E. P. Hubbard; secretary and treasurer, G. J. Barry. Main office, 501 5th Ave., New York, N. Y. Branch offices, 53 W. Jackson Blvd., Chicago, Ill.; Excelsior Life Bldg, Toronto, Ont., Can.

TECHNICAL SCHOOLS.—A list of American and Canadian technical schools and colleges that have electrical engineering courses for students in attendance is given under Education, electrical.

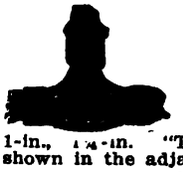
TECLA CO., INC.—Detroit, Mich. Manufacturer of electric control devices, high-frequency apparatus, radio instruments, combination fans and lighting fixtures, etc. Business established 1919. President and general manager, Thomas E. Clark; vice-president, S. W. Huff; secretary and treasurer, F. C. Morrison.

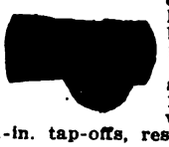
TEEFERRO.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

TEES, CONDUIT.—Special conduit fittings used largely for making taps to floor outlet boxes from a conduit line run in the floor. Of special value in large offices where many desks are to be served with telephones.

Manufacturer:

THOMAS & BETTS CO., THE, 63 Vesey St., New York, N. Y. Illustration shows the "T & B" Bulb Tee used in conjunction with brass floor coupling. It is made of malleable iron, galvanized, easy to pull through. Three sizes, ¾-in., 1-in., 1¼-in. "T & B" Split Tees shown in the adjacent illustration, are of malleable iron, heavily galvanized. Bushed and flanged at joints to prevent entrance of dust. Six sizes, ½, ¾, ¾, 1, 1, 1, in., run through with ½, ½, ¾, ½, ¾, 1-in. tap-offs, respectively.—Adv.





TEETH, ARMATURE.—The projections left on the periphery of armature cores after material has been removed by notching to make the slots.

TEGIT.—Trade name for insulating material manufactured by the Garfield Mfg. Co., Garfield, N. J.

TELAUTOGRAPH CORP.—New York, N. Y. Manufacturer of telautograph systems. President, G. H. Howard; vice-president, C. H. George; treasurer, H. M. Durning; sales manager, J. V. Mitchell. Main office, 448 W. 37th St., New York, N. Y. Branch offices, Bond Bldg., Washington, D. C.; Builders Exchange, Baltimore, Md.; 7 Water St., Boston, Mass.; 700 Elliott Sq. Bldg., Buffalo, N. Y.; 1106 Tacoma Bldg., Chicago, Ill.; 817 Holland Bldg., St. Louis, Mo.; 522 Shunkert Bldg., Kansas City, Mo.; 303 New England Office Equipment Bldg., Minneapolis, Minn.; 812 Empire Bldg., Detroit, Mich.; 410 Sloan Bldg., Cleveland, Ohio; 312 Bulletin Bldg., Philadelphia, Pa.; 2405 Union Central Bldg., Cincinnati, Ohio; 201 Keystone Bldg., Pittsburgh, Pa.; 25 Main St., E., Rochester, N. Y.; Gunter Hotel, San Antonio, Tex.; Adolphus Hotel, Dallas, Tex.; 700 Tompkins St., Syracuse, N. Y.; Grunewald Hotel, New Orleans, La.; Atlantic National Bank Bldg., Jacksonville, Fla.; 510 Union St., Seattle, Wash.; 240 Wilcox Bldg., Los Angeles, Cal.; 320 Market St., San Francisco, Cal.

TELAUTOGRAPH SYSTEMS AND EQUIPMENT.—Telautographs are systems of telegraphy which reproduce long-hand writing or any other figures or characters desired. The sending operator writes on a tablet with a pencil which is so linked to two arms of rheostats, that the motions are split up into two components and the resistances varied in proportion to these components. Each of the rheostats is in a separate line circuit, at the receiving end of which a magnet coil is connected. These coils are located in a uniform magnetic field maintained by a third coil. Variations in the current values in the lines produce corresponding variations in the pull acting between the receiving coils and the constant field. These coils are mechanically connected to arms linked to a pencil or pen point, which thus follows the movements of the transmitting pencil, reproducing anything that is written. The telautograph system is extensively used in railway terminals, hotels, clubs and for various industrial purposes, especially where it is desired to have at the receiving end, a copy of written orders, in the exact handwriting of the person issuing the order.

Manufacturer:

Telautograph Corp., 448 W. 37th St., New York, N. Y.

TELE-CALL.—Trade name for electric signaling systems manufactured by the Mead Electric Signal Co., 2109 Marquette Rd., Cleveland, Ohio.

TELECATOR.—Trade name for automobile testers manufactured by the Scott Corp., 105 N. Clark St., Chicago, Ill.

TELECHRON.—Trade name for electric clocks manufactured by the Warren Clock Co., Ashland, Mass.

TELECODE.—Trade name for relays for alarm systems made by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

TELEFAULT.—Trade name for cable testing outfit manufactured by W. N. Matthews & Brother, Inc., 2912 Easton Ave., St. Louis, Mo.

TELEGRAPH.—A system of communication by means of impulses or signals sent over a wire, which operate electromagnetic apparatus at the receiving end. The system was invented by Samuel F. B. Morse in 1837, and the first commercial message was sent in 1844. For a description of the various branches of telegraphy and of the apparatus and development, see Telegraphy, land line, commercial and technical progress in; Telegraph system, automatic; Telegraph systems, printing; Submarine cable telegraphy.

TELEGRAPH APPARATUS, AUTOMATIC TRANSMITTING AND RECEIVING.—This is apparatus used on telegraph lines in which very heavy traffic may be handled by comparatively few operators. The automatic transmitting apparatus consists of transmitters into which a perforated tape is fed. This tape may be prepared on a perforator as in printing telegraph systems or on a special machine which will send the message in the Morse code. The receiving apparatus is quite varied, and may consist of some type of a recorder, printer or stock ticker. Also see Telegraph systems, printing and Telegraph stock tickers.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Eastern Precision Electrical Instrument Co., 63-71 Observer St., Rockville Centre, N. Y.
Kleinschmidt Electric Co., Inc., 36 Flatbush Ave., Ext., Brooklyn, N. Y.
Morkrum Co., 1410 Wrightwood Ave., Chicago, Ill.
Piersen Mfg. Co., The, 700 E. 8th St., Topeka, Kans.
Vibroplex Co., The, 825 Broadway, New York, N. Y. "Martin Vibroplex" sending machine.

TELEGRAPH CIRCUITS.—See Circuits, telegraph.

TELEGRAPH KEYS.—See Keys, telegraph.

TELEGRAPH MESSENGER CALLS.—See Calls, messenger, district and telegraph.

TELEGRAPH PROTECTORS.—See Protectors, telephone, telegraph and fire alarm.

TELEGRAPH RELAYS.—See Relays, telegraph.

TELEGRAPH RESONATORS.—See Resonators, telegraph.

TELEGRAPH SETS, AMATEUR AND MISCELLANEOUS.—These are usually small sets of telegraph instruments, comprising a transmitting key and sounder. They are used principally for practice work by amateurs or men desiring to learn telegraph operating. Amateurs often use them in the construction of short lines between homes, etc. Before taking up radio telegraphy it is desirable for a student to experiment with one of these wire telegraph sets.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Amco."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Excelsior." "Eureka," "Giant," "Mesco."
St. John, Thomas M., East Windham, N. Y.
Trasco, 1201 Kahl Bldg., Davenport, Iowa. "Perfection."

TELEGRAPH SETS, MILITARY OR FIELD.—Military communication requires telegraph sets that operate on small dry batteries and are compact, strong, simple, accessible and weatherproof. Two general types of field sets are now used extensively by the United States Army. One is an induction telegraph set, consisting of a key, two dry batteries, an induction coil and a polarized sounder. When the key is closed, an instantaneous current, of fairly high voltage, flows from the secondary onto the line, pulling down the armature of the polarized sounders. When the circuit is broken, the instantaneous current in the opposite direction pulls the armatures against their upper stops. With slight modifications this set may be used on commercial lines for either simplex or duplex operation.

The other type, called the service buzzer, is more generally used and in connection with all kinds of lines of communication. It may be used as a telephone, and as a telegraph set or buzzer will operate on improvised lines even after they are broken. Sections of operating Morse lines may be used for either telephone or telegraph without causing any interference. It depends for its operation upon the effects of self-induction and in telegraphy receives the signals in a telephone receiver as a high-pitched hum. The entire instrument is mounted in a leather-covered aluminum case and may be operated with the cover closed in inclement weather.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill.

TELEGRAPH SOUNDERS.—See Sounders, telegraph.

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TELEGRAPH STOCK TICKERS.—One form of a printing telegraph, comprising a transmitter and a number of receiving instruments. The principal feature of the transmitter is a reversing commutator which sends alternating current over the line, causing the printing type wheels on all receivers to run in synchronism with the transmitting cylinder. Depressing a given key will always stop the transmitting cylinder and type wheels in the same place, and the printing magnets then press the recording tape against the type wheels, thus printing the character corresponding to the key depressed at the sending station. They are extensively used for transmitting stock and other market quotations.

Manufacturers:

Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y. "F. P. & Co."
Kleinschmidt Electric Co, Inc., 36 Flatbush Ave., Brooklyn, N. Y.
Lamson Electrical & Mfg. Co., 625 W. Jackson Blvd., Chicago, Ill.

TELEGRAPH SYSTEMS, AUTOMATIC.—The following are the most important systems of telegraphy in which the signals are transmitted and received independently of operators.

Autographic Telegraphy. A system of writing telegraph in which the message is transmitted as fast as it is written and is not prepared in advance.

Facsimile Telegraphy. A system which permits the transmission and reproduction of any combinations of lines, such as handwriting, etchings, etc.

Printing Telegraphy. Automatic systems in which the message is prepared on a tape or keyboard and is recorded by means of a type wheel which prints the message on a tape or in page form at the receiving station.

Quadruple-Duplex. A system used in connection with printing telegraphy, by means of which eight messages can be transmitted simultaneously over each circuit, four in each direction.

Telautograph. A form of facsimile telegraph. For description and manufacturers see Telautograph systems and equipment.

Writing Telegraph. An automatic system using a perforated tape for transmitting the signals, which are received in the form of a permanent record similar to handwriting.

TELEGRAPH SYSTEMS, MANUAL.—The following are the most important systems of telegraphy in which the messages are transmitted and received by operators.

Diplex System. A system by which two messages can be transmitted simultaneously over the same circuit, in the same direction.

Duplex System. A system by which two messages can be sent simultaneously over the same circuit in opposite directions. Also see Duplex, bridge; Duplex, differential; Duplex, polar.

Duplex-Diplex System. A system which permits the transmission of duplex or diplex messages, but not both simultaneously.

Morse Closed-Circuit System. A system used extensively in the United States, in which the circuit is normally closed through the transmitter keys and the relays are energized. By opening and closing any transmitter key, the sounders can be made to vibrate, thus delivering the message.

Morse Open-Circuit System. A system used mostly in Europe, operating in a similar manner to the closed-circuit but differing in having the transmitter keys normally open and the relays de-energized, the battery being in use only when messages are being sent.

Quadruplex System. A system by which four messages can be sent simultaneously over the same wire or circuit, two in each direction.

Simplex System. Simplex or single working systems are those which permit but one message to be sent at one time.

Synchronous System. A system in which the transmission and reception of signals is dependent upon the synchronous operation of similar commutators or other devices located at the sending and receiving stations of a circuit, which make possible a more complete use of the line, by consecutively connecting to the line separate sets of transmitters and receivers in operation.

TELEGRAPH SYSTEMS, PRINTING.—Printing telegraphs in general are automatic telegraph systems, controlled by a keyboard whose operation depends primarily upon the uniformity of revolution of a cylinder or disk at the transmitting station with a type wheel or disk at the receiving station. There are three principles of operation in use, the step-by-step method, synchronous disk method, and those actuated by electrical signals variable in character and succession, with mechanical transmitters.

The latter principle is now coming into general use and its development has come at an opportune time. The pole lines have nearly reached their maximum wire-carrying capacity, but by means of the keyboard transmitters in synchronous multiplex relation to page printers, the actual message-carrying capacity of the circuits has been increased as much as 400%. In addition to increasing the volume of traffic handled, the printing telegraph has also decreased the message cost, especially where traffic is heaviest. They are now used extensively by the Western Union Telegraph Co., which handles approximately 100,000,000 messages per year by means of the printers. The Associated Press also distributes news among newspaper offices in New York, Pittsburgh, Chicago, Milwaukee, St. Paul and Minneapolis, by means of the printers.

In these systems the messages are first prepared on a tape with a keyboard perforator. The perforators have five punches and the tape is perforated on a slight bias to permit a small time interval between signals; 32 combinations can be obtained by means of the five holes, permitting transmission of complete alphabet, figure shift, spacing, lining, backing, etc The tape is fed into the distributor passing over five pins which make contact depending on the perforations and correspondingly send either positive or negative impulses over the line by means of a disk rotating in synchronism with a similar disk at the receiving station. A correcting device operates each revolution to keep the two in correct relation.

At the receiving station the incoming signals are stored in relays until the letter is completed. The various combinations cause a rotating type wheel on the printer to stop at the corresponding letter, which is then printed on a sheet of paper.

At present the Western Union Telegraph Co. uses a quadruplex-duplex set, equipped for the simultaneous transmission of eight messages, four in each direction. This requires at each end of the line a distributor with driving fork and impulse motor, four transmitters, four automatic control units, four printer units, line and local relays, and duplex balancing equipment. The system is quite flexible and by means of switching arrangements and repeaters, branch lines and connecting lines equipped with printing apparatus may be connected together.

Manufacturers:

Kleinschmidt Electric Co., Inc., 36 Flatbush Ave., Brooklyn, N. Y.
Morkrum Co., 1410 Wrightwood Ave., Chicago, Ill. "Teletype."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEGRAPH SYSTEMS, PRINTING, COMMERCIAL DEVELOPMENT OF.—The development of printing telegraph systems began in the United States as early as the year 1849, when the House Printing Telegraph Co. was organized. Lines were built between New York and Boston; to Philadelphia, Buffalo, Cincinnati, and other cities. This pioneer printer worked satisfactorily, but was cumbersome and slow. Then followed the Hughes printer, the Phelps printer, the Buckingham printer, the Rowland printer and the Wright printer. Each system was given an extended tryout in service, but in the course of time gave way to the original and competing Morse system, which proved more reliable, more economical and was simpler.

In 1907 the Buckingham system was revived as the Buckingham-Barclay system and was used for four or five years quite extensively by the Western Union Telegraph Co. The replacement of this system began in 1913 when Western Union engineers built up an improved printing telegraph system based on the inventions of Donald Murray, of London, Eng. Several modifications and improvements were made and the system has been widely applied in the company's service.

The Western Union Telegraph Co. also uses the Morkrum duplex printing telegraph system on many of its lines. This system has been in continuous use since 1910 and has been widely applied in the telegraph service of railroads in the United States and Canada and by the two large commercial telegraph companies in Canada. The machine is manufactured by the Morkrum Co., of Chicago, which also has recently placed on the market a simplified printer for special service, known as the Teletype printer.

The Postal Telegraph-Cable Co., although it does not at the present time use any of the printing telegraph systems available, gave an extensive tryout to the Rowland octoplex printer in the years 1907 and 1908. The company also used the Wright system from 1909 until 1911, and the first Morkrum installation made (1910) was on a Postal wire.

Other printing telegraph systems likely soon to be introduced in American telegraph service include the simplified printer developed by Dr. L. M. Potts, of Baltimore, Md., and a system developed by the Kleinschmidt Electric Co., Inc., of New York.

TELEGRAPH TYPEWRITERS.—These are practically the same as ordinary typewriters and are used by operators in copying a message as it comes in over the wire. By using the typewriters the operators can copy much faster and can make a more legible copy than by hand writing. The typewriter keyboard is sometimes the standard keyboard and in other cases, since only the capital or uppercase letters, the numbers and period are used, some of the keys and the shift key are omitted.

Manufacturer:

Kleinschmidt Electric Co., Inc., 36 Flatbush Ave., Brooklyn, N. Y.

TELEGRAPHONE.—Trade name for telephone and telegraph composite system manufactured by the National Telegraphone & Supply Co., 317 Mills St., El Paso, Tex.

TELEGRAPHONE.—Trade name for telephone train dispatching systems manufactured by the Railway Telephone Mfg. Co., 9 S. Clinton St., Chicago, Ill.

TELEGRAPHS, SHIP.—The term ship telegraph is more or less a misnomer, inasmuch as it usually does not operate as other telegraph systems. It is essentially a mechanical device consisting of a series of brass dials or disks in various stations on the ship, which are operated in reponse to pulls on a brass wire or chain. These convey the necessary navigation signals to the proper persons. Electric telegraphs are also used occasionally on large vessels in communicating signals for anchoring, steering, docking, etc. These consist of transmitters and indicators. Also see Signaling systems, marine.

Manufacturer:

Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.

TELEGRAPHY.—A system of communication in which messages are transmitted by means of electromagnetically operated signals passing over wire or wire and ground circuits.

TELEGRAPHY AND TELEPHONY, GROUND.—A system of communication through the ground. See Ground telegraphy and telephony.

TELEGRAPHY, LAND LINE, COMMERCIAL AND TECHNICAL PROGRESS IN.—Morse's telegraph, introduced in the year 1844, was a "marking" telegraph, that is, the received signals were marked by a stylus on a strip of moving paper tape. The stylus was electromagnetically operated by the line current being interrupted by means of a sending key. The sending operator transmitted the elements of the alphabet in short and long strokes—"dots" and "dashes." It was but a few years until experienced telegraphers discovered they could read the incoming signals by the sound made by the armature of the recorder, and from that discovery developed the modern system of Morse telegraphy.

From 1846 until 1866, there were in existence a large number of independent telegraph companies in all parts of the United States. In the latter year the headquarters of the Western Union Telegraph Co. were moved from Rochester, N. Y., to New

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York City, and thenceforward consolidations continued until at the present there are two major competing commercial telegraph organizations—the Western Union Telegraph Co., and the Postal Telegraph-Cable Co. Including small companies, there are 21 land telegraph companies owning approximately 230,000 miles of pole lines carrying 2,000,000 miles of main single wire. In addition to this the American railroads own and operate about 30,000 miles of pole lines and 340,000 miles of wire. There are a total of about 30,000 telegraph offices, of which about 82% are railway offices and the remainder operated solely by the telegraph companies. The Western Union at present handles about 70% of its trunk line traffic by means of printing telegraph systems, while the Postal handles all of its large traffic by means of Morse telegraphy alone.

The technical improvements which have been made in Morse telegraphy have been important and have brought material advantages when viewed in retrospect. From relatively short circuits and slow speeds of operation the wire service has reached a stage where direct telegraph circuits are operated continuously between all of the large cities. Direct circuits are worked between New York and San Francisco; New York and Seattle; New York and New Orleans; New York and Dallas, Texas, and between other cities as widely separated. These long circuits are operated duplex; that is, one message is passed in each direction simultaneously over one wire. In certain territories where there is a minimum of inductive disturbance from neighboring high-tension power lines, single wires are carrying two messages in each direction simultaneously—quadruplex operation. Also, "pairs" of main line wires are being used for simultaneous telephone and telegraph transmission, while combinations of pairs are being used to carry physical and phantom telephone circuits and telegraph transmission in both directions simultaneously.

Morse "hand transmission" has been improved by the introduction of semiautomatic transmitters of the vibratory lever type. Operators using these sending machines are today handling 100 telegrams per hour on long circuits. Instruments used for repeating signals from one circuit into another have been considerably improved in order to pass accurately the high-speed signals transmitted by means of the semiautomatic transmitters.

Along engineering lines vast advances have been made during recent years in the character and workmanship of terminal office equipment installed. The switchboard, terminal room, and power room equipment of modern telegraph offices compare favorably with installations in other branches of electrical engineering. Development work now under way has in view further employment of underground cables in telegraph working. Terminal instruments which will operate on low current values are being developed in various telegraph laboratories.

TELEMEGAFONE.—Trade name for loud speaking telephones manufactured by the Magnavox Co., 2725 E. 14th St., Oakland, Cal.

TELEPHONE.—Any device for transmitting sound (especially articulate speech) to a distance by means other than air is a telephone. A speaking tube is not a telephone, but the acoustic telephone is properly a telephone. The electric telephone is the most prevalent, because it works the longest distances.

Acoustic Telephone. A telephone which transmits sound by mechanical vibrations of a body, usually a wire. A common form once used was made of two metal diaphragms whose centers were connected by a tightly stretched wire. The wire vibrated longitudinally.

Electric Telephone. This is the most widely used form of a telephone and is an electrical device for transmitting sound from one place to another. It does it by means of an electrical wave whose shape or component frequencies are nearly like that of the sound and controls the generation of the electric wave. A line conducts the electricity to the distant place. A receiver converts the electric wave back again into sound. The electric telephone was invented in 1876 by Dr. Alexander Graham Bell.

Electric telephones or telephone sets may be connected in various ways and either in series or multiple (called bridge connection). The series magneto telephone is a telephone instrument in which the bell and the hand generator are in series with each other and which is adapted to be connected in series on a party line. The bell resistance is from 80 to 125 ohms. The generator is normally shunted out. It is not much used now. The series common-battery telephone is an instrument in which the transmitter and a nonpolar receiver are placed in series with each other. The receiver is polarized by the battery current from the central office. The bridging telephone is a telephone instrument which is made to be bridged across a party line or a toll line. The line has high impedance and a resistance from 1000 ohms to 2500 ohms. The hand generator is normally open, but is connected in parallel with the bell when the handle is turned to ring. It is much used on rural lines.

A telephone installed on an individual line, or the chief instrument at one subscriber's station on a party line is called the "main set." There may be another set called the extension set, which is a subscriber set or telephone on a private branch exchange. Also a telephone instrument added to a main station on a subscriber line for the convenience of the subscriber. There is no separate listing in the directory. Subscribers' sets are usually called "sub-sets."

TELEPHONE AND TELEGRAPH COMPOSITE SYSTEM EQUIPMENT.—Composite telephone and telegraph sets permit the use of both sides of a metallic circuit, used primarily for telephony, as telegraph circuits. This gives two telegraph circuits, one circuit per wire with ground return, and in addition one metallic telephone circuit. An impedance coil and a condenser are used to prevent or retard the rise of current and e. m. f. in the line when the key is closed. Without such retardation the sharp rise and fall of the current would make a click in the telephone receiver and make that circuit noisy and communication impossible.

Manufacturers:

National Telegraphone & Supply Co., 317 Mills St., El Paso, Tex. "Telegraphone."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONE ARMS.—See Brackets, desk telephone.

TELEPHONE BELLS.—See Bells, telephone.

TELEPHONE BOOTHS.—See Booths, telephone.

TELEPHONE BOXES.—See Boxes, telephone, wall set.

TELEPHONE CABINETS (BATTERY).—See Cabinets, battery, telephone.

TELEPHONE CABLES.—See Cables, telephone and telegraph, aerial and underground; Cables, telephone and telegraph, interior; Cables, telephone and telegraph, submarine.

TELEPHONE CHANGERS (POLE).—See Changers, polarity or pole for telephone circuits.

TELEPHONE CIRCUITS.—See Circuits, telephone.

TELEPHONE COILS (INDUCTION).—See Coils, induction, telephone.

TELEPHONE COIN COLLECTORS.—See Coin collectors, telephone station and toll.

TELEPHONE CONDENSERS.—See Condensers, static, telephone and telegraph.

TELEPHONE CORDS.—See Cords, flexible, telephone switchboard and receiver.

TELEPHONE CUSHIONS (RECEIVER).—See Cushions, ear, telephone receiver.

TELEPHONE DROPS.—See Drops, telephone switchboard.

TELEPHONE FRAMES (DISTRIBUTING).—See Frames, distributing, telephone.

TELEPHONE FUSES.—See Fuses, telephone and telegraph, miscellaneous.

TELEPHONE GENERATORS (MAGNETO).—See Generators, magneto telephone.

TELEPHONE HEAT COILS.—See Heat coils, telephone.

TELEPHONE INSULATORS.—See Insulators, telephone and telegraph.

TELEPHONE JACKS.—See Jacks for portable telephones; Jacks, telephone, switchboard.

TELEPHONE LINE TROUBLES.—See Line troubles, telephone.

TELEPHONE METERS.—See Meters, telephone, call counting; Meters, telephone, long-distance, call measuring.

TELEPHONE MOUTHPIECES.—See Mouthpieces and mufflers, telephone.

TELEPHONE OPERATOR'S LOAD.—See Load, telephone operator's.

TELEPHONE, PORTABLE.—A telephone instrument which may be carried from place to place and used by attaching it to any telephone line for which it is adapted. It is usually built compactly in a box, with a carrying strap and much used by repair men, line patrolmen, train crews, etc., to communicate on street and interurban systems, transmission lines, etc.

TELEPHONE PHANTOM COILS.—See Phantom repeating coils, telephone.

TELEPHONE PLUGS.—See Plugs, telephone cord.

TELEPHONE PROTECTORS.—See Protectors, telephone, telegraph and fire alarm.

TELEPHONE RECEIVERS.—See Receivers, telephone, combined transmitters and; Receivers, telephone, head type; Receivers, telephone, loud speaking.

TELEPHONE RELAYS.—See Relays, telephone.

TELEPHONE RINGERS.—See Ringers, telephone.

TELEPHONE RINGING MACHINES.—See Ringing machines, telephone.

TELEPHONE SELECTIVE CALLING SYSTEMS.—There are three principal types of selective calling systems used on party lines. They are as follows:

Harmonic Signaling. This is a method of selective ringing which uses alternating current of different frequencies, and for each frequency a bell which is tuned to respond to that frequency alone. The multiple harmonic system uses 16 2/3, 25, 33 1/3, 50 and 66 2/3 cycles per second (all but one are multiples of the lowest). The nonmultiple system uses 20, 30, 42, 54 and 66 cycles per second.

Selective Signaling or Ringing. Often it is desirable on a party line that no bell shall ring except that of the called station. Any means of ringing bells which does this is selective signaling. The older means is biased bells, rung by pulsating current or direct and alternating current combined. The later means is harmonic bells, rung by alternating currents of different frequencies. See preceding paragraph.

Semiselective Signaling. This is a special means for party lines, in which each bell sounds part of the signals. It requires a few code signals, but no subscriber hears all of the calls. It is a cross between open code ringing and full selective.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass. "Intercommuniphone."
Hall Switch & Signal Co., Garwood, N. J.
Leich Electric Co., Genoa, Ill.
Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
North Electric Mfg. Co., The, Galion, Ohio.
Railway Electric Mfg. Co., 250-2 W. Water St., Milwaukee, Wis. "Remco."
Screw Machine Products Corp., The, 1012 Eddy St., Providence, R. I.
Spielman Electric Co., 1931 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONE SERVICE STATISTICS.—The first public telephone exchange was opened for business at New Haven, Conn., on January 25, 1878. In 1880 the first census of the industry was taken, and due to the fact that most of the telephone systems reporting had just started operations during the year the reports obtained by the Bureau of the Census were incomplete. In that year, 148 systems reported 3338 em-

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ployes, 437 exchanges with 34,305 miles of wire and 54,319 telephones connected. The capital stocks and funded debt was $14,605,787. By 1890 when the next census was taken the number of systems had decreased to 53, but they had 8645 employees, 1241 exchanges, 240,412 miles of wire and 233,678 telephones. The capital stocks and funded debt amounted to $72,341,736. While these figures are interesting to show the rapid growth of the telephone industry, they are not strictly comparable with those given in the table below, which were obtained by the Bureau of the Census in its census of electrical industries. These figures are for public telephone systems and do not include lines operated exclusively by railroads or those connecting branches or departments of manufacturing or mercantile establishments, hotels, mines, etc., or those operated exclusively by the government, whether federal, state or municipal.

	1917	1912	1907	1902
No. of systems.	53,234	32,233	22,971	9,136
Miles of wire (in thousands)	28,827	20,248	12,999	4,900
No. of telephones (thousands) ..	11,716	8,729	6,118	2,371
Telephones per 1000 population	113	91	72	30
No. of public exchanges ...	21,175	18,365	15,527	10,361
No. of messages (millions)* ..	19,809	13,735	10,400	5,070
No. of employees*	244,490	183,361	144,169	78,752
Salaries and wages (thousands)*..	169,655	96,040	68,279	36,255
Average messages per telephone* ...	2,043	1,875	2,190	2,140
Total revenue*.	372,502	253,894	175,750	86,852
Operating expenses (thousands)*..	313,103	202,568	134,525	65,164
Capital (thousands)*	1,169,074	970,691	739,877	348,031

*Companies with annual incomes over $5,000 only.

Data give figures covering the whole year.

Some of the figures given above apply only to the larger systems, as the figures are not available for systems with annual incomes under $5,000. The systems listed comprise such a large percentage of the total that the figures may be used for comparison. The relative importance of the smaller companies is shown by the fact that in 1917 the total number of employees for all systems was 262,629 with a total amount paid in salaries and wages of $175,670,449. The estimated number of messages was 21,845,722,335. These figures are but a small increase over those given in the table.

In the above table 2200 systems reported an annual income of $5,000 or more in 1917. Considerably more than half of these larger telephone systems are located in the Middle West; Illinois, Ohio and Indiana lead in the order named for states having the largest number of large systems. The largest wire mileage of all the states is in New York with 14.4% of the total; Illinois, Pennsylvania and Ohio follow. The greatest density of telephones per 1000 of population is in the Middle West, with Iowa and Nebraska leading.

In the last ten years, the increase in the miles of wire installed has been accompanied by an increase almost twice as large in the proportion of wire installed underground. In 1907, 38.4% of the total was underground and in 1917 this percentage had increase to 51.5.

The figures given in the table above for the capital stock and funded debt include some investments of the companies in other industries than the telephone. The net capitalization invested in the telephone industry alone in 1917 was $1,077,162,311. The total value of plants and equipment for all systems was $1,492,329,015 in 1917. Of this amount $1,435,912,142 was in plants with incomes of $5,000 or more. In 1912 the value for large plants was $1,081,433,227.

The reports giving the stocks and dividends of incorporated companies with incomes over $5,000 show an increase in the number of companies issuing common stock from 1708 in 1912 to 1896 in 1917. Of these totals in 1912 only 808 paid dividends and in 1917, 997. The net amount of common stock outstanding was $541,681,477 in 1912 and $622 433,912 in 1917. The dividend paid on this total averaged 5.95% in 1912 as compared to 6.47% in 1917. Only a small percentage of these companies have preferred stock, the number being 231 in 1912 and 210 in 1917. The net amount outstanding was $45,082,402 in 1912 and $43,510,559 in 1917. Dividends averaging 4.14% and 4.62%, respectively, were paid on these amounts.

It is interesting to compare the increase in telephones with that of the telegraph industry, inasmuch as both have the same primary object, to furnish quick and satisfactory communication. In 1880, telegraph companies operated 291,213 miles of wire as compared to 34,305 miles for the telephone companies. In 1917 the figures show telegraph companies to have 1,890,245 miles and telephone companies 28,827,188.

One peculiar thing about the telephone industry in this country is that a single organization, the American Telephone & Telegraph Co., which with its constituent organizations is commonly known as the Bell Telephone System, controls a very large proportion of the telephone equipment. In 1917 it was composed of 145 companies located in 27 different states. Although the number of public Bell exchanges only slightly exceeds those operated by non-Bell companies, the private branch exchanges connected with the Bell system are almost nine-tenths of the total. Nearly 85% of the total amount of wire belongs to the Bell system and in addition they have 287,049 miles of phantom circuit, representing 91% of that total. Over 73% of the telephones are on the Bell system and the annual revenue in 1917 was more than five times as much as all the other larger non-Bell systems combined. The assets were almost four times as much and the total dividends paid more than seven times as much as those of the independent companies.

TELEPHONE SHELLS, RECEIVER.—See Shells, telephone receiver.

TELEPHONE SHOP, THE.—506 S. Canal St., Chicago, Ill. Manufacturer of intercommunicating telephone equipment. Business established 1913. E. A. Phillips, owner.

TELEPHONE SIGNALING SYSTEMS, CODE.—See Signaling systems, code calling for factories, offices, stores, etc.

TELEPHONE, SINGING.—If the receiver of a good telephone be placed against the transmitter of the same instrument, a singing sound will be heard. It is due to a mutual action between receiver and transmitter. Sound entering the transmitter makes alternating current in the receiver, which gives forth a sound which vibrates the transmitter and sustains the action. In laboratories this is sometimes used to generate tone current for testing, but it is not very steady.

TELEPHONE STATION.—When a telephone instrument or set is installed it becomes a telephone station. A substation is an abbreviation for "subscriber's station."

TELEPHONE SWITCHBOARD LAMPS.—See Lamps, telephone switchboard.

TELEPHONE SWITCHBOARDS. — See Switchboards, telephone, automatic; Switchboards, telephone, central battery manual; Switchboards, telephone, magneto, manual; Switchboards, telephone, private branch exchange; Switchboards, telephone, semiautomatic.

TELEPHONE SWITCHES, HOOK.—See Switches, telephone, hook, etc.

TELEPHONE SYSTEMS. — Telephone systems may be divided into two general classes according to the nature of the service. This would give the manual systems and the automatic systems. They are more conveniently divided according to their application or commercial use as public or private systems; many of the systems in both these classes may be either manual or automatic as desired. Public telephone systems are those operated for commercial profit under some fixed schedule of tariffs or rates. In some countries the public systems are operated by the government without profit or little profit, but poor service generally results. The public systems must serve all who apply and are generally subject to some form of governmental public service regulation. Private systems are those operated as auxiliaries to some other form of business or enterprise, but not directly for commercial profit. They may be interconnected with public systems or entirely isolated.

Public systems are very largely interconnected. There are several terms used in referring to the degree of interconnection, as follows: Connected means that the subscribers in one exchange can call those in the other, with or without extra charge, the ownership remaining separate. Merged means that the ownership has become one. Unified or consolidated means that the two exchanges have been made into one, so that physically they are one plant.

Private systems are used for several purposes, the most important of which are train dispatching, load dispatching, line patrol, police signaling, general communication and intercommunicating. Train dispatching systems are employed by steam and electric railways in connection with the control of train movements by one or more train dispatchers. Load dispatching systems are used by many large central stations. The control of the distribution system by one or more load dispatchers is made possible in this way. Line patrol systems are also used by power companies and central stations to permit the linemen or men patrolling the transmission lines to communicate with headquarters. These systems are also used by forest rangers and by life savers in government service.

Police telephone systems consist of a private branch exchange devoted to the police department. Most of the stations are in cast iron boxes on posts along the streets. Often a police signaling system is combined with the telephone. A red lamp is mounted above the telephone box on the street. By lighting one or more of these lamps a patrolman can be called. He answers by telephoning from the nearest box. General communication systems are used by many large corporations, railroads, public service companies, etc. The intercommunicating systems are used for isolated local service, usually without an attendant, as in apartment houses, small factories, etc.

Public systems are generally divided into the two general classes, manual and automatic. The manual system is the older and at present more widely used type of exchange, employing manual switchboards at which connections are made by hand by operators, usually women. The call number is passed to the operator by the voice. This system is further divided into local-battery and common-battery systems, of which the common battery is most widely used. The apparatus and switchboards used in these two systems are different in design but operate in a similar way and accomplish about the same results, except that as a rule, much better service can be given by common-battery systems.

An automatic system is essentially a telephone exchange in which the great bulk of the connections are made by switches which are controlled by the subscriber without any operator. There is usually a dial calling device on each telephone instrument. The dial bears Arabic digits, from 1 to 0. By rotating the dial in accordance with the call number, electrical impulses are generated, which control the automatic switches in the central office. Hanging up the receiver on the hook causes disconnection. The older automatic system employed two line wires and earth return (sometimes common return) to send impulses to control the switches. One wire and earth carried pulsations corresponding to the digit of the call number. The other wire and earth carried one pulsation to change the connection in the switch so that the next series of pulsations would cause the next switching action. Grounding and clearing both line wires caused the release of the switches. This was called the three-wire automatic. The present automatic system uses only two line wires of the subscriber loop for controlling the switches. This is known as the two-wire automatic system.

A semiautomatic system is a telephone system which employs operators and automatic switches. Usually the subscriber gives the call number to the operator as in the manual system. Then the operator controls the automatic switches to set up the connection.

TELEPHONE SYSTEMS, APARTMENT HOUSE.—A private or private branch telephone system serving one apartment house or family hotel. Both manual and automatic systems are used. The latter requires no operator for local calls, and only an attendant for incoming calls whose destination is not known by the caller.

TELEPHONE TERMINALS, CABLE.—See Terminals, telephone, cable.

TELEPHONE TESTING SETS. — See Testing sets, portable, magneto and telephone type.

TELEPHONE TRAFFIC.—The volume of telephoning as an aggregate. The usual measure is the number of calls made by subscribers per day or per hour. More accurately it is the "call-hours" or the total holding time (number of calls multiplied by the average holding time per call).

TELEPHONE TRAIN DISPATCHING.—See Dispatching of railroad trains by telephone.

TELEPHONE TRAIN DISPATCHING SYSTEMS.—See Train dispatching systems, telephone.

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TELEPHONE TRANSMITTERS. — See Transmitters, telephone, desk or wall set; Transmitters, telephone, hand set; Transmitters, telephone, operators'.

TELEPHONE WIRE. — See Wire, telephone, drop; Wire, telephone, inside.

TELEPHONE, WIRELESS OR RADIO. —Telephone conversation by radio is possible by modulating or varying the current which oscillates in the aerial. These oscillations are above the range of audition, but may thus carry the characteristics of speech to the distant aerial, where they affect the receiving device with carrying intensity and so reproduce the speech. It is not yet in extensive commercial use.

TELEPHONES, AUTOMATIC. — Automatic telephones are made as both desk sets and wall telephones. They are similar to the ordinary common-battery telephones for this service except that they have a calling dial added, which is operated to obtain the desired number. In the desk set the dial is usually mounted on or directly above the base.

Manufacturers:

AUTOMATIC ELECTRIC CO., Chicago, Ill., designers, manufacturers and installers of Strowger Automatic Telephone exchanges for public and private systems of any size. More than one thousand such exchanges have been installed in all parts of the world and have been in operation for over 20 years. This equipment has been recognized by engineers and officials of the largest operating organizations as thoroughly practical and reliable, and has been adopted by the governments of the leading foreign countries. Strowger equipment renders a superior type of telephone service, being uniformly rapid and accurate in setting up connections, and by eliminating the switchboard operators, reduces the cost of operation to a minimum. Conferences with interested organizations either for public or private exchanges are invited.—Adv.

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass. "Autophone."

North Electric Mfg. Co., The, Galion, Ohio.

Pettes & Randall Co., 152 Nassau St., New York, N. Y.

Screw Machine Products Corp., The, 1012 Eddy St., Providence, R. I. "Select-O-Phone."

Spielman Electric Co., 1931 Broadway, New York, N. Y.

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, AUTOMOBILE OR LIMOUSINE.—A telephone set for enabling a person in an automobile to telephone to the driver. The transmitter is portable, the receiver is usually fixed near the driver and speaks loudly enough to be heard above road noises.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.

Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. "Motor Dictograph."

Globe Phone Mfg. Co., Reading, Mass.

KLAXON CO., Newark, N. J.

Spielman Electric Co., 1931 Broadway, New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, DESK STAND.—A telephone set which consists of a stand (bearing the transmitter, receiver, calling device, and hookswitch), a flexible cable or cord, and a bell box (containing the bell, condenser, and the rest of the apparatus). It is most used in offices, on tables and desks, etc., although often furnished for residence use.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

Audible Telephone Mfg. Co., 3037-39 N. Clark St., Chicago, Ill. "Audible."

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass. "Multiphone."

Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)

KLAXON CO., Newark, N. J.

Leich Electric Co., Genoa, Ill.

Monarch Telephone Mfg. Co., Fort Dodge, Iowa.

North Electric Mfg. Co., The, Galion, Ohio.

Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.

SAMSON ELECTRIC CO., Canton, Mass.

Spielman Electric Co., 1931 Broadway, New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

Stoddard Telephone Construction Co., The, Monroe, Mich.

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, HAND SET.—A transmitter, receiver, and often a calling device mounted on a handle. It takes the place of a desk stand in a desk set. Much used in Europe, but not much in America.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.

Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass. "Multiphone," "Yankee."

Evolution Phone Co., Inc., The, 48 Greenwich Ave., New York, N. Y. "Theraphone."

Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. "Grabaphone." (See display adv., page 1327.)

KLAXON CO., Newark, N. J.

Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."

North Electric Mfg. Co., The, Galion, Ohio.

SAMSON ELECTRIC CO., Canton, Mass.

Spielman Electric Co., 1931 Broadway, New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.

Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, INTERIOR OR INTERCOMMUNICATING.—These telephones are designed for use on interior or intercommunicating systems in large offices, factories, institutions, apartment houses, large residences, etc. They are often operated from a common battery or by dry batteries at each station. The telephones are generally wall sets, with the transmitter mounted on a short pivot. A button on the enclosing case is used for signaling by means of a code system, or a separate button and circuit is supplied for each other station; in the latter case these buttons are arranged in a compact panel with the number or name of each station adjoining its button.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."

American Watchman's Clock Co., 150 Nassau St., New York, N. Y.

Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.

AUTOMATIC ELECTRIC CO., Chicago, Ill. The P. A. X. (trade name for the Private Automatic Telephone Exchange equipment) has been adopted by hundreds of the world's largest and most important commercial, financial and industrial organizations, as well as hospitals, hotels, clubs, private estates and Government buildings. Also aboard ships. Serves any number of stations and is capable of unlimited expansion. Requires only two wires to each telephone. Gives accurate instant, reliable service, 24 hours a day, without an operator or attendant. The P. A. X. also renders unexcelled code call, watchman, conference, credit and other specialized services. Conferences as to specific requirements invited. —Adv.

Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.

Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."

Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."

Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass.

Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. "Dictograph."

Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."

Globe Phone Mfg. Co., Reading, Mass.

Hepburn Telephone Mfg. Co., The, 325 S. Dearborn St., Chicago, Ill.

HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)

KLAXON CO., Newark, N. J.

Leich Electric Co., Genoa, Ill.

Liddell Electric Mfg. Co., The, 481 N. Washington Ave., Bridgeport, Conn. "Crown."

Monarch Telephone Mfg. Co., Fort Dodge, Iowa.

North Electric Mfg. Co., The, Galion, Ohio.

Ostrander & Co., W. R., 371 Broadway, New York, N. Y.

Pettes & Randall Co., 152 Nassau St., New York, N. Y.

SAMSON ELECTRIC CO., Canton, Mass.

Screw Machine Products Corp., The, 1012 Eddy St., Providence, R. I.

Spielman Electric Co., 1931 Broadway, New York, N. Y.

Stanley & Patterson, 34 Hubert St., New York, N. Y. "Intertalk."

Stoddard Telephone Construction Co., The, Monroe, Mich.

Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y. "Inter-Comm-Phone."

Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, LOUD-SPEAKING. — Loud-speaking telephones are outfits used with a horn-shaped receiver to permit the message or sound to be distinctly heard several feet from the apparatus. They consist of a special transmitter, usually of low resistance, permitting the flow of an unusually high current when talking. In some instances the set is operated directly from a 110-volt d-c. supply, and the receivers are wound specially for this purpose. Also see Announcers, telephonic, depot, hotel, etc.

Manufacturers:

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Cory & Son, Inc., Charles, 183-187 Varick St., New York, N. Y.

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. "Dictograph."

KLAXON CO., Newark, N. J. "Klaxophone."

Magnavox Co., The, 2701-2765 E. 14th St., Oakland, Cal. "Telemegafone."

Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."

Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau Intertalk Magniphone."

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

Winkler-Reichmann Co., 4801 S. Morgan St., Chicago, Ill. "Still Small Voice," "Electric Page Boy."

TELEPHONES, MINE.—Telephone sets enclosed in a strong moistureproof metal box, with piped or bushed wire inlet, so that it may be used in a mine, or tunnel or other wet place without injury.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.

American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."

AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.

Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.

Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."

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Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
KLAXON CO., Newark, N. J.
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y. "Mine-A-Phone."
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, POLICE. — These are special forms of wall telephones made very ruggedly and of weatherproof construction. They are mounted on street corners in an iron box or in a small booth. They are generally used for outgoing calls only and are not provided with a ringer, any signaling that is necessary being done by means of a lamp placed on or near the telephone box.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, PORTABLE. — A telephone instrument which may be carried from place to place and used by attaching it to any telephone line for which it is adapted. It is usually built compactly in a box with a carrying strap and much used by repairmen, train crews, line patrolmen, etc., to communicate on street and interurban systems, transmission lines, etc.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, SENSITIVE, DICTOGRAPH.—This is a combination of a very sensitive transmitter and a loud-speaking receiver, so arranged that conversation can be carried on without putting the receiver to the ear or the transmitter to the mouth. The usual practical limit is about one meter (three feet). The term is also applied to a sensitive transmitter concealed in a room for the purpose of overhearing conversation without the knowledge of the speakers. It is used by police, detectives and other investigators. See Telephonic listeners for detectives.

TELEPHONES, SHIP.—A telephone set enclosed in a moistureproof box so that it can be used on deck without getting wet or suffering from mechanical injury.

TELEPHONES, SPECIAL AND MISCELLANEOUS.—Telephones are made for a large number of purposes. The most common types are described herewith, but in addition to these there are telephones made for special purposes, as in connection with radio telephone sets for aviators, etc. They are also made to be used around machinery, or where the noise would render an ordinary telephone useless. Weatherproof and moistureproof telephones of special design are also made for exposed service.

Manufacturers:

Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. (Aviator's) "Aviaphone."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (Weatherproof, special insulated.) (See display adv., page 1327.)
Magnavox Co., The, 2701-2765 E. 14th St., Oakland, Cal. "Anti-Noise."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, STREET OR INTERURBAN RAILWAY.—These are often called wayside telephones and consist of a telephone instrument installed at the side of a public highway for the use of subscribers. It may be in a locked box to which only special subscribers or railway employees have access. Sometimes only a jack is installed, the authorized persons being equipped with hand telephones, each having a cord and plug. Railways often install them along the right-of-way for regular or emergency use.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Stanley & Patterson, 34 Hubert St., New York, N. Y.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, WALL, CENTRAL-BATTERY TYPE.—A wall telephone set is one which is self-contained and adapted to be fastened to a wall. It is usually completely contained in a box with the transmitter mounted on a short pivot in the front. They are often provided with a small writing shelf. The "hotel type" or "residence type" do not have the writing shelf as a rule. The common-battery sets will contain the transmitter, receiver, hook switch, ringer, condenser and may have an induction coil also.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Couch Co., Inc., S. H., Arlington and Squantum Sts., Norfolk Downs, Quincy, Mass. "Multiphone."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
KLAXON CO., Newark, N. J.
Leich Electric Co., Genoa, Ill.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
SAMSON ELECTRIC CO., Canton, Mass.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONES, WALL, MAGNETO TYPE.—Magneto type wall telephones are sets enclosed in a wooden box and adapted to be secured to a wall. They generally have the transmitter mounted on a short pivoted arm or merely on a pivot in the front of the box. The boxes for this type are usually larger than the common-battery sets and are often provided with writing shelves. The sets contain the transmitter, receiver, hook switch, induction coil, magneto generator, ringer, and usually two dry batteries.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind. "Chicago."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
HOLTZER - CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Leich Electric Co., Genoa, Ill. "Automaphone."
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Spielman Electric Co., 1931 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TELEPHONIC DETECTORS FOR MACHINERY NOISES. — Sensitive telephone sets with loud-speaking receivers used in testing machinery in operation to determine the presence of noises indicating excessive wear, vibration or other abnormal condition.

Manufacturer:

Globe Phone Mfg. Co., Reading, Mass. "Auto Geophone."

TELEPHONIC DETECTORS FOR MINE AND OTHER UNDERGROUND SOUNDS. —These instruments are sensitive telephones for picking up very minute vibrations of the ground and by suitable amplification and loud-speaking receivers making them audible. They are useful in mine rescue work, for determining the presence and location of underground fires, leaks in water mains, etc. In locating the direction of the sound the binaural principle is used. They were also used extensively during the recent World War.

Manufacturer:

Globe Phone Mfg. Co., Reading, Mass. "Geophone."

TELEPHONIC LISTENERS FOR DETECTIVES.—These are telephone instruments designed for secret work by detectives and the police. They consist of a very sensitive small transmitter which is concealed in a room, and connected to the receiving or listening devices in another room. The transmitter is sensitive to any sounds, even to whispers and low tones, and these may be clearly heard in the receiving apparatus and recorded for future use as evidence in criminal prosecutions.

Manufacturers:

Dictograph Products Corp., 220 W. 42nd St., New York, N. Y. "Detective Dictograph."
Globe Phone Mfg. Co., Reading, Mass. "Secret-Phone."

TELEPHONY AND ITS DEVELOPMENT.—In this brief outline it is convenient to consider the commercial development of the telephone separately from the technical development.

Commercial Development. In the time from the invention of the telephone in 1876 to date (1921) there may be discerned four periods: Precompetitive period (1876 to 1891); period of strongest competition 1891 to 1905); period of relatively passive competition (1905 to 1913); period of cooperation (1913 to date).

First Period. The first period was not free from competition of a kind, for there was competition from the very start—for the possession of the invention itself. There was the fight between the claims of Bell and Gray, due probably to the unfortunately lax habits of the patent office at that early day. But Bell was proven to be the prior inventor. Then there were the claims of Drawbaugh, who brought 145 witnesses to his activities from 1867 to 1876. Also there was the inventive activity of Edison, Gray, and Dolbear, under the guidance of the Western Union Telegraph Co.

There was a rapid movement in this period from the first private lines to the rental system started in 1877 and the first public exchange at New Haven, Conn., in 1878, which became the Bell Telephone Co. in July, 1878, the National Bell Telephone Co. in March, 1879, and finally the American Bell Telephone Co. in 1880, which remained for many years. In 1881 it acquired from the Western Union Telegraph Co. an interest in the Western Electric Mfg. Co., which became the Western Electric Co. of today.

The period was not without some business competition. The Western Union Telegraph Co. decided to enter the field and from 1877 to 1879 made and installed apparatus, but retired from the field by an agreement settled out of court. In May, 1884, the Baxter Telephone Co. began operations, put in an exchange and built lines; but in March, 1885, it was closed by legal action of the Bell company. The Bell interests pushed the construction of exchanges and the extension of business arrangements and built up a large organization. By 1887 the cry of "monopoly" was first raised.

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Second Period. About 1891 telephone receivers made by independent manufacturers began to appear rather freely on the market. They were followed by magneto bells and other parts of apparatus, and soon by complete telephone instruments. They were absorbed by the public, each exchange or toll line being locally financed. The first independent telephone convention was held in Chicago in 1896. In 1897 the famous Berliner transmitter case was decided in favor of the Bell interests. It was followed by very many infringement suits against independent makers and users. The latter continued to be very active in their efforts to popularize the telephone.

This period was characterized by severe business methods on both sides. Heated conflicts occurred in many places, and for an independent operator to have anything to do with those of the other side was regarded as a sin. The Bell interests bought out many of the competing plants, and in some cases burned the telephones, as at Barnesville, Mass., and Cambridge, Ohio.

In 1901 a higher court reversed the Berlinger transmitter decision, finally throwing open the making of transmitters to all. The next five years saw a great spread of the telephone in the hands of both Bell and independents under a competition which was both technical and commercial. Many valued improvements, technical and economic, resulted.

Third Period. About 1905 the competition became less sharp, taking on a somewhat passive nature in many parts of the country. All concerned were learning to live together without undue feeling. This condition lasted about seven or eight years.

Fourth Period. About 1912 and 1913 there began a get-together movement for the division of territory, the merging of plants, etc. For instance, Lincoln, Neb., was taken over by the Lincoln Telephone & Telegraph Co., while Omaha, Neb., was taken by the Nebraska (Bell) Telephone Co. In many cases the plans were carried out. In some cases the public utility regulating commission refused permission.

Technical Development. There is not enough space here to recount the many interesting details, so it must suffice to sketch in broad outlines, illustrated here and there by suitable instances.

There has been development all the way, but two periods of very great activity stand out in the production of ideas. Often the slow refinement which fills the years after an invention or improvement means as much as the invention itself. The period from 1876 to 1880 was filled with a very remarkable development from the simple telephone receiver to public exchanges large enough to have "chaos" during the busy hour, and contained the beginnings of the multiple switchboard. The other period was from about 1898 to about 1905, during which time at least twelve outstanding improvements were made. Trial by public use and gradual refinement followed both these periods and continues to the present day.

Period of Beginnings (1876-1880.) These may be run over briefly as follows:—1877 Permanent magnet receiver by Bell. Magneto bell and generator by Watson. Carbon transmitter by Edison. Hard-drawn copper wire. Doolittle. Private lines. Experimental exchange.—1878. Hughes threenail experiment and carbon pencil microphone. Blake transmitter. Condenser to shunt series bells. New Haven, Conn., first public exchange. Bridging clearing-out drop by R. G Brown. Cable with twisted pairs by Brooks.—1879. Numbered directory by Shaw. Automatic switch hook. Repeating coil (though unsatisfactory). Crude phantom circuits by Black and Rosebrugh. Selective ringing (two-party) by Anders. Party-line lockout scheme by Dickerson. First office cable at San Francisco, Cal. Lead press cable by Berthoud and Borel, in Switzerland. Multiple switchboard with forerunner of present jack.

Second Period of Great Activity (1898-1905).—1898. Combined drop and jack, a unit, self-restoring. Party line with central checking, divided circuit. Compact, modern switchboard key.—1899. Automatic listening on cord circuit.—1900. Indicating ringing key, one per cord circuit. Harmonic selective ringing by electrical action.—1901. Compact type wall telephone. Self-contained switch hook.—1902. An adequately strong magneto generator. Safe telephone instrument with no exposed electrical circuits.—1905. Harmonic selective ringing by mechanical resonance. Steel telephone boxes. Superimposed selective ringing (battery with a-c. generator to ring biased bells).

It will be profitable now to follow the development of a few things separately.

The Receiver. Dr. Bell's experimental receiver was first polarized but the model exhibited at the Centennial Exposition in 1876 was nonpolarized, requiring battery current to polarize it. In 1877 he made it in the straight bar magnet form known as "single pole." In the 90's the bipolar receiver was produced and by 1898 it was rapidly coming into general use. In 1909 the nonpolar receiver was brought back by the Automatic Electric Co. in small compact form. Both polar and nonpolar types are in wide use today.

The Transmitter. The need of a transmitter (a modifier of battery current) was felt from the start. Bell made a crude one with a wire projecting down into a liquid. In 1877 Edison made a transmitter in which the rheostatic part was compressed plumbago, followed by Professor Hughes' delightfully original three-wire nail experiment in loose contacts and his very sensitive carbon-pencil microphone. The real transmitter was born when Henry Hunnings, an English clergyman, invented the granular carbon transmitter in 1881. Nine years later (1892) it took its present form under the hand of White.

Battery Systems. The era of local battery lasted up to 1893, but local battery lasted much longer on farmer lines and in small exchanges for years after. Wet primary cells held sway for a long time, dry cells coming in about 1898. "Dry versus wet cells" was argued for a time (1901-1903) and the wet cell was practically extinct, telephonically, by 1907.

Common battery was tried by White in 1890, but in 1892 Stone and Hayes produced the two battery-feed appliances which bear their separate names. The Hayes repeating coil was developed by the Bell engineers to a point of very high efficiency, and is today the accepted standard feed for long-distance toll work. The impedance coil of Stone was improved by others by giving each subscriber line its own coil and connecting the lines by condensers. This was most used by independent manufacturers—it is a little more crisp in transmission, but is no barrier to noise from external lines.

The first common-battery exchange was at Lexington, Mass., in 1893. By 1899 the conversion to common battery was in full swing among both Bell and independent plants.

Single-office exchanges were generally in favor up to about 1905. This caused long subscriber loops, weak current, and the need for transmitters which were fairly efficient on weak battery current. Battery feeds were used which had as much as 800 or 900 ohms resistance. The growth of multioffice exchanges shortened the subscriber loop and increased the current strength delivered to the telephone to from 0.100 to 0.175 ampere on short lines with a resistance of feed coils in the office from 400 ohms down to 44 ohms.

The first common-battery experiments were chiefly with a 16-volt battery. Gradually the Bell engineers standardized on 24 volts, but later added another voltage (48) for toll. The independents from 1900 to 1905 ventured on 30 volts to 40 volts for all work. The Strowger automatic system always worked with higher voltage, because it had to have it to operate its relays at what was considered high speed (five to eight impulses per second). It settled on 54 volts for three-wire plants. When the two-wire automatic was brought out (about 1907-1908) it dropped to 48 volts (46 to 49) for all work, local and toll.

Exchanges in General. There was a period of crude beginnings and makeshifts about 1876 to 1880. The series-multiple switchboard took form in 1883 with jacks not unlike those now in use. The name "jack" arose from the switch made in the late 70's which had two members hinged together like the blades of a jackknife. The branch-terminal multiple board arrived about 1891 and did away with many of the troubles which made the life of the telephone man miserable.

The one-office idea held sway until about 1905. In order to handle many thousands of lines in one office, attempts were made to subdivide the multiple, for it could not be made small enough to be reached by one girl. The transfer board, the "express" board, and the divided multiple boards of different inventors were tried during the period from 1892 to 1905. But about that time the straight multiple board was recognized as supreme and displaced all others from that time on. Since the best boards could place only about 10,000 lines within the reach of one operator, larger exchanges were forced to become multioffice, and branch offices came in very generally.

Long-Distance Service. — The idea of communication over long distances has always appealed to man's imagination and it is not to be wondered that the interest aroused by the invention of the telephone resulted in contributions to the art from all parts of the world. Commercial progress was rather slow and very little was attempted until 1885. Among the earliest attempts made were those on lines about 40 miles long, stretched with single overhead wires and earth return between Boston, Mass., and Providence, R. I. These lines soon developed cross-talk, which was a commercial barrier as only one message could be carried at a time.

In 1885 the American Telephone & Telegraph Co. was formally organized to engage in furnishing long-distance telephone service. Metallic lines were tried in order to overcome the difficulties encountered with grounded circuits. The first line was built between New York and Philadelphia, a distance of 90 miles. This line was completed in 1886, and in spite of the metallic circuits the original difficulty, cross-talk, again appeared, so that only one metallic circuit could be used at one time. This obstacle was overcome very largely by John A. Barrett, an electrician for the company, who developed step by step a scheme of transposition. This made it feasible to use all circuits simultaneously for commercial service. The commercial opening of toll development was marked by this discovery and the building of toll lines between other cities was immediately undertaken.

The next step, which followed as a result of the wide interest taken in this art both in this country and abroad, was the discovery of a suitable means for telephoning and telegraphing simultaneously over a single wire. Van Rysselberghe, a Belgian, came to America in 1885 to demonstrate a method on the lines of the Baltimore & Ohio Telegraph Co. Successful experiments clearly showed the possibility of so modifying the telegraphic impulses or signals as to be practically inaudible in the telephone receivers, thus making possible simultaneous commercial telephone service. These experiments culminated in a test between New York and Chicago made in 1886 over metallic lines, which is of special interest because it was without doubt the longest circuit actually spoken over until 1893. In that year one of the most important events in long-distance telephony was the opening of the New York-Chicago line for commercial service. There was much uncertainty over the outcome of this project, as there was little to rely on in the way of proven theory, but the remarkable success which attended it was responsible for the rapid spread of this service between all large cities east of the Mississippi.

The phantom-circuit discovery was regarded for some time as a system of multiplex telephony. It was made by Frank Jacobs, whose plan permitted as many independent telephone circuits as there were wires. This discovery was not appreciated at the time and languished for a few years and its commercial application had hardly commenced by 1900. Since that time, however, its spread has been rapid.

The method of improving transmission by inductive loading was announced by Dr. Michael Pupin in 1900. This invention was of immense commercial value and has been very widely and successfully employed. Its greatest relative improvement was in relation to cable circuits, but it also resulted in a material gain on open wire lines. One of its more recent applications has been to phantom circuits.

The search for a successful telephone repeater has involved many investigators. Probably the earliest and most notable results have been obtained by Herbert E. Shreeve who was granted a patent on his repeater in 1905. More recent developments in this line have led to the use of electron tube repeaters, which have proven very successful.

One of the most important advances in long-distance telephony was the opening of the first transcontinental line for commercial service, Jan. 25, 1915, connecting New York and San Francisco, a distance of 3400 miles. The combination of long-distance telephony and radio telephony has also added effectively to the distances over which the human voice may be carried. In 1915 telephone messages were sent by wire to the Naval radio station at Arlington, Va., and thence by radio telephone to California, where the message was heard. Radio communication has since been established between Arlington and the Hawaiian Islands and the Eiffel tower at Paris, France.

One of the important developments during the World War was that of multiplex telephony which has been used to a limited extent. The first application was on lines between Baltimore, Md., and Pittsburgh,

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Pa. This system makes use of several different sets of high-frequency carrier waves, upon which the voice waves are superposed. By a method of tuning at the receiving end the messages are clearly separated. This method has also been called "wired wireless."

Automatic Switching.—In 1879, C. E. Scribner said that "perfect chaos existed in the larger telephone exchanges." In that same year began the work on automatic switches to do the work of operators. But the development really began in 1889, when the Strowger interests started to put out the series of public exchanges which was to try on the public the idea of automatic switching.

By 1905 the automatic telephone had become a factor with which telephone operating companies reckoned and about which they argued with varying degrees of heat during the following fourteen years. In the year 1919 it was acknowledged generally that automatic switching, including the calling device on the telephone, was the only answer to the question of proper telephone service and economical operation of exchanges in a world of rising costs.

TELEPHONY, AUTOMATIC, DEVELOPMENT OF.—The electric telephone was invented in March, 1876, by Alexander Graham Bell, and exhibited at the Centennial Exposition in Philadelphia a few months later. The first work on an automatic switchboard was done within three years after this. Already the need for escape from confusion was felt.

From that time to the present there have been more than 19 attempts to make an automatic switchboard. Five of them may be classed as major lines of development, five as minor, and the rest as isolated experimentation.

First Period. The first ten years 1879-1889) are marked by only one line of development, and that a minor one. On Sept. 10, 1879, M. D. Connolly, T. A. Connolly and T. J. McTighe applied for a patent on an automatic telephone switchboard. The switch proper consisted of a circle of metallic bars, one per line, and a center shaft which carried one loosely mounted contact arm per line. By means of battery at the telephone the subscriber sent pulsations of current to operate a polarized magnet at the switch. The latter moved the contact arm of the calling line by a ratchet action to touch the bar of the called line. To release, more impulses were to be sent to move the contact arm step by step ahead of the home position. The apparatus was crude.

They continued their efforts until at least 1883. In 1881 they inserted relays in the lines, to operate the magnets on local circuits. They also devised the first semi-automatic system, arranging for an operator to receive the number from the subscriber and to control the switches. In 1883 they devised the first power-driven switch, and a positively controlled calling device, which controlled the switch, but was itself advanced step by step by the switch as it moved.

Second Period. The period of 15 years from 1889 to 1904 was one of many workers, many starts and failures and short-lived lines of development. In the preceding ten years telephony had been finding itself. The time was ripe for earnest work to begin on automatic switching. The year 1889 saw two beginnings, one of which lasted only a few years while the other continued to the present day.

J. G. Smith first produced an automatic switching system for telegraph lines. It was to enable business men to have private-line service between cities by using intercity trunks. His switch had a complete circle of contacts with a power-driven shaft in the center. The latter carried contact arms. There were selectors to hunt an idle trunk to the distant city and connectors to connect the trunk to the called line. Later he adapted his system to switch telephone lines. Using the same switches he had but one trunk between groups. He even had a small system in which one switch acted as both selector and connector.

Strowger Development. The Strowger line of development covers a period of 32 years to date. In 1889 Almon B. Strowger, of Kansas City, Mo., reached the limit of his patience with telephone operators and started to work on an automatic switch to do away with them. He devised a completely cylindrical bank of 1000 contacts, ten horizontal rows of 100 contacts each. The wiper was mounted on a vertical shaft in the center, to be lifted by a ratchet magnet, then rotated by long steps by a rotary magnet to the desired group of ten contacts, and lastly rotated by single steps by another rotary magnet to the called line. The release back to normal was positive, by withdrawing detents.

In 1890 the first model switch was completed. Joseph Harris, of Chicago, undertook to finance it, moved the work to Chicago in 1891, and formed the Strowger Automatic Telephone Exchange, a company to develop the invention.

In the fall of 1891 a flat disk switch of 100 lines was produced and installed in 1892 at LaPorte, Ind., the first commercial automatic telephone exchange. The wipers "jumped" from contact to contact to avoid friction. Several modern features were present—the pawl standing free of the ratchet cylinder, the pawl stop to prevent overthrow of the wipers, the rudiments of a sideswitch with three-wire control, consisting of one line wire for impulsing and the other for changing the circuits in the switch by means of the sideswitch. Discovering that subscribers got electric shocks from the receiver binding posts, the inventors made the first receiver with concealed binding posts. In 1893 a small disk-switch exchange was installed at Fort Sheridan, Ill., for the United States Government. There were private trunks between certain of the switches where privacy was essential.

In 1894 the piano-wire board was made and installed at LaPorte to replace the disk-switch board. The later device had for a bank a layer of piano wires stretched tightly across a frame. At right angles to the wires were a number of wiper shafts, one for each subscriber line. Common battery was used for operating the magnets, but local battery for talking. There was a sideswitch and a crude busy test with partial privacy.

In the winter of 1894-5 the Strowger people produced the form and general size of contact bank now used. There were ten horizontal rows or levels of contacts, ten contacts per level spaced angularly to the equivalent of 28 in a complete circle, the same as today. They were insulated by electrose. New switches with these banks were installed in 1895 at LaPorte and at Michigan City, Ind. That same year plaster of Paris was used to imbed the bank contacts. They were first installed at Rochester, Minn. This material was not abandoned until 1901, when the built-up bank came in. At first the insulating layers were hard fiber, but in recent years phenol-fiber has been adopted. The year 1896 was marked by activity in building exchanges and in producing new ideas. The party-line lockout for automatic lines, the dial calling device, and the selector and connector idea were started. This grew out of the need for larger exchanges. Several 100-line boards had to be connected together, hence the origin of the selector to choose the boards. At first there was but one trunk from any selector to a given 100-line board, ending in a connector. The Augusta, Ga., exchange was first so installed. In 1897 group trunking was secured by inserting a figure 0 in the call number between the hundreds digit and the tens digit. The first pull of the dial lifted the wipers of the first selector to the desired level. The 0 pull gave ten impulses to the rotary magnet, which followed them until the first idle trunk was found.

The first machine rotary was produced in 1899, having a machine in the central office to produce the impulses instead of the extra digit in the call number. It was installed in the exchange at New Bedford, Mass., in 1900.

The sideswitch took form in the New Bedford exchange. The line relays also appeared in all switches, 30-ohm coils shunted by a 150-ohm resistance, for they were in series with the talking circuit. The ringing of the telephone bell was done by the first selector, controlled by a push button at the telephone, which grounded the center of the bell coils. In the Fall River, Mass., exchange, installed in 1901, the ringing was shifted to the connector, where it has remained to date.

The Automatic Electric Co. was organized in January, 1901, taking over all the activities of the Strowger Automatic Telephone Exchange, which went out of business.

The first automatic exchange in Chicago was completed in September, 1903. For the first time the code of impulses was the same for all time digits. There was metered service depending on the dialing of the full number of digits. Free numbers (fire, police, etc.) had one less digit and did not cause the meter to register.

The Los Angeles, Cal., installation marks a number of interesting facts. One office was made automatic in 1904, with the intention of gradually converting the whole system office by office, which was later done. From the beginning the automatic switches had to work in connection with manual switchboards over trunks to which the automatic engineers applied a device to render the third wire unnecessary between offices. Here appeared for the first time the release trunk for the first and second selectors. The third selectors and connectors still had bridged-relay release.

In the fall of 1904 the first Keith lineswitches were installed at Wilmington, Del., reducing the first selectors from one per line to ten per 100 lines. Up to 1906 the trunking of automatic exchanges had been a matter of expediency. In that year A. E. Keith devised his trunking system, which has been used with but minor changes ever since. He also introduced "trunk hip" to equalize the traffic among the switches and cut down the time to find an idle trunk.

Strowger apparatus was first made common battery for talking at South Bend, Ind., in 1906. Here also were manual and automatic switchboards in one building, working freely with each other. The second selectors had no sideswitch, a move which resulted in 1907 in making all selectors sideswitchless and in 1918 the connectors also.

The impulse repeater came into service in 1906 at Los Angeles to secure better operation of the switches on interoffice calls. The suboffice was first used in 1906 at Dayton, Ohio. A small number of subscriber lines were served by lineswitches and connectors, but their selectors were in the nearest main office.

In 1907 the repeater was combined with the selector at Columbus, Ohio. This selector-repeater acted first as a selector, then it repeated impulses to another office. The Strowger system was made to operate without ground return (two-wire system) in 1907. The calling device opened the circuit in groups of impulses, with a pause between groups, during which a slow-acting relay in the switch fell back to switch to the next function. In the same year the Keith lineswitch was applied to outgoing trunks to reduce their number (Los Angeles, Cal.). In 1909 lineswitches were used as local secondaries at Lansing, Mich. By the year 1908 the automatic suboffice for manual exchanges had passed the experimental stage. It economized cable and improved service.

The San Francisco, Cal., installation (1909) had a rapid-fire suburban toll service, with means for verifying the number of the calling subscriber who waited while the call was put through. Here was the first small calling device, with a dial which did not rotate back while the interior mechanism was sending the impulses. In the winter of 1910-11 it was changed so that the dial returned with the mechanism, because the older form was too complicated for extended use. San Francisco had also automatically operated coin boxes. The user dialed the number, but when the called station answered, the reversal of current prevented conversation until the calling subscriber dropped a coin into the box. The two-wire trunk holder (so called series repeater) was also used here.

The second automatic exchange in Chicago was installed in 1910-11 with eight offices; owing to the fact that it was tied up financially with the narrow-gage Illinois tunnel system, it failed as a commercial venture. The automatic traffic distributer was produced in 1911 to distribute the traffic of a manual switchboard to all the operators. It consisted chiefly of Keith lineswitches. The period of 1911-13 was one of foreign development, chiefly in England, France, and Australia.

In 1913 the private automatic exchange took its place as a commercial efficiency device, and was installed in large numbers from that time to date. In the same year the present method of trunk scattering by "spill over" was developed, increasing the efficiency of trunks without using secondary lineswitches. The switching repeater was made for Sydney, Australia, in 1914, to permit subscribers in a suboffice to talk to each other without using interoffice trunks.

The period from 1915 to date was one of elaboration of the finer details in the Strowger system. Changes were made in switch mechanism and circuits to make the apparatus more permanent and reliable. A complete system of standard adjustments, which had been growing up through the years, was crystallized into scientific form. A program of inspections and adjustments, known as "routines" was developed and its effectiveness and efficiency proven. The standardization of the nomenclature, at the request of the British Engineering Standards Association, was started through the American Institute of Electrical Engineers, including representa-

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tives from the Bureau of Standards and of Bell and independent telephone interests.

In the same period other advances were made by the Strowger line, such as the application of composite telegraph to dialing on toll lines, both ordinary and phantomed lines, automatic voltage regulation of the central-office battery, the rotary lineswitch, the community automatic exchange, and other things.

Callender-Lorimer Development.—This line extends from 1892 to about 1911. Romaine Callender, a music teacher, of Brantford, Canada, made a first attempt, which had two orders of switches, ground-return subscriber lines, much common apparatus, a time-limit for talking, and a drum-shaped calling device. It was very complicated. In 1893 he invented a second system using metal balls and runways, and a drum calling device with setup levers. Though intended for exhibition at the Chicago World's Fair it could not be shown as it did not work. After operations in New York City and Europe the Callender Telephone Exchange Co. was formed in 1896 at Brantford. Soon after this Callender separated from the enterprise.

The Lorimer brothers, who had been employed in the work, were now in charge and finished the Troy, Ohio, exchange, although this proved a failure from defects in design. The Lorimer brothers then began to work out their own ideas, among which were the reduction of individual line apparatus to the limit, positive control of the calling device, and the sectional bookcase plan for building up an exchange out of 100-line units. They made a model switch in 1897, and a 12-line board in 1898 in their factory at Piqua, Ohio. The latter had disk switches set vertically in a horizontal row, with a common shaft running through the center.

In the spring of 1899 they redesigned it, setting the driving shafts upright and making each switch cylindrical with 12 horizontal rows of contacts. The apparatus was separated into "divisions," each corresponding to a manual cord circuit. Each subscriber line was represented by a segment on a stationary commutator over which a brush was constantly rotating. This brush stopped on the segment of any calling line and set in motion the apparatus for taking care of the call. There was rigid control between switches and calling device.

In 1900 the name was changed to American Machine Telephone Co., which built the exchange for Peterboro, Canada, and an exhibit board for Paris, France. For some years patent interferences occupied its attention and not much was done in development. In 1909 it built the exchange of Brantford, Canada. In 1911 the patents were sold to the Bell interests.

Minor Developments. Space forbids more than the mention of some inventors, such as J. W. McDonough, Pippette, W. W. Davis, Apostoloff and Freudenberg, Seligman-Lou, Timberlake and Fonquernie, who worked along various lines.

The Clark line started with E. A. Clark and others about 1893; the Clark Automatic Telephone Co. was formed and many 72-line exchanges made. There were many installed in the winter of 1899-1900 and as late as 1904 several of them were still working in Sioux City, Iowa.

From 1901 to 1904 Enrest A. Faller worked on a semiautomatic system with a lever setup calling device at each telephone which caused the call number to be displayed before the operator. Apparatus was exhibited at the World's Fair at St. Louis, Mo., in 1904.

The Lundquist line runs from about 1896, when Frank A. Lundquist left the Strowger group, to about 1911, when he entered the Bell organization. A few exchanges were installed by the National Automatic Telephone Co. and the Globe Automatic Telephone Co., which operated during this period.

Third Period. The period from 1904 to date was one of long steady developments. During these 16 years the more discerning telephone men (aside from automatic workers) began to see that automatic switching was the coming thing, although the rank and file resisted the change until 1919.

The period is characterized by the Strowger line of development, the Western Electric, and the activities of Kellogg, Lattig and Goodrum, of Clement, and of Corwin.

In 1904 Clement began work on a semiautomatic system which the North Electric Co. began to put out in 1907 as the "Automanual" system. The Strowger-like switches rotated their wipers first and then lifted them through the bank. Subscriber lines came to the banks of finder switches, each of which was tied "tail to tail" with a first selector. The links between finders and selectors were arranged to be handled by operators, who set up the call number on a push-button calling device. Later a system of relays was used as a line finder. The first commercial installation was at Ashtabula Harbor, Ohio. A number of other plants were installed with good results. About 1914 financial difficulties overtook the business and not much was done for several years. In 1919 it was revived under K. B. Miller and F. R. McBerty.

From 1908 to 1916 Corwin was working on a traffic distributer, leaving the manual board unchanged. In 1912 there was great patent activity. In the spring of 1914 Frank B. Cook undertook the manufacture of it and installed an exchange at Fort Wayne, Ind., that summer. The last patent activity seems to have been in 1916.

Lattig and Goodrum began working on automatics in 1903. After being with the Automatic Electric Co. and the Stromberg-Carlson Co., the American Automatic Telephone Co. was formed about 1906. Their first commercial exchange was in Ellis Hospital, Schenectady, N. Y., 1906. The system has a flat, one-motion, 50-point switch, back-action magnet drive, line finders, and a 50-point calling device. Numerous plants were installed in the following years until in 1913 they sold their patents to the Bell interests.

Bell Development. The Western Electric Co. began to work on automatic switching in 1899. The large use of manual switchboards by the Bell interests made them cautious about hastily adopting new and untried substitutes. Their first interest lay along the line of automatic interoffice trunking, to relieve conditions which were becoming steadily worse. To replace the B operators with switches would simplify the sum total of operation, improve the accuracy, and speed up the service. It would be an advantage to have even local connections completed automatically, although they retained the A. operator.

They soon developed two distinct forms of switch, the panel type and the rotary type. The former has a long vertical bank with all the contacts in one row, up which the wiper or brush is caused to run. The latter has its contacts on the surface of half a cylinder, the wipers being in sets, one set per level of contacts. Both systems are power-driven.

In 1910 the first commercial trial was made in the form of a 450-line semiautomatic switchboard in the offices of the Western Electric Co. in New York City.

In about 1911 the two developments were divided. The rotary system was made at Antwerp, Belgium, for sale in Europe. The panel system was developed in America. The European work continued until stopped by the German advance in the World War in 1914. Since the war it has been started again.

In 1912 the Western Electric Co. installed switches in one of the offices at Newark, N. J. Since that time much careful work has been done on the panel-type system, and its mechanism and circuits greatly elaborated. It has taken the form of a 500-line unit, consisting of five 100-line banks on which 60 selecting mechanisms act. In reality the unit has 30,000 sets of bank contacts. The frame is massive and carefully alined. The five-bank structure is not operated directly by the calling device, but by a sender, which contains a translator to change the decimal call number into the signals necessary for the switch.

Present Conditions. Labor conditions have been bringing about important changes in the manual telephone field. Operators who formerly could be had for $20 or $25 per month began calling within the last ten years for $40, $50 and even more per month. Then came the World War, which greatly intensified the conditions, and made telephone operating by manual switchboards a very difficult matter.

In the spring of 1919, soon after the war ended, the world movement to full automatic telephony began. England, France, Canada, Australia, the United States, and to a certain extent other countries, began to lay definite plans for converting their exchanges to automatic in a systematic way, having due regard to avoid upsetting conditions any more than was necessary. In the United States, the Bell interests came out openly with statements, and began to buy automatic equipment of the Strowger type as well as to make panel-type switchboards as rapidly as possible. At the present time (1921) the factories cannot produce automatic equipment fast enough for the desires of operating companies.

TELETYPE.—Trade name for telegraph printing system manufactured by the Morkrum Co., 1410 Wrightwood Ave., Chicago, Ill.

TELHARMONIUM.—The telharmonium, invented by Dr. T. Cahill, produces music by electrical means, giving to the composer the possibility of producing effects which are impossible with other musical instruments. The music is produced by mixing vibrations generated in a set of inductor alternators. In some installations as many as 144 of these alternators are geared together and driven by a constant-speed motor. On acount of the initial expense of the installation the telharmonium has not been widely used.

TELLTALES, MARINE RUNNING LIGHT.—Red and green running lights are required on each vessel. They are very important, as they indicate the starboard and port sides (right and left sides when looking forward on the vessel) and thus show whether the ship is approaching or receding. They must be kept burning and to insure this telltales are located in the pilot house that indicate whether these lamps are in service. The simplest type of telltale consists of a pair of small indicating lamps installed at the telltale and connected in series with the corresponding running lights; if either of the latter burns out its telltale lamp is extinguished. Other telltales employ relays to actuate the telltale lamps or indicators and may be combined with audible signals to call attention to the trouble.

Manufacturers:

Cummings Ship Instrument Works, 10 High St., Boston, Mass. "Cummings."

GENERAL ELECTRIC CO., Schenectady, N. Y. Running light telltale boards to indicate the failure of running lights by both visible and audible signal. They are provided with switches to throw into the circuit a spare lamp in each lantern. The boards are made up of individual panels. The one contains the incoming lines, the buzzer and the receptacle for the warning lamp; the other contains the relays and switches for the running lights. Additional relay panels may be added at any time. (Bulletin 69011.) See adv. pages 1203-1223.—Adv.

Marine Electric Co., 195 Fremont St., San Francisco, Cal. "Meco."

Seidler-Miner Co., 36 E. Larned St., Detroit, Mich. "S-M."

TELPHERAGE SYSTEMS, ELECTRIC CONVEYING.—These are aerial electric carrier systems on the principle of the electric monorail or traveling hoist having the car only moving along the supports. They are of two main classes, the automatic and the nonautomatic or "man telpher". The automatic type is used largely for handling coal, ore and such bulk material. It is operated by motors that are controlled at a distance and on discharging its load reverses and returns, unless the track be in loop form. The simpler telpherage systems sometimes use tightly drawn cables as supports for the car, these also carrying the operating current, but the more important ones use permanent rails or I-beams, from which the telpher is supported, the power being collected from conductors by trolleys or shoes. Man telphers have a cage attached in which the operator rides, and controls both the hoisting and traveling mechanisms. By proper arangement of tracks this type may be made to cover a considerable yard space. It is used for transporting bulk materials, also for packages, freight, etc., in loading and unloading railway cars and steamships.

Manufacturers:

Columbia Hoist & Crane Co., Borden & Van Pelt Aves., Long Island City, N. Y.

LINK-BELT CO., 329 W. 39th St., Chicago, Ill. "Link-Belt."

Northern Crane Works, Ltd., Walkerville, Ont., Can. "Northern."

Northern Engineering Works, 10 Chene St., Detroit, Mich. "Northern."

TEMCO ELECTRIC MOTOR CO., THE.—504 Sugar St., Leipsic, Ohio. Manufacturer of portable electric tools and motors. Business established 1911. President and

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general manager, O. P. Edwards; vice-presidents, W. E. Edwards, T. C. Edwards; secretary, treasurer and sales manager, J. E. Werner.

TEMPERATURE.—A scale for measuring intensity of heat. Both the centigrade and Fahrenheit scales are used. See these scales. The centigrade scale, which is used for most scientific work, calls the freezing point of water 0°C and its normal boiling point 100°C., divides this interval into 10 equal degrees, and extrapolates below zero and above 100° to any desired extent. It appears that – 273°C. is the temperature of space, and therefore we cannot know anything colder than that; the temperature of the sun is about 5,000° C., with a possible error of 500°. We do not know whether there is a maximum possible temperature. Instruments for measuring low temperatures, up to 350° C., are called thermometers; for higher temperatures, pyrometers. Temperatures reckoned from – 273°C., are called absolute temperatures, or degrees Kelvin (after Lord Kelvin) 0°C=273°K.

TEMPERATURE, AMBIENT.—The temperature of a surrounding medium. The term is most commonly used to designate the temperature of the air surrounding an electrical machine and on which the cooling of the machine depends.

TEMPERATURE COEFFICIENT.—The proportion of itself by which any physical property varies for an increase of temperature of 1° C. Strictly speaking, it is referred to the value starting at 0° C., and is either the percentage variation from 0° to 1° C., or one-hundredth of the percentage variation from 0° to 100° C., or the average variation from 0° to t° C. The most used temperature coefficient in electrical work is the temperature coefficient of resistance.

TEMPERATURE COEFFICIENT OF RESISTANCE.—The resistance of materials changes with temperature. The temperature coefficient of resistance is the change per ohm per degree change in temperature at the standard temperature, usually 0° centigrade. The temperature coefficient, like the resistance, depends upon the purity of the material. For all pure metals the temperature coefficient is practically the same. Copper of 100 per cent conductivity has a resistance temperature coefficient equal to 0.00393 per degree centigrade at 20°; at 0° C. the temperature coefficient is 0.00427. The corresponding temperature coefficients on the Fahrenheit scale are 0.00218 at 68° and 0.00238 at 32° F. The resistance of a conductor at any temperature may be calculated by the formula $R_t=R_0(1+at)$, where R_0 is the resistance at 0 degrees, a is the temperature coefficient of resistance at 0°C. and t is the centigrade temperature. A practical application of the temperature coefficient is the determination of temperature by measuring changes in resistance. See Thermometers, resistance type.

TEMPERING, ELECTRIC.—The method of bringing metal to the proper degree of hardness and elasticity by first raising it to a high temperature in an electric furnace, and then rapidly cooling. See Furnaces, electric, hardening. Also see Heat treatment of steel.

TEMPLE.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TEMPLETON, KENLY & CO., LTD.—1020 S. Central Ave., Chicago, Ill. Manufacturer of jacks. Business established 1899. President, W. B. Templeton; vice-president and general manager, H. B. Hench. Sales representatives, Sanford Bros., Chattanooga, Tenn., Cleveland, Ohio, San Francisco, Cal., 30 W. Walton St., Chicago, Ill.

TEMPLETON MFG. CO.—Business St. and Glenwood Ave., Hyde Park, Mass. Manufacturer of steam and vacuum traps. Vice-president and general manager, Charles H. Stebbins; secretary and treasurer, William R. Templeton; sales manager, Charles G. Stebbins.

TENACITY OAK.—Trade name for leather belting manufactured by George Rahman & Co., 31 Spruce St., New York, N. Y.

TENNESSEE BURNER MFG. CO.—Chattanooga, Tenn. Manufacturer of lava insulators and other lava products. President, J. C. Roberts; vice-president, J. P. Payne; secretary and general manager, W. T. Free; treasurer, William Roberts.

TENSION.—The word tension is sometimes applied in electrical work to the difference of potential or electromotive force existing in a circuit. In an electric field, it is thought of as a stress along the lines of induction producing pressure on the intervening dielectric or nonconducting medium. The word tension is often included in terms like high tension and low tension expressing relative potential or voltage of circuits or apparatus.

TENSO.—Trade name for die castings manufactured by Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill.

TENTS, MANHOLE PROTECTING.—Small tents set up over manholes in streets when work is being done in them, to protect the workmen from the weather, especially when cable-splicing work is being done. These tents also serve as warnings to traffic.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
BUHRKE CO., R. H., 1238 Fullerton Ave., Chicago, Ill.

TERKELSEN MACHINE CO.—Boston, Mass. Manufacturer of insulation molding machines. President, C. J. Wennberg; treasurer, A. Terkelsen.

TERMAAT-MONAHAN MFG. CO.—Oshkosh, Wis. Manufacturer of internal-combustion engines. President, T. J. Hyman; vice-president and general manager, George H. Mueller; secretary, T. H. Spence; treasurer, Walter Brown.

TERMILET.—Trade name for conduit fittings manufactured by E. H. Freeman Electric Co., Trenton, N. J.

TERMINAL BLOCKS.—See Blocks, terminal, generator and motor; Blocks, terminal, railway signal; Blocks, terminal, transformer.

TERMINAL, CABLE, PROTECTED.—A telephone cable terminal which is equipped with lightning arresters, fuses, etc., to protect the cable from foreign current.

TERMINAL DETECTORS.—See Detectors, terminal or polarity, direct current.

TERMINAL ELECTRIC CO.—685 11th Ave., New York, N. Y. Manufacturer of bell-ringing transformers, burglar and fire alarms, etc. Business established 1915. President, G. Weil; treasurer and general manager, A. Robinson. Sales representatives, Rumsey Electric Co., Philadelphia, Pa.; J. H. Healey, Boston, Mass.; Johnson Electric Co., Minneapolis, Minn.

TERMINAL ENGINEERING CO., INC.—17 W. 44th St., New York, N. Y. Manufacturer of electric trucks. R. H. Sartor, sales engineer.

TERMINAL LUGS.—See Lugs, cable and wire, cast or wrought, soldering.

TERMINAL PER STATION.—An arrangement of connector bank terminals used in telephone switchboards for ringing party lines. Each station has its own terminals just as if it were on an individual line. A four-party line requires four groups of connectors, one group to ring each of the four classes of stations. It is similar to jack per station.

TERMINAL, SPADE.—A flat terminal for a cord. It has a notch cut in the end so as to fit around the screw of a binding post.

TERMINALS.—See Connectors, solderless; Connectors, solderless, insulated.

TERMINALS, AUTOMOBILE, PRIMARY AND SECONDARY WIRE.—Wire connecting terminal fittings, consisting usually of pressed or stamped sheet metal eyelets, loops, forks, etc., of special design to fit various forms of binding posts, studs, etc., and made with cup-shaped or channeled shanks for making soldered or crimped connection with solid or stranded wire. Secondary terminals may consist of looped eyes with insulating sleeves and spring contact ends to enable quick detachment from spark-plug terminals, etc.

Manufacturers:

American Bosch Magneto Corp., Springfield, Mass. "Bosch."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Breaznell, J. H., 26 Court St., Brooklyn, N. Y.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Economy Mfg. Co., 616 W. Monroe St., Chicago, Ill. "Universal."
FITZGERALD MFG. CO., THE, Torrington, Conn.
Guaranteed Battery Co., 2017-25 Lucas Ave., St. Louis, Mo.
Hobbs Storage Battery Co., 1231 Olive St., Los Angeles, Cal.
Ideal Clamp Mfg. Co., Inc., 200 Bradford St., Brooklyn, N. Y. "Ideal."
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich. "Becco."
Morse, Frank W., 289 Congress St., Boston, Mass. "Morse Eureka."
PATTON-MAC GUYER CO., 31 Mathewson St., Providence, R. I.
Pines Mfg. Co., 208 N. Wabash Ave., Chicago, Ill.
Rajah Auto-Supply Co., Bloomfield, N. J. "Rajah."
Shain, Charles D., Times Plaza, Brooklyn, N. Y.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)

TERMINALS, CLAMP TYPE, FOR CONNECTING TO BUSBARS.—Clamp type terminals are used for making a tap from a busbar stack with a cable, solid round conductor or metal tubing. The terminals consist of a lug with a long lip or lips and a clamp for holding the lip in contact with the bar or bars. The lugs are usually cast of copper or brass and machined so that where more than one bar is used the lips will fit tightly in the spaces between bars. The cable or other conductor is soldered into the sleeve at the other end of the lug. The clamps are usually reinforced to be rigid, and are made to extend just beyond the edges of the busbars, where bolts are placed to hold the two clamping members together and make a tight contact between the lug and bars.

Manufacturers:

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Southern Electrical Equipment Co., Charlotte, N. C.

TERMINALS, FUSE.—See Clips, fuse.

TERMINALS, HIGH-TENSION.—See Bushings, high-tension terminal for transformers, etc.

TERMINALS, LIGHTING AND POWER CABLE.—These are terminal fittings which are attached to the ends of lead-covered cables and are intended to protect the insulation from moisture and protect the emerging conductors from electrical discharge between each other or between any one and the cable sheath. The terminal is securely fastened to the cable, the joint being thoroughly sealed and protected. Each conductor is provided with a terminal protected by a petticoated hood. These terminals are made in different types for outdoor and indoor service, the former being of weatherproof design. Also see Potheads.

Manufacturers:

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "D. O. A.," "D. S."
Worcester Electric & Mfg. Co., Worcester, Mass.

TERMINALS, METER LOOP.—Meter loop terminals consist of a porcelain block on which usually five brass screw terminals are mounted, the whole block being enclosed in an iron box, with a sealing cover and provided either with conduit knockouts or with tapped conduit holes. They are installed on a meter board in a residence or other building by the electrical contractor and the proper wires from the service switch are connected to the terminals. When the central-station company installs the meter, all that is necessary for connecting is to insert the wires in the opposite ends of the terminals used and connect them to the meter terminals and seal the cover on the meter loop terminal box so that the connections cannot be tampered with.

Manufacturers:

Appleton Electric Co., 1703 Wellington Ave., Chicago, Ill.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Johns-Pratt Co., The, 555 Capitol Ave., Hartford, Conn.
METROPOLITAN ELECTRIC MFG. CO., East Ave. & 14th St., Long Island City, N. Y.

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TERMINALS, TELEPHONE CABLE.—Telephone cable terminals are made of insulating material such as a fiber or impregnated wooden block, having mounted on it a number of metallic terminals or binding posts, one for each wire in the cable. These terminals are usually protected by an enclosing cover for pole top mounting. For interior work, there are several other forms of terminals made, some being built up of strips of fiber or hard rubber with flat contacts placed between them.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Auth Electrical Specialty Co., 422 E. 53rd St., New York, N. Y.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Cook Electric Co., 900-10 W. Van Buren St., Chicago, Ill. "Cook."
Eby Mfg. Co., H. H., 13th and Wallace Sts., Philadelphia, Pa.
Electrical Engineers' Equipment Co., 35 S. Desplaines St., Chicago, Ill.
PETERSON CO., INC., CHARLES J., 723-29 Fulton St., Chicago, Ill.
Reliable Electric Co., 3145 Carroll Ave., Chicago, Ill. "Reliable."
Shain, Charles D., Times Plaza, Brooklyn, N. Y.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.

TERMINALS, TELEPHONE CORD.—Telephone cord terminals are metallic tips or terminals attached to cords, such as silver cords, where a permanent or solid connection is not desired. The terminals are made as tips (see Tips, cord) as spade and hook terminals. Brass is commonly used.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
EBDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Chicago Hand Phone Co., 511 W. Jackson Blvd., Chicago, Ill.
Cleveland Electric Co., 525 W. Van Buren St., Chicago, Ill.
Eich Electric Co., Genoa, Ill.
EVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 27.)
Shain, Charles D., Times Plaza, Brooklyn, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Telephone Shop, The, 506 S. Canal St., Chicago, Ill.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TERMINALS, WIRE, MISCELLANEOUS. — Wire terminals are made in a number of forms for miscellaneous wiring. In large sizes they are frequently cast or formed from heavy tubing and commonly called Cable Lugs, cable or wire. For use with small wires they are generally punched from sheet copper having a hole or slotted hole at one end and a channel or partial sleeve at the other. The wire is inserted in the sleeve end of the terminal and soldered in place, and the other end usually fastened on a terminal screw or binding post. There are numerous special forms of terminals comprising hooks, flat terminals, terminals with wings bent over the wire without sleeves, sleeves set at various angles, open sleeves, etc. Some terminals are made as straight tubular tips into which the wire is soldered and which fit over the holes of binding posts or spring terminals, thus protecting the wire from breakage.

Manufacturers:

American Pin Co., The, Waterbury, Conn. "Ampinco."
CHICAGO MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Chicago Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Cleveland Electric Co., The, 1421 State St., Bridgeport, Conn. "Bryant."
Cook & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Dominion National Carbon Co., Ltd., 1 Strachan Park, Toronto, Ont., Can.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa. "E-B."
ELECTRIC POWER EQUIPMENT CORP., 13th & Wood Sts., Philadelphia, Pa. A very complete line of cast copper fittings, including lugs, connectors, and special fittings made to order where a standard fitting can not be used. See display advertisement on page 1261.—Adv.
Electrical Engineers' Equipment Co., 35 S. Desplaines St., Chicago, Ill.
FITZGERALD MFG. CO., THE, Torrington, Conn.
Frankel Connector Co., Inc., Hudson and Vestry Sts., New York, N. Y. (Exclusive distributor, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.)
General Devices & Fittings Co., 441-445 S. Desplaines St., Chicago, Ill. (Copper, for cables, rods and tubing).
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Michigan Motor Specialties Co., 44-50 Mt. Elliott Ave., Detroit, Mich. "Becco."
Morse, Frank W., 289 Congress St., Boston, Mass.
MULTI ELECTRICAL MFG. CO., 703 Fulton St., Chicago Ill. "Multi."
PATTON-MAC GUYER CO., 31 Mathewson St., Providence, R. I.
Salem Electrical Supply Co., 9 Front St., Salem, Mass.
Shain, Charles D., Times Plaza, Brooklyn, N. Y.
SHERMAN MFG. CO., H. B., Battle Creek, Mich. (See display adv. page 1323.)
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stanley & Patterson, 34 Hubert St., New York, N. Y.
STATES CO., THE, 72 Francis Ave., Hartford, Conn.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TERRIER.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TERRY STEAM TURBINE CO., THE.—Hartford, Conn. Manufacturer of turbogenerators, turbines, steam blowers and other power plant equipment. President, D. H. Thomson; vice-president and general manager, N. L. Snow; treasurer, L. Rossiter, sales manager, R. L. Thomsen. Main office, Terry Sq., Hartford, Conn. Branch offices, 1521 Candler Bldg., Atlanta, Ga.; 3 S. 20th St., Birmingham, Ala.; 141 Milk St., Boston, Mass.; 1328-29 McCormick Bldg., Chicago, Ill.; 436 Engineers Bldg., Cleveland, Ohio; 1710 Glenarm St., Denver, Colo.; 715 Dime Bank Bldg., Detroit, Mich.; 636 Michigan Trust Bldg., Grand Rapids, Mich.; 410 Mutual Bldg., Kansas City, Co.; 625 Washington Bldg., Los Angeles, Cal.; 95 Liberty St., New York, N. Y.; 90 West St., New York, N. Y.; Maxwell Bldg., Philadelphia, Pa.; 816 Oliver Bldg., Pittsburgh, Pa.; 301 American National Bank B'dg., Richmond, Va.; 1070 Folsom St., San Francisco, Cal.; 220 Railway Exchange Bldg., Seattle, Wash.; 1105 Chemical Bldg., St. Louis, Mo. Sales representatives, A. M. Lockett & Co., 508 Flatiron Bldg., Fort Worth, Tex.; 423 Southern Pacific Bldg., Houston, Tex.; McBee Engine & Implement Co., 338 Plomingo St., Memphis, Tenn.; L. E. Pollard Co., 423 5th St., S., Minneapolis, Minn.; A. M. Lockett & Co., 521-525 Baronne St., New Orleans, La.; Fraser & Chalmers of Canada, Ltd., Guarantee Bldg., Montreal, Que., Can.

TESLA, NIKOLA.—A prominent inventor and electrical engineer (born in Smitjan, Lika, Austria-Hungary, 1857), who invented the polyphase a.-c. induction motor. After studying engineering at the Polytechnic School at Graz and philosophy and languages at Prague and Budapest, he worked in the telegraphic engineering department of the Austrian government until 1881. In 1884 he came to America, where he was naturalized, and his first employment was with Edison. In 1887 he organized a company to further his electrical researches. He was the first to conceive an effective method of utilizing the alternating current for converting electrical into mechanical energy more simply, effectively and economically than by direct current. He invented the principle of the rotating magnetic field, embodied in the induction motor and the revolving field generators used for the first time in the hydroelectric plant of the Niagara Falls Power Co. Among Mr. Tesla's discoveries and inventions are: polyphase sytems of power transmission, rotating magnetic field, revolving field, polyphase generator, polyphase transformer, induction motor, split-phase motor, oscillation transformer, electrical oscillator, mechanical oscillator, high-frequency machines and coils, Tesla tube, lamp and other high-potential, high-frequency apparatus, some of the earliest equipment for electrotherapy, an arc-light system, third-brush regulation, steam turbine, gas turbine, water turbine, pump, compressor, igniter, condensers, etc. Work on these lines led to his investigations in the field of radio power transmission. In addition, he has made various other scientific investigations, especially in the fields of low-weight, high-powered prime movers and atmospheric nitrogen production. In 1917, on the 21st anniversary of the reading of his paper announcing his discovery in polyphase transmission, before the American Institute of Electrical Engineers, he received the Edison medal for "early original work in polyphase and high-frequency electric currents."

TESSMER MACHINE & TOOL CO.—285-91 Rivard St., Detroit, Mich. Manufacturer of electric sand riddles. F. P. Tessmer, manager.

TEST BOARD, TELEPHONE.—Any arrangement of plugs and jacks or keys for the purpose of testing lines and sometimes apparatus. Also see Desks, telephone, wire chief's.

TEST PLUG OR TEST SHOE, TELEPHONE.—When a tester at the wire chief's desk needs to test a line at the main distributing frame, he uses a trunk which ends in a device that may be inserted in the protector. It has springs which slip in between the springs of the protector so as to open the line and permit the tester to oprate out to the line or in to the switchboard.

TEST SPECIAL.—Trade name for belting manufactured by the New York Belting & Packing Co., 91 Chambers St., New York, N. Y.

TEST STANDS FOR GENERATORS.—Stands used to hold an automobile generator while under test or when making repairs.

Manufacturer:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."

TESTALL.—Trade name for automobile testers manufactured by the Testall Electric Mfg. Co., 339 Moore Bldg., San Antonio, Tex.

TESTALL ELECTRIC MFG. CO.—339 Moore Bldg., San Antonio, Tex. Manufacturer of automobile testers. President, J. B. Herff; vice-president, M. Bierhower; secretary and treasurer, W. L. Herff.

TESTERS, ARMATURE. — Armatures, either during manufacture, operation, or repair, are subject to certain faults or defects, the principal of which are "open circuits," short circuits, and grounds. These must all be tested for before placing the armature into service and several different types of testers, using electrical current, have been devised which indicate the condition and locate the trouble, if any, by the sound given out. Other testers are more simple, consisting of a lamp in series with a source of energy that may be used for the same tests by moving contacts to test the coils connected between the proper commutator bars and between the segments and the armature core or shaft. Other testers use a voltmeter to make the tests, as these give a more accurate indication of the nature of a fault.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Century Electrical Co., 102 Randall Ave., Syracuse, N. Y. "Century."
Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.
Electric Controller & Mfg., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Niehoff & Co., Inc., Paul G. 232-242 E. Ohio St., Chicago, Ill.
Quality Electrical Products Co., 907 E. 15th St., Kansas City, Mo. "Quality Products."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.

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THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)

TESTERS, AUTOMOBILE.—Automobile testers are instruments made in compact and handy forms, designed to be used in testing the various electrical apparatus on automobiles. They consist of battery testers to determine the condition of the plates and the state of charge, circuit testers for the horn, ignition systems, lights, etc., magneto testers, spark plug testers, lamp testers, etc. The starting and generating equipment also requires special testing equipment to determine the presence of shorts, grounds and burnouts. Some of these outfits combine means for testing several electrical parts or circuits of an automobile and indicate exactly what the nature of the trouble may be. These testers are much used in garages, service and repair stations.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
American Electric Co., 6401 S. State St., Chicago, Ill. "Sonoscope."
Ballman-Whitten Mfg. Co., 4060 Forest Park Blvd., St. Louis, Mo. (Coil.) "B-W."
Becker Bros., 25 N. Jefferson St., Chicago, Ill. "B. B."
Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo. (Starter.)
Dayton Automotive Specialty Co., 310 E. 2nd St., Dayton, Ohio. "Wampler."
Electric Signal Mfg. Co., Inc., 31 Tremont Ave., Orange, N. J. "Emka."
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
Flash-O-Light Sales Co, 507 5th Ave., New York, N. Y. (Spark plug.)
Franco Electric Corp., Franco Bldg., Brooklyn, N. Y.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Leich Electric Co., Genoa, Ill.
Metal Specialties Mfg. Co., 3200-3208 Carroll Ave., Chicago, Ill. "Presto."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill. "Liberty." "Generometer."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Scott Corp., 105 N. Clark St., Chicago, Ill. "Telecator."
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.
Stahl Rectifier Co., 1401-5 W. Jackson Blvd., Chicago, Ill. "Mag Fixer."
Testall Electric Mfg. Co., 339 Moore Bldg., San Antonio, Tex. "Igni-Test." "Testall."
Weber & Morgan, 1336 Michigan Ave., Chicago, Ill. (Spark plugs and ignition systems.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TESTERS, BATTERY.—Battery testers are usually special forms of voltmeters and ammeters or voltammeters, arranged with convenient terminals and connectors and made small enough to be carried in a pocket. Very often the solenoid or iron vane principles are used in the instruments which results in a cheaper and more rugged tester. They are sometimes arranged for making the cadmium test also, but such instruments usually are of better grade, operating commonly on the D'Arsonval principle.

Manufacturers:

Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis.
American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
F. B. Electric & Mfg. Co., 119 E. Atwater St., Detroit, Mich. "F. B."
GENERAL ELECTRIC CO., Schenectady, N. Y. See description under Voltmeters, Battery or Pocket.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Metric Appliance Corp., 299 Broadway, New York, N. Y. "Mac."
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "Battery-Test-O-Meter."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Prest-O-Lite Co., 538 N. Capital St., Indianapolis, Ind.
Prest-O-Lite Co. of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.
Quality Electrical Products Co., 907 E. 15th St., Kansas City, Mo. ("Quality Products" cadmium test device.)
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Readrite Meter Works, Bluffton, Ohio. "Readrite."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.
Service Station Supply Co., 30-32 Larned St., Detroit, Mich. (Cell tester) "Hyrate."
Thompson Battery Tester Co., Greensburg, Pa.
Usona Mfg. Co., Inc., The, 1 Hudson St., New York, N. Y.
Western Electro-Mechanical Co., Inc., 465 2nd St., Oakland, Cal.
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TESTERS, BLASTING CAP AND CIRCUIT.—These devices, usually consisting of a special testing set or galvanometer, are used to test out the blasting circuit before firing. They may also be used in locating breaks and leaks in the circuit.

Manufacturer:

New York Blasting Supply Co., 11 Broadway, New York, N. Y. "Blasters Friend."

TESTERS, CABLE.—See Testing sets, portable (battery, bridge and galvanometer type); Bridges, Wheatstone, portable.

TESTERS, CIRCUIT, MISCELLANEOUS.—These are testing outfits used by electricians for testing out various wiring systems and circuits for continuity and for grounds. They are also used by wiremen and inspectors working on complicated apparatus where the circuits are in cable form and it is necessary to test out both before and after soldering to determine the presence of incorrect connections or imperfect joints. Various systems are used, the more simple ones being merely lamps or bells which light or ring if the circuit is correct. There are also special testers made for use on apparatus where the tests made are of the operating nature. These include timing features, and indicating instruments to measure the current or voltage required to make the apparatus function, etc.

Manufacturers:

Electric Signal Mfg. Co., Inc., 31 Tremont Ave., Orange, N. J. "Emka."
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y.
Leich Electric Co., Genoa, Ill.
Maroa Mfg. Co., Maroa, Ill. "Boss."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WHITALL ENGINEERING CO., THE, 59 W. Main St., Waterbury, Conn. "Universal."

TESTERS, COIL, FIELD, INDUCTION, ETC.—Testing outfits, usually portable, for detecting trouble in field and other coils. They sometimes operate on the magnetic induction principle and indicate conditions by the tone given out. Other testers are used to give continuity and resistance tests. Some consist of a lamp that is lighted when the coil is continuous or when it is grounded to the bobbin or pole piece. The testers for determining the resistance usually operate on the bridge principle.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Century Electrical Co., 102 Randall Ave., Syracuse, N. Y. "Century."
Cowie Electric Co., The E. S., 1818 McGee St., Kansas City, Mo.
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
Leich Electric Co., Genoa, Ill.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

TESTERS, COMBINATION.—These testers are used for testing various fuses and lamps, the clips and connections being mounted on the same board. The term combination is also applied to various other testers which may be used for testing several different devices or circuits.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
Century Electrical Co., 102 Randall Ave., Syracuse, N. Y. "Century."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Service Station Supply Co., 30-32 Larned St., Detroit, Mich. "Electric trouble detector." "Hyrate."

TESTERS, EGG, OR ELECTRIC CANDLERS.—See Egg testers or candlers, electric.

TESTERS, FUSE.—These devices are used to test nonrenewable cartridge, plug and other enclosed fuses that have no indicator to show their condition. They usually consist of a suitable means for holding the fuse in series with a resistance and indicator connected directly across the test circuit. By using an incandescent lamp the resistance and indicator are combined, and this is the usual arrangement. The fuse holder is a shallow screw shell cutout base for plug fuses or a pair of inclined copper bars arranged like the letter V, but not connected together, for either ferrule or knife-blade cartridge fuses of various lengths; both these types of holders may be mounted on the same block together with the indicating lamp. The current rating of the lamp must not exceed that of the smallest fuse to be tested.

Manufacturers:

Electric Specialty Co., The, 233 N. Elm St., Cresco, Iowa. "Addie."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WHITALL ENGINEERING CO., THE, Waterbury, Conn. The Universal for a-c. or d-c. circuits from 110 to 600-volts, is used for locating open or short circuits, grounds, blown fuses, or other troubles in lighting or power lines or apparatus. Case made of moulded insulation, no current carrying parts exposed. Weighs 8 oz.; overall dimensions, 3 ins. long, 2 ins. wide, 1 in. deep. Equipped with 6-in. flexible leads with brass tips. Used by electricians, trouble men, inspectors, motormen, power house operators, building engineers, metermen, linemen and electrical contractors.—Adv.



Universal Fuse Tester

TESTERS, LAMP.—For testing incandescent lamps at the counter where they are sold and for similar simple lamp testing to see whether the filament is intact, handy lamp testers are used. A shallow receptacle shell, or a still simpler device such as three contact strips, one to engage the center end contact and two parallel ones at right angles thereto to engage the screw contact shell, are provided to quickly connect the lamp into the circuit. A fuse or auxiliary lamp may also be included in the testing circuit to protect the lamp under test. The lamp must be tested on the circuit voltage for which it is designed. For this purpose separate tester receptacles should be provided for low-voltage miniature lamps, standard 110 to 120 and 220 to 240-volt medium and mogul base lamps, automobile lamps require a different receptacle.

Manufacturers:

JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Metal Specialties Mfg. Co., 338-52 N. Kedzie Ave., Chicago, Ill. "Presto."
Propp Co., M., 108 Bowery, New York, N. Y. "Standard."
Roller-Smith Co., 233 Broadway, New York, N. Y.

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TESTERS, MILK.—These are motor-driven centrifuges or Babcock testers used to determine the butter value of samples of milk by whirling at a high speed test bottles or tubes containing the selected samples. The motor is usually connected (through gears when mounted on the tester frame, or by belting when mounted external to it) to a shaft from which are suspended the test tubes.

Manufacturers:

Bets Co., Frank S., Hoffman St., Hammond, Ind.
Burrell & Co., Inc., D. H., Little Falls, N. Y. "Facile."
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Crepaco Babcock."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.

TESTERS, RAIL BOND.—Testing outfits used to determine the resistance of a bond or joint in a rail or to compare its resistance with a length of continuous track. In general, the principle of a Wheatstone bridge is employed, and a length of track containing the bond is either balanced against a length having equal resistance, which is determined by sliding the contact on the rail, or the resistances of equal lengths are compared by varying the ratio arms contained in the instrument. The instrument in this latter case includes a fairly sensitive galvanometer and an adjustable resistance arm. The contacts which are placed on the rail are an important feature of the tester, as they must not include contact resistance of any scale or dirt on the rail. The contacts are generally mounted on a bar and are pressed against the rail by the operator's foot.

Current flowing through the rail is utilized wherever possible, as this makes it possible to carry only a light instrument. Where measurements are taken with no current flowing in the rail, a large storage battery must be connected in circuit around the section to be tested to provide current while obtaining the balance.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. The sole purpose a bond serves is to conduct current with minimum heat loss. This means that the bond must have sufficiently low resistance so as not to add materially to the resistance of the return rail circuit. It is imperative to replace



Thompson-Levering Rail Bond Tester

or repair bonds whose resistance has become damagingly and expensively high. The Thompson-Levering Co. offers an instrument (illustrated above) for locating with exactness badly conducting bonds. This instrument is just as simple to operate and just as rugged and durable as an ordinary portable voltmeter. One person of average ability without technical training can locate badly conducting bonds by noting the position an index assumes of itself on a graduated scale. Also see display adv. on page 1286.—Adv.
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TESTERS, SEED.—Electrically heated hot-beds for testing seeds by forcing sprouting under conditions of warmth and relatively high humidity. The relative value of seeds can be readily determined by such accelerated tests.

TESTING INSTRUMENTS.—See Ammeters; Bridges, Wheatstone; Dynamometers; Electroscopes; Exploring coils; Galvonometers; Ohmmeters; Photometers; Power-factor meters; Pyrometers; Voltmeters; Wattmeters, etc.

TESTING LABORATORIES.—Large electrical manufacturing and utility companies usually maintain well equipped electrical laboratories for the conduct of routine tests as well as in some cases for special research for the further development of processes of manufacture and improvement of products. Smaller organizations, with little of such work to be done regularly, cannot afford to maintain laboratories adequately equipped for special tests that occasionally are required to save development work that would be misdirected. For such purposes, as well as for the conduct of performance tests of newly purchased equipment, for the calibration of instruments used in routine tests and for other special tests, it is found advantageous to have the testing done by an organization specializing on electrical and related testing work, and which has all of the necessary equipment in the way of instruments and apparatus of precision.

The following list of testing laboratories includes only those laboratories equipped to do electrical, magnetic, photometric and related commercial and general research testing work. A large number of engineering firms and consulting engineers do commercial testing work at times, but do not maintain completely equipped electrical laboratories in which general tests may be made, and are not listed here. The list contains only a few names, and is probably not complete, but information as to the nature of the testing done by other laboratories could not be obtained directly from them. The information given indicates the nature of the testing for which the laboratories are equipped and the name of the director, president or manager.

Bureau of Standards, Department of Commerce, Washington, D. C. Dr. S. W. Stratton, director. The Electrical Division of the Bureau is equipped with large laboratories for testing of electrical apparatus with respect to the standards of performance and the testing and calibration of comparative standards and measuring instruments. Testing and standardization are carried on in the fields of electrical measurements, measuring instruments, electrochemistry (batteries), radio telegraphy and telephony, electrolysis, photometry, magnetism, safety standards, radioactivity, and X-rays. The Bureau is recognized as an impartial referee in tests and claims made by other laboratories regarding electrical products. Also see separate entry on Bureau of Standards.
Detroit Testing Laboratory, 3726 Woodward Ave., Detroit, Mich. W. P. Putman, president. Laboratories equipped for testing generators, motors and transformers; also for making special electrical investigations and doing research work.
ELECTRICAL TESTING LABORATORIES, Eightieth St. and East End Ave., New York, N. Y. Dr. C. H. Sharp, technical director; P. S. Millar, general manager. Laboratories equipped for making tests and investigations upon electrical apparatus and materials in general and for acceptance tests at factories and for operation, and service tests of equipment. See advertisement on page 1260.
FitzGerald Laboratories, Inc., Niagara Falls, N. Y. F. A. J. FitzGerald, president. Laboratories equipped for experimental and testing-out work in connection with electric furnaces.
Hunt & Co., Robert W., 2200 Insurance Exchange, Chicago, Ill. R. W. Hunt, president. Inspection and testing of all kinds of electrical apparatus at the point of manufacture and after installation.
Illinois Testing Laboratories, 430 S. Green St., Chicago, Ill. J. A. Obermaier, President. Meter and instrument testing and inspection service.
National Electrical Laboratories, 107 Front St., New York, N. Y. R. J. Geddes, manager. Laboratory equipped for calibrating all types of electrical meters and instruments, also for making motor and generator tests.
Pittsburgh Testing Laboratory, Pittsburgh, Pa. A. R. Ellis, manager. Laboratories for testing in the field of electrochemistry.
Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago, Ill. W. H. Merrill, president. Laboratories for commercial testing of general electrical apparatus. Also see separate entry on Underwriters' Laboratories, Inc.

TESTING MACHINES FOR AUTOMOBILE ENGINES, GENERATORS AND STARTING MOTORS.—These machines are used for testing the individual units of an automobile before assembly. The engines are placed on a wooden framework, and may be tested either by the dynamometer method or by connecting to a generator and measuring the output. This latter method is simple and accurate, and the power need not be wasted. The generators are tested by being driven at certain predetermined speeds, and the output measured by means of a voltmeter and ammeter. Starting motors have their starting torque measured by a dynamometer when connected to a standard low-voltage source of supply.

Manufacturers:

Electric Machine Co., The, 329 W. Ohio St., Indianapolis, Ind. "Elmco Liberty."
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.

TESTING MACHINES, MISCELLANEOUS.—Practically all electrical testing machines have been separately listed. There are, however, many testing machines for mechanical tests, that are not separately listed, and which are included under this classification. These machines, many of which are motor-driven, comprise the many standard and special types used for tension, torsion, compression, bending and other tests of metals, concrete, wood, etc., and for many special tests, such as fatigue tests of metal, mechanical puncture tests of fabrics, etc.

Manufacturers:

Olsen Testing Machine Co., Tinius, 500 N. 12th St., Philadelphia, Pa.
Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa.

TESTING OF MEASURING INSTRUMENTS.—In order that accurate and reliable results may be obtained, electrical measuring instruments must be tested at regular intervals. In many instances it is good practice to test them before and immediately after a particular set of measurements has been made. The kind of test to be used in any instance depends upon the degree of accuracy desired and facilities available for conducting the tests. Tests may thus be considered under two heads, standardization and checking.

The standardization test is one in which the instrument tested is compared with the fundamental units. It is employed only when secondary standards are to be established. The checking test is the one most commonly used. It consists in comparing the reading of the tested instrument with the readings of instruments that have previously been standardized. The simplest procedure is to compare the reading of a similar standardized instrument under exactly like conditions with the readings of the tested instrument and note the difference. Also see Checking of ammeters, and of other instruments.

TESTING OUTFITS, WATT-HOUR METER.—There are several methods used in loading watt-hour meters for testing. The common ones are: Consumer's load, portable lamp bank, specially designed load box, portable storage battery, portable low-voltage transformers.

There are several valid objections to the first two, hence most companies use some one of the last three. For testing a meter on the consumer's premises the load box is perhaps the most extensively used. In its simplest form the load box consists of a set of resistors of different current capacities mounted on a frame or box and provided with switches for interconnection and binding posts for connection to the circuit. The resistors may be mounted in a box together with a voltmeter. The current taken by the resistor coils in different combinations and under different voltages is determined in the laboratory. A knowledge of the coils used and the voltage of the circuit is all that is necessary to know the load on the meter. By the aid of a stop watch the number of revolutions of the meter disk in a given time interval is counted, and from these data the meter accuracy can be calculated. These load boxes are made in various forms and load capacities.

For d-c. meter testing a portable storage battery of a few cells may be used. The transformer loading device consists of a specially designed stepdown transformer of low voltage and high-current-capacity sec-

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ondary. The primary is wound in sections for multiple or series connection, and the secondary has several taps through which connection is made for different loads. The exact manner of making connections differs with the manufacturers, but the principles are the same. In some makes connections between sections are made by a rotating switch, in others by knife switches and in some by plugs. The transformer switches are compactly assembled and mounted in a box.

Manufacturers:

Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont. ,Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eastern Specialty Co., 3551 N. 5th St., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. Meter testing rheostats comprising suitable resistances, switches, housing and carrying handle. They are light, portable and convenient to handle. Furnished in two sizes, 15 and 30 amp. (Bulletin 46026.) See adv. pages 1203-1223.—Adv.
Johns-Mansville, Inc., Madison Ave. & 41st St., New York, N. Y.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Stansico."
STATES CO., THE, 72 Francis Ave., Hartford, Conn.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TESTING SET, INSULATION.—A high-tension stepup transformer equipped for testing insulation; see Transformers, high-tension testing.

TESTING SETS, OIL.—See Oil testing cups and devices.

TESTING SETS, PORTABLE, (BATTERY, BRIDGE AND GALVANOMETER TYPE).—Portable testing sets are a compact assembly of resistance coils, galvanometer, and dry cells, all forming a self-tained Wheatstone's bridge. The whole assembly is mounted in a box with hinged or detachable cover and handle for carrying. These sets are made in many different forms and combinations of resistances. The rheostats are usually arranged on the decade plan and the connections in some forms are made by means of rotatable switches, called dials. These testing sets may be used for measuring resistance in general and determining the location of faults, crosses, grounds and open circuits, chiefly in communication cables and overhead circuits. When specially designed for locating faults in telephone, telegraph or power circuits they are called fault finders. For cable testing, the sets are made for a wider range, and special features are added so as to include everything necessary for locating faults, measuring resistance of conductors, insulation and liquid, and capacitance.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can., "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Essex Storage Battery & Supply Co., Inc., 279-81 Halsey St., Newark, N. J.
Foote, Pierson & Co., Inc., 160-162 Duane St., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. For all resistance measurements in field or shop that come within the range of a Wheatstone bridge, the Type S portable testing set is a most convenient and trustworthy instrument. Dial construction, simple to use; contacts protected from dirt, but easily accessible. Rheostat coils, 1/10%, ratio coils, 1/20%, guaranteed accuracy, high grade resistance wire. Rugged, suspended coil galvanometer, sensitivity one microampere per division. Good design



Type S Portable Testing Set.

and quantity production make possible the low price at no sacrifice of workmanship. The guarantee of satisfaction accompanying all our high grade instruments applies to the Type S set. —Adv.
Morse, Frank W., 289 Congress St., Boston, Mass. "Shuro."
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Service Products Co., The, Greenawalt Bldg., Springfield, Ohio.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. The T-2000 set is the official standard of the largest public service corporation in the Uni-



T-2000 Set

ted States and is used throughout the world. The set is arranged for resistance measures and arrangements also are made for making the Murray and Varley loop tests for fault locations. The rheostat is composed of four dials of ten coils each of the values of



Peerless Government Standard Test Set

units, tens, hundreds and thousand-ohm coils. The bridge has 1, 10, 100, and 1000 ohms in each arm. An Ayrton shunt protects the galvanometer. A self-contained battery of six cells is furnished with each set renewable by unscrewing two screws. Provisions are made for external e.m.f. and also a high sensibility galvanometer may be used if desired. The "Peerless Government Standard Test Set" is made in strict accordance with the government specifications 17-T-2, issued by the Navy Department. It is a decade set of the plug-in type, arranged for making all resistance tests, as well as Murray and Varley loop tests. The "Peerless Plug Type Testing Set" is an improved type of plug set, used by companies where extreme speed is not required for making measurements. All of the testing sets described above will make the following tests: (a) measure resistance by the Wheatstone-bridge method; (b) measure insulation resistance by the direct-deflection method; (c) compare e.m.f.'s by the fall-of-the-potential method; (d) check up voltmeters; (e) measure battery resistance; (f) make the Murray loop test; (g) check up ammeters by using a shunt of known value; (h) make the Varley loop test; (i) test out grounds, if desired the resistance coils only may be used so that the bridge can be operated as a straight resistance box. Also see display adv. on page 1286.—Adv.



Peerless Plug Type Testing Set

TESTING SETS, PORTABLE (EXPLORING COIL. INTERRUPTER AND TELEPHONE TYPE.)—These are testing sets used to locate hidden faults in underground cables and in conductors in conduit and other concealed systems. They operate by means of an exploring coil, a small coil that is moved around over the place where the break is suspected. When a pulsating current is applied to the conductors by means of the interrupter and the exploring coil is connected to the telephone, a characteristic inductive hum or noise is heard in the telephone; by moving the coil the break or ground may be located, because beyond it no such hum is heard.

Manufacturers:

Brocklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Century Electrical Co., 102 Randall Ave., Syracuse, N. Y. "Century."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Electric Specialty Mfg. Co., Cedar Rapids, Iowa. "Wireless."
HOLTZER-CABOT ELECTRIC CO., 125 Amory St., Boston, Mass.
Matthews & Brother, Inc., W. N., 2912 Easton Ave., St. Louis, Mo. "Telefault."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
THOMPSON-LEVERING CO., 327 Arch St., Philadelphia, Pa. "Peerless." (See display adv. page 1286.)
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TESTING SETS, PORTABLE (MAGNETO AND BELL TYPE).—These consist of a relatively high voltage magneto generator and a ringer or bell in series, mounted in a portable box. They are used for practical testing of insulation resistance of house wiring, telephone lines and of elecrical machinery. In testing for grounds one terminal of the generator is connected to the wire under test and the other terminal is grounded. The ringing of the bell when the crank of the magneto is turned is an indication that the wire is grounded. Such a device gives no indication of the actual resistance to ground and in case the wire or line has considerable capacitance the charging current may ring the bell, thus giving a false indication. The ease of

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operation and portability make such a set very useful, however, for roughly determining the presence of grounds and short-circuits.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eisemann Magneto Corp., 32 33rd St., Brooklyn, N. Y.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Frankel Connector Co., Inc., Hudson & Vestry Sts., New York, N. Y.
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TESTING SETS, PORTABLE (MAGNETO, RINGER AND TELEPHONE TYPE).—These portable testing sets are used extensively by linemen in testing out telephone lines to determine the location of trouble. They consist of a magneto, telephone receiver, transmitter and ringer all contained in a compact wooden box. When the receiver is in the holder, the magneto rings through the ringer and may be used for testing. When the receiver is removed, the instrument may be used to ring on the line, to test out subscribers' bells, etc.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
American Electric Co., 6401 S. State St., Chicago, Ill.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eisemann Magneto Corp., 32 33rd St., Brooklyn, N. Y.
Electric Controller & Mfg. Co., The, 2700 E. 79th St., Cleveland, Ohio. "E. C. & M."
Federal Telephone & Telepgraph Co., Buffalo, N. Y. "Federal."
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Monarch Telephone Mfg. Co., Fort Dodge, Iowa.
Niehoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill. "Defectometer," "Liberty."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Valley Electric Co., 4919-29 Connecticut St., St. Louis, Mo. "St. Louis."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TESTING TRANSFORMERS. — See Transformers, high-tension, testing.

TETDCO.—Trade name for signaling systems, tachometers and other indicating and recording instruments, manufactured by the Electric Tachometer Corp., 310 N. 11th St., Philadelphia, Pa.

TEXACO.—Trade name for lubricating oils and greases manufactured by the Texas Co., 17 Battery Pl., New York, N. Y.

TEXARKANA PIPE WORKS.—Texarkana, Tex. Manufacturers of fire brick.

TEXAS CO., THE.—New York, N. Y. Manufacturer of lubricating oils and greases. Business established 1902. President, A. L. Bently; sales managers, (North) C. E. Woodbridge, (South) C. P. Dodge. Main office, 17 Battery Pl., New York, N. Y. Factory, Port Arthur, Tex. Branch offices, Houston, Tex.; Chicago, Ill.; Philadelphia, Pa.; Boston, Mass.; Norfolk, Va.; Dallas, Tex.; El Paso, Tex.; Atlanta, Ga.; New Orleans, La.; Denver, Colo.; Pittsburgh, Pa.; Tulsa, Okla.; Youngstown, Ohio; Buffalo, N. Y.; Detroit, Mich.; Baltimore, Md.; San Francisco, Cal.; Charleston, S. C.; Savannah, Ga.; Galveston, Tex.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION.—President, R. B. Still, Tyler, Tex.; secretary, Oscar Burton, Tyler, Tex.

TEXAS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS—Secretary, H. S. Ashley, Fort Worth, Tex.

TEXTILE MACHINE WORKS.—Reading, Pa. Manufacturer of wire braiding and insulating machinery. President, Henry Janssen; secretary and treasurer, Ferdinand Thun.

THAWING OUTFITS, PIPE, COMPLETE ELECTRIC.—Electric pipe-thawing outfits depend for their design on the source of current available. Outfits to operate on a-c. systems usually consist of a pipe-thawing transformer, which see, and special regulating equipment. The transformers are often fairly large and considerable cable is required for completing the secondary circuit and also for making connections to the distributing mains either in a manhole or on an overhead line. The complete units, transformer, cable reels, regulating equipment, instruments, etc., are therefore often mounted on a small truck or cart so that they may be quickly transported to the place where the thawing is to be done.

For d-c. service it is sometimes possible to connect directly to the mains and regulate the current supply by means of rheostats, which are sometimes liquid rheostats. This method is not very efficient and where much of such work is to be done a motor-generator set is usually provided. The motor operates from the distributing mains at about 230 or 500 volts, depending on the power available, and the generator supplies a large current at low voltage which is sent through the frozen pipe. Motor-generator sets for d-c. service are a little more expensive than transformers for a-c. service.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Thomson Co., Ltd., Fred, 9 St. Genevieve St., Montreal, Que., Can.
WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

THAWING TRANSFORMERS. — See Transformers, pipe thawing.

THEATER DIMMERS.—See Dimmers, theater or stage.

THEATER SWITCHBOARDS — See Switchboards, theater.

THEATRICAL ELECTRICAL EFFECTS, SPECIAL.—Special apparatus for theater stages employing special forms of border, bunch or spotlights, arc lamps, spark-producing devices to imitate lightning, etc. Such apparatus is employed in producing waterfalls, rain and similar effects by means of rotating slides in a projection lantern; for producing various effects by concealing objects by distribution of glare and shadow, and for creating optical illusions. A large number of effects are produced by employing lighting auxiliaries in connection with the regular equipment for stage settings, the special lighting serving to bring out with striking prominence some part of the scene or some actor on the stage or to change the natural colors.

Manufacturers:

Botanical Decorating Co., 208 W. Adams St., Chicago, Ill.
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St. New York, N. Y.
Chicago Stage Lighting Co., 112 N. La Salle St., Chicago, Ill.
Hub Electric Co., 2225 W. Grand Ave., Chicago, Ill.
Kansas City Scenic Co., 1002 E. 24th St., Kansas City, Mo.
Newton, Charles I., 305 W. 15th St., New York, N. Y.
Pennefather, James S., 358 W. 43rd St., New York, N. Y.
Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y. "Kliegl."
Ward Leonard Electric Co., Mt. Vernon, N. Y.

THEBIAN.—Trade name for illuminating glassware manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

THELCO.—Trade name for electric drying ovens, incubators, thermostats and baths for laboratories manufactured by the Thermo Electric Instrument Co., 8 Johnson St., Newark, N. J.

THERAPEUTIC LAMPS.—See Lamps, therapeutic.

THERAPHONE.—Trade name for telephone transmitter mouthpieces, muffiers, receiver earcaps, transmitters, receivers and hand set telephones, manufactured by the Evolution Phone Co., Inc., 48 Greenwich Ave., New York, N. Y.

THERLO.—Trade name for resistance wire manufactured by the Driver-Harris Co., Harrison, N. J.

THERMAL ARRESTER.—A name sometimes used for the protective device for telephone apparatus, which by the heating effect of "sneak currents" or stray currents operates to protect the apparatus. See Heat coils, telephone.

THERMAL EFFICIENCY.—The efficiency with which developed heat is applied in an apparatus to a useful purpose. If, for instance, a boiler puts 75% of the heat generated within it by burning fuel into the actual task of converting cold water into steam (its primary object) the thermal efficiency is 75%. If an electric furnace uses 1 kw-hr. to melt a kilogram of steel, which latter contains 325 Calories of heat, the thermal efficiency is 325 divided by the theoretical heat equivalent of 1 kw-hr. or $325/860 = 0.37 = 37\%$.

THERMAL ELECTROMOTIVE FORCE.—This is an e.m.f. produced when the temperature of the junction of two dissimilar metals is raised above the temperature of the other ends. This principle is applied in the thermopile or thermocouple which is used for measuring differences in temperature.

THERMAL GALVANOMETER.—See under Galvanometer.

THERMELECTRIC.—Trade name for electric water heaters manufactured by the Electric Sales Service Co., Berkeley, Cal.

THERMIONIC VALVE, RADIO.—See Electron tubes.

THERMIT.—Trade name for welding alloys manufactured by the Metal & Thermit Corp., 120 Broadway, New York, N. Y.

THERMO.—Trade name for electric drink mixers manufactured by the Fulton-Bell Co., 451 Greenwich St., New York, N. Y.

THERMO.—Trade name for arc lamp globes manufactured by the Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

THERMO.—Trade name for electric vacuum type washing machine manufactured by the Standard Washing Machine Co., 1100 E. 55th St., Chicago, Ill.

THERMO.—Trade name for electric water heaters manufactured by Thermo Electric, Ltd., Brantford, Ont., Can.

THERMO ELECTRIC INSTRUMENT CO.—8 Johnson St., Newark, N. J. Manufacturer of electrically heated drying ovens, incubators, thermostats and baths for laboratories.

THERMO ELECTRIC, LTD.—Brantford, Ont., Can. Manufacturer of electric water heaters.

THERMO-FAN ELECTRIC CO., INC.—2 Columbus Circle, New York, N. Y. Manufacturer of electric fans, driers and heaters. Business established 1920. President, James B. Olson, Jr.; vice-president and treasurer, Howard R. Sharkey; secretary, James B. Olson, Sr. (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

THERMO JUNCTION.—The uniting of two unlike metals to form part of an electric circuit so that by heating one of the points of joining an electric current will be produced in the circuit. This is more commonly called a thermoelectric junction or a thermocouple.

THERMOCHEMICAL EQUIVALENT OF THE VOLT.—One Faraday of electricity, 96,500 coulombs, is required to separate one chemical equivalent of any element. If this work is done under a pressure of one volt, the energy absorbed is 96,500 coulombs $\times$ 1 volt = 96,500 joules; 1 joule = 0.2389 calorie; therefore 96,500 joules =

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23,050 calories. Any thermal reaction involving one chemical equivalent will then require an electromotive force of as many volts as 23,050 will be contained in the number of calories involved in the given thermal reaction. See Reaction, heat of.

THERMOCOUPLES FOR PYROMETERS.—The proper thermocouple for use in these instruments is dependent upon the conditions of use, that is, maximum temperature, and nature of atmosphere or material in which the couple will be placed. The base-metal couples are usually copper and constantin, or elements of standard nickel-chromium alloys. For higher temperatures a couple of platinum and an alloy of platinum and rhodium is used. The couples are nearly always encased in protection tubes, the tube material used depending largely on the temperature it must withstand. Materials most commonly used for such protection are porcelain generally with the platinum couples, quartz, and alloys, the metal tubes being also used to protect the porcelain or quartz casing.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv. on page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Cleveland Instrument Co., The, 6523 Euclid Ave., Cleveland, Ohio.
Foxboro Co., Inc., The, Foxboro, Mass.
Hanovia Chemical & Mfg. Co., Chestnut St. and New Jersey Railroad Ave., Newark, N. J.
Hoskins Mfg. Co., Lawton and Buchanan Sts., Detroit, Mich.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y. "Pyod."

THERMOCOUPLES, MISCELLANEOUS.—Small alternating currents of high frequency may be measured by thermocouple ammeters. For these ammeters and various special scientific apparatus thermocouples of special design are employed.

Manufacturers:

Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Electrical Alloy Co., The, Morristown, N. J.
Foxboro Co., Inc., The, Foxboro, Mass.
Hanovia Chemical & Mfg. Co., Chestnut St. and New Jersey Railroad Ave., Newark, N. J.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia Pa.
RAWSON ELECTRIC INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.

THERMOELECTRIC COEFFICIENT.—This is usually but incorrectly called "thermoelectric power." It is the thermal e.m.f. per degree difference of temperature between the junctions of two dissimilar metals. It is not a power, but a constant depending on the metals used.

THERMOID RUBBER CO.—Trenton, N. J. Manufacturer of rubber rings, tires and other rubber products. Main office, Trenton, N. J. Branch office, 1907 S. Michigan Ave., Chicago, Ill.

THERMOLAK.—Trade name for insulating varnish manufactured by the John C. Dolph Co., 168 Emmett St., Newark, N. J.

THERMOLITE.—Trade name for medical lamp manufactured by H. G. McFaddin & Co., 38 Warren St., New York, N. Y.

THERMOMETERS.—These are instruments for indicating relative temperatures by means of some physical change which is proportional to the change in temperature. The expansion of liquids and gases is the physical change most commonly employed in low-temperature measurements. The mercury-in-glass thermometer is a good example. This type of mercury thermometer has serious limitations, however. It is easily broken, it cannot be used above temperatures at which the glass becomes soft, and its form prevents its use in rather inaccessible places, such as windings of electrical machinery, etc. For measuring higher temperatures and temperatures at rather inaccessible places electrical resistance and thermoelectric thermometers are used. For measuring very high temperatures, such as those of furnaces, the special thermometers are commonly called "pyrometers." Electrical pyrometers are widely used. See Pyrometers.

THERMOMETERS, BATTERY OR ELECTROLYTIC.—These are mercury bulb thermometers with the temperature scale etched on the glass as in the case of chemical thermometers. They are used for obtaining the temperature of electrolytic solutions and other liquids, as for obtaining the temperature of a battery electrolyte during the charging process, of an electroplating bath, etc.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
Caldwell & Co., Inc., Edward F., 36-40 W. 15th St., New York, N. Y.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia, Pa.
Freas Glass Works, Inc., Francis L., 146 E. 9th Ave., Conshohocken, Pa.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
General Scientific Equipment Co., North Philadelphia, Pa. "Genco."
Hearn & Harrison, 418 Notre Dame St., West, Montreal, Que., Can.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS, ELECTRICAL INDICATING OR RECORDING.—Thermometers of these types generally consist of thermomelectric or resistance thermometers together with a galvanometer, Wheatstone bridge or potentiometer for the indicating types and these two electrical thermometer types and a suitable recording apparatus for the recording types. This class of instruments is particularly useful when the temperatures must be read or recorded at a distance from the thermometer. They are often made to indicate or record (or both), at a central control point or the office of the superintendent of the plant, in which case a group of such instruments may be mounted on one panel.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Brown Instrument Co., The, Philadelphia, Pa. "Brown."
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Cooper Oven Thermometer Co., The, Pequabuck, Conn.
Foxboro Co., Inc., The, Foxboro, Mass.
Hanovia Chemical & Mfg. Co., Chestnut St. and New Jersey Railroad Ave., Newark, N. J.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Stupakoff Laboratories, The, 6617-6627 Hamilton Ave., Pittsburgh, Pa. "Stupakoff."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS, FEED WATER, CONDENSATE, ETC.—For testing and for economic operation of power plants a knowledge of feed water and condensate temperatures, etc., is essential. The thermometers generally used consist of the thermometer set in a scale and special fitting which is inserted into the water pipe or tank plate. The thermometers are made straight or with the scale at right angles with the part of the thermometer inserted into the water so that the scale may be so fastened as to be most easily read.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Foxboro Co., Inc., The, Foxboro, Mass.
Marsh & Co., James P. 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Crescent," "Schaeffer."
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS, FLUE GAS.—In making tests of power-plant boilers and as an important check on the operation of such boilers the temperature of the flue gases is determined by means of a specially constructed thermometer. The usual form of these instruments is a long glass tube to the upper half of which is attached a temperature scale, the lower half being covered by a tube and guard for insertion at the point in the path of the gases where it is desired to determine the temperature.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Dwight Mfg. Co., 564 W. Washington Blvd., Chicago, Ill. "Dwight."
Foxboro Co., Inc., The, Foxboro, Mass.
Green, Henry J., 1191 Bedford Ave., Brooklyn, N. Y.
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Crescent," "Schaeffer."
Scientific Instrument Co., 711 8th St., Detroit, Mich.

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Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS FOR GENERATORS AND OTHER ELECTRICAL MACHINERY.—These are usually either thermoelectric or resistance thermometers. The resistance thermometer for electrical machinery is a very small flexible coil wire of high temperature coefficient of resistance. Nickel is quite satisfactory for this purpose. This is imbedded in the winding whose temperature is to be measured, and its changes in resistance are measured by some form of Wheatstone bridge, which is marked to read in temperature instead of resistance. The Standardization Rules of the A. I. E. E. require the use of such devices for locating spots of highest temperature in electrical machinery.

Mercury thermometers are also employed sometimes, the thermometer being applied with special care to the winding immediately after the test run has been made, but correction must be made for heat loss due to radiation.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Chaney Mfg. Co., The, 557-575 E. Pleasant St., Springfield, Ohio.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Foxboro Co., Inc., The, Foxboro, Mass.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa., 1304 Monadnock Block, Chicago, Ill. Switchboard indicating and recording instruments, with thermocouple and resistance detectors imbedded in machines, transformers or cable ducts. The recording instruments keep an accurate record of variations of temperatures in the apparatus, permit loading of the equipment for maximum efficiency, and by ringing an alarm when the danger temperature is reached at any point they constitute effective insurance against shutdowns.—Adv.
Moeller, A. E. 261-3-5 Sumpter St., Brooklyn, N. Y. "A. E. M."
National Gauge Co., 300 Pacific St., Brooklyn, N. Y.
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Crescent," "Schaeffer."
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS, NONELECTRICAL RECORDING AND INDICATING.—The simplest of these thermometers is the common mercury, glass-tube thermometer much used for the temperature measurement of liquids and gases where the glass tube will not be subjected to hard usage. Other indicating and recording thermometers most commonly employ one of three mediums to measure the temperature; the direct expansion of liquids, the vapor tension of volatile liquids, or the expansion of inert gases. The construction of the three types is very similar, consisting essentially of a small bulb containing the liquid or gas, and a flexible steel capillary tube system which connects the bulb to the recording or indicating device. The bulb is inserted at the point where the temperature is to be measured. For standardization purposes constant-volume hydrogen or nitrogen thermometers are generally employed.

Manufacturers:

National Regulator Co., The, 208-12 S. Jefferson St., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Crescent," "Schaeffer."
Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.
Standard Thermometer Co., 65 Shirley St., Boston, Mass. "Standard."
Taglabue Mfg. Co., C. J., 18-88 33rd St., New York, N. Y.
TAYLOR INSTRUMENT COMPANIES, Rochester, New York. Mercury and Vapor Tension. The Tycos recording thermometer is an instrument that automatically writes in ink on a revolving paper chart a continuous record of the temperatures to which its bulb is subjected. The self-contained recorder has the bulb, or sensitive member, inside or directly below the case, whereas with the capillary form instrument the bulb may be located at a distance. The Tycos Mercury Recording Thermometer is made in the capillary form for recording temperatures within limits of 40 deg. below to 1000 deg. above zero F., or the equivalent in C. The length of flexible connecting



Tycos Recording Thermometer

tubing, form of bulb, and bulb connection are designed to meet the requirements of each individual installation. The illustration shows an instrument with moistureproof case. The Tycos vapor-tension recording thermometer is also made in the capillary form for recording temperatures within limits of approximately 100 deg. to 500 deg. F., or the equivalent in C. Like the mercury type, its details of construction can be varied to suit the installation. The Tycos self-contained recording thermometer is designed to record the temperature surrounding it, within limits of zero and 150 deg. F., or the equivalent in C. All Tycos recording thermometers are equipped with patent pen-arm sealing device, to prevent adjustment by unauthorized person; high-grade, specially designed clock movement; pivoted pen-arms, to insure correct time readings and bearing pressure of pen points on charts; and are under lock and key, to eliminate willful or malicious interference with the records. Extreme ruggedness of construction, to meet the severe usage of industrial installations, is an outstanding feature.—Adv.

THERMOMETERS, RESISTANCE TYPE.—This thermometer depends for its operation on the fact that the electrical resistance of a conductor increases in proportion to the temperature. It consists of a coil of resistance wire, usually copper, nickel alloy, or platinum, in a suitable protecting tube, the coil being connected to a Wheatstone bridge and galvanometer. If the coil is installed at the point where the temperature is to be measured the resistance of the coil will vary with the surrounding temperature. This resistance is measured by means of the Wheatstone bridge, the galvanometer serving to indicate when the balance is reached. The balancing resistance of the bridge is scaled to read the temperatures directly. These thermometers are very accurate and have the additional advantage that they can measure temperatures at a distance or at places difficult or impossible of access. For very high temperatures they are generally called pyrometers, which see.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
Hanovia Chemical & Mfg. Co., Chestnut St. and New Jersey Railroad Ave., Newark, N. J.
Kuhlman Engineering Co., The, 840 Champlain St., Toledo, Ohio.
LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Standard Scientific Co., 9 Barrow St., New York, N. Y. "Meliorate."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOMETERS WITH ALARM OR OTHER CIRCUIT CONTACTS.—To control temperature within close limits is very important in a large number of industrial processes. To accomplish this it is the usual practice to employ a thermometer which is itself electrical or one of the liquid bulb and tube type with an auxiliary electrical contacting device, the latter being set to turn off or on the heating medium when the upper and lower temperature limits, respectively, are reached. These instruments may also be used for indirect control of temperature as for brine tanks when they are used to start and stop the motor which drives the ammonia compressor. This class of instrument is also made for various special purposes and for alarm systems wherein they serve to indicate by colored lights or similar means whether the temperature is too high or too low or correct, the regulation of the process being done manually by the operator receiving the signal.

Manufacturers:

Beck & Co., Oscar, 280 Maujer St., Brooklyn, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Foxboro Co., Inc., The, Foxboro, Mass.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Philadelphia Thermometer Co., The, 54 N. 9th St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa. "Princo."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Inc., Brooklyn, N. Y. "Crescent," "Schaeffer."
Scientific Instrument Co., 711 8th St., Detroit, Mich.
Scranton Glass Instrument Co., 322 N. Washington Ave., Scranton, Pa.
Standard Thermometer Co., 65 Shirley St., Boston, Mass. "Standard."
TAYLOR INSTRUMENT COMPANIES, 95 Ames St., Rochester, N. Y. "Tycos."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOPHONE.—Trade name for hearing devices for the deaf, telephone and radio receivers and telephones manufactured by the American Thermophone Co., 114-116 Bedford St., Boston, Mass.

THERMOPHORE.—Trade name for electric heating pad manufactured by the Sanitarium Equipment Co., Battle Creek, Mich.

THERMOPILE.—A group of thermocouples connected in series and arranged so that one set of junctions can be heated and the other kept cool, thus resulting in a considerable current flow.

THERMOPLAX.—Trade name for molded insulation manufactured by the Cutler-Hammer Mfg. Co., Milwaukee, Wis.

THERMOSTATIC METAL.—Thermostatic metal is a bimetallic sheet or strip made up by welding together two layers of metal having widely differing coefficients of expansion. The two metals frequently used are steel and brass. The metal is made up in strips, U-shaped pieces or, for obtaining more active metal in a given space, in spirals or helicles. The metal is used in various thermostatic temperature controlling devices and for temperature compensation in accurate instruments.

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Manufacturers:

Driver-Harris Co., Harrison, N. J.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. on page 1251.)
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Wilson Co., The H. A., 97 Chestnut St., Newark, N. J. "Wilco."

THERMOSTATS, FIRE-ALARM.—Temperature-operated contact-making or breaking devices consisting either of a combination of dissimilar metals (the unequal expansion of which causes contacts to be opened or closed), or tubes or vessels containing liquids or gases which are caused to expand on the application of heat and in either case, to close or open contacts for the purpose of indicating the presence of excessive heat by controlling signal alarm circuits.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv., page 1286.)
American Fire Prevention Bureau, Inc., 1 Madison Ave., New York, N. Y. "Derby Fire Sentinel."
Beers, I. F., 1158-60 Portland Ave., Rochester, N. Y.
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Dee Electric Co., 79 W. Monroe St., Chicago, Ill. "Guardian."
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Relc Equipment Corp., 5 Beekman St., New York, N. Y.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.

THERMOSTATS FOR ELECTRIC CAR HEATERS.—Contact-making or breaking, electric heater control devices which, through the expansion and contraction of their principal elements, make or break electric circuits that in turn control the operation of electromagnetic switches which apply current to or cut it off from the electric heaters. These devices, according to type, may operate at a fixed temperature (within close limits), or within a range of a few degrees. The thermostatic elements are of several types, such as mercury thermometer, metallic, bellows, etc. The mercury thermometer design employs a special type of thermometer using mercury as its expanding and contracting element, and having suitable contact wires fused in the tube at the proper points. The metallic type depends on the different rates of expansion and contraction of two dissimilar metals to operate the contacts. The bellows type consists of thin metallic bellows filled with a liquid which expands and contracts with varying temperature, thus actuating suitable electric contacts. The electromagnetic switches that are used by the several manufacturers in connection with their various types of thermostats are actuated by a small current, passing through the thermostat circuit or controlled by relays which are operated by the thermostat.

Thermostatic control equipments comprise one of the most important contributions to the art of electric car heating, because of the economical use of electric current made possible by their use. Savings in current consumption, using thermostatic control as compared to the manual control, range up to 50% depending on conditions. The advantages of the electric method of clean, easily regulated and distributed car heating is thus made possible in many instances where the manual type of heater control would be too expensive, in use of current, to warrant consideration.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. A thermostat used on systems with electrical temperature control. See adv. pages 1203-1223.—Adv.
Railway Utility Co., 151 W. 22nd St., Chicago, Ill. (Electric Railway Heaters.)

THERMOSTATS, MISCELLANEOUS.—Temperature-operated circuit control devices consisting of combinations of dissimilar metals having unequal expansion characteristics or confined liquids or gases whose volume is altered by changes in applied temperatures causing the making or breaking of contacts to control signal circuits or pilot circuits for automatic temperature control systems, etc., in miscellaneous heating, ventilating or refrigerating systems, etc.

Manufacturers:

ABSOLUTE CON-TAC-TOR CO., 127 N. Dearborn St., Chicago, Ill. "Con-Tac-Tor." (See display adv., page 1286.)
American Thermostat Co., 226 Jelliff Ave., Newark, N. J. "Marvel."
AUTOMATIC ELECTRIC HEATER CO., Warren, Pa. "Sepco."
AUTOMATIC RECLOSING CIRCUIT BREAKER CO., THE, 6th & Wesley Aves., Columbus, Ohio. The illustration herewith shows a thermostat that may be applied to the bearings of any rotating machine. It has both circuit making and circuit breaking contacts and may be used to operate any signal device or protective device desirable. It is operated by a liquid which passes into a vapor at a definite temperature, thus providing positive operation always at the same temperature. It is designed to be placed in top cap of bearing. The lower end of the thermostat (composed of babbitt metal and housing the liquid charge) is thus brought in direct contact with bearing shaft, so that any heat generated by revolving shaft will be transmitted immediately to the liquid and causes the thermostat to function whenever the heat becomes excessive. —Adv.



Thermostat

Beers, I. F., 1158-60 Portland Ave., Rochester, N. Y.
BRISTOL CO., THE, Waterbury, Conn. (See display adv., page 1286.)
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Chicago Surgical & Electrical Co., 314-324 W. Superior St., Chicago, Ill.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Fort-ified Mfg. Co., 14th and Agnes Sts., Kansas City, Mo. "Fort-ified."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Hicks, W. Wesley, 660 Market St., San Francisco, Cal. "Wesix."
Honeywell Heating Specialties Co., Wabash, Ind.
Ideal Fire Detector Co., 161-163 W. Clay Ave., Roselle Park, N. J. "Ideal."
KLAUS RADIO CO., Eureka, Ill.
Minneapolis Heat Regulator Co., 2747 4th Ave., South, Minneapolis, Minn.
Moeller, A. E., 261-3-5 Sumpter St., Brooklyn, N. Y. "A.E.M."
Munning & Co., A. P., Church St., Matawan, N. J.
Pelton & Crane Co., The, 632 Harper Ave., Detroit, Mich. "Pelcrane," "Pelton."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Refrigo Corp., 18th St. and Forest Home Ave., Milwaukee, Wis.
Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia, Pa.
Standard Thermometer Co., 65 Shirley St., Boston, Mass. "Standard."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Thermo Electric Instrument Co., The, 8 Johnson St., Newark, N. J. "Freas," "Thelco."
Wagner, Carl H., 1944 N. Albany Ave., Chicago, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

THERMOVAC.—Trade name for electric heating devices manufactured by the H. B. Gibson Co., 38 Park Pl., New York, N. Y.

THESCO.—Trade name for insulator clamps made by the States Co., 72 Francis Ave., Hartford, Conn.

THEW SHOVEL CO., THE.—Lorain, Ohio. Manufacturer of electric cranes, hoists and excavators. Business established 1895. President, F. A. Smythe; vice-president, C. B. Smythe; secretary and treasurer, R. B. Miller; sales manager, H. E. Billington. Main office and factory, E. 28th St., Lorain, Ohio. Branch offices, 303 Church St., New York, N. Y.; 1164 Monadnock Block, Chicago, Ill.; 510 Railway Exchange, Kansas City, Mo. Sales representatives, Feenaughty Machinery Co., 309 E. Yamhill St., Portland, Ore.; Graves Machinery Co., Healy Bldg., Atlanta, Ga.; Spears Wells Machinery Co., Oakland, Cal.; Mussens, Ltd., Montreal, Que., Can.; Smith-Booth-Usher Co., 228 Central Ave., Los Angeles, Cal.; Ambler & Riter, Kearns Bldg., Salt Lake City, Utah.

THIMBLES, GUY OR WIRE ROPE.—In securing a stranded guy wire to an anchor rod, the radius of the bend around the eye is so sharp as to weaken the steel strand. A thimble is therefore provided to give a large radius an increased bearing surface. It is a piece of steel formed into a groove or circular trough and bent into the eye shape.

Manufacturers:

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Peirce."
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Marine Hardware-Equipment Co., South Portland, Me.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Roebling's Sons Co., John A., Trenton, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

THIRD RAIL CLAMPS.—See Clamps, third rail.

THIRD RAIL END SLOPES.—See End slopes, third rail.

THIRD RAIL GUARDS.—See Guards, third rail.

THIRD RAIL INSULATORS.—See Insulators, third rail.

THIRD RAILS.—See Rails, conductor or "third."

THISTLE BRAND.—Trade name for taps and dies manufactured by the Winter Bros. Co., Wrentham, Mass.

THISTLE MFG. CO., THE.—5716 Armitage Ave., Chicago, Ill. Manufacturer of electric washing machines. Business established 1906. President and treasurer, August Clausen; vice-president, C. Clausen; secretary, E. Clausen.

THOMAS.—Trade name for sockets manufactured by the Bryant Electric Co., Bridgeport, Conn.

THOMAS.—Trade name for electrically operated gas and air meters manufactured by the Cutler-Hammer Mfg. Co., 12th St. and St. Paul Ave., Milwaukee, Wis.

THOMAS.—Trade name for flexible shaft couplings manufactured by the Thomas Flexible Coupling Co., Warren, Pa.

THOMAS.—Trade name for transmission line insulators and fittings manufactured by the R. Thomas & Sons Co., East Liverpool, Ohio.

THOMAS & BETTS CO., THE.—New York, N. Y. Manufacturer of conduit and conduit fittings. President, Robert M. Thomas; vice-president and treasurer, Hobart D. Betts; secretary, Adnah McMurtrie; sales manager, R. P. Harrison. Main office, 63 Vesey St., New York, N. Y. Factory, Elizabeth, N. J. Branch offices, 1309 Arch St., Philadelphia, Pa.; 10 High St., Boston, Mass. Sales representatives, Lyman C. Reed, New Orleans, La.; C. S. Broward, Atlanta, Ga.; H. B. Squires Co., San Francisco, Los Angeles, Cal.; Seattle, Wash.; Doherty-Hafner Co., 618 W. Jackson Blvd., Chicago, Ill.

THOMAS & SONS CO., THE R.—East Liverpool, Ohio. Manufacturers of transmission line insulators and fittings. Business established 1873. President, George W. Thomas; secretary, Atwood W. Thomas; treasurer, Lawrence M. Thomas; general manager, H. R. Holmes; sales manager, J. E. Way. Main office, East Liverpool, Ohio. Factories, East Liverpool, Ohio, and Lisbon, Ohio. Branch offices, 61 Broadway, New York, N. Y.; 261 Franklin St., Boston, Mass.; 1055 Old Colony Bldg., Chicago, Ill. Sales representatives, Northern Electric Co., Ltd., 121 Shearer St., Montreal, Que., Can.; Western Electric Co., Inc., 195 Broadway, New York, N. Y.

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THOMAS CLOCK CO., SETH.—Thomaston, Conn. Manufacturer of electric clocks. President, Seth E. Thomas, Jr.; vice-president, Mason T. Adam; secretary and treasurer, Arthur S. Hamblin. Main office and factory, Thomaston, Conn. Branch offices, 215 W. Randolph St., Chicago, Ill.; New York, N. Y.; San Francisco, Cal.

THOMAS ELEVATOR CO.—20 S. Hoyne Ave., Chicago, Ill. Manufacturer of electric hoists.

THOMAS FLEXIBLE COUPLING CO.—Warren, Pa. Manufacturer of flexible shaft couplings. President, Walter Bould; vice-president, L. H. Burkhart; treasurer, M. T. Thomas; secretary, D. A. Thomas. Main office and factory, Warren, Pa. Branch offices, 50 Church St., New York, N. Y.; 436 Engineers Bldg., Cleveland, Ohio; 711 Empire Bldg., Pittsburgh, Pa.

THOME, MATHIAS.—22 W. Monroe St., Chicago, Ill. Manufacturer of electric hair driers and curling irons.

THOMPSON.—Trade name for high-tension switches manufactured by the Pacific Electric Mfg. Co., 827-833 Folsom St., San Francisco, Cal.

THOMPSON.—Trade name for lamp hangers manufactured by the Thompson Electric Co., 226 St. Clair Ave., N. E., Cleveland, Ohio.

THOMPSON & CO., A. T.—15 Tremont Pl., Boston, Mass. Manufacturers of stereopticons and projectors. Business established 1885. A. T. Thompson, sole owner.

THOMPSON & CO., RICHARD.—187 Greenwich St., New York, N. Y. Manufacturers of planimeters, etc.

THOMPSON, SILVANUS PHILLIPS.—An English physicist born at York, 1851, and died, 1916. He was educated at Bootham School, York, at Flounders' Institute, Pontefract, and at the Royal School of Mines. In 1876-85 he held the professorship of experimental physics at University College, Bristol, and in 1885 became principal and professor of physics in the City and Guilds Technical College, Finsbury. He was president of the Physical Society, of the Institution of Electrical Engineers and of the Roentgen Society. Professor Thompson, while also carrying on original researches, did much to spread knowledge of electricity, especially through his books on dynamo-electric machinery, which gave him international fame.

THOMPSON & JAMESON, INC.—360 W. Superior St., Chicago, Ill. Manufacturer of automatic controllers. President, J. E. Thompson; vice-president, R. H. Kuehnsted; secretary, H. Conne; treasurer, C. W. Jameson.

THOMPSON BALANCE CO.—Denver, Colo. Manufacturer of chemical balances.

THOMPSON BATTERY TESTER CO.—Greensburg, Pa. Manufacturer of battery testers. Business established 1920. President, James Thompson; secretary, treasurer and general manager, W. M. Berlin; sales manager, P. H. Bailey.

THOMPSON EFFECT.—This is an example of thermoelectric action. In a copper bar carrying an electric current, heat is carried when the current flows from a hot portion to a cold one, and when the current flows from the cold regions to the hot ones, the hot parts of the bar are cooled. In iron these effects are reversed. In explanation of this effect, the conductor may be thought of as composed of a number of little elements of volume at the junctions between which occur reversible heat effects, similar to the junction between two different metals.

THOMPSON ELECTRIC CO., THE.—226 St. Clair Ave., N. E., Cleveland, Ohio. Manufacturer of lamp hangers. President, treasurer and general manager, Allison J. Thompson; vice-president, E. H. Thompson; secretary, Charles M. Buss.

THOMPSON-LEVERING CO.—327 Arch St., Philadelphia, Pa. Manufacturer of electrical measuring and other scientific instruments.

THOMPSON LIGHTNING ROD CO., INC., THE GEORGE E.—Owatonna, Minn. Manufacturer of lightning rods and accessories therefor. Business established 1910. President and treasurer, George E. Thompson; vice-president, E. T. Winship; secretary, R. H. Naylor. Branch office, Moose Jaw, Sask., Can.

THOMPSON MACHINE & SUPPLY CO., EMERY.—271-75 Rider Ave., New York, N. Y. Manufacturer of motor-driven ice cream freezers. Business established 1907. President, Emery Thompson; secretary, H. Plunkett; treasurer, V. Thompson, general manager, Fred Ergenzinger. Factory, Bronx, New York, N. Y.

THOMPSON MACHINERY CO., LTD.—Grand Bay, N. B., Can. Manufacturer of boring machines, aluminum, brass, copper and other metal castings. Business established 1890. President, W. H. Thorne; vice-president, Thomas Bell; general manager, Joseph Thompson.

THOMPSON MFG. CO.—Des Moines, Iowa. Manufacturer of electric water pumping systems, automobile heaters, etc.

THOMPSON MFG. CO.—Meadville, Pa. Manufacturer of commutator slotting devices and battery repair tools. Business established 1917. W. M. Thompson, owner.

THOMPSON-PLASTER X-RAY CO.—Leesburg, Va. Manufacturer of X-ray apparatus. Business established 1908. President, H. A. Thompson; vice-president, W. E. Plaster; secretary and treasurer, H. C. Littlejohn. Main office, Leesburg, Va. Factories, Chicago, Ill., Cincinnati, Ohio. Branch offices, Philadelphia, Pa.; Kansas City, Mo.; Washington, D. C.; Baltimore, Md.; New York, N. Y.; Pittsburgh, Pa.; Chicago, Ill.; Los Angeles, Cal.; Denver, Colo.; Seattle, Wash.; Little Rock, Ark.; Vancouver, B. C., Montreal, Que., Calgary, Alta., Toronto, Ont., Can.

THOMPSON SCENIC RAILWAY CO., THE L. A.—220 W. 42nd St., New York, N. Y. Manufacturer of electrical amusement devices.

THOMSON.—Trade name for meters manufactured by the General Electric Co., Schenectady, N. Y.

THOMSON, ELIHU.—An American inventor and electrical engineer, born at Manchester, England, 1853. In 1858 he came to the United States and was educated in the public schools in Philadelphia. He was professor of chemistry and mechanics in the Central High School there from 1870 to 1880, when he resigned to devote himself to electrical research work. In 1880 he became electrician for the American Electric Co., afterward known as the Thomson-Houston Electric Co. This, after consolidation with the Edison Co. in 1892, became the General Electric Co., the largest electrical manufacturer in the world. Among Dr. Thomson's inventions are the three-coil armature for arc dynamos; the constant-current regulator for arc-lighting dynamos; the process of electric resistance welding of metals; the magnetic blowout for switches and fuses and the motor type of electric meter for direct and alternating currents. Since 1892, when the General Electric Co. established its plant in Lynn, Mass., he has resided there, retaining his connection as consulting electrical engineer. In recognition of his extensive contributions to applied science numerous honors have been bestowed upon him. He was president of the American Institute of Electrical Engineers in 1889-90 and the first recipient of the Edison Medal awarded annually by the A. I. E. E. In 1916 he was awarded the John Fritz medal by the four national engineering societies of the United States.

THOMSON, SIR JOSEPH JOHN.—An English physicist, born near Manchester, 1856. He was educated at Owens College, Manchester, and at Trinity College, Cambridge. In 1884 he became Cavendish professor of experimental physics at Cambridge, and in 1905 was appointed professor of physics in the Royal Institution To J. J. Thomson is due the development of the electron theory of electricity, the theoretical and experimental discussion of radioactivity, and the electrical theory of inertia of matter.

THOMSON, SIR WILLIAM (LORD KELVIN).—A British mathematician and physicist, born at Belfast, 1824, and died at Glasgow, Scotland, 1907. After completing his education at Glasgow and Cambridge, he became professor of natural philosophy, first at Cambridge, then at Glasgow University. He was editor of the Cambridge Mathematical Journal and was the first editor of the Cambridge and Dublin Mathematical Journal which succeeded it, some of his most brilliant discoveries having been first described in these journals. Lord Kelvin, who was the electrical engineer for the company which undertook the laying of the Atlantic Cables in 1857-58 and 1865-66, made many very valuable improvements in cable signaling apparatus; he invented the mirror galvanometer first used for cable signaling, devised the siphon recorder still in use for receiving cable signals, and from his study of the properties of the cable made an observation that a limit of the speed of operation would early be reached owing to the effect of the electrostatic capacity. Lord Kelvin invented many pieces of electrical apparatus and methods for measurements, among them the Kelvin current balance; and developed an improved form of mariners' compass free from the magnetic action of the iron of the ship, and a deep-sea sounding apparatus. His quadrant and absolute electrometers are well known, and his portable electrometer and water dropping apparatus are of great use in practical meteorology. He also propounded a modified atomic theory in which the atoms are conceived as vortices, and he threw much light on such questions as the age of the earth, cosmic evolutions and geological time. For his work in connection with the Atlantic cables he was knighted in 1866 and in 1892 he was raised to the peerage as Baron Kelvin of Netherall, Large Ayrshire. He was president of the British Association for the Advancement of Science in 1871 and of the Royal Society of London from 1891 to 1895.

THOMSON & EVANS.—Trade name for electric deep well pumps and steam reciprocating pumps manufactured by C. H. Evans & Co., 187 Fremont St., San Francisco, Cal.

THOMSON CO., LTD., FRED.—9 St. Genevieve St., Montreal, Que., Can. Manufacturer of motors, switchboards and pipe thawing outfits. Business established 1894. President and general manager, Fred Thomson; vice-president, secretary and treasurer, Clarence Thomson.

THOMSON PRESS & MFG. CO., JOHN.—253 Broadway, New York, N. Y. Manufacturer of motor-driven printing presses.

THOR.—Trade name for electric ironing machines, vacuum cleaners and washing machines manufactured by the Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill.

THOR.—Trade name for electric drills and grinders manufactured by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.

THORDARSON ELECTRIC MFG. CO.—501 S. Jefferson St., Chicago, Ill. Manufacturer of transformers, radio, ignition and testing equipment. Business established 1895. President and general manager, C. H. Thordarson; secretary, J. G. Thordarson; treasurer, S. E. Lambert. Sales representative, W. I. Otis, 324 Rialto Bldg., San Francisco, Cal.

THORN, W. J.—London, Ont., Can. Manufacturer of fiber products, metal washers and stampings. Business established 1900. Partnership, W. J. Thorn and C. H. Thorn.

THREAD, INSULATING, SILK, LINEN, COTTON, ETC.—Silk, linen and cotton threads are used extensively for wire insulation. Cotton, which is used more than any other material except enamel for insulating magnet wire, is braided in one, two or three thicknesses. When untreated, cotton is hygroscopic, and will puncture at about 800 to 850 volts per mm. Impregnating improves it considerably, 3,300 to 3,400 volts per mm. being then required to puncture it. Silk thread is also used extensively for insulating wires and cords, especially where a thinner and better quality covering than cotton is required. Linen and wool threads are used occasionally, wool chiefly in the form of yarn.

THREADED-CATCH.—Trade name for sockets and receptacles manufactured by the General Electric Co., Schenectady, N. Y.

THREADERS, CONDUIT AND PIPE.—See Stocks, die, conduit and pipe threading.

THREADING MACHINES, CONDUIT AND PIPE.—Motor or power-driven machine tools having cutting dies to form threads on the interior or exterior of pipe or conduit. Such machines are always used in mills where pipe or conduit is made and occasionally also on large construction jobs where much conduit has to be cut and threaded.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y.
BORDEN CO., THE, Warren, Ohio.
Champion Blower & Forge Co., The, Lancaster, Pa. "Champion."
Geometric Tool Co., The, Blake & Valley Sts., New Haven, Conn. "Geometric."
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "Little Giant," "G.T.D."
Greenfield Tap & Die Corp. of Canada, Ltd., Front and York Pl., Galt, Ont., Can.
Landis Machine Co., Waynesboro, Pa.
National Acme Co., The, E. 131st St. and Colt Rd., Cleveland, Ohio. "Namco."
National Acme Co., The, 278 De Courcelles, St. Henri, Montreal, Que., Can.
Oster Mfg. Co., Cleveland, Ohio. "Oster."
Pipe Machinery Co., The, 930 E. 70th St., Cleveland, Ohio.

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Rivett Lathe & Grinder Co., 20 Riverview Rd., Brighton District, Boston, Mass.
Toledo Pipe Threading Machine Co., The, Toledo, Ohio.
Williams Tool Corp., Erie, Pa. "Williams."

THREADLESS PIPE FITTING CORP.—Newark, N. J. Manufacturer of switchboard fittings, pole-line hardware, etc. Exclusive distributors, Rubino & Liebstein, Newark, N. J.

THREE E.—Trade name for high tension and substation equipment manufactured by the Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.

3 IN 1.—Trade name for draft gages manufactured by the Precision Instrument Co., 21 Halsey St., Newark, N. J.

THREE PHASE.—This is a term characterizing a generator which develops three electromotive forces differing by one-third of a period in phase. On a clock diagram the three e.m.f.'s are represented by three equal vectors differing phase by 120 degrees. A three-phase circuit is a combination of circuits energized by three-phase e.m.f.'s. A three-phase circuit may be either three-wire or four-wire.

360-POINT.—Trade name for spark plug manufactured by the Derf Mfg. Co., Inc., 9 Walker St., New York, N. Y. (Exclusive distributor, Derf Sales Co., 1311 S. Figueroa St., Los Angeles, Cal.)

THREE STAR.—Trade name for flashlights and flashlight batteries manufactured by the International Battery Co., Inc., 453-455 Broome St., New York, N. Y.

THREE STATES CEDAR CO.—Plymouth Bldg., Minneapolis, Minn. Producer of ceder poles and posts. Business established 1909. President, Louis C. Oleson.

THREE STROKE.—Trade name for electric vibrators manufactured by the Capital Novelty Co., 138 N. 12th St., Lincoln, Neb.

3-WAY.—Trade name for bell-ringing transformer. Manufactured by the Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

THREE-WIRE CIRCUIT.—This is generally either a d-c. or single-phase a-c. circuit employed mainly in lighting distribution systems. The circuit derives its name from the fact that three wires are employed, the voltage between two of the wires (sometimes called the outers), being double that between the third (neutral or middle), and either of the other two. The neutral wire is usually grounded. Common voltages used are 110 and 220 up to 125 and 250. By such a circuit the power loss in the wires can be considerably reduced. Three-phase and two-phase circuits may be operated with three wires and are then special forms of three-wire circuit, but having different voltage relations from the common three-wire circuit described above.

THROTTLE.—Trade name for fuses, cut-outs and circuit breakers manufactured by the Line Material Co., South Milwaukee, Wis.

THRU-CORD.—Trade name for switches manufactured by the General Electric Co., Schenectady, N. Y.

THURMAN.—Trade name for electric vacuum cleaners manufactured by the General Compressed Air & Vacuum Machinery Co., St. Louis, Mo.

THURMAN VACUUM CLEANER CO.—Pontiac Bldg., St. Louis, Mo. Manufacturer of electric vacuum cleaners. Business established 1900. President and general manager, J. S. Thurman; secretary, C. V. Thurman.

THWING INSTRUMENT CO.—Philadelphia, Pa. Manufacturer of pyrometers. President, C. B. Thwing; secretary and general manager Edward J. Albert; treasurer, M. Thwing. Main office and factory, 2339 Lancaster Ave., Philadelphia, Pa. Branch offices, 59 Pearl St., New York, N. Y.; 716 S. Hill St., Los Angeles, Cal.; 932 Oliver Bldg., Pittsburgh, Pa.; 506 Butler Bldg., San Francisco, Cal.

TICHON PROCESS.—Trade name for brazing compounds manufactured by the Standard Brazing Co., 45 Bromfield St., Boston, Mass.

TICO.—Trade name for resistance wire manufactured by the American Steel & Wire Co., 208 S. La Salle St., Chicago, Ill.

TIDEMAN ELECTRIC MFG. CO.—Cairo, Ill. Manufacturer of electric fans and motors. President and general manager, Henry Tideman; vice-president, H. F. Tideman; secretary, C. M. Roos; treasurer, James H. Galligan. Main office and factory, Cairo, Ill. Branch office, 33 S. Clinton St., Chicago, Ill. Sales representatives, Globe Commercial Co., San Francisco, Cal.; C. H. Wallis & Co., St. Louis, Mo.; Brian & Powers, New Orleans, La.; Carl Johnson, Grand Rapids, Mich.; A. W. Marshall & Co., Detroit, Mich.; R. E. T. Pringle, Ltd., Toronto, Ont., Montreal, Que.; Federal Agencies, Winnipeg, Man., Can.; P. M. Dryfuss & Co., New York, N. Y.

TIDE WATER IRON WORKS.—725 Jefferson St., Hoboken, N. J. Manufacturers of smoke stacks, tanks, industrial cars, forgings, etc. President, J. W. McCoy; secretary, D. MacArthur; treasurer, H. J. McCoy.

TIDEWATER CROSSARM & CONDUIT CO.—Tacoma, Wash. Producer of fir crossarms and underground conduit.

TIDEWATER OIL CO.—New York, N. Y. Manufacturer of lubricating oil, etc. Main office, 11 Broadway, New York, N. Y. Factory, Bayonne, N. J. Branch offices, Chicago, Ill.; Kansas City, Mo.; Minneapolis, Minn.; Atlanta, Ga.; Dallas, Tex.; San Francisco, Cal.; Pittsburgh, Pa.

TIE LINE.—A term used in describing an electric conductor employed for the sole purpose of conveying current between two points in a transmission or distribution circuit in order to equalize pressures and distribute the load. The stations thus connected are said to be "tied together."

TIE RODS.—Tie rod is the name applied to the rods which connect the webs of the two rails forming a track. The function of the tie rod is to assist in holding the rails to proper gage and prevent their spreading under traffic. In the case of the higher rails used in paved streets there is a decided tendency of the rail to tip outward under traffic and the tie rods tend to reduce this tendency.

Manufacturers:

Ames & Co., W., Jersey City, N. J.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Lanz & Sons, Mathew, Pittsburgh, Pa.

TIE WIRE.—In overhead line construction, a tie wire or short piece of wire about 16 ins. long, is used for tying the line wire to the insulators. The tie wire passes around the insulator and is twisted around the line wire.

TIER-LIFT.—Trade name for electric loaders, tractors and trucks manufactured by the Lakewood Engineering Co., Cleveland, Ohio.

TIERING MACHINES, MOTOR-DRIVEN.—Motor-driven hoisting apparatus on portable frames having elevating platforms for use in stacking or storing boxes, bales, etc., in layers or tiers in warehouses. They save a great deal of labor. Some of these machines not only have motor-driven hoisting apparatus but propel themselves by motor so that they can be used to carry the material from the loading platform or dock into the warehouse and stack it, this one machine being practically the only machine needed at the terminal. Also see Stackers, lumber, motor-driven.

TIES, ELECTRIC RAILWAY, STEEL.—Steel ties on electric railway track are steel beams, usually laid at right angles to the rails, and constituting the portion of the track structure to which the rails are fastened. Steel ties have some arrangement of punching in the upper face so that when the proper fastenings are used the rails can be placed at the required distance apart. There is a considerable variety of steel ties manufactured many of which have special patented features.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv., page 1257.)
BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv., page 1258.)
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Dayton Mechanical Tie Co., 703-6 Commercial Bldg., Dayton, Ohio. "Dayton."
International Steel Tie Co., The, 16702 Waterloo Road, Cleveland, Ohio.
Weir Frog Co., Station H, Cincinnati, Ohio. "Weir Titan."

TIES, ELECTRIC RAILWAY, WOOD.—Wooden ties on electric railway track are timbers, usually laid at right angles to the rails, and constituting the portion of the track structure to which the rails are fastened. On open track work they are sometimes identical with the ties used in steam railroad track, but as electric railway wheel loads are generally lighter they may be and frequently are smaller timbers. Ties 6 ins. deep, 8 ins. wide and 7 ft. long are frequently used and give very satisfactory results, especially when incased in concrete. A great variety of timbers are used in street railway ties, many of which are subjected to some preservative treatment before being placed in the track. Among the timbers that are used without treatment, oak and long-leaf yellow pine are quite prominent, although both of these timbers are treated to some extent.

Manufacturers:

American Creosoting Co., 401 W. Main St., Louisville, Ky.
Anguera Lumber & Tie Co., 1101 Conway Bldg., Chicago, Ill.
Atlantic Creosoting & Wood Preserving Works, Norfolk, Va.
Baudette Cedar Co., Box 615, Baudette, Minn.
Bell Lumber Co., Security Bldg., Minneapolis, Minn.
Canadian Cedar & Lumber Co., Ltd., 301 Electric Ry. Chambers, Winnipeg, Man., Can.
Cascade Timber Co., Tacoma, Wash.
Cedar River Lumber Co., 914 Plymouth Bldg., Minneapolis, Minn.
Clark Pole & Tie Co., Bemidji, Minn.
Cloquet Tie & Post Co., Cloquet, Minn.
Colonial Creosoting Co., 401 W. Main St., Louisville, Ky.
Compressed Wood Preserving Co., Winton Bank Bldg., Cincinnati, Ohio.
Cook Tie & Pole Co., 919 Commercial Trust Bldg., Philadelphia, Pa.
Georgia Creosoting Co., 401 W. Main St., Louisville, Ky.
Gulfport Creosoting Co., Gulfport, Miss.
Indiana Creosoting Co., 401 W. Main St., Louisville, Ky.
International Creosoting & Construction Co., Galveston, Tex.
Long-Bell Lumber Co., R. A. Long Bldg., Kansas City, Mo.
Lord & Co., Lee H., Box 693, Peoria, Ill.
MacGillis & Gibbs Co., The, 1201-09 Wells Bldg., Milwaukee, Wis.
Martin Bros., 618 Manhattan Bldg., Duluth, Minn.
Morrison Lumber Co., J. W., 927-928 Lumber Exchange, Minneapolis, Minn.
Mountain Lumber & Supply Co., Mount Union, Pa.
Moss Tie Co., T. J., Security Bldg., St. Louis, Mo.
NATIONAL POLE CO., Escanaba, Mich. (See display adv., page 1254.)
Naugle Pole & Tie Co., 5 S. Wabash Ave., Chicago, Ill.
Northern Cedar & Timber Co., Menominee, Mich.
Northern Pole & Lumber Co., Palladio Bldg., Duluth, Minn.
Park Falls Lumber Co., Park Falls, Wis. (Exclusive distributor, Edward Hines Lumber Co., 2431 S. Lincoln St., Chicago, Ill.)
PARTRIDGE LUMBER CO., T. M., Lumber Exchange, Minneapolis, Minn. (See display adv., page 1254.)
Southern Creosoting Co., Slidell, La.
Southern Dimension Oak Co., 343 S. Dearborn St., Chicago, Ill.
VALENTINE-CLARK CO., THE, 510 Peyton Bldg., Spokane, Wash. (See display adv., page 1255.)
Virginia & Rainy Lake Co., The, Virginia, Minn.
Walsh Tie Co., 914 Security Bldg., Minneapolis, Minn.

TIGER.—Trade name for grease cups manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

TIGER.—Trade name for bronze bearings manufactured by the More-Jones Brass & Metal Co., St. Louis, Mo.

TIGHTENERS, BELT.—Belt tighteners are used on generators driven by a short belt from any engine or other prime mover and also on motors which are connected to their loads by means of a short belt. They serve the double purpose of permitting a loose belt which gives flexibility, and providing a means of applying the load gradually or providing some speed variation. Generally an idler or pulley mounted between the main pulleys is arranged so that its height may be varied by means of a control lever to increase or decrease the length of the path over which the belt must travel, thus making it tighter or loser. On smaller motors and generators a special base is usually provided for the purpose of adjusting the belt tension; see Basis, belt-tightening, motor and generator.

Manufacturers:

Caldwell Co., W. E., Brook and D Sts., Louisville, Ky.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv., pages 1203-1223.)
Medart Patent Pulley Co., Inc., Potomac and DeKalb Sts., St. Louis, Mo.
Meese & Gottfried Co., 660 Mission St., San Francisco, Cal. "Meeseco."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Gem."

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ryibil Machine Co., P., 512-524 W. 41st St., New York, N. Y.
yott Co., George W., North Ave. and Noble St., Chicago, Ill.
:andard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

ILLEY, J. B.—Pen Yan, N. Y. Manufacturer of farm lighting and power ıts.

IMBERLAKE & SONS, J. B.—114-116 Washington Ave., Jackson, Mich. Manufacturers of lamp shades, frames and ɔters. Business established 1880. Presi-, J. B. Timberlake; vice-president and ral manager, W. B. Timberlake; secre- and treasurer, P. J. Timberlake.

ME CONSTANT.—The time constant circuit is the ratio of the inductance ıe resistance of the circuit. T = L/R. called the time constant because on epends the rate of increase and de-se of the current in a circuit.

ME DETECTORS. — See Detectors, hman's, time.

ME RECORDERS. — See Recorders, electric, miscellaneous; Clocks, electime recording.

ME RECORDING LOCKS, ELECTRIC. Locks, time recording.

ME SAVER.—Trade name for electric ing machines manufactured by Beatty , Ltd., Fergus, Ont., Can.

ME SIGNALS, RADIO.—A very imnt function of radio communication is oroadcasting of time signals for the it of ships and isolated stations. Some e radio stations in the United States ı transmit time signals at specified are Arlington, Annapolis, Key West, Lakes, San Diego, San Francisco, New Orleans. See under Radio comcation, development and status of.

IE STAMPS.—See Stamps, time, elec-

IE SWITCHES.—See Switches, time, controlled.

IE, TELEPHONE HOLDING.—The time which a telephone line is held connection. It is always greater than tual talking time. The average holdime differs greatly with different countries and classes of service. It rter for business than for residence s. In automatic exchanges it may r 90 seconds; in similar service the ıl holding time will be nearer 110 s.
disconnect time is the time from the g up of the last receiver to the pull-wn of the connection by the operator. automatic system this requires less second and is uniform.

ELITE.—Trade name for electric clock manufactured by the F. W. Clock Co., 215 W. Randolph St., ɔ, Ill.

ERS, IGNITION OR SPARK. — ing mechanisms driven by and ɔnized with internal-combustion enɔ distribute the electrical impulses ry for firing the mixtures in the enlinders at the proper time intervals. ypes are made for application to a ar make of automobile, tractor or others of more general design for is of utility gasoline and kerosene

facturers:

Engineering Corp., The, Meriden, n.
.tor Mfg. Co., Auburn, Ind. "Gladi-."
Lamp & Mfg. Co., 115-123 E. On- St., Chicago, Ill.
Mfg. Co., 65 Eagle St., Pittsfield, s. "J & B."
ioch Mfg. Co., 216 High St., Bos-Mass.
ıkee Auto Engine & Supply Co., 'aukee, Wis. "Milwaukee."
:o., The, 122 N. 14th St., Lincoln, "K-L".
' & Co., Inc., Paul G., 232-242 E. St., Chicago, Ill.
ɔ-Tor Fabricating Corp., 182 Lo- Ave., New York, N. Y. "Herz."
A soft, white metal, malleable and Symbol Sn.; at. wt. 119.0; sp. gr. . 232° C.; b. p. 2200° C. The prinis tin stone, cassiterite, SnO_2. The ɔducing countries are the Malay Bolivia, Dutch East Indies and There is practically no production in the United States. The world's n in 1919 was 113,900 long tons. .lly reduced from the ore by smelt-verberatory furnaces, but electric-melting is increasing. Electroly- also made, but in general the too high. However, electrolytic of tin from scrap (see Detinning), as in the Goldschmidt process is of considerable importance.

TIN SHADES.—See Shades, tin, aluminum, brass, steel, etc.

TINFOIL, FOR CONDENSERS, ETC.—Tinfoil is used in many small condensers for telephone work, radio sets, induction coils, electrostatic apparatus and in many similar devices where a condenser may be used for its capacitance or to reduce sparking across contacts. The foil is made up in sheets or rolls of various widths and thicknesses to be cut to size for the condensers.

Manufacturers:

Johnson Tin Foil & Metal Co., 6030 S. Broadway, St. Louis, Mo.
Standard Rolling Mills Co., 363-367 Hudson Ave., Brooklyn, N. Y. "Stromi."

TINKHAM, C. P.—1011 Majestic Bldg., Milwaukee, Wis. Producer of cedar poles and posts.

TINOL.—Trade name for solder and soldering compounds made by the American Solder & Flux Co., 2910 N. 16th St., Philadelphia, Pa.

TIP-TOP.—Trade name for automobile push buttons made by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

TIP-TOP.—Trade name for rubber insulated wire manufactured by the Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa.

TIPPING IRONS, ELECTRIC.—See Irons, soldering and tipping.

TIPS, CORD.—Cord tips are used on small wires and cords, especially in connection with telephone equipment, such as receiver cords, on voltmeter, wattmeter and other instrument cords, and on dental, electrotherapeutic and surgical apparatus, and other light apparatus where removable connections are desired. The cord tip is merely a small metallic sleeve into which the wire is soldered. The other end of the tip is smaller in diameter, usually about the size of the wire and is of sufficient length to be inserted in the hole in a binding post or terminal post. It serves to prevent fraying of stranded conductors and gives a good contact.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Eby Mfg. Co., H. H., 13th and Wallace Sts., Philadelphia, Pa.

TIPTON.—Trade name for chains manufactured by the Clinton E. Hobbs Co., 30-35 Pearl St., Boston, Mass.

TIRE PUMPS.—See Pumps, electric, air, tire or garage.

TIRE VULCANIZERS.—See Vulcanizers, electric.

TIRES, ELECTRIC VEHICLE OR TRUCK.—For this type of vehicle the solid tire has been most used. The solid tire is for certain uses, as for passenger or light delivering trucks carrying more or less fragile loads, modified in design and material. This modified tire, called a cushion or soft-base tire, is considerably more resilient than the ordinary solid tire. For certain service pneumatic tires are used on trucks or vehicles. These tires are similar in appearance to the ordinary gasoline automobile tires, but are of much greater strength and are differently constructed to overcome the difficulties peculiar to heavy truck service.

Manufacturers:

Empire Rubber & Tire Corp., N. Clinton Ave. and Mulberry St., Trenton, N. J.
Goodrich Rubber Co., B. F., Akron, Ohio. "Goodrich." (Truck.)
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.
Lee Rubber & Tire Corp., 61 Broadway, New York, N. Y.
Mansfield Tire & Rubber Co., The, Mansfield, Ohio.
Miller, Charles E., Anderson, Ind.
Swinehart Tire & Rubber Co., 21 W. North St., Akron, Ohio. "Swinehart."
Thermoid Rubber Co., Trenton, N. J. "Thermoid."
Traveler Rubber Co., Box 589, Bethlehem, Pa. "Traveler."
Tuscan Tire & Rubber Co., Carrollton, Ohio. "Tuscan," "Buckskin."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

TIREX.—Trade name for mining machine cable and portable heater cord manufactured by the Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.

TITAN.—Trade name for storage batteries manufactured by the General Lead Batteries Co., Chapel St. and Lister Ave., Newark, N. J.

TITAN AUTOMATIC TOOL CO.—25 W. Broadway, New York, N. Y. Manufacturer of motor-driven hammers.

TITAN METAL CO.—Bellefonte, Pa. Manufacturer of brass and bronze rods and forgings. Business established 1913. President, R. W. Funk; vice-president, J. H. Allport; secretary and sales manager, W. P. Sieg; treasurer, C. H. Jacobs.

TITANIUM BRONZE CO., INC.—Niagara Falls, N. Y. Manufacturer of bronze and brass castings. Business established 1914. President and general manager, A. Weber; vice-president, C. A. Finnegan; secretary and treasurer, Eugene D. Hofeller; sales manager, Hugh R. Corse. Main office and factory, Sugar and Lafayette Sts., Niagara Falls, N. Y. Branch offices, 536 Marine Trust Bldg., Buffalo, N. Y.; 81 Fulton St., New York, N. Y.

T-L CO.—Trade name for tachometers manufactured by the Thompson-Levering Co., 327 Arch St., Philadelphia, Pa.

TOASTERS, ELECTRIC, HOUSEHOLD OR TABLE.—Portable heating appliances having open coil elements for use in toasting bread, etc., and furnished in capacities not exceeding 660 watts. They have flexible cords and attachment plugs for connection to fixture sockets or wall receptacles. Such toasters are designed for table use and are neatly and attractively finished. They are made in various sizes and forms, some of the stove type, many others with the coils vertical, the bread slices being placed on the opposite sides of the device. The stove types are sometimes arranged to be used also for boiling water, frying, etc. Their many advantages have made them one of the most popular of household electrical devices.

Manufacturers:

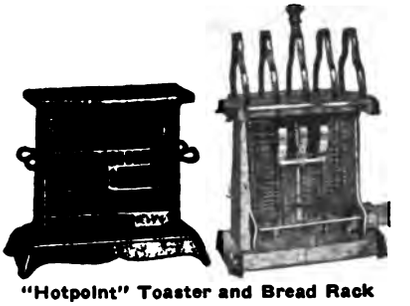
AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "American Beauty" upright electric toaster. Made entirely of sheet steel, finished in highly polished nickel; has double base,



"American Beauty" Upright Toaster

equipped with heat insulating legs, light, unbreakable. Also glowing coil type heating element. Furnished complete with 6-ft. twin conductor cord, with detachable porcelain plugs and attachment plugs.—Adv.

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Branford Electric Co., Inc., 9 Church St., New York, N. Y.
Calorex Corp., The, 10 W. 23rd St., New York, N. Y.
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.
Curtainless Shower Co., Inc., 507 5th Ave., New York, N. Y. "Reddy."
EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill.



"Hotpoint" Toaster and Bread Rack

Manufacturer of Hotpoint, Hughes and Edison electric appliances. The toast-

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er illustrated herewith has gravity contro'led bread clamp. Bread rack (shown on top of toaster) is 4½x5¼ ins. The other toaster has spring controlled bread clamp and is 8 ins. high, 4 ins. deep and 9 ins. wide. Both are made of steel and finished in polished nickel. Complete with cord and plug. See display adv. pages 1292-3.—Adv.

Electro-Weld Co., 70 Munroe St., Lynn, Mass. "Reverso."

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Elektro."

Equator Mfg. Co., 144 York St., Hamilton, Ont., Can. "Equator."

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Mesco."

Manning, Bowman & Co., Meriden, Conn.

Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.

Perfection Electric Products Co., New Washington, Ohio. "Pepco."

Redtop Electric Co., Inc., 8 W. 19th St., New York, N. Y.

Renfrew Electric Products, Ltd., Renfrew, Ont., Can. "Canadian Beauty."

Rochester Stamping Co., Rochester, N. Y. "Royal-Rochester."

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

Rutenber Electric Co., Marion, Ind. "Flip Flop."

Simplex Electric Heating Co., 85 Sidney St., Cambridge, Mass.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

UNION ELECTRIC CORP., 103 Mott St., New York, N. Y. "American Lady."

WAAGE ELECTRIC CO., 12-14 S. Jerferson St., Chicago, Ill., and 6 Reade St., New York, N. Y. "Dandy."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. "Turn Over." See display adv. pages 1395-1402.)

TOASTERS, ELECTRIC, RESTAURANT OR HOTEL.—Heating appliances having open coil elements of relatively large capacity and designed for toasting bread in large quantities for hotel and restaurant use. Such toasters usually are provided with selective control switches and are arranged for permanent connection to supply circuits. They have many advantages over the gas toasters, their cleanliness, exact heat control, and freedom from objectionable odors being among the most important.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs and Cass Aves., Detroit, Mich. "American Beauty."

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Branford Electric Co., Inc., 9 Church St., New York, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint, "Edison."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Clemens Electrical Corp., Ltd., 197 King William St., Hamilton, Ont., Can.

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric ranges, ovens and appliances. A six-slice open type toaster on which two, four or six slices of toast can be made at one time. Toast is placed in the hinged racks, which then are tipped into toasting position between heating units. Sides and back are of sheet metal. Entire toaster is substantially made and mounted on rugged metal frame. Supplied complete with two-heat indicating snap-switches, two contact-plugs and 4 ft. cords to the switches. Another type manufactured is a two-unit 16-slice, hotel-type toaster. Each unit is controlled by three-heat indicating snap switches. See display adv. pages 1292-3.—Adv.



"Hotpoint" Hotel Type Toaster

STRITE AUTOMATIC TOASTER CO., 422 Sixth Avenue, South, Minneapolis, Minn. The Strite automatic electric toaster for use in hotels, institutions, restaurants, cafeterias, etc., does just what its name implies, it makes toast automatically without any one having to watch it, thus having a decided advantage over other methods which are slow, insanitary and unsatisfactory. The bread is placed in the toaster and



Strite Automatic Electric Toaster

the machine set to give any desired degree of toasting, or for any quality of bread, thus assuring perfect toast. Through a timing arrangement which can be regulated accordingly, the current is shut off and the toast raised out of the machine automatically, without any attention, and kept warm by the residual heat of the oven until served. The toast is made a uniform golden brown, with a minimum of current, and without attention from an attendant. There is no watching and no burning.—Adv.

Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

TOBIN BRONZE.—Trade name for rods, sheet and tubes for engineering purposes manufactured by American Brass Co., 414 Meadow St., Waterbury, Conn.

TOCH BROS.—320 5th Ave., New York, N. Y. Manufacturers of insulating paints, varnishes, compounds, enamels, etc. Business established 1848. Partnership, Henry M. Toch and Maxmilian Toch.

TOEERING CO., INC., C. J.—1215 Bristol St., Philadelphia, Pa. Manufacturer of blueprinting and photoengraving lamps.

TOGGLE BOLTS.—See Bolts, toggle.

TOGGLE SWITCHES.—See Switches, toggle or tumbler, snap.

TOLEDO.—Trade name for motor-driven refrigerating apparatus manufactured by the Toledo Coldmaker Co., 1690 Fernwood Ave., Toledo, Ohio.

TOLEDO COLDMAKER CO.—1690 Fernwood Ave., Toledo, Ohio. Manufacturer of motor-driven refrigerating apparatus. President and general manager, F. B. Riley; vice-president and secretary, W. S. Reynolds; treasurer, H. H. Zimmerman.

TOLEDO ENAMELED WIRE PRODUCTS CO., THE.—1345-1349 Miama St., Toledo, Ohio. Manufacturer of enameled wire. Business established 1919. President, Jerome Ackerman; vice-president, Harry Hirsch; secretary, treasurer and sales manager, Seymour Hirsch.

TOLEDO METAL MANUFACTURERS CO.—Toledo, Ohio. Manufacturer of gas producers, smoke stacks and tanks.

TOLEDO PIPE THREADING MACHINE CO., THE.—Toledo, Ohio. Manufacturer of pipe threading machines, stocks and dies. President, Frank Collins; vice-president, J. H. Barr; secretary, W. W. Vosper; treasurer and sales manager, W. C. Longenecker. Main office, 1425-45 Summit St., Toledo, Ohio. Branch office, 50 Church St., New York, N. Y.

TOLEDO STANDARD COMMUTATOR CO.—2242 Smead Ave., Toledo, Ohio. Manufacturer of solid-core commutators. Business established 1919. President and general manager, C. A. Van Dusen, Sr.; vice-president, Eugene Rheinfrank; secretary and treasurer, E. D. Moon.

TOLEDONAMEL. — Trade name for enameled wire manufactured by the Toledo Enameled Wire Products Co., 1345-1349 Miama St., Toledo, Ohio.

TOMLAC.—Trade name for insulating varnish manufactured by B. Binswanger & Co., 829-835 N. 3rd St., Philadelphia, Pa.

TOMLINSON.—Trade name for car couplers manufactured by the Ohio Brass Co., Mansfield, Ohio.

TOMMY TUCKER.—Trade name for violet ray generator manufactured by the Tucker Mfg. Co., 118 Noble Ct., Cleveland, Ohio.

TONE, DIAL, OR TRUNK TONE.—A tone placed on the line by the first selector in an automatic telephone exchange. It is to indicate to the calling subscriber that the apparatus is ready for him to begin dialing. If no dial tone is heard, it will do no good to dial. Not all exchanges are thus equipped.

TONGS, CARBON.—These are small tongs used for handling hot arc-lamp carbons, especially to facilitate their removal from a projecting or other arc lamp when the carbon has burned to a short length and needs replacement with as little delay as possible.

TONGS, FUSE, HIGH-TENSION. — Where high-tension fuses must be replaced with the line alive it is necessary to provide insulated tongs by which the fuse holder can be withdrawn from its spring clips, and replaced after the fuse has been renewed. These are usually of impregnated wood.

Manufacturers:

Bowie Switch Co., Nevada Bank Bldg., San Francisco, Cal.

BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.

DELTA-STAR ELECTRIC CO., 2433-53 Fulton St., Chicago, Ill.

General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.

ROYAL ELECTRIC MFG. CO., 606 E. 40th St., Chicago, Ill.

SCHWEITZER & CONRAD, INC., 4431-4439 Ravenswood Ave., Chicago, Ill.

TONGS, FUSE, LOW OR MEDIUM-TENSION.—See Removers, fuse.

TONKA.—Trade name for belting manufactured by the Republic Rubber Corp., Youngstown, Ohio.

TOOL BAGS.—See Bags, electricians' and linemen's tool.

TOOL BOXES, TELEPHONE.—See Coin collectors, telephone station and toll.

TOOL CARTS.—See Carts, linemen's tool and supply.

TOOL CHESTS.—See Chests, electricians' tool.

TOOL KITS.—See Kits, tool, electricians' and linemen's.

TOOLS.—See specific tool desired.

TOOLS, ELECTRICIANS' AND LINEMEN'S, SPECIAL AND MISCELLANEOUS.—Practically all electricians' and linemen's tools in common use have been separately listed. A few tools of uncommon use or very special purpose have not been so listed and are included under this classification.

Manufacturers:

Bridgeport Hardware Mfg. Corp., The, Bridgeport, Conn.

Buck Bros., Millbury, Mass. (Chisels.)

Deuse, J. S., Chester, Conn.

Duffy Mfg. Co., 214 W. Grand Ave., Chicago, Ill.

Hisey-Wolf Machine Co., The, Colerain and Marshall Aves., Cincinnati, Ohio. "Hisey."

KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. ("DI-Stock" sleeve twister.) See display adv. page 1259.)

TOPAZ.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TOPS, ORNAMENTAL, ELECTRIC RAILWAY POLE.—In some cities where electric railways run through the central part of the city, the poles are fitted with ornamental iron tops, designed to harmonize with the ornamental lamp posts used on the same or adjoining streets. In some cases these tops are made to serve as brackets to carry the street lamps so as to eliminate separate posts for the latter.

Manufacturer:

St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

TOPS, ORNAMENTAL STREET LAMP POST.—This is another name for ornamental street-lighting units. See Lighting units, ornamental street.

TORCHES, ACETYLENE, OXYACETYLENE, OXYHYDROGEN.—These torches include a nozzle having valves and openings for controlling the combination of combustible gases, such as acetylene or hydrogen with air, or with oxygen, contained in storage tanks under pressure.

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ie larger torches are used for welding, tting, etc., and some of the others for azing and lead burning. Their use for id burning is important in connection th the manufacture and repair of stor- e batteries. The various plates, ter- nals, etc., are burned together by their e. The term torch is more commonly stricted to mean only the nozzle. These zzles are made in various types with ecial tips suitable for use in welding l cutting metals, brazing, etc.

Manufacturers:

ashton Mfg. Co., 184 Emmet St., Newark, N. J. "Red-Hot."
Bishop & Babcock Co., The, 2100 E. 55th St., Cleveland, Ohio.
Carbo-Hydrogen Co. of America, Bene- dum-Trees Bldg., Pittsburgh, Pa.
Carleton Co., The, 170 Summer St., Bos- ton, Mass. ("Spartan.")
Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.
International Oxygen Co., 796 Freling- huysen Ave., Newark, N. J. "I.O.C. System."
J-G Welding & Cutting Co., Inc., 556 W. 34th St., New York, N. Y.
KLEIN & SONS, MATHIAS, 3200 Bel- mont Ave., Chicago, Ill. Our "Stays- alite" linemen's torch can be quickly lit or extinguished. It can be carried very conveniently in the belt and used as a small heater or with soldering iron. It is arranged with windshield that can be removed at will, and is also pro- vided with cap for holding soldering paste. See page 1259 for illustration of this and other Klein products. Also send for complete catalog of construc- tion tools.—Adv.
Lburn Co., The Alexander, 1420-28 W. Baltimore St., Baltimore, Md. "Cut- Weld."
Moderall Co., The, 129 Sussex Ave., Newark, N. J.
WERNER BRASS WORKS, THE, Syca- more, Ill. "Hot Blast," "Double Jet," "Turner New Line." (See display adv. page 1326.)

TORCHES, GASOLINE, KEROSENE, ALCOHOL.—The first two types comprise a cylindrical containers for the com- bustible liquid with burners or vaporiz- ing chambers into which the liquid is in- jected under pressure to be preheated and vaporized prior to ignition in an air- gas combustion chamber. A small flame is provided, usually in the handle, to give the requisite pressure to produce a flame. These torches are used by tinsmiths for heating solder pots and soldering coppers and for miscellaneous purposes where the flame is desired for un- soldering cable lugs, burning off paint, etc. Torches for open-air work are usually con- structed with a shield to protect the flame from the wind.

Alcohol torches consist of small con- tainers for the combustible liquid which is fed by a wick or equivalent means to the nozzle to which is added air under pressure to produce a high degree of heat. The alcohol torches are usually made to give a fine pointed flame suitable for soldering very fine work, as in instruments of various kinds, telephone work, etc. Other types are also made for outdoor use as the type telephone cable terminals.

Manufacturers:

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen."
Atlantic Stove Co., St. Louis, Mo.
Bernz Mfg. Co., 184 Emmet St., Newark, N. J. "Red-Hot."
BERRY & CRAIGHEAD, 1526 Tribune Bldg., Chicago, Ill. The "Everhot," a self-contained, gasoline operated soldering-torch and soldering iron com- bination; of great utility in limited space. (See Irons, soldering.)—Adv.
Bishop Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Brown Co., Otto, 17-37 Ashland St., Newark, N. J. "Always Reliable."
Carleton Co., The, 170 Summer St., Bos- ton, Mass. (Gasoline.) "Imp."
Clayton & Lambert Mfg. Co., 1370-1380 Beaubien St., Detroit, Mich.
Dayton Mfg. Co., Inc., 27 Haymarket Square, Boston, Mass. "Supreme."
Dreadnaught Mfg. Co., 126 Tenth St., Brook- lyn, N. Y.
Eclipse Mfg. Co., Valparaiso, Ind.
Electric American Mfg. Co., The, 5902 Bessemer Ave., Cleveland, Ohio. (Gas- oline.) "Flameblast."
Enterprise Mfg. Co., Leetsdale, Pa.
Essex Cord., The, Maywood, Ill.
KERR BRASS WORKS, THE, Syca- more, Ill. "Hot Blast," "Double Jet," "Turner New Line." (See display adv., page 1326.)
UNIVERSAL MFG. CO., 2633 Randolph St., Lincoln, Neb. "Universal."
Wall Mfg. Supply Co., P., 705 Preble Ave., Pittsburgh, Pa. "Dreadnaught."

TORCHIERS OR TORCHERES.—A form of ornamental portable lamp with several vertical candle sockets mounted on a tall stand similar to a candelabrum. The original meaning included only such lamps as had four candles but the term is now applied to lamps of the same general form regardless of the number of candles.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION.—Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont., Can.

TORONTO LAUNDRY MACHINE CO.—Toronto, Ont., Can. Manufacturer of electric refrigerators.

TORQUE.—Turning or twisting effort, usually about a shaft. It is commonly used in connection with motors and is measured by the force which the motor exerts in a direction at right angles to the shaft and to a line perpendicular to the shaft. The force is usually taken in pounds and the perpendicular (or radial), distance to the center of the shaft in feet, so that the torque is expressed in pounds-feet.

TORQUE, BREAKDOWN, PULLOUT, OR STALLING.—A torque which is the maximum that a motor can exert while running and which if applied as a load causes the motor to come to rest. Some motors exert their maximum torque at starting, for example series motors, and therefore have no breakdown torque. Others, like the squirrel-cage induction motor, have a much higher torque at some running speed than at starting.

TORREY CEDAR CO. — Clintonville, Wis. Producer of cedar poles.

TORRINGTON CO., THE, NATIONAL SWEEPER DIVISION.—Torrington, Conn. Manufacturer of electric vacuum cleaners. President, F. P. Weston; secretary, W. R. Reid; treasurer, C. B. Vincent. Main office and factory, Torrington, Conn. Branch of- fices, 833 Market St., San Francisco, Cal.; Upper Bedford, Que., Can.

TORSION BALANCE CO.—92 Reade St., New York, N. Y. Manufacturer of chemi- cal balances, etc.

TOURISCOPE.—Trade name for motion picture machines manufactured by Under- wood & Underwood, Inc., 417 5th Ave., New York, N. Y.

TOURNIQUET, ELECTRIC. — A very light, delicately poised wheel with elec- trodes terminating in points, radiating from the center and bent at right angles in the same direction. When a source of electricity is connected to the wheel, it spins rapidly on account of the discharge of convection streams from the points re- sisting the surrounding air.

TOWER WAGONS.—See Wagons, tower, electric; Wagons, tower, gasoline; Wagons, tower, horse-drawn.

TOWERS, REINFORCED CONCRETE, RADIO POWER, TRANSMISSION, ETC.—Reinforced concrete towers are used in some radio stations for supporting the antennas. They may be built very high and are not subject to corrosion as are steel towers or wooden structures. This is of special advantage in some climates, especially in the torrid zone near the sea- coast.

Manufacturer:

Weber Chimney Co., The, 1452-56 Mc- Cormick Bldg., Chicago, Ill.

TOWERS, STEEL, RADIO, ANTENNA.—Towers used for the support of radio antennas are usually built of structural steel and range from 100 to over 1,000 ft. in height. The Arlington station has one tower over 600 ft. high and two over 400 ft. high. The new LaFayette station in France has several towers over 1,000 ft. in height.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv., page 1257.)
Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Chicago Radio Laboratory, Ravenswood and Schreiber Aves., Chicago, Ill.
Cole Mfg. Co., R. D., Newnan, Ga.
Coombs & Co., R. D., 30 Church St., New York, N. Y.
Hull & Co., S. W., 3729 Prospect Ave., Cleveland, Ohio.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."
Liberty Electric Corp., Port Chester, N. Y.
Republic Structural Iron Works Divi- sion of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Walsh & Weidner Boiler Co., The, Chat- tanooga, Tenn.

TOWERS, STEEL, TRANSMISSION LINE.—With overhead lines carrying im- portant power service the requirements of the service justify the use of steel towers instead of wood poles. Towers may be used on a private right-of-way without interfering seriously with the use of the land for agriculture, since the spans are made from 500 to 750 ft. to secure best economy of construction. With a private right-of-way the tower is built with a base 10 to 15 ft. square. If the base is restricted to 3 or 4 ft., as at railway crossings on a highway, the structure must be much more rugged. The steel should be galvanized and is often painted as well. The footings are of concrete and of such weight as to withstand any overturning moment to which the tower may be sub- jected by wind pressure or by broken line conductors. The height is fixed by the sag of the conductors and the contour of the country, varying from 35 to 150 ft. or more.

At corners and dead-ends the structure is designed to support the stresses due to the tension of the line, wind and sleet, without guying. In straight runs a flexible type of tower is often used. This is rigid against transverse stresses but allows some play longitudinally. The crossarms are made a part of the tower, except with the narrow base type. Also see A-frames; Structures, special, for transmission lines.

Manufacturers:

Aeromotor Co., 2500 W. Roosevelt Rd., Chicago, Ill. "Aeromotor."
AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. "Shiffler." (See display adv., page 1257.)
Archbold-Brady Co., Syracuse, N. Y.
BATES EXPANDED STEEL TRUSS CO., 208 S. La Salle St., Chicago, Ill. (See display adv. page 1299.)
Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
Cole Mfg. Co., R. D., Newnan, Ga.
Coombs & Co., R. D., 30 Church St., New York, N. Y.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill. "Three E."
Hull & Co., S. W., 3729 Prospect Ave., Cleveland, Ohio.
Railway & Industrial Engineering Co., Greensburg, Pa. "R. and I. E."
Republic Structural Iron Works Division of the Consolidated Iron-Steel Mfg. Co., East 53rd St., Cleveland, Ohio.
Riter-Conley Co., Pittsburgh, Pa.
ROYAL ELECTRIC MFG. CO., 556-606 E. 40th St., Chicago, Ill. "Royal."
Walsh & Weidner Boiler Co., The, Chat- tanooga, Tenn.

TOWNSEND CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution.

TOY ENGINES.—See Engines, toy, elec- tric.

TOY MOTORS.—See Motors, battery and toy.

TOY RAILWAYS.—See Railways, elec- tric, miniature and toy.

TOY STOVES.—See Stoves, electric, toy.

TOY TRANSFORMERS.—See Trans- formers, toy.

TOYS, ELECTRIC, MISCELLANEOUS.—Many small solenoid, motor or other elec- trically operated devices, such as engines, toy motors, locomotives, railways, lamps, and toy stoves have been listed separately. However, various ingenious and instructive toys do not come under these general classi- fications and to provide for them this classification is inserted. Such toys are strongly built, simple to operate, and are sometimes designed so that they may be taken apart and reassembled; or several toys made up from a kit or parts so that the child can exercise his ingenuity and imagination in devising toys of his own design.

Manufacturers:

Adams Morgan Co., Alvin Place, Upper Montclair, N. J. "Paragon."
American Thermophone Co., 114-116 Bed- ford St., Boston, Mass. "Juniorphone."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Elektra Toy & Novelty Co., 400 Lafayette St., New York, N. Y.
Elektro Mfg. Co., The, 4642-4644 Ravens- wood Ave., Chicago, Ill. "Elektro."
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Gilbert."
H-K Toy & Novelty Co., The, Indian- apolis, Ind.

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Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y.
Lionel Corp., The, 48-52 E. 21st St., New York, N. Y. "Lionel."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Pony" dynamo.
Martalex Mfg. Co., Inc., 450 E. 148th St., New York, N. Y. (Countershafts for electric engines, motors, etc.)
NORTHERN ELECTRIC CO., 542 St. Clair St., Chicago, Ill. ("Midget" toy iron.)
Rittenhouse Co., The A. E., Honeoye Falls, N. Y. "AER CO." (Aeroplanes.)
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."
W. N. Mfg. Co., The, 180 Main St., Manchester, Conn. (Water driven generators.)
Wood Electric Co., C. D., 441 Broadway, New York, N. Y. (Motor.) "Monocoil."

T P S COMMUNICATION.—See Ground telegraphy and telephony.

TRACING BOARDS, ILLUMINATED.—A box or frame with a smooth clear or opal glass top and containing incandescent lamps, used to facilitate tracing a drawing, map or print by illuminating it from below. Boxes used in these devices are lined with asbestos or other fire-proofing material. These devices are particularly useful for tracing indistinct or badly worn drawings.

TRACK DRILLS.—See Drills, electric, portable, railway track.

TRACK GAGE.—To make possible the interchange of cars from one road to another, practically all American and Canadian steam and electric railroads have the same track gage. For the ordinary tee rails, the gage is defined as the distance between the heads of the rails, measured from a point ⅝ inch from the top of the rail, and in a direction at right angles to the rails. The U. S. standard gage is 4 ft. 8½ ins. on tangents and on curves of 8° or less. Several forms of grooved rails in use on street railways do not allow of measurement in this manner and for these types the distance is measured between points on the flanges ¼ inch below the treads. There are several street railways using track of greater than standard gage, and a large number of industrial plants and mines using a narrow-gage track on roads in their yards or buildings, or in and about the mine.

TRACK GRINDERS.—See Grinders, electric, railway track.

TRACK INSULATION.—See Insulation, rail joint and track.

TRACK SPECIALTIES CO., INC.—29 Broadway, New York, N. Y. Manufacturer of rail joints, benders, spikes and other track specialties. Business established 1914. President, W. B. Lee; vice-president, J. A. Bodkin. Factory, Easton, Pa.

TRACK SWITCHES.—See Switches, track, electrically operated; Switches, track, manually operated.

TRACK WORK, SPECIAL, FOR ELECTRIC RAILWAYS.—The name applied to "switches, mates, frogs, crossings, guarded curves and parts of track, other than plain unguarded curves"; (note: Quoted words are the definition adopted by the American Electric Railway Engineering Association, Oct. 11, 1920.

Owing to the limited space at street intersections, sharp curves must be used and small clearances allowed between passing cars in order to get all the work into the available space. This necessitates the making of a special design for each location and the manufacture of the work with a high degree of accuracy. As a result, this class of work came to be known as "special track work" and the name is now generally used as applying to any of the various items referred to above. Owing to the above factors, electric special track work has developed along quite different lines from the special track work performing a similar function on steam railroads or electric interurban lines.

In street railway special track work two separate pieces, known as a switch and a mate are ordinarily used instead of the split switch so generally used in open track construction. It is the general practice to place the switch at the point where the inside rail of the curve branches off from the straight track. It is a long narrow piece with a long groove in its upper surface which lies, in a general way, along the gage line of the straight track. In this groove is fitted a long heavy bar of special shape which is known as the switch tongue, and which is fastened at one end of the groove but is free to move across the width of the groove at the other end. When the switch is placed as described above and it is desired to send a car around the curve the switch tongue is pushed to the inside of the groove so that the wheel flange strikes it and the tread of the wheel, running on the body of the switch, is forced around the curve. When it is desired to send the car along the straight track the switch tongue is pushed to the outside of the groove and the flange continues along the straight track throatway, the wheel tread running on the top of the switch tongue. The mate is placed on the other rail of the track and directly opposite to the switch. It usually has no movable parts, but consists of a body corresponding in shape to that of the switch but having two flangeways cut in its upper surface, one following the gage line of the straight track and the other the gage line of the curve. It is designed in connection with the switch lying opposite to it so that when the switch is set for either direction the flanges of the wheels opposite to those passing through the switch will follow the corresponding flangeway in the mate.

In general, a special track work layout consists of a number of switches, mates and frogs connected by pieces of accurately bent rail and the chief differences between the various types in use consist in the method of manufacturing these switches, mates and frogs. There are three general methods by which such pieces are constructed: First by bolting together a number of properly curved rails to form the body of the piece, second by pouring molten metal around properly curved pieces of rail in order to hold them in position, and third by making the entire piece as one solid casting.

There is considerable variation in the actual work under each of these methods. In the first type rivets or the electric arc welder may be used in constructing the piece, but a piece made in this way is usually referred to as "built up." When the second type is composed only of the pieces of rail and holding metal, it is usually referred to as "cast in." In this second type, however, it is usually necessary to insert a wearing plate of hard steel, generally referred to as manganese steel, at all points where gage lines meet or intersect in order to increase the wearing life of the piece. Such pieces are known as "hard center" pieces and are referred to as "cast iron bound" or "cast steel bound" according to the metal used as a binder. In the third type the castings are frequently made entirely of manganese steel, in which case they are referred to as "manganese steel castings." However, they sometimes are made of cast steel with a manganese steel wearing plate inserted at the points of greatest wear and such pieces are referred to as "hard center castings."

Manufacturers:

American Frog & Switch Co., The, 1028 Main St., Hamilton, Ohio. "American."
Buda Co., The, Harvey, Ill.
Cleveland Frog & Crossing Co., Cleveland, Ohio.
Conley Frog & Switch Co., Bodley Ave., Memphis, Tenn.
Kilby Frog & Switch Co., Birmingham, Ala.
Ramapo Iron Works, Hillburn, N. Y. "Ramapo."
St. Louis Frog & Switch Co., 6500 Easton Ave., St. Louis, Mo.
Weir Frog Co., Station H, Cincinnati, Ohio.
Wharton, Jr., & Co., Inc., William, Easton, Pa.

TRACK WORK, TANGENT, FOR ELECTRIC RAILWAYS.—Tangent or straight track as built by street railways on their paved rights of way has developed along quite different lines from the open track usually built by steam railroads and interurban electric lines. These differences have developed almost entirely from the fact that the right of way in streets must be kept paved in order that the entire street may be available for vehicular traffic.

In earlier days low tee rails were used, but these rails were so low as to render paving the right of way with any form of block paving almost impossible and as a result the high tee rail, usually about 7 ins. high, was developed. Such rails, however, proved unsatisfactory on streets having heavy vehicular traffic as the vehicle wheels tended to follow along the side of the rail and in consequence it was very difficult to keep the paving along the rail in proper condition.

This difficulty led to the development of the girder rail, which not only had a head to carry the car loads but also a metal projection or tram on the inside and somewhat lower than the rail head to carry vehicular traffic passing along the track. This rail proved quite satisfactory for some time, but with the increase in vehicular wheel loads and with the weakening of the tram portion by wear the tram began to bend down and break off, thus ceasing to perform its function. In some cases this failure took place before the full life of the rail head for the car wheel traffic had been obtained.

To overcome this difficulty and some others of a minor nature a new type of girder rail with a lip instead of a flat tram for carrying the vehicular load was developed. This rail has a greater amount of metal used to support the vehicular load and the metal is so placed as to be of more value structurally in supporting the load. This is the type of rail now in most general use on heavy-traffic paved streets; it is often called "grooved" rail because it has a continuous groove for the car-wheel flange.

Since track of the type referred to above must carry not only the car but also the vehicular traffic and give a solid support for the pavement, a heavier foundation has also been developed and a stronger fastening is generally used to hold the rail to the tie. The types of foundations developed are very numerous, but in general they contain a considerable amount of concrete and are sometimes of solid concrete with steel ties and clip fastenings for attaching the rails to the ties.

The tangent open tracks of interurban electric railways are built substantially of the same general construction as the corresponding tracks of steam railroads operating similar loads at similar speeds, except that electric railway tracks are heavily bonded to provide adequate conductance at the joints for the return power current.

TRACKLESS TRAIN.—Trade name for electric tractors manufactured by the Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill.

TRACKLESS TROLLEY CARS OR OMNIBUSES.—See Cars, trackless trolley and omnibuses.

TRACTION LUBRICATING CO.—69 W. Washington St., Chicago, Ill. Manufacturer of lubricating oils and greases. Business established 1911. President and treasurer, Warren Pease; vice-president, James T. Fales; secretary, M. Kuffel.

TRACTORS, ELECTRIC.—The electric tractor is used for general hauling of all kinds of material. The tractor is not designed to carry any load itself, but only to pull a string of loaded carts or cars of any description. It is very powerful, compact and simple in control and operation. The tractors run at a speed of from 5 to 6 miles per hour and are capable of pulling loads up 20 to 25% grades. Among their many uses are hauling baggage or mail to and from the trains in railroad depots, for hauling freight from the train or boat to the storage rooms at terminals, docks and warehouses, for conveying raw materials from storage to shops in industrial plants, or finished articles to shipping rooms, etc. Their speed and flexibility has made them superior to other handling methods which are limited by the speed of manual labor or confined to haulage of one material, or to a definite path as when rails are used.

Manufacturers:

Automatic Transportation Co., 2933 Main St., Buffalo, N. Y. "Automatic."
Baker R & L Co., Cleveland, Ohio. "BRL."
Buda Co., The, Harvey, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Couple-Gear Freight-Wheel Co., 1450 Buchanan Ave., S. W., Grand Rapids, Mich.
Cowan Truck Co., Dorchester, Mass. "Universal."
Crescent Truck Co., The, 30 Church St., New York, N. Y.
Electric Tractor Co., 53 W. Jackson Blvd., Chicago, Ill.
Elwell-Parker Electric Co., 4223 St. Clair Ave., N. E., Cleveland, Ohio. "Elwell."
Industrial Truck Co., Division of Cowan Truck Co., Holyoke, Mass. "I.T.C."
Koppel Industrial Car & Equipment Co., Koppel, Pa. "Electromobile."
Lakewood Engineering Co., Cleveland, Ohio. "Tier-Lift."
Lansden Co., Inc., The, Danbury, Conn. "Lansden."
Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill. "Trackless Train."
WALKER VEHICLE CO., 531 W. 39th St., Chicago, Ill. "Walker." (See display adv., page 1326.)

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le & Towne Mfg. Co., Stamford, Conn. "Yale."
ung Mfg. Co., R. W., 111 W. Monroe it., Chicago, Ill.

ADE JOURNALS OR PAPERS, ELEC-AL.—See Periodicals, electrical, for a lete list of American and Canadian ical weeklies and monthlies having a nal circulation.

ADE-MARKS. — Distinctive marks identify goods as those of a par-r trader and which distinguish them other goods of a similar nature can gistered as trade-marks in the United Patent Office under certificates run for 20-year periods and which e renewed, if the mark is still in To be registrable, the mark must be tive, must be affixed to the goods e containers in which the goods are d), and must already have been used pments across state borders.

re being registered, each presented is first examined as to its apparent y and is reproduced in the "Official e" of the United States Patent Of-give the required 30-day notice to ublic as to the intention of the ap-to monopolize the mark for a given of goods. If no opposition is duly or properly substantiated, the ation certificate is then issued.

such registration applies only to icular class of goods, it being as-that goods of different types or sually hailing from different classes ories or distributors could not be d with one another. To facilitate amination of applications by the Office employees, as well as the g for possible anticipations by the Trade-Mark Division of the Office has sorted merchandise into sifications including "Class 21, al Apparatus, Machines and Sup-Applications must be accom-by specimens or facsimiles of the s actually used, and by a formal reproducing the same, the gen-cedure being allied to that con-with patent applications.

the long dominating Trade-Mark ebruary 20, 1905, marks were not le if they were clearly descriptive aphical without being displayed in ual manner. In recent years this n has proved increasingly ser-exporters of goods as many countries (and particularly those l and South America), permit the ve applicant to register any mark a nonresident from registering a ich he has not first registered wn country. To overcome this the Act of March 19, 1920, now descriptive and geographical be registered also in the United tent Office when they have been le use for at least twelve months. ment of even unregistered marks opped by proceeding under com-rights in local courts, but a istration gives the Federal Courts n and generally enables the user rk to suppress imitators without litigation by merely presenting procured copy of his registra-cate as attesting his rights. If ger persists, the registrant can ieral Court enjoin the latter and damages, particularly if he has notice, "Registered U. S. Patent h his mark.

ployed for directing trade con-oward one source, every trade-part of the "good will" of its ce, trade-marks are commonly nong the intangible assets of under the head of "good will," valued jointly with patents and od will resulting from general However, the rules issued in Treasury Department in con-Income Taxes permit no de-of the value of trade-marks, allowed in the case of unex-s.

gistrant of a trade-mark dis-use for a considerable period, others to use the same mark t made or furnished by him, apse. Being closely allied to , the rights to a trade-mark old apart from the business to tes, nor can licenses ordinarily under such a mark to other

ctrical industry, trade-marks played an important part and ly is no other line where such been more carefully selected ffectively used, although the Prints and of Labels also the U. S. Patent Office by electrical concerns is relatively much smaller than in many other lines.

TRADE SCHOOLS.—A list of trade schools teaching various branches of electrical work is given under Education, electrical.

TRADE WINNERS.—Trade name for cedar poles and posts manufactured by Burk & Co., Spokane, Wash.

TRAHERN.—Trade name for electric pumps manufactured by the Trahern Pump Division, George D. Roper Corp., Rockford, Ill.

TRAIL.—Trade name for electrolytic copper and zinc produced by the Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B. C., Can.

TRAIN DISPATCHING BY TELEPHONE.—See Dispatching of railroad trains by telephone.

TRAIN DISPATCHING EQUIPMENT, TELEPHONE.—The equipment used in telephone train dispatching consists of special calling keys and selectors for use in the terminal offices. These equipments are made for both a-c. and d-c. systems. In addition to these there is used a large amount of standard telephone apparatus, including repeating coils, retardation coils, condensers, switches, etc. The selector, however, is one of the most important articles. See Switches, train dispatching, selector. Also see Dispatching of railroad trains by telephone.

TRAIN DISPATCHING SYSTEMS, TELEPHONE.—A telephone line is provided which runs the length of a division, with a way station wherever needed. The train dispatcher wears a head receiver so that any operator can speak to him at any time without signals. He can call any operator by selectors, one at each station, arranged to ring only the bell of the desired station. It is an extreme case of party line, 40 or more stations being on the line. The way stations talk by local battery.

Manufacturers:

Erie Tool Works, The, 11th and French Streets, Erie, Pa.
Hall Switch & Signal Co., Garwood, N. J.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)
Railway Telephone Mfg. Co., 9 S. Clinton St., Chicago, Ill. "Telegraphone."

TRAINING, ELECTRICAL.—See Education, electrical.

TRALUCO.—Trade name for lubricating oil and grease manufactured by the Traction Lubricating Co., 69 W. Washington St., Chicago, Ill.

TRANSATLANTIC. — Trade name for radio receivers manufactured by C. Brandes, Inc., 32 Union Sq., New York, N. Y.

TRANSCONTINENTAL OIL CO.—Benedum Trees Bldg., Pittsburgh, Pa. Manufacturer of transformer and lubricating oils. Refinery, Tulsa, Okla.

TRANSFER TABLES, ELECTRIC.—See Tables, transfer, electrically operated.

TRANSFORMER.—The transformer is used to transform electric voltage or current from one value to another. It operates through a varying magnetic flux and without mechanical motion; for the latter reason it is commonly called the static or stationary transformer, although these adjectives are technically superfluous. The change is usually from a high voltage, such as is most economical for transmission, to a relatively low one suitable for use in lighting, motor operation, etc. An important, though less frequent, application is to raise the voltage from that of the generator to a value suitable for long-distance transmission. Transformers are also used for changing from one value of current to another, as in street-lighting systems.

The method of operation of the transformer limits its application to alternating-current systems and it cannot be used with direct currents. Transformers may be classified according to function, service or construction. Details will be found below.

Construction. The transformer consists of a core built up of a special grade of sheet steel, around which are wound the two circuits, the primary and the secondary. The primary winding is that which is connected to the supply circuit, the secondary that which supplies energy to the load. These circuits must be adequately insulated. Each usually consists of two or more coils which may be connected either in series or in parallel. The size of the conductor of which the coils are made is proportioned to the current to be carried. The core is rectangular or of certain other special shapes, but always forms a closed magnetic path or circuit threading through both the primary and secondary coils.

For mechanical protection, as well as to assist in the dissipation of heat, the transformer is usually enclosed in an iron case or tank filled with an insulating oil. Terminals and devices for handling and support complete the design.

Electrical Operation. When the primary circuit is connected to an a-c. system of the proper voltage, a current flows which magnetizes the iron core. As the current alternates, the direction of magnetic flux is periodically reversed. In reversing, the flux cuts through the turns of the secondary winding and produces an electromotive force in them.

Since the primary and secondary windings are cut by the same flux, the same e.m.f. will be set up in each turn and, the turns being in series, the ratio of the primary and the secondary no-load e.m.f.'s will be the same as the ratio of the numbers of turns in the two coils. Thus, by this ratio of turns, the voltage which the transformer will give at its secondary terminals is determined. As the e.m.f. induced is proportional to the product of turns times flux, a certain number of primary turns must be supplied for any given line e.m.f. in order to avoid too high a magnetic density and excessive heating. From this it follows that a transformer should not be used for a voltage much above that for which it is designed. It also follows that, if the two coils of a primary winding are connected in series, the transformer will be suited to double the line voltage that can be used when they are in parallel. When the secondary coils are in series, thus giving double the voltage of one coil, a third or neutral wire can be connected to the junction of the two coils and the transformer used to supply an Edison three-wire system.

As the losses in a transformer are very small the efficiency is high, running even above 99% in large sizes. As a useful approximation, therefore, the following relation is often assumed: Primary voltage × primary current = secondary voltage × secondary current. From this it follows that the currents vary approximately inversely with the number of turns in the coils, or inversely with the ratio of voltage transformation.

While the voltage at the secondary terminals drops slightly when the current is increased, the regulation is in general very good, thus adapting the transformer to constant-potential service. The power-factor of the loaded transformer, as it affects the supply system, is practically the same as that of the load on the secondary.

Temperature Rise and Methods of Cooling. In spite of their high efficiency, the compactness of transformers makes necessary devices for disposal of the heat produced, especially in the case of the larger sizes. Transformers are air, oil or water-cooled. Air-cooling is used where the transformer body is not immersed in oil. Air is blown through ducts within the body of the transformer. This method is not used above 35,000 volts. In oil-cooled transformers, convection currents in the oil are depended upon to carry the heat from the iron core and coils to the case, from which it is dispersed to the surrounding air. As the size of transformers increases, corrugations are first added to the tanks and, in the largest sizes, special outside radiators are used. The height of the tank is also increased to provide a large storage space for oil, more radiating surface and more rapid convection. In the case of water-cooling, water is forced through a coil of copper tubing located in the oil above the body of the transformer. For outdoor service oil cooling is generally used.

TRANSFORMER BLOCKS, TERMINAL.—See Blocks, terminal, transformer.

TRANSFORMER BREATHING VENTS.—See Breathing vents, transformer.

TRANSFORMER BUSHINGS, HIGH-TENSION TERMINAL. — See Bushings, high-tension terminal for transformers, etc.

TRANSFORMER CASES.—See Cases, transformer.

TRANSFORMER COILS. — See Coils, transformer.

TRANSFORMER COILS COOLING. — See Coils, cooling, transformer.

TRANSFORMER, CORE TYPE. — The name refers to the relative position of the core and coils. The core forms a rec-

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tangle, with the coils surrounding two sides. The coils are cylindrical and relatively long. They are divided, part being on each leg, and one coil is inside the other. This type has the advantage of being easy to take apart for repair work. Also, the coils being outside the iron, have the best condition for cooling. The circulation of oil or air between the coils is also favorable.

TRANSFORMER CORES. — See Cores, transformer.

TRANSFORMER CUTOUTS.—See Fuses, transformer, primary.

TRANSFORMER, DRY TYPE.—This is not oil-insulated, and is used without a closed tank, though it may be enclosed with a ventilated case. These transformers are principally for instrument use or of the constant-current type. Air-blast transformers are really of this type, though not generally so described.

TRANSFORMER, INDOOR TYPE.—One not suited to outdoor use. It need not be weatherproof, and temperatures below freezing need not be provided for. The bushings need not be designed for wet surface insulation. Included in this type are air-blast transformers, water-cooled, except in warm climates, and all dry types built without a core.

TRANSFORMER, LIGHTING.—A small to medium-sized distributing transformer, with two 110-volt secondary coils, usually connected in series, for a three-wire Edison system. This is designed primarily for incandescent lighting.

TRANSFORMER, LOW VOLTAGE. — The National Electric Code specifies potentials up to 600 volts as low voltage. Not all the transformers coming within this range are commonly called low-voltage, rather those whose primary voltage is 110 or 220 and whose secondary voltage is considerably below 110 volts. Such transformers are usually special types, such as bell-ringing, toy, welding, sometimes also thawing, etc.

TRANSFORMER OIL.—See Oil, transformer and switch.

TRANSFORMER, OIL-FILLED. — The core and coils of this transformer are contained in a tank or case which is filled with transformer oil. The oil acts as a high-grade and self-repairing insulator and keeps out moisture. By its circulation, it also acts as a cooling medium. Most transformers for power and distribution service are oil-filled.

TRANSFORMER OIL FILTERS.—See Oil filters, dehydrators and purifiers.

TRANSFORMER, OUTDOOR TYPE. — Oil-filled transformers usually of large size and for high voltage, designed for use in outdoor substations. The tanks are weatherproof and the terminals made for adequate insulation, when wet. Except for use in warm climates, the self-cooled type is used, and on account of the large size, special cooling devices are common. Distributing transformers, which see, while for outdoor use are not generally included under this type.

TRANSFORMER PANELS.—See Panels, transformer.

TRANSFORMER, POLE. — An outdoor type of small to medium size provided with hangers or lugs, adapting it to mounting on a transmission pole or its crossarms. These are usually known as distributing transformers.

TRANSFORMER, PORTABLE. — A current or voltage transformer designed to be carried about and used for temporary connections in testing. See Transformers, current, portable and Transformers, potential, portable.

TRANSFORMER, ROTARY. — A name sometimes applied, formerly more frequently than at present, to a synchronous or rotary converter.

TRANSFORMER, SELF-COOLED. — An oil-filled transformer in which the natural flow of oil due to temperature difference is depended upon to bring it into contact with the surface exposed to the atmosphere and thus to provide the necessary cooling. In large sizes corrugations in the tank are necessary, and in the largest, specially designed radiators. Extra height is also given to the tank so as to provide oil storage, more surface, and better circulation. See Transformers, radiator type, self-cooling.

TRANSFORMER, SHELL TYPE.—This name refers to the relation of the core and coils. The laminations of the core are built up around the coils so that when finished the coils thread through two holes in the core. A double magnetic circuit around the coils is thus formed. The coils are generally flat, and the primary and secondary coils are alternating so as to reduce the magnetic leakage. This gives a mechanically strong construction, and is easy to insulate for high voltages. It is difficult to take down for repairs, and the coils being largely inside the hot iron core, are harder to cool. A newer form of the shell type transformer has four magnetic circuits around the coils, arranged in two pairs at right angles to each other and joining at the center. The thickness of the iron is thus reduced, more of the coils is exposed and a symmetrical arrangement is produced. In some cases the coils are cylindrical and placed one inside of the other. This does not offer the difficulty in tearing down which is present in the ordinary form.

TRANSFORMER SOCKETS.—See Sockets, transformer.

TRANSFORMER, STATIC.—A name applied to ordinary transformers without moving parts, to distinguish them from special forms of the general transformer, such as the induction motor.

TRANSFORMER THERMOMETERS. — See Thermometers, for generators, motors, transformers, etc.

TRANSFORMER, THREE-PHASE.—This has three sets of coils, one for each of the three phases, wound on a single core structure. There is one primary and one secondary to each set. This core structure has three cores, all ending in two common yokes, with one set of coils on each core. There is a saving in core loss and in cost of such a transformer over the three separate single-phase transformers which it replaces. On the other hand, damage to one set of coils throws the whole three-phase transformer out of service.

TRANSFORMERS, AIR-BLAST.—These are cooled by forcing air under a pressure of ½ to 1 ounce through ducts arranged throughout the windings. Absence of oil insulation limits their use to about 33,000 volts. They have the advantages of less fire risk and smaller outside dimensions. The rating is limited only by the cost of forcing a large volume of air through the windings. They may be arranged so that the temperature in the hottest part of the winding may be kept safely low. Motor-driven blowers usually furnish the blast. Provision is often made to sound an alarm in case the blast fails, and to cut off the blast for any transformer that fails due to short-circuit or other cause. These transformers are used mostly in electric railway substations.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. See description under Transformers, high-tension, power.—Adv.
Liberty Electric Corp., Port Chester, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, AUTO — See Autotransformers.

TRANSFORMERS, BELL-RINGING.—A small low-voltage transformer, usually operated on standard a-c. lighting circuits. The secondary of the transformer gives from 4 to 30 volts and its current is used for ringing bells, operating annunciators, buzzers, and similar purposes. It thus takes the place of a battery of primary cells as commonly used for this purpose and saves the bother and expense of battery renewals. The primary is usually wound for 110 volts, 60 cycles, and is permanently connected to the line. The magnetizing current is generally so small that by itself it does not actuate the customer's watt-hour meter. These transformers have come into extensive use because of their reliability and low operating cost.

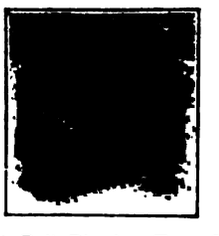
Manufacturers:

Air-Way Electric Appliance Corp., Toledo, Ohio. "Arrow."
Amrevo Electric Co., 2309 Archer Ave., Chicago, Ill. "Signalrite."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill. "Pep," "Trivolt." (Exclusive distributor, Peerless Light Co., 665 W. Washington Blvd., Chicago, Ill.)
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B. & B.," "Vim."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Connecticut Telephone & Electric Co., Meriden, Conn. "Connecticut."
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
DURALECTRIC CORP., Jamestown, N. Y.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio. "King."
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."
GENERAL ELECTRIC CO., Schenectady, N. Y. "Wayne." Made in household and heavy-duty sizes. The household size is connected to the standard alternating-current lighting circuit and has ample capacity for door-bells and residential signal systems. The heavy-duty type is made in two standard sizes, 50 and 100 watts, for annunciator systems in clubs, hotels, large apartment houses, fire stations, factories and mines. G-E Wayne Bell Ringing Transformers are inexpensive, easy to install, consume an infinitesimal amount of current, and last indefinitely. They are approved by the Underwriters' Laboratories. Other G-E Transformer Specialties are displayed on page 1218.—Adv.
Haas Electric & Mfg. Co., The R., 305 E. Monroe St., Springfield, Ill. "Adams."
JEFFERSON ELECTRIC MFG. CO., 426 S. Green St., Chicago, Ill. The Jefferson line of bell-ringing transformers is furnished in six types, ranging in capacity from 25 to 125 watts, and is the only complete line listed by the National Board of Fire Underwriters. Our "Junior" type (illustrated) is one of the most popular bell-ringing transformers on the market. It is adapted to light work such as used in ordinary residence or apartment service. The heavier transformers are designed to take care of large installations and operate a number of bells and signal devices. Our engineering staff is at your disposal—put your transformer problems up to us.—Adv.



Junior Bell Ringer

KILLARK ELECTRIC MFG. CO., 3940-46 Easton Ave., St. Louis, Mo. "Ferrocase," "Vitrocase."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Leich Electric Co., Genoa, Ill.
Liberty Electric Corp., Port Chester, N. Y.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. "Vim," "Hercules." (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
Monarch Electric Co., Ltd., St. Lawrence & Waterman Sts., St. Lambert, Que., Can.
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Rittenhouse Co., The A. E., Honeoye Falls, N. Y. "Ritco."
Standard Transformer Co., The, Dana Ave., Warren, Ohio. "Standard."
STATES CO., THE, 71 Francis Ave., Hartford, Conn. The "Alert", "the latchstring to a million homes," is inexpensive, easily installed, very re-



Alert Bell Ringing Transformer

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lable, attractive and rugged. For use wherever alternating current is avail-.ble.—Adv.
rling Electrical Corp., 2711 Church .ve., Cleveland, Ohio.
'minal Electric Co., 685 11th Ave., New 'ork, N. Y.
)rdarson Electric Mfg. Co., 501 S. Jef-)rson St., Chicago, Ill. "3-Way."
ITED ELECTRIC APPARATUS CO., 529-33 Columbus Ave., Boston, Mass.
S. E. M. Co., 505 W. 42nd St., New ork, N. Y. "U S E M."
ing Electric Co., 150-152 Chambers St., ew York, N. Y. "Viking," "Veco."
dron Electric Co., 12957 Merl Ave., leveland, Ohio.
STINGHOUSE ELECTRIC & MFG. ., East Pittsburgh, Pa. (See dis-ay adv. pages 1395-1402.)

NSFORMERS, CABLE TESTING.—ransformers, current.

NSFORMERS, CONSTANT-CUR-.—These are used on constant-poten-ystems, but deliver approximately nt current from their secondaries, to series lighting circuits. The -coil operating principle is generally ed. The primary or secondary coil able and is balanced by a counter- or both are movable and balanced each other. The core may be used unterweight. When there is no sec-current the coils are together. With l load and low impedance they are apart. When loaded to the maxi-they are drawn near together and ximum e. m. f. is generated, sending current through the high impedance load. When the impedance is de-as by cutting out series lamps, the increases a little; it thus exerts an d force between the coils, which them apart, thus decreasing the e. duced in the secondary, and stop-further rise of the current. Such increase is needed to produce the tion that the current is practically within the working range of the mer. They are built for standard of 4, 6.6, 7.5 and 10 amperes and gh as 110 lamps. The power-factor low.
ation use these transformers are with rocker arms, from one arc-nd of which the movable coil is d, while counterweights are sus-rom the similar opposite end. For nting a more compact scissors-like ient is used, the entire outfit being in a metal case similar to regular ier cases.

cturers:

on Mfg. Co., Albert & J. M., 289-St., Boston, Mass.
Electric Works, 3055 Lincoln Ave., go, Ill.
in General Electric Co., Ltd., 212 St., W., Toronto, Ont., Can.
n Westinghouse Co., Ltd., San-and Myler Sts., Hamilton, Ont., "Westinghouse."
al Engineering Co., 922 E. 41st hicago, Ill.
AL ELECTRIC CO., Schenec-N. Y. A complete line of con-current transformers in capacities to 80 kw., inclusive, which can plied for any commercial volt-equency and current. Two types anufactured; one for station use ie other for pole mounting for r service. (Bulletins 65109 and See adv. pages 1203-1223.—Adv.
SON ELECTRIC MFG. CO., 426-Green St., Chicago, Ill.
Electric Corp., Port Chester, N.

Y ELECTRIC CO., 7th and Sts., St. Louis, Mo.
Electric Co. of Canada, Ltd., r, Ont., Can.
Electric Co., Warren, Ohio. rd."
ELECTRIC APPARATUS CO., Columbus Ave., Boston, Mass.
ectric Co., 150-152 Chambers St., rk, N. Y. "Viking," "Veco."
GHOUSE ELECTRIC & MFG. st Pittsburgh, Pa. (See display ges 1395-1402.)

ORMERS, CURRENT.—Current s are transformers of from 25 mpere capacity with very ac-sformation ratios, and used to -reading ammeter or wattmeter nents on a high-current circuit. lso used for operating relays, ters and other purposes. Five he standard secondary current, g to the maximum rating on . Two or more instruments nected in series on the sec-if the transformer is over-loaded, the accuracy of the transformation ratio is affected. The insulation of the instruments from the high-voltage circuit is also an important function of this transformer. Where used for this purpose primarily, even-ratio or one-to-one transformers are used; they have the same number of turns on the primary and secondary, and the coils are carefully insulated from each other; such transformers are often called series transformers.

TRANSFORMERS, CURRENT, PORTABLE.—The portable current transformer is intended to be carried about and used for temporary connections for ammeters, wattmeters, etc. One style has plugs or connectors by which the two or more primary coils can be connected in series or parallel, thus adapting the same transformer to several current transformation ratios. A second style, sometimes called a "through" transformer, has no primary winding but a hole through the center. The conductor, whose current is to be measured, is run through this hole, thus giving a primary of one turn. These transformers are often used in testing instruments and for laboratory work. They are almost always designed to be used with five-ampere ammeters, wattmeters, or watt-hour meters.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
GENERAL ELECTRIC CO., Schenectady, N. Y. Transformers which meet the demands for accuracy, flexability and portability. (Bulletin 46030.) See adv. pages 1203-1223.—Adv.
Liberty Electric Corp., Port Chester, N. Y.
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TRANSFORMERS, CURRENT, PORTABLE, CABLE-TESTING.—Cable-testing transformers are always made with a split core, which can be separated into two parts, thus allowing it to be placed around a permanently located conductor and clamped together. It then forms a transformer with a single-turn primary, similar to the "through" type portable current transformer. In determining the load on a feeder or part of a distribution network it is often a decided advantage to be able to do so without opening the circuit to insert an instrument. The cable-testing transformer enables this to be done. Although its accuracy is not as high as that of the nonseparable core forms, it is ample for practical purposes.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Cable testing sets of various capacities designed to withstand 2,300 volts between windings and core. Transformer is provided with handle and the ammeter with carrying case. (Bulletin 46030.) See adv. pages 1203-1223.—Adv.
Liberty Electric Corp., Port Chester, N. Y.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TRANSFORMERS, CURRENT, SWITCHBOARD.—Switchboard current transformers are dry type or oil-filled, the latter for very high voltage work. They are of three styles. The wound primary has the usual two windings. The busbar type has a strip of copper bar passing through the transformer which forms the primary and can be bolted directly into a busbar. The "through" type is similar to the portable type of the same name. Also see general discussion under Transformers, current.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
GENERAL ELECTRIC CO., Schenectady, N. Y. Switchboard current transformers are supplied, air insulated for not exceeding 15,000 volts. Oil insulated for higher voltages. High accuracy for metering purposes is maintained through the entire line. (Bulletin 46049.) See adv. pages 1203-1223.—Adv.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
Liberty Electric Corp., Port Chester, N. Y.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Packard Electric Co., Warren, Ohio. "Packard."
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TRANSFORMERS, DISTRIBUTING, STANDARD.—These are used for the general distribution of electrical energy throughout a community. They are usually of small to medium size and designed for a primary voltage of 2200 to 2400. They generally have two 110-volt secondary coils which can be connected in series or in parallel, the former for 110-220-volt, three-wire distribution. They are often provided with auxiliary taps to give a limited range of secondary voltages. While usually of the pole type, subway or manhole transformers may also be included in this general class. The distributing type includes a very large percentage of all transformers.

In the smaller sizes distributing transformers are enclosed in weatherproof sheet-metal tanks, while cast iron tanks are generally employed for the larger sizes. The windings and magnetic circuit are locked in position by means of wrought iron braces welded to the frame and bolted to the tank. Oil-immersed transformers of the self-cooling type are the most common, and special construction is required to prevent oil siphoning and the entrance of moisture.

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Distributing transformers are used in standard ratings from 1 kv-a. to 200 kv-a., perhaps the largest number being rated at 7.5 kv-a. Single-phase transformers are standard; in many cases where large users of power are supplied with three-phase current, three single-phase transformers are used with their secondaries connected in delta. The selection of the proper size transformer for any given service or locality is important, since excess capacity involves idle investment and unnecessary core losses. Where a number of consumers are served by one transformer the various maximum demands do not occur at the same time and therefore the resultant maximum demand on the transformer is less than the sum of the individual demands. See Diversity-factor.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.

ENTERPRISE ELECTRIC CO., THE, Warren, Ohio. Manufacturer of Peerless transformers of distribution type for sizes 200 kv-a. and below for supplying lighting and power service. Peerless transformers are core type oil immersed, self cooled, standard frequency, 25 and 60 cycles. Have been on the market for 20 years. Have kept pace with all improvements during that time and have always made good. The core-type construction with form wound coils has been proven to give the best combined electrical and mechanical advantages, insuring efficiency of insulation not obtainable in any other form of transformer construction, allowing the most satisfactory proportioning of material, giving low losses, close regulation and having uniform temperature rise in all parts of the apparatus, which means no hot spots, such as are likely to develop in deep windings or those buried in iron. Cores are of highest grade silicon alloy steel. All coils are thoroughly dried and impregnated. This company has adopted as standard, a pressed steel case of very pleasing and substantial design which is a distinct improvement over cast iron case as it allows a considerable reduction in weight and saving in transportaton costs, greater ease in installing and a much greater mechanical strength. The plain cases have hanger irons permanently attached which is an added advantage. The corrugated cases are equipped with a very substantial wrought iron base which forms a perfect support for the tank and which cannot be broken. These tanks are equipped at present with a cast iron collar and cover, this design will soon be superceded with a pressed steel collar which will result in a transformer case welded into one unit having no joints which are not welded, or any similar defects. All leads coming through the case are brought out through very heavy porcelain bushings with either two or four-hole units for the low tension side. All low-tension windings of double-voltage type or to supply two voltages by series or parallel connection outside the case, are perfectly balanced windings and will show no unbalanced effect when in operation. Every possible precaution is taken during the manufacture of Peerless transformers to insure as near as possible a perfect piece of apparatus. They are correctly designed electrically and mechanically and are as well made as any transformer can be. They have proven their dependability through years of service and the Enterprise Electric Co., stands back of any Peerless transformer with an absolute guarantee of one year against any electrical and mechanical defects. See display adv. page 1328.—Adv.

Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E distribution transformers include 200 kv-a. sizes and smaller of any voltage rating. Made single phase and three phase for all commercial frequencies. Standard high voltages of 460 to 66,000 inclusive, and low voltages for standard lighting, power and secondary distribution. (Bulletin 45110A.) As no single form of core construction can be ideal for this wide range in sizes and voltage ratings, several forms have been developed and standardized, each particularly adapted to the zone wherein it is used. Various coil constructions have been developed to meet particular requirements. In the larger sizes circular coils of either disk or cylindrical form are used on account of greatly superior mechanical qualities and the facilities they give for rigid support. Tanks are all of strong weather-proof construction, those for subway installation being made water tight. G-E service in electric power transmission and distribution is portrayed on page 1305.—Adv.



KUHLMAN ELECTRIC CO., Bay City, Mich.

MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.

Moloney Electric Co. of Canada, Ltd., Windsor, Ont, Can.

Packard Electric Co., Warren, Ohio. "Packard."

PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh." (See description under Transformers, medium voltage, miscellaneous.)

Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

Western Electric Co., Inc., 195 Broadway, New York, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, HIGH-FREQUENCY.—This type is used with auxiliary equipment for transposing from low-frequency, high-voltage, to high-frequency, extra-high-voltage currents. The transformer is of the air-core type, that is, it has no iron in the magnetic circuit. Because of the very high frequency, both the flux and the number of turns in the coil are relatively small. The primary consists of a helix with a few turns of heavy copper wire. The secondary has a large number of turns of fine wire wound in one layer with the turns highly insulated from each other. The high frequency for the primary may be obtained by interrupting a high-voltage low-frequency arc with an air blast, or by other means. These transformers are often called Tesla transformers.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Betz Co., Frank S., Hoffman St., Hammond, Ind.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Clapp-Eastham Co., 139 Main St., Cambridge, Mass.

De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.

Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.

Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."

Federal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal.

Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.

Gray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.

JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.

Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.

Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K. & C."

Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.

Liberty Electric Corp., Port Chester, N. Y.

McINTOSH BATTERY & OPTICAL CO., 217-223 N. Desplaines St., Chicago, Ill. "Hogan" Silent Roentgen Transformer for X-Ray work—2 kw. and "Baby Hogan" X-Ray transformer for dental radiography and examinations of fractures.—Adv.

Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.

Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.

Packard Electric Co., Warren, Ohio. "Packard."

PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."

Radio Corp. of America, 233 Broadway, New York, N. Y.

Vulcan Electric Co., 239 S. Los Angeles St., Los Angeles, Cal. "Vulcan."

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

Wireless Specialty Apparatus Co., C and Fargo Sts., Boston, Mass.

TRANSFORMERS, HIGH-TENSION POWER.—High-tension power transformers are for use on high-tension power transmission systems. The term is used broadly for transformers employed for the transformation of the main electrical energy, as distinguished from those for special purposes, such as potential or current instrument transformers, etc. These power transformers are generally made in large sizes, ranging upwards from about 50 kv-a., and with primary voltage from 6,600 to 220,000, if installed at the receiving end of a power line; the secondary voltages are also generally high, being designed either for primary distribution systems with voltages such as 13,200, 11,000, 6,600, etc., or the operation of large motors. If installed at the generating end of the line, these voltages are reversed. The transformers may be of the oil-filled or air-blast types, and the oil filled may be with or without water cooling.

A very important quality in transformers of this type is reliability. They should be able to withstand the most exacting conditions met in service without being weakened appreciably. It is always important that the insulating material shall not be subjected to excessive temperatures and therefore the cooling is important, to see that every portion of the coil surface is exposed to the cooling medium. In many transformers a reasonably good performance and reliability are of greater importance than the efficiency or regulation.

There are many different types used for this service, being generally classified as to the cooling method: The principal types are: Self-cooled in corrugated or radiator tanks; oil-insulated and water-cooled; oil-insulated with forced external circulation of air; forced oil circulation; air blast. They are also divided into classes depending on the voltage of the transmission lines to which they are to be connected, the weights and efficiencies varying slightly for the same rating in the different classes. In all cases the efficiency increases with the increase in power capacity.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

GENERAL ELECTRIC CO., Schenectady, N. Y. G-E transformers embody features which have made them preferred by the large central stations of this country. Reliability has always been the first consideration and the many thousands of kv-a. capacity now in service are evidence of their ability to operate continuously with minimum losses and maximum factor of safety. Units have been built for commercial use up to 220,000 volts. Oil Insulated Transformers, for indoor or outdoor service, are divided into two general types: Self-cooled, Type H, and water cooled, Type W C. They have circular coil construction throughout and can be obtained for any voltage and capac-

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y. Transformers are placed in steel nks, for the self-cooled generally ith corrugated sides, electrically eided or cast to the base and top rim. large sizes external radiators are ed to increase the cooling surface. ater-cooled transformers have all- elded steel plate tanks. Air blast ansformers, either single-phase or ree phase and for all frequencies, are commended where restrictions are posed upon oil-filled transformers. E service in electric power trans- ssion and distribution is portrayed page 1205.—Adv.

Scheerer Corp. of America, 56-58 W. d St., New York, N. Y.

ILMAN ELECTRIC CO., Bay City, h.

r Co., Bertrand F., High and Canal ., Trenton, N. J. "Hercules." (Ex- sive distributor, Betts and Betts p., 511 W. 42nd St., New York, N.

ONEY ELECTRIC CO., 7th and kory Sts., St. Louis, Mo.

ney Electric Co. of Canada, Ltd., ndsor, Ont., Can.

rd Electric Co.; Warren, Ohio. ckard."

BURGH TRANSFORMER CO., mbus and Preble Aves., Pittsburgh, "Pittsburgh." (See description un- Transformers, medium voltage, ellaneous.)

Corp. of America, 233 Broadway, York, N. Y.

arson Electric Mfg. Co., 501, S. rson St., Chicago, Ill.

r Electric Mfg. Co., 6400 Plymouth , St. Louis, Mo.

& Bartlett Mfg. Co., 53 Jackson Long Island City, N. Y.

INGHOUSE ELECTRIC & MFG. East Pittsburgh, Pa. (See display pages 1395-1402.)

FORMERS, HIGH - TENSION .—These are of several types de- r different purposes. Insulation- transformers are high - voltage ansformers, either with secondary n the case of the higher voltages, parate regulating transformer in- egulator or motor generator set, ise the primary voltage gradually. potentials of about 1,000,000 e obtained in this manner. For ltages they are frequently pro- h suitable cables and terminals insulated regulating switches. ller sizes may be mounted on

of their intermittent service, ansformers are usually not given ous rating as other transformers usual rating depends on the volt- has a time limit so that when at full voltage this time must eeded, regardless of the value of

turers:

Transformer Co., 178-182 Em- t., Newark, N. J. "American," m Made."

Electric Works, 3055 Lincoln hicago, Ill.

Crocker-Wheeler Co., Ltd., St. nes, Ont., Can.

General Electric Co., Ltd., 212 ., W., Toronto, Ont., Can.

Westinghouse Co., Ltd., San- d Myler Sts., Hamilton, Ont., Westinghouse."

Heat Control Co., The, 2711 Ave., Cleveland, Ohio. "King."

Engineering Co., 922 E. 41st cago, Ill.

RISE ELECTRIC CO., THE, Ohio. "Peerless." (See dis- ., page 1328.)

ELECTRIC CO., Schenec- . Y. High voltage testing ners are manufactured for quirement. The importance of rate measurement of the test has led to the development of meter coil to a point where it s the most accurate method of ion voltage measurement now Several standardized equip- e available. Problems should ed to the nearest G-E sales ee adv. page 1223.—Adv.

Co., Edward J., 207 Market rk, N. J. (High tension test-

N ELECTRIC MFG. CO., 426- een St., Chicago, Ill.

& Clark Mfg. Co., 3451 E. Mar- y, Seattle, Wash. "K & C."

ctric Corp., Port Chester, N.

Bertrand F., High and Canal nton, N. J. (Exclusive dis- tributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.

Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.

Packard Electric Co., Warren, Ohio. "Packard."

Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, INSULATING.—These are transformers used primarily to insulate a low-voltage device from a high-voltage supply as a lighting circuit from a power circuit. They are also used on series lighting circuits for insulating the street lamps and are sometimes called "safety coils." See Transformers, series.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. Insulating transformers for 50-140 cycle service, 110/220-110/220 volts in sizes of 1 to 5 kv-a. inclusive. They are air cooled and suitable for either indoor or outdoor installation. See adv. pages 1203-1223.—Adv.

TRANSFORMERS, LOW - VOLTAGE, MISCELLANEOUS.—Low-voltage transformers, for service other than those listed above and below, are often made to meet special requirements for a variety of purposes. Some of these uses are: To provide low-voltage ringing current for telephone systems using the lighting or power circuits as the source, for electrical rivet-heating machines, for electric furnaces, for supplying low-tension soldering irons, etc.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "Hercules," "B & B."

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio.

Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."

ENTERPRISE ELECTRIC CO., THE, Warren, Ohio. "Peerless." (See display adv., page 1328.)

GENERAL ELECTRIC CO., Schenectady, N. Y. Special small transformers may be built with a minimum of expense for development and the assurance of correct design, high-class material and workmanship. See adv. pages 1203-1223.—Adv.



G-E Low Voltage Transformer

Goettmann, O. J., 525 E. Ohio St., N. S., Pittsburgh, Pa.

JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.

KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv., page 1327.)

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.

Leich Electric Co., Genoa, Ill.

Liberty Electric Corp., Port Chester, N. Y.

Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. "Lo-Lite," "Beso."

MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.

Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.

Packard Electric Co., Warren, Ohio. "Packard."

PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh." (See description under Transformers, medium voltage, miscellaneous.)

Sterling Electrical Corp., 2711 Church St., Cleveland, Ohio.

Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.

Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, MEDIUM-VOLTAGE, MISCELLANEOUS.—This type of transformer is taken to be one operating on from 500 to 5,000-volt circuits. This range includes practically all standard distributing transformers, which are separately listed above. The largest class of uses for miscellaneous medium-voltage transformers is for general power service in mills and other industrial plants. There are many special industrial applications of medium-voltage transformers, such as for electric furnaces or where a special process requires a lower voltage than that used for power service throughout the plant. An example of this is a sherardizing oven, which usually requires a heavy current and rather low voltage. Other miscellaneous or special applications, mostly for other purposes than standard distribution, include those for operating a-c. track signals for railways, where small stepdown transformers are connected to the power systems to supply 110-volt secondary feeders which in turn have other stepdown transformers connected to them.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

Betz Co., Frank S., Hoffman St., Hammond, Ind.

BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.

Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.

Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.

Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."

ENTERPRISE ELECTRIC CO., THE, Warren, Ohio. "Peerless." (See display adv. page 1328.)

GENERAL ELECTRIC CO., Schenectady, N. Y. See description under Transformers, distributing, standard, and Transformers, high-tension, power. See adv. pages 1203-1223.—Adv.

JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.

Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y.

Liberty Electric Corp., Port Chester, N. Y.

Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.

Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.

Packard Electric Co., Warren, Ohio. "Packard."

PITTSBURGH TRANSFORMER CO., Pittsburgh, Pa. Manufactures transformers in all sizes, all voltages, all types. All Pittsburgh Transformers have steel cases or tanks. Distributing transformers of 1 kv-a. to 25 kv-a. have smooth cases, and all other self-cooled transformers, whether distributing or power, have fluted cases. In water-cooled transformers, a smooth steel case is supplied. Pittsburgh Transformers are of the D. M. C. core type design. The coils only are impregnated under the thermo-vacuum system with Aerio Compound, an insulating material developed and used exclusively by Pittsburgh Transformer

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Co. When this insulating compound is once dry and hard in the coils, the application of heat only tends to harden it further. The coils for Pittsburgh Transformers are provided with vertical ducts to permit the cooling oil to circulate freely in the natural direction, from bottom to top of the case. Thus the most efficient cooling is accomplished. The smooth inner surface of the steel case also aids the circulation of the cooling oil. All Pittsburgh Power Transformers are equipped with an automatic safety valve, also a product of Pittsburgh Transformer Co.



Pittsburgh Mill Type Transformer

This valve is a simple, reliable device, with spring adjustable to any desired pressure, and is automatic and self-closing. After the valve has operated to relieve the gases generated in the transformer in operation, it immediately resets and closes the opening. The Pittsburgh Mill Type Transformer, illustrated herewith, by reason of its rugged design, is exceptionally well adapted for heavy duty.—Adv.

Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, MOTION - PICTURE. —Arc lamps used on a-c. circuits for motion-picture projecting machines operate at about 35 volts. As nearly all theaters are supplied with current at 110 volts, it is necessary to provide some means of reducing this to the operating value. Transformers are very often used, as they are by far more efficient means than rheostats. The transformers are usually of the dry type and the secondary is provided with several taps to provide adjustment by means of a switch handle. They are usually of special construction to withstand the short-circuit occasioned when the carbons are placed in contact, without overheating excessively. Current of 30 to 60 amperes is generally supplied to the lamp.

Special transformers are now made for use with the incandescent projecting lamps that have come into considerable use in the last few years, such as the 20 and 30-ampere Mazda C projecting lamps, which operate at about 30 volts. These transformers are arranged to give very close regulation.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Bell & Howell Co., 1801-15 Larchmont Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio. "King."
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. "Compensarc"—An A-C. to A-C. transformer device, simple, compact and adjustable, for use where only alternating current is available. Being relatively inexpensive, it is recommended for the smaller theatres, where the throw is under 110 feet and where the outlay for more costly A-C. to D-C. equipment is not warranted. May be used also as reserve equipment. A-C to D-C. and D-C. to D-C. "Compensarcs" are made as motor generator sets All three types described in Booklet 45113. See adv. pages 1203-1223.—Adv.



JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Nicholas Power Co., Inc., 90 Gold St., New York, N. Y.
Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, OSCILLATION. — A high-frequency transformer used in radio transmitting sets to transfer energy to the aerial circuit. It consists of two coils of wire containing a relatively small number of turns so arranged that the number of turns and the flux interlinking the two coils can be varied at will. The coils used in oscillation transformers are usually in the form of spirals of copper ribbon. The inductance of either coil is varied by a sliding clip. The flux interlinking the two coils is varied by changing the distance or angular relation between them.

TRANSFORMERS, PIPE-THAWING. — These are designed to send a large current through a stretch of frozen water pipe, thereby thawing it and saving the expense of digging it up or reaching it otherwise. It has a secondary of but few turns of large conductor so as to give considerable current at low voltage. The primary is generally designed to operate from a standard distribution system. The secondary is always connected around that section of the pipe that is frozen. Where this is outside of the house the transformer has one end of the secondary connected to the service pipe in the house. The other end is connected to the house side of the water meter, if there is one, or to the nearest fire hydrant in the street and the current passed between these points. Regulation of the current is obtained by potential taps on the transformer or by a rheostat.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler St., Hamilton, Ont., Can. "Westinghouse."
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
ENTERPRISE ELECTRIC CO., THE, Warren, Ohio. "Peerless." (See display adv., page 1328.)
Farranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Wayne pipe thawer, a transformer for use on 100-125 volt, a-c. lighting circuit, 50-60 cycles. Eliminates fire hazard incident to use of blow torch. A good addition to any plumbing establishment in cold climates. Its operation is illustrated on page 1218.—Adv.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co., of Canada, Ltd., Windsor, Ont., Can.
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, POTENTIAL (OR INSTRUMENT), SWITCHBOARD. — A small transformer of about 200-volt-ampere capacity designed for adapting 110-volt voltmeters, wattmeters, watt-hour meters, etc., to use for measurement on high-voltage circuits. The transformer is designed to give very accurate transformation ratio in the neighborhood of its rated voltage and on condition that too great a load in the way of too many instruments is not put upon it. The insulation of the instrument from the high-voltage circuit is also an important function of this transformer. The switchboard type transformers are for permanent mounting on the rear of the board and are always connected to the lines. They are often used for relays operating oil switches, circuit breakers, etc., in addition to their meter and instrument use.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Potential transformers for voltages not exceeding 2,500. Supplied either in 50 or 200 watt sizes. Higher voltages 200-watt rating only. Capacities up to and including 6,600 volts air insulated; higher ratings oil insulated. Uniform accuracy maintained throughout entire line. (Bulletin 46049.) See adv. page 1218.—Adv.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Miller Co. Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Packard Electric Co., Warren, Ohio. "Packard."
Roller-Smith Co., 233 Broadway, New York, N. Y.
SANGAMO ELECTRIC CO., Springfield, Ill. "Sangamo."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

TRANSFORMERS, POTENTIAL, PORTABLE.—Portable potential transformers are intended to be carried about and used for temporary connection in the circuit for testing purposes. While called portable, some types are necessarily quite heavy, because the rating must be from 50 to 200-kv-a., and the insulation suited to the high-tension circuit involved. There are smaller capacity transformers made for testing work on medium voltages that are much lighter and yet are constructed so as to be sufficiently accurate. They are generally enclosed in a wooden case and provided with carrying straps similar to those used on portable instruments.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Brown & Pengilly, 607 E. 4th St., Los Angeles, Cal.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.

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STERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind.
ENERAL ELECTRIC CO., Schenectady, N. Y. Furnished in convenient carrying cases, in any desired capacity, with single and double primary and secondary windings when required. A certificate bearing the actual test points will be furnished with each transformer, also a blue-print of characteristic curve. Made in 14 sizes and two types, 50-200 watt and 25-watt capacity. (Bulletin 46030.) See adv. pages 1203-1223.—Adv.
ldberg Ozone Machine Co., 800 Fort Wayne Ave., Indianapolis, Ind.
ler Co., Bertrand F., High and Canal ts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 2nd St., New York, N. Y.)
LONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
oney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
kard Electric Co., Warren, Ohio. "Packard."
er-Smith Co., 233 Broadway, New ork, N. Y.
rdarson Electric Mfg. Co., 501 S. Jefrson St., Chicago, Ill.
ner Electric Mfg. Co., 6400 Plymouth e., St. Louis, Mo.
STINGHOUSE ELECTRIC & MFG. ., East Pittsburgh, Pa. (See display v., pages 1395-102.)
ton Electrical Instrument Co., Wavy Park, Newark, N. J.

NSFORMERS, RADIATOR TYPE, COOLING.—Self-cooling transformoil-filled and depend on the natural ion flow of oil due to a temperature ce in or near the coils and against es of the tank. As the capacity of nsformer increases there is more re- to the flow of the oil, as the length ducts in the element increases, and ernal surface of the tank also does ease in proportion to the losses. It fore necessary to provide additional or heat-radiating surface by corruhe sides of the tank or making the emble a radiator. In one form there ided a large number of tubes which n near the top of the tank outd down to the bottom, and provide large cooling surface for the oil. form of the radiator type has a f vertical radiator sections with posed area located around the circe of the tank. Both of these ovide effective cooling of the oil nulate its circulation. Radiator nsformers are used outdoors where oling might fail due to freezing ny case would prove troublesome of the need for close attention to radiator type requires very little tention than any other outdoor ner, such as the pole type dis- units.

cturers:

almers Mfg. Co., Milwaukee,

n Transformer Co., 178-182 Em- St., Newark, N. J. "American," om Made."
ELECTRIC CO., 12th and Cran- Sts., Erie, Pa.
n Crocker-Wheeler Co., Ltd., St. ines, Ont., Can.
n General Electric Co., Ltd., 212 t., W., Toronto, Ont., Can.
n Westinghouse Co., Ltd., Sand Myler Sts., Hamilton, Ont., "Westinghouse."
l Engineering Co., 922 E. 41st icago, Ill.
L ELECTRIC CO., Schenec- N. Y. See description under rmers, high-tension, power.—

Y ELECTRIC CO., 7th and Sts., St. Louis, Mo.
Electric Co. of Canada, Ltd., r. Ont., Can.
RGH TRANSFORMER CO., us and Preble Aves., Pittsburgh, Pittsburgh." (See description Transformers, medium voltage, neous.)
HOUSE ELECTRIC & MFG. st Pittsburgh, Pa. (See display ges 1395-1402.)

RMERS, RADIO.—For radio ral types of transformers are gh-voltage stepup transformer to derive from standard comult the power for operating nent. A high voltage, up to volts, is needed for charging er in the oscillating circuit, frequency current which would the gap when the circuit was voltage were constant, is not wanted. For this reason, a large magnetic leakage between the coils is provided so that the drop through the resulting impedance will lower the secondary voltage after the circuit is closed by the signaling key. These are known as radio power transformers.

Another type used in radio communication, usually called an oscillation transformer or a helix, is a high-frequency aircore transformer, similar to the Tesla type, which transfers energy from the oscillating to the antenna circuit in radio sending. The number of turns and the relative position of the primary and secondary coils are adjustable for tuning. The coils used are usually in the form of spirals of copper ribbon.

Another form of transformer used in receiving circuits to connect the detector circuit to the antenna circuit is called a coupler. It generally has two solenoid coils mounted on the same axis and the coupling is varied by sliding one coil in or out of the other.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
American Radio & Research Corp., 21 Park Row, New York, N. Y.
American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chicago Radio Laboratory, Ravenswood and Schreiber Aves., Chicago, Ill.
Clapp-Eastham Co., 139 Main St., Cambridge, Mass. "Hytone," "De Luxe."
Coto-Coil Co., 87 Willard Ave., Providence, R. I.
Cramer & Swain, 2916 N. 16th St., Omaha, Nebr.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."
Fabricated Steel Products Corp., Leetonia, Ohio.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
Great Lakes Radio Supplies Co., Inc., 1st National Bank Bldg., Elmhurst, Ill. "RVA."
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Kilbourne & Clark Mfg. Co., 3451 E. Marginal Way, Seattle, Wash. "K & C."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Liberty Electric Corp., Port Chester, N. Y.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Murdock Co., William J., Everett Ave. and Carter St., Chelsea, Mass. "Murdock."
New Era Radio Sales Co., Elmira, N. Y. "Universal."
Packard Electric Co., Warren, Ohio. "Packard."
Radio Corp. of America, 233 Broadway, New York, N. Y.
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Simon, Emil J., 217 Broadway, New York, N. Y.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Western Radio Electric Co., 550 S. Flower St., Los Angeles, Cal. "Westrad."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)
Wireless Mfg. Co., 619 4th St., N. W., Canton, Ohio. "Wimco."
Wireless Specialty Apparatus Co., C and Fargo Sts., Boston, Mass.

TRANSFORMERS, REGULATING.—The purpose of these special transformers is to obtain a secondary voltage easily adjustable over a more or less wide range. They are usually called regulators. See Regulators, feeder voltage.

TRANSFORMERS, SERIES.—These are current transformers and are connected in series on a constant-current circuit. Their use is largely confined to street lighting, where each lamp or small group of lamps has its separate transformer. They make possible the use of lamps for larger or smaller current than that used in the distribution circuit and also insulate the lamps from that circuit, which usually is of high voltage. Transformers of this type must be arranged so that in case the secondary or lamp circuit should be opened while the primary current is on the effect on that current would not be appreciable. This is secured by contracting the section of the core so that the iron is saturated at full-load primary current. These transformers are usually installed in the base of the lamp post or mounted on the same or a nearby pole in case of overhead circuits. They have also been provided with special sealed and protected cases and buried in the ground near the base of the post. When used primarily to insulate the lamp or other device from high-voltage supply, they are sometimes called insulating transformers or safety coils.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. See description of complete line under Transformers, Constant Current.—Adv.
KUHLMAN ELECTRIC CO., Bay City, Mich.
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, SIGN-LIGHTING.—These are designed for the operation of the many small lamps in an electric sign. They may be connected to a lighting circuit or a power circuit. In one type there are two 10-volt secondaries. Another less expensive and more efficient style is of the autotransformer type, which has eleven taps giving 12 10-volt circuits. This can only be used when the lamps are wired in 12 approximately equal groups. Sign-lighting transformers are used very little now, as tungsten incandescent sign lamps are made in 7½ and 10-watt sizes for 105 and 125-volt circuits, and the use of such lamps is increasing. As long as it was impossible to obtain standard-voltage lamps of such low ratings, it was necessary to use low-voltage lamps and this necessitated use of a small stepdown transformer or connecting the lamps in series, the latter being an undesirable arrangement. Such transformers are now used chiefly for signs having very small and therefore low-voltage lamps.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "B & B."
Brink, Inc., C. I., 24 Gold St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
Electrical Engineering Co., 922 E. 41st St., Chicago, Ill.
ENTERPRISE ELECTRIC CO., THE, Warren, Ohio. "Peerless." (See display adv. page 1328.)
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Made for 110/220 volts pri-

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mary, 11/22 volts secondary. Capacities 250 to 2,000 watts, 25 to 140 cycles. See adv. pages 1203-1223.—Adv.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. "Hercules." (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
SMITH-HECHT CO., Century Bldg., Indianapolis, Ind.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, SOCKET TYPE.—Socket type transformers have the appearance of an extension socket, having a standard medium-base screw plug at one end and a candelabra lamp receptacle at the other end of a small cylindrical casing containing the transformer. The latter reduces the voltage from 110 to 6 volts and has a capacity of from 2 to 5 watts. These transformers are generally placed in lamp sockets to provide an efficient means for using low-power lamps that may be lighted all night. Such outfits find application in hallways, bathrooms, bedrooms, etc. They have a much higher over-all efficiency than individual lamp dimmers or dimming sockets.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. "All-Nite-Lite" affords a most economical all-night illumination. It consists of a miniature transformer encased in an attractive brushed brass shell. The All-Nite-Lite fits into any standard lamp socket, and uses a 6-8 volt, 2 candle-power Mazda lamp. Turn to page 1218 where other G-E Transformer Specialties are displayed.—Adv.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. "Liberty." (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)

TRANSFORMERS, SPECIAL OR NOT OTHERWISE LISTED.—Transformers are very often made to meet special requirements of current or voltage or to have transformation ratios not standard and to be used for purposes other than those listed herewith. This may be true of small low-voltage transformers or those made in very large sizes, such as special high-tension testing transformers. Transformers are also used for other purposes than changing the voltage or current; for instance, as a compensating transformer for neutralizing inductive disturbances in telephone and telegraph lines, or one used for protecting and insulating both the telephone and the user from high-voltages on the line due either to inductance or accidental contact with a high-tension line. Phasing transformers are sometimes made special for changing two-phase to three-phase current, or the reverse.

Testing transformers for use on rather low voltage circuits are used for testing coils and armatures. The coil testing transformer is built with a separable yoke so that a wound coil can be tested for short circuit by making it the secondary. The armature testing transformer has an approximately U-shaped core wound with the primary coil. This is pressed against the armature core so that the armature coil forms the secondary.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Standard G-E transformers meet many special requirements. Nevertheless, special problems may demand unusual and original developments. This company has designed and perfected many equipments for special purposes and the services of G-E Transformer Engineers, because of their wide experience, frequently effect material savings and insure apparatus of maximum operating convenience and economy. Inquiries carrying detailed information as to purpose and available power sources should be addressed to the nearest G-E sales office. See page 1223.—Adv.
General Radio Co., 11 Windsor St., Cambridge, Mass.
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill.
KUHLMAN ELECTRIC CO., Bay City, Mich.
Liberty Electric Corp., Port Chester, N. Y.
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
Packard Electric Co., Warren, Ohio. "Packard."
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, SUBWAY OR MANHOLE.—Transformers designed for use in the manholes of underground distributing systems. They are of the oil-filled self-cooling type. Because of the conditions of their location they must be air and water-tight, compact and rugged and with low iron loss, and low temperature rise. Manhole transformers are made in about the same capacities and voltage ratings as the pole type distributing transformers. The joint between cover and tank is made water-tight and air-tight by using a special gasket. Because they are made air-tight, internal pressures are developed due to the expansion of air and oil with the increased temperature under load. An air chamber is provided between the oil level and the cover to form a cushion for these pressures. Special construction is also used to give water-tight outlet bushings.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. See description under Transformers, distributing, standard.—Adv.
MOLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
Moloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh." (See description under Transformers, medium voltage, miscellaneous.)
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, TOY.—Small transformers with nominal rating of about 50 to 150 watts, for use on standard lighting circuits. The secondary current is of low voltage and is used to operate electrical toy motors, miniature lamps, electric trains, etc. These transformers are generally made with several secondary taps connected to a small switch on the transformer case, so that several low voltages may be obtained. In some transformers this gives as many as 20 steps between 1 and 30 volts. Instead of a switch several binding posts are sometimes used. The primary is usually wound for 110 volts and always has its circuit continued through a connecting cord passing through a bushed hole in the case and terminating in a standard attachment plug; this is to prevent connecting the low-voltage winding to the lighting circuit, which would make the outfit a dangerous stepup transformer.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Betts & Betts Corp., 511 W. 42nd St., New York, N. Y. "Hercules."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Heat Control Co., The, 2711 Church Ave., Cleveland, Ohio. "King."
Electrical Products Mfg. Co., 69 Sprague St., Providence, R. I.
Elektro Mfg. Co., The, 4642-4644 Ravenswood Ave., Chicago, Ill. "Empire."
GENERAL ELECTRIC CO., Schenectady, N. Y. "Wayne." Made in two general classes: The Wayne Junior replaces two or three dry cells and is furnished with a liberal length of cord and separable plug. Larger sizes of Wayne Toy Transformers for operating heavy electrical toys, have a nominal rating of 50 and 100 watts, and are furnished with electric controllers for giving various voltages. Taps are available for operating toys at constant voltages as well as small incandescent bulbs. See page 1218 for information on other G-E Transformer Specialties.—Adv.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Gilbert."
JEFFERSON ELECTRIC MFG. CO., 426-430 S. Green St., Chicago, Ill. "Little Jeff," "Midget."
Knapp Electric & Novelty Co., 511 W. 51st St., New York, N. Y. "Kenco."
Lionel Corp., The, 48-52 E. 21st St., New York, N. Y. "Multivolt."
Miller Co., Bertrand F., High and Canal Sts., Trenton, N. J. "Hercules." (Exclusive distributor, Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.)
PITTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh."
Rittenhouse Co., The A. E., Honeoye Falls, N. Y.
Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.
Thordarson Electric Mfg. Co., 501 S. Jefferson St., Chicago, Ill. "Danditoy."
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
Viking Electric Co., 150-152 Chambers St., New York, N. Y. "Viking," "Veco."

TRANSFORMERS, TRIPPING.—Tripping transformers are used to provide the necessary power for operating the tripping mechanisms of oil circuit breakers and switches. They are usually of the current or series type, and often are the same transformers that are used for the ammeters and wattmeters on lines in which heavy currents are present. See Transformers, current.

Manufacturers:

American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Condit Electrical Mfg. Co., 838 Summer St., South Boston, Mass.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
Monarch Electric Co., Ltd., St. Lawrence and Waterman Sts., St. Lambert, Que., Can.
Sterling Electrical Corp., 2711 Church Ave., Cleveland, Ohio.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston, Mass.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv., pages 1395-1402.)

TRANSFORMERS, WATER-COOLED.—There are oil-filled transformers, with a coil of copper pipe immersed in the top of the tank well above the transformer element. Cool water is pumped through this coil and thus the heat is abstracted from the circulating oil. This type is mostly used for large transformers at central stations and indoor substations. The length of the coiled pipe necessary is determined by the rate of flow of the water and the total losses in the transformer. It is generally computed from the relation that water flowing at the rate of 3.8 gals. per min. will absorb 1000 watts, with a temperature rise of 1° C.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Transformer Co., 178-182 Emmett St., Newark, N. J. "American," "Custom Made."
BURKE ELECTRIC CO., 12th and Cranberry Sts., Erie, Pa.
Canadian Crocker-Wheeler Co., Ltd., St. Catharines, Ont., Can.

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anadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
anadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."
abricated Steel Products Corp., Leetonia, Ohio.
ENERAL ELECTRIC CO., Schenectady, N. Y. See description under Transformers, high-tension, power.—Adv.
OLONEY ELECTRIC CO., 7th and Hickory Sts., St. Louis, Mo.
oloney Electric Co. of Canada, Ltd., Windsor, Ont., Can.
TTSBURGH TRANSFORMER CO., Columbus and Preble Aves., Pittsburgh, Pa. "Pittsburgh." See description under Transformers, medium voltage, miscellaneous.—Adv.
agner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.
ESTINGHOUSE ELECTRIC & MFG. O., East Pittsburgh, Pa. (See display dv., pages 1395-1402.)

ANSFORMERS, WELDING.—Welding iformers are used to provide low-voltcurrent used in welding. The primary ually wound for the ordinary distribuvoltages, although they are used on r voltage circuits at times. They are ded with secondaries of usually only urn of large conductor so as to give large currents at very low voltage for ng metals. The transformer is usually ted with suitable water-cooled jaws ther auxiliaries to form a complete ig machine or outfit.

ufacturers:

erican Transformer Co., 178-182 Emett St., Newark, N. J. "American," Custom Made."
ter Electric Works, 3055 Lincoln Ave., icago, Ill.
adian General Electric Co., Ltd., 212 ng St., W., Toronto, Ont., Can.
gan Electric Mfg. Co., 2987 Franklin , Detroit, Mich.
tric Heat Control Co., The, 2711 urch Ave., Cleveland, Ohio. "King."
ERPRISE ELECTRIC CO., THE, arren, Ohio. "Peerless." (See display ., page 1328.)
and Electric Riveter Co., 509 West d Trust Bldg., Philadelphia, Pa. veland."
cated Steel Products Corp., Leeia, Ohio.
ERSON ELECTRIC MFG. CO., 426-S. Green St., Chicago, Ill.
LMAN ELECTRIC CO., Bay City, h.
ty Electric Corp., Port Chester, N. Y.
Co., Bertrand F., High and Canal , Trenton, N. J. (Exclusive distrior, Betts & Betts Corp., 511 W. 42nd New York, N. Y.)
ONEY ELECTRIC CO., 7th and Hick-Sts., St. Louis, Mo.
ey Electric Co. of Canada, Ltd., dsor, Ont., Can.
rd Electric Co., Warren, Ohio. ckard."
g Electrical Corp., 2711 Church , Cleveland, Ohio.
arson Electric Mfg. Co., 501 S. Jefon St., Chicago, Ill.
INGHOUSE ELECTRIC & MFG. East Pittsburgh, Pa. (See display pages 1395-1402.)

SIENT PHENOMENA.—Any elecnagnetic phenomena that are tempresent in electric circuits or apare termed transients. These na usually occur on a-c. circuits me of the conditions are changed, switching, a change in load, a cuit, an arc across an insulator,

SIL.—Trade name for lubricating factured by the General Electric nectady, N. Y.

SIT.—Trade name for steam pumps ured by the National Transit Machine Co., Oil City, Pa.

ITE.—Trade name for asbestos ufactured by Johns-Manville, Inc., Ave. and 41st St., New York,

LATOR, TELEPHONE. — See elephone.

MISSION LINES, CONSTRUC-.—Transmission lines are those ivey energy in bulk from point of point of distribution or utiliza-oltages higher than those comd for distribution purposes, usual-000 volts. These lines are, how-two general types, (a) those liver energy at various points line, and (b) those which deliver all their energy at one or perhaps two points.

The lines which deliver energy to towns and industries along their route are in effect merely high-voltage distribution systems, but from the point of view of line construction they are classed with transmission systems. The number of such systems is great and increasing steadily, since economy of production requires that the generating stations formerly maintained in each town or industrial plant give way to energy produced in a large and efficient station located with reference to adequate supplies of coal and water, or perhaps driven by water power.

These high-voltage distribution lines are operated at voltages from 6,600 to 33,000, but for the most part below 25,000 volts. The distances would in many cases make a higher voltage desirable, but the cost of transformer stations increases materially and the choice of routes is likely to be more restricted at the higher voltages.

The through lines are operated at such voltages as the distance and amount of load require. The substation equipment being a small part of the total cost, the voltage is preferably made a little more than 1,000 volts per mile, for distances less than 100 miles. The construction for important lines is often of steel and carried on private right-of-way by the most direct route.

In selecting the route for lines which are to be tapped at various points, highways and railroad rights-of-way form the natural channels to be followed. Such lines are carried from town to town and where the railroad route is shorter than the highways it is often desirable to arrange for a right-of-way along (but usually to one side of) the railroad property.

When energy is not likely to be taken from the line along the route, highways are used for the lower voltage lines carrying less important service, as this is usually the most feasible plan. But for lines at voltages over 50,000 a private right-of-way or a long-time easement is often found best. This makes it possible to run the line by the most direct route across country without regard to highways.

Lines along highways are usually on wood poles with pin-type insulators. Small lines are carried on a two-pin arm with the third wire on the pole top. Others use two two-pin arms with one wire on the lower arm and perhaps a ground wire for lightning protection on the pole top. Where two circuits are on the same pole a four-pin arm is used above and two wires are carried at the ends of the second arm.

Where the width of the right-of-way permits, lines carrying heavier conductors are sometimes doubled. This is done by inclining the poles toward each other to make an A-frame, or by setting them erect about 10 ft. apart and attaching double-length crossarms to each pair of poles. In places where reinforcement against side stresses is required, braces are attached from the lower part of one pole to a point about 12 ft. higher on the other pole. This construction presents some difficulties in handling the wires between the poles, and the flexible type of steel tower is therefore often used under circumstances which would require double-pole lines.

Steel construction is often used in eastern states where steel is readily available in places where pole construction would be preferred in rough country. For important lines structural steel poles set in concrete are found quite frequently in eastern states. These are required where poles of unusual height are needed, and where the space available for foundations does not permit the use of a tower. Railroad and river crossings and lines carried through railroad yards are often supported on such poles. Tubular steel poles and expanded truss poles are used to some extent for lines supplying electric railway service.

For important service along private rights-of-way the steel tower is found preferable. Such lines, in level or rolling country, are carried on towers of light structural steel shapes, spaced from 500 to 600 ft. apart. The height must be sufficient to allow for safe clearance with 15 to 20 ft. sag in the span. The strength of the structure must be sufficient to withstand the combined stresses of sleet and wind exerted at right angles to the line. It is customary to assume that ½-inch radial thickness of sleet may be accompanied by a wind pressure of 8 lbs. per sq. ft. (72 miles per hour), and make the steelwork strong enough to withstand it. These conditions are rarely met in combination except, perhaps, in lines passing over mountainous country, but sleet may be more than ½-inch thick and equivalent stresses may be encountered with lower wind pressures. In rough country, the line may often be carried from hill to hill with spans of 1,000 to 2,000 ft. or more. The towers and foundations for such lines must usually be designed for the condition at each tower location.

The insulators for transmission lines are perhaps the most vital part of the system, since the reliability of the service depends in large measure upon their dependability. Lines up to about 40,000 volts are quite generally equipped with pin-type insulators. At voltages below 10,000 to 20,000 volts they are usually of two pieces and at higher voltages they are in three or four parts. The number of petticoats and their diameter is steadily increased with rising voltages, and experience has indicated that it is a material help to continuity of service to use an insulator rated at a voltage 25 to 50% higher than the working voltage of the line. This gives higher flash-over values, greater mechanical strength, and higher factor of safety generally.

At the higher voltages, the suspension type insulator is standard, and it is sometimes used at lower voltages where there is probability of the voltage being increased later. The string of suspension units varies from three to six or more in number. The potential gradient along the string is, however, not uniform and the addition of more units is of less value as the number is increased beyond four. The extra units are, however, of value as reserve insulator capacity in case any of the units is short-circuited or weakened by puncture. One or two units beyond the probable flash-over voltage are, therefore, usually provided.

With the suspension type, provision must be made at turns for transmitting the tension of the line without drawing the conductor too near to the tower for safe clearance. This is accomplished in most cases by treating the insulator string at the corner tower as a strain insulator, and using a separate string for each adjacent span. This turns the units to an approximately horizontal position and puts them under the line tension. The failure of insulators is likely to be first observed at such points.

Considerable trouble has been experienced in suspension insulators in recent years due to an aging effect, the character of which is receiving considerable attention.

Lines are generally protected from lightning by a ground wire carried above the line and grounded several times in each mile. Copperclad steel is a desirable type of conductor to use for this purpose, but galvanized strand is very common. In the vicinity of transformers and cable poles lightning arresters are required. These are of the multipath or horn-gap type on the less important lines and of electrolytic or gelatinous type on more important service.

The sag of conductors varies with the length of span, size of conductor and tension to which it is drawn up. The tension should not exceed one-half the ultimate breaking strength of the conductor when it is loaded with sleet, and the thermometer is at 0°. The tension being fixed by these assumptions, the sag is found by the formula, $s = Wl^2/(8T)$, in which W is the weight of a foot of the conductor with ice, l is the length of the span, and T is the tension. This is the minimum sag which should be used, but it is often desirable to use a greater sag in order to ease the stresses on the supporting structures. The sag varies somewhat with expansion and contraction and if wire is strung at summer temperatures, allowance must be made for contraction and resulting increase of tension at winter temperatures. (Also see Transmission systems, development of.)

TRANSMISSION LOSS, TELEPHONE LINE.—Weakening of transmitted speech by lines and apparatus. It is measured in terms of standard cable (88 ohms and 0.054 mf. per mile).

TRANSMISSION STANDARD, TELEPHONE LINE.—A measure of allowable transmission loss permitted in any given case. The total over-all commercial limit has been assumed to be 30 miles standard cable with a certain kind of apparatus at each end.

TRANSMISSION STRUCTURES, STEEL.—See Structures, steel, special for transmission lines, etc.; also A-frames; Towers, steel, transmission line.

TRANSMISSION SYSTEMS, DEVELOPMENT OF.—Alternating-current systems having been introduced in 1886, for the purpose of supplying at higher voltages districts in which the distances were too great for 110-volt supply, it was but natural that still higher voltages should be proposed for transmission to greater distances.

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The first long-distance transmission lines were constructed in the United States in 1889. Two single-phase, 10,000-volt systems were placed in service between Oregon City and Portland, Ore., a distance of 13 miles, and between Pomona and San Bernardino, Cal., a distance of 29 miles. The first three-phase long-distance systems to be installed were in Europe, since the alternating-current system had been first developed there. Systems of 10,000 volts were installed to transmit energy from Lauffen to Frankfort in Germany, and from Deptford to London in England in 1891-2, and these are of great interest since most of the problems of high-voltage insulation of transformers, cables and overhead lines had to be met and in a measure overcome before these installations could go into service. Swiss engineers and manufacturers were identified with these first undertakings, perhaps because of their familiarity with hydroelectric practice.

The development of three-phase transmission enterprises in America began about the same time and proceeded rapidly under the impetus of the presence of water powers, many of which were within reach of a power market. Hydroelectric plants were installed and delivered energy to lines at 10,000 and 15,000 volts in Colorado, California, Oregon and other western states, between 1891 and 1894.

The development of power at Niagara Falls began in 1893, with transmission to Buffalo and to industries which soon located nearby to use the power. This plant was unique in that it was the first 25-cycle plant in America, this frequency having been chosen because it was expected that a considerable part of the energy would be converted to direct current by synchronous converters. Direct current was required for certain electrolytic processes which were established near Niagara Falls to avail themselves of cheap power. Aluminum, carborundum and certain chlorine products were made available in quantity for the first time by the Niagara Falls development.

In 1897, the Edison systems first availed themselves of the alternating-current system for the transmission of energy from station to station in bulk. Synchronous converters were employed to produce direct current from 25-cycle a-c. supply, transmitted at 6,600 to 10,000 volts. This made possible the use of large generator units at the main station with the most economical types of prime mover, and saved the expense of running the small stations during long periods of the day when the load was small and the cost of production very high. These small stations were shut down except for the periods of the heavy load, thus saving both labor and fuel during 16 of the 24 hours.

This joining of forces with a-c. transmission has made it possible for d-c. systems to continue in operation with a degree of economy comparable with that of a-c. distribution systems.

The discussion of frequencies which took place before the Niagara development proceeded served to emphasize the disadvantages of the 125 and 133-cycle systems which had been common and resulted in the adoption of 60 cycles as a compromise between the severe limitations of a frequency of 25 cycles, which gave very unsatisfactory lighting service and the frequencies above 100 cycles which accentuated voltage fluctuations very badly. It is unfortunate that the compromise was not made at 50 cycles as this would have simplified the design of frequency changers which are often needed to form a connecting link between 25 and 60-cycle systems. Voltages were increased by gradual steps each year as experience was gained in the manufacture of high-voltage equipment and line insulators.

Increase of Line Voltage. By the year 1,900 lines had been built at 22,000, 33,000 and in a few cases at 40,000 volts in the western states. With these increases the permissible distance was correspondingly increased, since with copper conductors it happens that a three-phase line has a loss of 10% when the length in miles is the same as the number of kilovolts (thousands of volts), of line pressure, and the current is one ampere per 1,000 circular mils in each line conductor. This means that a 40,000-volt line can be twice as long as a 20,000-volt line, and (if the size of conductor is the same), can carry twice as much load with the same percentage of loss, as a 20,000-volt line.

As distances were increased more water powers were brought within economical range and further impetus was given to increase in voltages in order to reach others between 1910 and 1918 the advance stopped at 150,000. The highest voltage transmission line operating at present is the 150,000-volt line transmitting 240 miles from Big Creek to Los Angeles, Cal. A 165,000-volt line is now being constructed in California. The longest high-voltage transmission line now operates at 87,000 and 55,000 volts in different sections and transmits a distance of 539 miles from Mono County, Cal., to Yuma, Ariz.

The interconnection of large power systems in the last few years has indicated the desirability of further increase in line voltage. The most ambitious scheme in this direction is the 220,000-volt, 1,100-mile transmission line which has been proposed to interconnect all of the California power companies, as an economic necessity, to transfer large amounts of power from one system to another when it is most needed. The combined power capacity of the line is to be 1,500,000 kw., and because of its function, which is in the nature of a busbar, it is called a transmission bus. The proposed system is to be a 60-cycle system throughout, although some of the present systems are 50-cycle. This is because an interconnection of such large power sources through frequency changers would be uneconomical, limit the exchange of power and increase tremendously the required operating vigilance. One part of the proposed system now operating a 240-mile line at 150,000 volts can be operated at 220,000 volts without material change. The towers allow sufficient clearance and by lengthening the nine-unit string of suspension insulators to eleven units the insulation will be ample. The spacing of the line conductors is proposed to be 17 ft. 6 ins.

Effect of Voltage Increase on Line Construction. The steady advance in voltage necessitated a complete change in the type of overhead line construction, after the voltage had passed 50,000. Below this point insulators carried on pins with wood crossarms had been standard practice. The early insulators were of glass, since the manufacture of porcelain for such purposes had not been developed, and molded glass was less expensive. However, as the size and number of petticoats was increased to meet increased voltages, the difficulties of breakage in service began to multiply and porcelain was substituted for the glass. Porcelain insulators were made in two, three or four pieces and cemented together after being fired. This removed the difficulty due to internal stresses and gave a mechanically stronger support for the line conductor.

Each successive increase, however, added to the weight of the insulator and to the length of the pin, necessitating the use of steel pins with threaded thimbles for the attachment of the insulator. Above 50,000 volts, individual insulators were about one foot in diameter and weighed about 15 lbs. These limitations suggested the use of two or more insulators in series, and this was most conveniently done by suspending the insulators from the crossarms instead of carrying them on a pin set into the arm. Thus the suspension type of insulator became standard for the higher voltages and is used quite universally for lines above 50,000 volts.

The various units are of a single piece of porcelain from 6 to 10 ins. in diameter with corrugations on the under side and with galvanized steel connecting terminals, by which they are secured to each other, to the support and, at the bottom, to the line conductor.

The use of suspended strings which have more or less freedom to sway laterally in the wind, made it necessary to keep the strings a safe distance away from the pole or tower, and near the ends of the arm. This resulted in the three conductors being mounted in a vertical plane, on one side, the other side being occupied by or reserved for a second circuit. After a few years' experience with sleet it was found desirable to have the middle conductor a little to one side of the others, as the sleet in melting off would drop from one of the lower wires first in some cases, allowing it to rise dangerously near to the ice-loaded conductor above it.

The extent of insulator failures and the increasing cost of insulators with increasing voltages suggested the desirability of minimizing the number of insulators by lengthening the spans. The prevailing practice for wood pole lines of using 150-ft. spans was increased to 250-ft., reducing the number of insulators about 40%. With heavy conductors and with two circuits the loading of poles was too great for safety and double-pole lines were resorted to in many cases.

In mountainous districts where the line could be carried from one eminence to another longer spans were the rule and this demanded structures stronger than wood poles would afford. Steel towers were thus made a part of such lines and the necessary details of cement foundations and conductor supports were developed. As conductor sizes became larger and experience with wind and sleet demanded, the use of steel structures was extended to important lines in more level country and span lengths of 500 to 600 ft. were found to be most economical. (Also see Transmission lines, construction of.)

Economic Effect of Power Transmission Systems. Between 1905 and 1910 the construction of intercity lines was begun for the purpose of supplying groups of cities and villages from one large generating station, thus effecting great economies by shutting down small and inefficient stations at least for most of the year.

Extensive systems operating at transmission voltages up to 40,000 were thus built up in various parts of the country. These systems were then added to by establishing outdoor transformer substations to supply villages through or near which they ran in which no electric service had before been given. In coal-mining districts they were also extended to supply power for mining purposes and to industries located away from city supply systems.

In some parts of the country power was supplied for pumping water for irrigation, or for the drainage of overflowed lands. Thus the large capacity of higher voltage lines was applied to the economic supply of power in large blocks from sources where it could be generated cheaply from water or coal, and the net result has been a vast saving in the consumption of fuel and a tremendous addition to the industrial power facilities of the country.

The super-power survey now being conducted by the United States Geological Survey in the metropolitan and industrial district lying between Boston, Mass., and Washington, D. C., aims at a survey of all existing and potential power sources in this extensive area with the aim of showing how all these may be co-ordinated and interconnected by high-voltage transmission lines so as to meet the great power demands in the most economical manner and conserve fuel resources in the most effective way.

TRANSMITTER ARM. — A mounting piece to hold the transmitter out from a base and to permit vertical adjustment to the varying heights of users. On the hotel type telephone it practically vanished by becoming merely a pivot.

TRANSMITTER BUTTON, TELEPHONE. —A colloquial expression for microphone cell.

TRANSMITTER, MAGNETO. — A polarized receiver will act as a transmitter if the user speaks rather loudly into the ear cap. The diaphragm, vibrated by the voice, varies the magnetic strength of the pole pieces and thus generates current in the line. The first electric telephone operated in this way.

TRANSMITTER, TELEPHONE.—This is the part of a telephone set which converts sound waves in air into talking current (alternating current). It consists of a mouthpiece to collect the sound and a diaphragm vibrated by the sound. The diaphragm moves one of two electrodes between which is granular carbon. The varying pressure thus produced varies the electrical resistance and thus varies the direct current which is flowing through the transmitter. The two electrodes and the granular carbon are called the "microphone cell."

TRANSMITTERS, RADIO. — A radio transmitter is a complete set of apparatus for the production of alternating current of high frequency and permitting its radiation as electromagnetic waves. Transmitters therefore are varied, depending upon the nature of the communication desired and upon the distance over which the messages will be transmitted. The manufacturers listed here make radio transmitters, sometimes as standard sized equipments and also as special equipment. For a complete description of the apparatus used, see Radio telegraph transmitting apparatus; also Radio telephone transmitting apparatus.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Chicago Radio Laboratory, Ravenswood and Schreiber Aves., Chicago, Ill. "Hy-Rad."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal. "Radiophone."

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)e Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
'ederal Telegraph Co., 812 Hobart Bldg., San Francisco, Cal. "Federal."
ray & Danielson Mfg. Co., 579 Howard St., San Francisco, Cal.
REBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. Y. "Grebe Radio."
OLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
ennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
lbourne & Clark Mfg. Co., 8451 E. Marginal Way, Seattle, Wash. "K & C."
litzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
berty Electric Corp., Port Chester, N. Y.
ercury Radio Appliance Co., 672 Broadway, Brooklyn, N. Y. "Meraco."
odern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
w Era Radio Sales Co., Elmira, N. Y. "Universal."
dio Corp. of America, 233 Broadway, New York, N. Y.
dio Service & Mfg. Co., 454 Merrick Rd., Lynbrook, L. I., N. Y. "Radio Service."
GNAL ELECTRIC MFG. CO., Menomiee, Mich. "Signal."
ion, Emil J., 217 Broadway, New York, N. Y. "Elwell."
icox Laboratories, Inc., The, 131 S. Fairview Ave., Lansing, Mich.
reless Specialty Apparatus Co., C and Largo Sts., Boston, Mass. "Priess-Earth."

ANSMITTERS, TELEGRAPH, MA-E TYPE.—Instruments which, in re-e to a hand-operated control, effect in n-line circuit electrical changes neces-to send signals over the line. The ine type transmitters are used to per-aster sending, with less effort for the tor. One form, a semiautomatic nitter, consists of a hand-operated which moves in a horizontal plane. lever has an adjustable pendulum or which forms dots and dashes of niform and regular character. The are formed as long as the lever is gainst one contact and the dashes held against the other. Other ma-type transmitters operate when a ated tape bearing the message is fed hem. In this way an operator may e messages on the tape when he use the line to transmit them.

facturer:

ien Mfg. Co., The, 700 E. 8th St., peka, Kans.

NSMITTERS, TELEPHONE, DESK ALL SET.—These transmitters are lly of the solid-back type, having an ng brass shell. There are a number es of transmitters used, but they erally quite similar. For common-systems, high-resistance transmit-e used. They have a resistance re from 30 to 60 ohms. The same re sometimes used on local-battery they have the advantage of being ical of current. For special service al-battery service in general, low-ce transmitters are used; these resistance of from 10 to 15 ohms. nes for announcing trains, paging in hotels, and for other loud-g telephones, special low-resist-ansmitters are used on 110-volt cuits.

facturers:

can Electric Co., 6401 S. State St., ago, Ill.
o Telephone Supply Co., 1142-1228 Beardsley Ave., Elkhart, Ind.
l Telephone & Telegraph Co., Buf-N. Y. "Federal."
OGG SWITCHBOARD & SUPPLY Adams and Aberdeen Sts., Chi-. Ill. (See display adv. page 1327.)
Electric Co., Genoa, Ill.
ttan Electrical Supply Co., Inc., ark Pl., New York, N. Y.
r Electric Co., 3800-3810 Ravens-Ave., Chicago, Ill.
y & Patterson, 34 Hubert St., York, N. Y. "DeVeau."
rd Telephone Construction Co., Monroe, Mich.
erg-Carlson Telephone Mfg. Co., University Ave., Rochester, N. Y.
n Electric So., Inc., 195 Broadway, York, N. Y.

MITTERS, TELEPHONE, HAND ransmitters for use on hand sets with a special back to fit into the flat brass tubing handle generally employed. They are usually smaller than the ordinary transmitter, having a smaller diaphragm.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
American Thermophone Co., 114-116 Bedford St., Boston, Mass. "Thermophone."
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Modern."
Stanley & Patterson, 34 Hubert St., New York, N. Y. "DeVeau."
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TRANSMITTERS, TELEPHONE, OPERATORS'.—Transmitters designed to be worn by operators. They are carried on a plate which rests on the breast, held by a strap or band around the neck. The mouthpiece is long and curved. The transmitter is usually made similar to those used in the desk and wall telephones, but has a special brass shell. They are also called breast transmitters or chest transmitters. On some types of private branch exchange or other small boards the operator's transmitter is suspended by cords from an adjustable bracket extending forward over the top of the board. This is usually a plain solid-back transmitter.

Manufacturers:

American Electric Co., 6401 S. State St., Chicago, Ill.
Chicago Telephone Supply Co., 1142-1228 W. Beardsley Ave., Elkhart, Ind.
Federal Telephone & Telegraph Co., Buffalo, N. Y. "Federal."
KELLOGG SWITCHBOARD & SUPPLY CO., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
Leich Electric Co., Genoa, Ill.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Stoddard Telephone Construction Co., The, Monroe, Mich.
Stromberg-Carlson Telephone Mfg. Co., 1050 University Ave., Rochester, N. Y.
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TRANSMITTERS, TELEPHONE, SPECIAL.—Special telephone transmitters are used for some purposes, such as demonstrations in windows, for use in transmitting music, etc., by radio telephone, for use in telephones made in novel styles for homes, etc. The latter class includes transmitters chased with gold or silver, etc. Glass mouthpieces are also used on some of the special transmitters.

Manufacturers:

Modern Radio Equipment Co., 27 S. Broad St., Elizabeth, N. J. "Micro-Fone-O-Graf."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

TRANSMITTING SETS, RADIO.—See Radio telegraph transmitting apparatus; also Radio telephone transmitting apparatus.

TRANSPORT NUMBERS.—Numbers which express relatively the carrying power of supposed ions in solutions, whose motions towards the electrodes provides the mechanism of carrying the electric current, according to the dissociation theory. The sum of the transport numbers of the two sets of ions gives the electric conductivity of the solution.

TRANSPORT OF IONS.—In the dissociation theory of solutions, the fact that the parts of an electrolyte appear continuously at the electrodes is explained by assuming them to exist a priori in the solution, before electrolysis is applied, and to be directed or attracted to the two electrodes by the electric charges upon them. This provides a picture of the transport of the ions from the body of the electrolyte to the electrodes. It is more probable that there are no such pre-existing ions, that the electric current passes and produces chemical changes in the electrolyte at the electrodes, that these changes in composition diffuse throughout the electrolyte, and thus virtually bring the ions to the electrodes as a result of the passage of the current, and not as its pre-existing necessary condition.

TRANSPOSITION BRACKETS.—See Brackets, transposition.

TRANSPOSITION OF TELEPHONE LINES.—To equalize the exposure of telephone line wires to external disturbances, they are transposed or caused to trade places on the insulators at regular intervals. In cable this is secured by twisting the insulated wires in pairs. In order to transpose open wire lines in an orderly fashion so as to eliminate cross talk from all the circuits of a large lead, it is necessary to divide the line into sections. In each section an elaborate scheme of transpositions is carried out, which is repeated in the next section. There are two common forms of transposition.

Two-Pin Transposition. A transposition in open wire line made by dead-ending the wires on transposition insulators and cross connecting. It is subject to considerable leakage from one wire of the pair to the other.

Running Transposition. In this form of transposition there is no dead-ending of the line wires. They are carried unbroken over each other. An older way is to let them cross each other on one transposition insulator. The newer way uses a transposition bracket, carrying two ordinary insulators, set vertically. For lines carrying a phantom circuit, there are four insulators on the transposition bracket. The newer way gives better insulation.

TRANSVERTER.—Trade name for motor-generators for motion-picture service manufactured by the Hertner Electric Co., 1905 W. 114th St., Cleveland, Ohio.

TRAPS, BURGLAR-ALARM CONTACT-MAKING.—Contact springs intended for mounting in concealed locations on windows and door frames and designed to be operated by the movement of the windows, etc., to complete burglar-alarm circuits, or of cords under tension which when disturbed permit a contact mechanism to complete a burglar-alarm circuit. Also see Springs, burglar-alarm contact.

Manufacturers:

Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
PARTRICK & WILKINS CO., 51 N. 7th St., Philadelphia, Pa.
UNITED ELECTRIC APPARATUS CO., 1529-33 Columbus Ave., Boston Mass.

TRAPS, STEAM.—Steam traps are installed in steam mains at points in the system where water of condensation would collect and must be drawn off. They serve to drain the water from these points and return it to the boilers or feed tanks, thus being an important auxiliary in power plants. There are four principal types of steam traps, known as the bucket, float, tilting and expansion types. In the bucket type the condensation flows into a bucket or float and sinks it. This bucket is connected with the discharge valve which is opened to release the condensation when the bucket operates. The tilting type tilts when the proper amount of water is present and returns the water to the gravity drain system. These types and the float type are the most common and widely used traps.

Manufacturers:

Albany Steam Trap Co., The, Albany, N. Y.
American Blower Co., Detroit, Mich. "Detroit."
American District Steam Co., N. Tonawanda, N. Y. "Adsco."
American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American Ideal."
Anderson Co., The V. D., 1935 W. 96th St., Cleveland, Ohio.
Armstrong Machine Works, Three Rivers, Mich.
Burrows Mfg. Co., York, Pa. "Burrows."
Chicago Engineer Supply Co., 68 W. Lake St., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago Ill. "Crantilt."
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can. "Crantilt."
Davis Regulator Co., G. M., 420 Milwaukee Ave., Chicago, Ill. "Davis."
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Elliott."
Fisher Governor Co., The, Marshalltown, Iowa.

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Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
H. S. B. W. Cochrane Corp., 17 St. and Allegheny Ave., Philadelphia, Pa. "Cochrane."
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McAvity & Sons, Ltd., T., St. John, N. B., Can.
Nason Mfg. Co., 71 Fulton St., New York, N. Y.
Nicholson & Co., W. H., 125 Oregon St., Wilkes-Barre, Pa. "Wyoming."
Page Boiler Co., 815-819 Larrabee St., Chicago, Ill. "Aaball."
Plant Engineering & Equipment Co., Inc., 192 Broadway, New York, N. Y.
Reliance Gauge Column Co., The, 5924 Carnegie Avenue, Cleveland, Ohio.
Sarco Co., Inc., 229 Broadway, New York, N. Y. "Sarco."
Squires Co., The C. E., E. 40th St. and Kelley Ave., Cleveland, Ohio.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
Templeton Mfg. Co., Business St. and Glenwood Ave., Hyde Park, Mass. "Sterling."
Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tyler's."
Walworth Mfg. Co., Boston, Mass.
Watson & McDaniel Co., 150 N. 7th St., Philadelphia, Pa. "McDaniel."
Watts Regulator Co., 252 Lowell St., Lawrence, Mass. "Lawrence."
Williams Valve Co., The D. T., Cincinnati, Ohio. "Cookson."
Wright-Austin Co., Detroit, Mich. "Victor", "Emergency."

TRAPS, VACUUM.—Vacuum traps are used on low-pressure or vacuum return steam piping systems, such as heating systems, to keep the system free from air and to drain off condensation. One type of trap operates in response to the action of thermal members, which open or close a valve by expansion or contraction. When air is present the member contracts and allows the air to escape, but when the steam comes, the expansion causes the valve to close tightly. When the steam condenses the thermal member opens the trap and the condensation passes into a return piping system.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Chicago Engineer Supply Co., 68 W. Lake St., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Marsh & Co., James P., 114-124 S. Clinton St., Chicago, Ill.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
Page Boiler Co., 815-819 Larrabee St., Chicago, Ill. "Aaball."
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
Templeton Mfg. Co., Business St. and Glenwood Ave., Hyde Park, Mass. "Sterling."

TRASCO.—Trade name for guard rail clamps, joints, braces, and other track specialties manufactured by the Track Specialties Co., Inc., 29 Broadway, New York, N. Y.

TRASH RACKS.—Trash racks are an important appendage to a hydraulic power plant. They are usually built of flat iron bars, from ¼ to ½ in. thick and 2 or 3 ins. wide, spaced 1½ or 2 ins. apart, with the flat sides parallel to the flow. They extend from above the head water level to the bottom of the forebay and are set at an angle of about 30° from the vertical, to facilitate cleaning with a rake. The purpose is to strain out floating matter which, if not removed at this point, would be carried into the turbines and might cause serious damage. It is necessary that these racks be strong enough to sustain the entire head of water, as the accumulation of matter may completely clog up the passage.

TRAVELER.—Trade name for automobile tires manufactured by the Traveler Rubber Co., Box 589, Bethlehem, Pa.

TRAVELER RUBBER CO.—Box 589, Bethlehem, Pa. Manufacturer of tires for electric vehicles and soft rubber products. Business established 1916. President, Gdela Rigaudiere; vice-presidents, Victor Durand, Jr.; G. J. P. Raub; secretary and treasurer, E. E. Pollard; sales manager, John J. Lamond. Branch Office, 819 N. Broad St., Philadelphia, Pa.

TRAYS, STORAGE BATTERY.—These trays are used to hold a set of cells in electric vehicles and trucks. They are wooden crate-like boxes, usually impregnated with paraffin or coated with an acid-resisting paint or enamel and provided with strong handles for carrying and pulling the box from its compartment. Terminals for the set of cells within the tray are usually mounted on one end of the tray. These trays differ from battery boxes in that the sides usually consist of horizontal slats instead of solid boards.

Manufacturer:

Electric Storage Battery Co., The, 19th St. and Allegheny Ave., Philadelphia, Pa.

T. R. B.—Trade name for lighting fixtures manufactured by the Mitchell Vance Co., Inc., 503-511 W. 24th St., New York, N. Y.

TREADS, FLOOR, CONTACT-MAKING.—See Floor treads, contact-making.

TREADS, SAFETY, FOR CAR STEPS, STAIRWAYS, ETC.—Safety treads are strips of antislip material which are placed on the treads of car steps and stairways and at the places where there is danger of persons losing their footing by reason of slippery walking surface. Safety treads are made of a variety of materials, such as metal with lead inserts, metal with abrasive inserts, metal with the antislip material cast integral, paper with abrasive surface, cast or rolled metal with numerous raised portions having gripping edges, etc. All types have been tried and are successfully used. A safety tread should retain its antislip qualities throughout its wearing life and should not break because of weight carried or action of the elements. Such treads are a necessary part of the equipment of all cars and greatly minimize accidents on car steps. Likewise on stairways safety treads reduce accidents materially and are a good investment. On stairways that are likely to be wet or slippery from any other cause they should be insisted on.

Manufacturers:

American Abrasive Metals Co., Hudson Terminal Bldg., New York, N. Y. "Feralun."
American Mason Safety Tread Co., 125 Perry St., Lowell, Mass. "Mason."
Irving Iron Works Co., Long Island City, N. Y.
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
Norton Co., Worcester, Mass.
Stanwood Equipment Co., 308 N. Michigan Ave., Chicago, Ill.
Universal Safety Tread Co., 40 Court St., Boston, Mass. "Universal."
Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

TREADWELL CONSTRUCTION CO.—Midland, Pa. Manufacturer of smoke stacks, tanks, penstocks, etc. President, J. H. Killinger; vice-president and general manager, A. A. Neave; secretary and treasurer, W. I. Gassert; sales manager, A. J. McVay.

TREAT 'EM ROUGH.—Trade name for tanks manufactured by the Fabricated Steel Products Corp., Leetonia, Ohio.

TRECO.—Trade name for electric whistles manufactured by the Russell Electric Co., Danbury, Conn.

TREE TRIMMERS OR PRUNERS.—These are tools often used by linemen and maintenance men in stringing or caring for lines in suburbs or other districts where branches of trees are in the way. They consist of a pair of heavy pruning shears or a special knife consisting of a movable blade and fixed rest that is placed directly under the branch to be cut. The shears or knives are always mounted on a long pole so that the branches may be reached from the ground. They are used only for small branches, the larger ones being cut by saws. See Saws, pruning.

Manufacturers:

Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
BUSH ELECTRIC CO., THE, 6654 Broadway, Cleveland, Ohio.
Cronk & Carrier Mfg. Co., The, 109 W. Water St., Elmira, N. Y.
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. Klein's "Favorite" tree trimmers are made with malleable iron heads with crucible steel knife integral with lever. Will cut one inch branch, has two threaded holes for attaching saw. Furnished with or without saw. For illustrations of this and other Klein products, see page 1259. Also write for complete catalog of construction tools.—Adv.
OSHKOSH MFG. CO., Oshkosh, Wis. "Oshkosh." (See display adv. page 1253.)
Peck, Stow & Wilcox Co., The, Southington Conn., "Pexto."
Rochester Rotary Washer Co., 87 Franklin St., Rochester, N. Y.

TREMONT.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TREMONT PRODUCTS CO.—216 High St., Boston, Mass. Manufacturer of sockets and switches. Manager, R. D. Smith.

TRENLE PORCELAIN CO., THE.—P. O. Box 493, East Liverpool, Ohio. Manufacturer of porcelain knobs, tubes and cleats. Business established 1893. President, G. A. Trenle; vice-president, H. D. Brookman; secretary-treasurer, H. W. Blake.

TRENTON ELECTRIC & CONDUIT CO.—Tyler and Canal Sts., Trenton, N. J. Manufacturer of fuses and other wiring devices. Business established 1912. President, Lambert Alpaugh; secretary, treasurer and general manager, Clifford J. Alpaugh. Sales representatives, Ohio Distributing Co., 222 Lomax Pl., Chicago, Ill.; A. W. Marshall Co., 213 E. Jefferson Ave., Detroit, Mich.; W. A. Leiser & Co., 1607 Sansom St., Philadelphia, Pa.; J. P. Lane, 811 Holland Bldg., St., Louis, Mo.; E. O. McDowell, 30 Church St., New York, N. Y.; W. T. McDowell, 50 Church St., New York, N. Y.; E. R. Bryant, 183 Congress St., Boston, Mass.

TRENTON MALLEABLE IRON CO.—Trenton, N. J. Manufacturer of malleable iron castings. E. D. Bloor, secretary.

TRENTON PORCELAIN CO.—803 E. State St., Trenton, N. J. Manufacturer of electrical porcelain products. President, B. H. Maguire; secretary and treasurer, George E. Maguire; sales manager, P. T. Bradley. Factories, New Brunswick and Trenton, N. J.

TRESCO.—1201 Kahl Bldg., Davenport, Iowa. Manufacturer of radio and telegraph equipment. Business established 1917. Secretary, Olga Schurr; general manager and sales manager, W. H. Kirwan. Factory, Clinton, Iowa.

TRI-COAT.—Trade name for cable insulation manufactured by the General Electric Co., Schenectady, N. Y.

TRI-PLEX.—Trade name for vacuum type electric washing machines made by the Tri-Plex Vacuum Electric Washing Machine Co., Inc., Pekin, Ill.

TRI-PLEX VACUUM ELECTRIC WASHING MACHINE CO., INC.—Pekin, Ill. Manufacturer of electric washing machines. Business established 1919. President and general manager, Peter W. Schrock; vice-president and sales manager, C. H. Ropp; secretary and treasurer, E. M. Dirksen.

TRI-STATE WATER AND LIGHT ASSOCIATION.—Secretary-treasurer, W. F. Stieglitz, Columbia, S. C.

TRIANGLE.—Trade name for lightning arresters manufacturer by J. H. Bunnell & Co., 32 Park Pl., New York, N. Y.

TRIANGLE.—Trade name for lubricating oils manufactured by the Ohio Grease Co., Loudonville, Ohio.

When writing to manufacturers please mention the

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RIANGLE.—Trade name for flexible is manufactured by the Triangle Con- Co., 50-52 Columbia Heights, Brooklyn, Y.

RIANGLE.—Trade name for flashlights, eries and Christmas tree lighting out- manufactured by the Triangle Electro ding Co., 79 Chambers St., New York, Y.

RIANGLE CHANDELIER MFG. CO.— Ravenswood Av., Chicago, Ill. Manu- urer of electric lighting fixtures.

IANGLE CONDUIT CO.—50-52 Co- ia heights, Brooklin, N. Y. Manufac- of flexible nonmetallic conduit and . Business established 1916. Presi- James R. Strong; vice-president and manager, V. C. Gilpin; treasurer and al manager, J. E. McAuliffe. Sales sentatives, A. D. Stein, Boston, Mass.; Gilpin Co., New York, N. Y.; W. A. r Co., Philadelphia, Pa.; Gordon D. n, Chicago, Ill.; George A. Gray Co., Francisco, Cal.; Alex H. Hibbard, er, Colo.; Moncrief H. Smith, St. , Mo.; Southern Jobbers Supply Co., Orleans, La.; R. S. Wakefield, Dal- Tex.; Walker Lilly Electrical Supply Louisville, Ky.; W. P. Ambos Co., and, Ohio.

ANGLE ELECTRO TRADING CO.— hambers St., New York, N. Y. facturer of flashlights, flashlight bat- and Christmas tree lighting outfits. ess established 1916. President and l manager, Bernard Berwick; vice- ent and sales manager, J. W. Ber- secretary, A. Werner; treasurer, A. nano.

ANGLE LEKTRIK.—The name for food warmer manufactured by the an Electrical Heater Co., Wood- Burroughs and Cass Aves., Detroit,

NGLE WOOD SPECIALTY CO., 1347 W. Madison St., Chicago, Ill. cturer of portable electric lamps p bases. Business established 1920. nt, Louis Goldberg; vice-president, Ettinger; secretary, treasurer and anager, S. M. Ettinger.

O.—Trade name for fuses manu- l by the Trico Fuse Mfg. Co., 1009 ng Ave., Milwaukee, Wis. Exclu- tributor, M. B. Austin Co., 700 Blvd., Chicago, Ill.

FUSE MFG. CO.—1009 Coldspring ilwaukee, Wis. Manufacturer of Business established 1917. Presi- C. Guttenstein; vice-president, S. enstein; secretary, treasurer and manager, O. H. Jung.

RD.—Trade name for portable nufactured by the Triangle Con- 50-52 Columbia Heights, Brook- Y.

NT.—Trade name for guy clamps ured by the Diamond Expan- Co., 90 West St., New York, N. Y.

NT.—Trade name for air, water ric meters manufactured by the Meter Co., 50 E. 42nd St., New Y.

NT.—Trade name for duct rods, s and vises manufactured by the Chain Forge & Iron Co., 90 West York, N. Y.

T.—Trade name for flexible non- conduit manufactured by the Conduit Co., 50-52 Columbia Brooklyn, N. Y.

R-LOCK.—Trade name for con- ers manufactured by the Russell 14-818 Bath Ave., Niagara Falls,

NDICATOR CO., THE.—Corry, acturer of engine indicators.

ASTENERS.—Metal fittings de- securing and alining the mats flush or surface cutout or switch r panelboards.

urer:

HINDS CO., Wolf and 7th ts., Syracuse, N. Y. "Conduiet."

IETER PROTECTIVE.—These metal enclosures of special de- apt them to various types of enclosed switches. They are ver the connections from the tch to the meter to prevent pering with the connections or wires.

Manufacturers:

Metropolitan Engineering Co. of Canada, Ltd., 90 Sherbourne St., Toronto, Ont., Can.

SQUARE D CO., 1400 Rivard St., Detroit, Mich. "Square D." (See display adv. pages 1279-1281.)

TRIMO.—Trade name for wrenches and pipe cutters manufactured by the Trimont Mfg. Co., 55-71 Amory St., Roxbury, Mass.

TRIMONT MFG. CO.—55-71 Amory St., Roxbury, Mass. Manufacturer of wrenches and pipe cutters. President, Alfred G. Ely; secretary, W. T. H. Salter; treasurer, Charles C. Ely.

TRIO.—Trade name for die stocks manufactured by the Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass., and the Greenfield Tap & Die Corp. of Canada, Ltd., Front and York Pl., Galt, Ont., Can.

TRIODE.—Trade name for electron tubes manufactured by the Wireless Specialty Apparatus Co., C and Fargo Sts., Boston, Mass.

TRIPLE DIAMOND.—Trade name for pliers, screw drivers, spark plugs and wrenches manufactured by the Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill.

TRIPLE LABEL PRINCE'S.—Trade name for protective paint manufactured by the Atlas Mineral Products Co., Mertztown, Pa.

TRIPLEX.—Trade name for transmission line structures manufactured by the Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.

TRIPLEX.—Trade name for buffing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

TRIPLEX.—Trade name for electric heaters, fans and driers manufactured by the Thermo-Fan Electric Co., Inc., 2 Columbus Circle, New York, N. Y. (Exclusive distributor, S. O. S. Electric Sales Co., 2 Columbus Circle, New York, N. Y.)

TRIPOD.—Trade name for fixture hangers manufactured by the Fairmount Electric & Mfg. Co., 59th and Woodland Ave., Philadelphia, Pa.

TRIPP.—Trade name for metallic packing for pistons and valve stems of stationary and marine engines, pumps, etc., made by William B. Merrill & Co., 3368 Washington St., Boston, Mass.

TRITON.—Trade name for insulated wire and cable made by the Atlantic Insulated Wire & Cable Co., 52 Vanderbilt Ave., New York, N. Y.

TRITON.—Trade name for electric furnace steel manufactured by the Hammond Steel Co., 2600 Milton Ave., Syracuse, N. Y.

TRIUMPH.—Trade name for arc lamp chains manufactured by the Bridgeport Chain Co., Bridgeport, Conn.

TRIUMPH.—Trade name for asbestos gaskets manufactured by the Goetze Gasket & Packing Co., Georges Road, New Brunswick, N. J.

TRIUMPH.—Trade name for stereopticons manufactured by the McIntosh Stereopticon Co., 30 E. Randolph St., Chicago, Ill.

TRIUMPH—Trade name for belt dressing manufactured by George Rahmann & Co., 31 Spruce St., New York, N. Y.

TRIUMPH.—Trade name for generators and motors manufactured by the Triumph Electric Co., 3058 South St., Cincinnati, O.

TRIUMPH.—Trade name for motor-driven ice making and refrigerating machines manufactured by the Triumph Ice Machine Co., 3058 South St., Cincinnati, O.

TRIUMPH ELECTRIC CO., THE.—Cincinnati, Ohio. Manufacturer of motors and generators. Business established 1889. President, J. C. Hobart; vice-president, Graham P. Hunt; secretary, J. S. Louis; sales manager, C. E. Winchell. Main office, 3058 South St., Cincinnati, Ohio. Branch offices, 704 Old South Bldg., Boston, Mass.; 628 W. Lake St., Chicago, Ill.; 11 Wade Bldg., Cleveland, Ohio; 80 Cortlandt St., New York, N. Y.; 1121 Liberty Bldg., Philadelphia, Pa.; 712-713 Ferguson Bldg., Pittsburgh, Pa.; 1310 Seattle Blvd., Seattle, Wash. Sales representatives, Kingsbury-Samuel Electric Co., 213 N. Calvert St., Baltimore, Md.; L. E. Coast, 751 Ellicott Sq., Buffalo, N. Y.; W. C. Teas Co., 116 E. 8th St., Chattanooga, Tenn.; Reeves Machinery Co., 17 E. Rich St., Columbus, Ohio; Gus Sachs, 408 S. Ervay St., Dallas, Tex.; W. H. Snyder, 1247 Highland Ave., Dayton, Ohio; Edwin E. Curry, 1156 7th St., Denver, Colo.; E. S. Player, Masonic Temple, Greenville, S. C.; Wente Electric Co., 801 S. Broadway, Hamilton, Ohio; Barden Electric & Machinery Co., 111 Main St., Houston, Tex.; Electrical Sales Co., Kenyon Bldg., Louisville, Ky.; Sterling Electric Co., 33 S. 5th St., Minneapolis, Minn.; W. A. Taylor, 841 Carondelet St., New Orleans, La.; Norton Machinery & Supply Co., Norton, Va.; R. T. Lyons Engineering Co., 801 S. Broadway, Oklahoma City, Okla.; H. F. Watkins Co., 268 Market St., San Francisco, Cal.; Wood & Lane, 915 Olive St., St. Louis, Mo.; Joseph L. Sheldon Engineering Co., 931 Nichols Bldg., Toledo, Ohio; C. A. Hubly, Oke Bldg., St. Johns, Newfoundland; Rudel-Belnap Machinery Co., Ltd., 95 McGill St., Montreal, Que.; Marchand Electrical Co., 128½ Sparks St., Ottawa, Ont.

TRIUMPH ICE MACHINE CO.—Cincinnati, Ohio. Manufacturer of motor-driven ice making and refrigerating machines. Business established 1889. President, J. C. Hobart; vice-president, Graham Hunt; secretary, J. S. Louis; sales manager, C. P. Wood. Main office, 3058 South St., Cincinnati, Ohio. Branch offices, 912 Healey Bldg., Atlanta, Ga.; 628 W. Lake St., Chicago, Ill.; 1265 S. High St., Columbus, Ohio; 209 W. Jefferson St., Louisville, Ky.; 605 Baronne St., New Orleans, La.; P. O. Box 917, Oklahoma City, Okla.; 712 Forguson Bldg., Pttsburgh, Pa. Sales representatives, Kanawha Engineering Co., Inc., Virginian Land Bank Bldg., Charleston, W. Va.; Karl S. Kuehn Co., 300 Builders Exchange, Minneapolis, Minn.; Pennsylvania Engineering Co., 1119 N. Howard St., Philadelphia, Pa.; H. F. Watkins Co., Hansford Bldg., San Francisco, Cal.; Northwest Ice Machine Co., 1310 Seattle Blvd., Seattle, Wash.

TRIUMPH LAMP WORKS.—Union Hill, N. J. Manufacturers of tungsten incandescent lamps.

TRIVOLT.—Trade name for bell-ringing transformers manufactured by the Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

TRI-VOLT.—Trade name for bell-ringing transformers manufactured by the Jefferson Electric Mfg. Co., 426-430 S. Green St., Chicago, Ill.

TROEMNER, HENRY.—911 Arch St., Philadelphia, Pa. Manufacturer of electric grinders, chemical balances, scales, etc. Business established 1840.

TROJAN.—Trade name for wet batteries manufactured by the Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.

TROJAN.—Trade name for electric washing machines made by the Hogan-Spencer-Whitley Co., 1052 W. 12th St., Erie, Pa.

TROJAN.—Trade name for commercial lighting fixture manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

TROJAN.—Trade name for electric washing machines manufactured by McDonald & Wilson, Ltd., 347 Yonge St., Toronto, Ont., Can.

TROJAN.—Trade name for wet batteries manufactured by the National Carbon Co., Inc., Highland and Madison Aves., Cleveland, Ohio.

TROJAN.—Trade name for tinners' shears manufactured by the Peck, Stow & Wilcox Co., Southington, Conn.

TROJAN ELECTRIC STEEL CO.—3401 S. Hoyne Ave., Chicago, Ill. Manufacturer of electric furnace steel and alloy steels. President, W. F. Aldrich; vice-president, Charles J. Farwell; secretary and general manager, E. G. Lilly.

TROLLEY BASES.—See Bases, trolley (car roof).

TROLLEY BRACKETS, POLE.—See Brackets, trolley suspension.

TROLLEY CATCHERS AND RETRIEVERS.—See Catchers, and retrievers, trolley.

TROLLEY CLAMPS (CROSSING).—See Clamps, trolley crossing.

TROLLEY CROSSINGS.—See Crossings, trolley.

TROLLEY EARS.—See Ears, trolley, clamping and clinch; Ears, trolley, feeder and strain; Ears, trolley, splicing and soldered.

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TROLLEY FROGS.—See Frogs, trolley.

TROLLEY GUARDS (WHEEL).—See Guards, trolley wheel.

TROLLEY HARPS.—See Harps, trolley.

TROLLEY INSULATORS.—See Insulators, strain, trolley.

TROLLEY PICKUPS.—See Pickups, trolley wire.

TROLLEY POLES (CAR).—See Poles, trolley wheel carrying.

TROLLEY POLES (IRON AND STEEL).—See Poles, iron and steel, tubular.

TROLLEY POLES (WOOD).—See Poles, cedar, treated; Poles, cedar, untreated; Poles, chestnut, pine, etc.; treated; Poles chestnut, pine, etc., untreated.

TROLLEY SLEET CUTTERS.—See sleet cutters, trolley wire.

TROLLEY SLEEVES (SPLICING).—See Sleeves, trolley wire, splicing.

TROLLEY SPRINGS (BASE).—See Springs, trolley base.

TROLLEY SUPPLY CO., THE.—Massillon, Ohio. Manufacturer of trolley car equipment. Business established 1903. President and treasurer, J. E. McLain; secretary, H. K. Fenwick.

TROLLEY SUSPENSIONS.—See Catenary hangers; Hangers, trolley wire; Suspensions, trolley wire, mine.

TROLLEY SWITCHES.—See Switches, trolley.

TROLLEY WHEELS.—See Wheels, trolley.

TROLLEY WIRE.—See Wire, trolley.

TROPHY.—Trade name for oil cups manufactured by the D. T. Williams Valve Co., Cincinnati, Ohio.

TROTTER & CO., E. T.—576-602 Johnson Ave., Brooklyn, N. Y. Manufacturer of insulating compounds.

TROTTERS.—Trade name for commutator lubricating compounds manufactured by the James Goldmark Co., 83 Warren St., New York, N. Y.

TROUBLE BELLS, FIRE ALARM.—See Bells, trouble, for fire alarm systems.

TROUBLE FINDERS.—See testing sets, portable, exploring coil type.

TROUBLE LAMPS.—See Lamps, hand, inspection, extension or trouble.

TROUBLE SHOOTING.—The work of hunting for the cause of trouble. It often involves the repair work as well. This term is most widely applied to telephone circuits.

TROUBLE, TELEPHONE, DOUBLE NUMBER.—This is caused by the inability of one telephone to call a certain other telephone. Formerly called "can't raise."

TROY ENGINE & MACHINE CO.—Troy, Pa. Manufacturer of steam engines. Business established 1890. President, John A. Parsons; vice-president, T. W. Parsons; secretary, A. R. McMahan; treasurer, W. H. Parsons.

TRUCKS, ELECTRIC LOCOMOTIVE.—Trucks for locomotive work are in a general way similar to the electric railway car trucks described below, except that not all of the same types can be used and locomotive trucks are much heavier. Much study and experimentation has been conducted in the effort to improve the riding qualities of the locomotive and minimize its lateral thrust on the truck. One type that is suitable for low-speed locomotives is called the rigid-bolster type. The cross piece or bolster which carries the weight of the cab is solidly fastened to the side frames and forms an integral part of them. The spring suspension for the superstructure is sustained by means of box springs placed between the side frames and the journal boxes. These springs may be of semielliptic or spiral type. The disadvantage of this type is that it offers no compensation for the swaying of the superstructure. The swinging-bolster construction is used for some high-speed work. This comprises a movable bolster traveling in a guide or transom, mounted upon elliptic springs. The elliptic springs rest in a saddle hung from the transom or side-frame construction in such a manner that opportunity is provided for a transverse swing of the superstructure. This allows it to swing or roll when rounding curves and offers an easy riding truck for high-speed service. Special guide wheels are often provided at the front and rear of the locomotive.

Manufacturers:

Brill Co., The J. G., 62nd St., and Woodland Ave., Philadelphia, Pa.
Cowan Truck Co., Dorchester, Mass. "Universal."
Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.
McGuire-Cummings Mfg. Co., 111 W. Monroe St., Chicago, Ill.
Yale & Towne Mfg. Co., Stamford, Conn. "Yale."

TRUCKS, ELECTRIC, OR STORAGE BATTERY, HEAVY-DUTY.—These trucks are made in sizes up to 5 tons and are extensively used for all kinds of haulage, chiefly in the larger cities where the congested traffic makes many stops necessary and gives this method of hauling superior economy. These trucks have also been used for long hauls, but their employment for such service is exceptional. They are used for delivery service, particularly for heavy loads, such as ice, coal, steel, baggage, construction material, etc. In hauling and delivery service through or in business districts it has been found that these trucks will make the trip as rapidly as the gasoline-driven trucks.

Manufacturers:

Atlantic Electric Vehicle Co., 893 Freylinghuysen Ave., Newark, N. J. "Atlantic."
Blair Motor Truck Co., Newark, Ohio.
Brill Co., The J. G., 62nd St. and Woodland Ave., Philadelphia, Pa.
Commercial Truck Co. of America, 5th St. and Hunting Park, Philadelphia, Pa. "C-T."
Couple-Gear Freight-Wheel Co., 1450 Buchanan Ave., S. W., Grand Rapids, Mich.
Cowan Truck Co., Dorchester, Mass. "Universal."
Ehrlich Electric Truck Co., 839 W. Lake St., Chicago, Ill. "Ehrlich."
Eldridge Mfg. Co., Boston, Mass.
Fritchle Electric Co., Denver, Colo.
Industrial Truck Co., Division of Cowan Truck Co., Holyoke, Mass. "I.T.C."
Lancashire Dynamo & Motor Co. of Canada, Ltd., 45 Niagara St., Toronto, Ont., Can.
Lansden Co., Inc., The, Danbury, Conn. "Lansden."
Oneida Motor Truck Co., Green Bay, Wis. "Oneida."
Terminal Engineering Co., Inc., 17 W. 44th St., New York, N. Y. "Tec."
WALKER VEHICLE CO., 87th and State Sts., Chicago, Ill. "Walker." (See display adv. page 1326.)
Ward Motor Vehicle Co., S. Fulton Ave., Mt. Vernon, N. Y. "Ward Electric."
Yale & Towne Mfg. Co., Stamford, Conn. "Yale."

TRUCKS, ELECTRIC RAILWAY CAR.—Trucks are the "running gear" of electric railway cars, and in order to facilitate repairs are removable from the car body. They carry the weight of the car body, absorb road shock and vibration, and support the electric motors which propel the cars, when used under motor cars. They consist of a unit assembly of framework to maintain the various parts in proper relation to each other, members to transmit the weight of the car body to the framework, springs to absorb shock and vibration, journal or oil boxes, axles and wheels. Some types of trucks have additional members interposed between the framework and the journal boxes to provide a different means of taking up road shock.

Trucks as a general class are of two types, known as "single trucks" and "double trucks." Single trucks have four wheels, i. e., two axles and the axles are separated as far as possible consistent with the ability of the truck to negotiate curves. On trucks of this type, wherein the axles are maintained parallel to each other, the distance between them, called wheel base, is a maximum of about 9 ft. with wheels 24 to 33 ins. in diameter, having the usual flange, and where short-radius curves exist as in street railway systems. The difficulty of designing this kind of single truck so as to overcome galloping action when carrying long car bodies has limited the length of cars for such trucks to about 33 to 35 ft. as a maximum. Another type of single or four-wheel truck is that having axles which can take other than parallel relations with respect to each other; these are called nonparallel-axle or radial trucks. In such trucks the journal boxes are so connected to the main frame, or the axles are connected together in such a manner, that the pressure against the wheel flanges on entering a curve causes the axles to take nonparallel positions with respect to each other. The wheel base of such trucks may be from 12 to 15 ft. and car bodies up to about 40 ft. in length have been mounted and operated on them. They have not as yet come into general use.

The traffic requirements of many electric railways, including all elevated, subway and nearly all interurban and suburban and many street-railway systems, are such that large cars, i. e., those 40 ft. and over in length, are required for economically handling the business. To carry the cars on such systems around the curves, which of necessity have short radii compared to steam-railway practice, two four-wheel trucks are required. Trucks operating under such conditions are called double trucks. They are classified as trailer trucks (those without motors) and motor trucks (those having motors mounted on them). All double trucks are characterized by a pivotal mounting with respect to the car body, by means of a fitting called a center plate, fixed at or near the lateral and longitudinal center of the truck. Thus the trucks enable the car to pass around curves in the track. Side bearings are essential features of double trucks and limit the rolling motion of the car body due to uneven track and when rounding curves.

Motor trucks are of several designs according to the mounting of the motors, i. e., whether they are inside hung or outside hung. When the motors are placed between axles of a truck they are said to be "inside hung" and when placed on the axle farthest from the center of the truck they are said to be "outside hung." Another design of motor truck known as the "maximum traction" type is in quite extensive use on street-railway systems. In this type of truck there are two large driving wheels and two smaller idler or guiding wheels. The driving motor is mounted on the axle of the larger wheels and the weight of the car body is transmitted to the frame of the truck and thence to the wheels at a point as near to the driving wheels as practicable so that the "traction" on the driving wheels is a maximum—hence the name. In trucks of this type there are two motors per car, one per truck, and the weight on the driving wheels will be from about 60% to about 70% of the total weight of the car body. If two ordinary four-wheel trucks where the load is carried at the center were used under a car with one motor on each, the weight on the driving wheels would, of course, be only slightly over 50% of the total weight of the car body. The wheel base of double trucks varies from a minimum of about 4 ft. in street-railway trailer trucks to about 7 ft. and over in heavy interurban electric and suburban-car motor trucks. The wheel base of motor trucks is determined largely by the method of mounting the motors, i. e., whether inside or outside hung.

Manufacturers:

Brill Co., The J. G., 62nd St. and Woodland Ave., Philadelphia, Pa.
Hunt Co., Inc., C. W., 1580 Richmond Terrace, West New Brighton, N. Y.
McGuire-Cummings Mfg. Co., 111 W. Monroe St., Chicago, Ill.
Oneida Motor Truck Co., Green Bay, Wis. "Oneida."
Taylor Electric Truck Co., Troy, N. Y.

TRUCKS, STORAGE BATTERY, BAGGAGE AND INDUSTRIAL.—The cost of interior handling of material and merchandise in large industrial plants, railway stations, docks, etc., has always been high because of the high cost of the necessary labor. Within recent years material-handling equipment has come into use which has resulted in a substantial reduction of this cost. Industrial electric trucks have been among the most important contributions to this line of equipment. Their flexibility of operation has given them a considerable advantage over other methods of hauling. They are commonly used for hauling baggage, mail and other material from an unloading point to the storage rooms (or the reverse) at terminals, docks, and storage warehouses, or for moving material between departments in factories and especially in large industrial plants.

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ir construction and control in the com- types is simple, consisting of a low- nted truck containing the battery box motor and a steering lever and motor rol usually mounted on a step provided the operator at either the front or rear e truck. For various special purposes type is modified, as for automatic or loading and unloading, or for an ele- g truck to be used in piling materials connection with a lift-truck storage m. These trucks are also made to be as both trucks and tractors. Also Tractors, electric.

nufacturers:

tomatic Transportation Co., 2933 Main t., Buffalo, N. Y. "Automatic."
ker, R. & L. Co., Cleveland, Ohio. BRL."
ll Co., The J. G., 62nd St. and Wood- nd Ave., Philadelphia, Pa.
la Co., The, Harvey, Ill.
ple-Gear Freight-Wheel Co., 1450 hanan Ave., S. W., Grand Rapids, ich.
an Truck Co., Dorchester, Mass. Universal."
cent Truck Co., The, 30 Church St., w York, N. Y.
ll-Parker Electric Co., 4223 St. air Ave., N. E., Cleveland, Ohio. llwell."
gland-Thayer, Inc., 300 Washington , Newark, N. J.
strial Truck Co., Division of Cowan ck Co., Holyoke, Mass. "I. T. C."
y-Lode Industrial Co., Inc., 100 Na- al Ave., Long Island City, N. Y.
el Industrial Car & Equipment Co., opel, Pa. "Electromobile."
wood Engineering Co., Cleveland, o "Tier-Lift."
ire-Cummings Mfg. Co., 111 W. iroe St., Chicago, Ill. (Industrial.)
a Motor Truck Co., Green Bay, . "Oneida."
Carrier Co., Benton Harbor, Mich. oss" electric lumber carrier.)
metz Electric Motor Car Corp., ngton, Baltimore, Md. "Steinmetz."
nal Engineering Co., Inc., 17 W. St., New York, N. Y. "Tec."
Towne Mfg. Co., Stamford, Conn. e."

A.—Trade name for color-match- ctors manufactured by the Na- -Ray Reflector Co., 235 W. Jackson hicago, Ill.

ALIGHT.—Trade name for color- reflectors manufactured by the X-Ray Reflector Co., 235 W. Jack- l., Chicago, Ill.

)GE.—Trade name for grinding ssers manufactured by the Chal- chine Co., Inc., 5116 Springfield ladelphia, Pa.

)ULL ELECTRIC MFG. CO., ainville, Conn. Manufacturer of and wiring devices. President, rumbull; vice-president, F. T. secretary, S. S. Gwillim; treas- ry Trumbull; sales manager, L. w. Main office, Plainville, Conn. Plainville, Conn. and Trenton, anch offices and warehouses, 14 St., Chicago, Ill. and 595 Mis- ian Francisco, Call. District of- iberty St., New York, N. Y.

ULL-VANDERPOEL ELECTRIC —Bantam, Conn. Manufacturer switches and conduit boxes.

K I N G.—The arrangement of ich tie together the parts of a switchboard or exchange. In a exchange, it consists of the which tie together the offices, which a subscriber talks when connection with another sub- ose line is attached to another an automatic exchange there unk lines which link together switches, such as first select- l selectors, connectors, etc. A trunking scheme gives an in- he underlying structure.

The general scheme or plan by which the parts of an exchange or the parts of an office are linked together, is known as the trunking plan. In an automatic system, the trunking plan consists of groups of automatic switches linked together by groups of trunks. A trunk holder is a device sometimes used in automatic telephony to ground the release trunk on an outgoing call so that the third wire will not need to be carried to the distant office. This is when offices are close together. It employs a series line relay, from which it is sometimes called a "series repeater", although it does not act as a repeater at all.

Several kinds of trunks are used in both manual and automatic telephony. One of these is the individual trunk. This is a trunk in an automatic exchange which is available to a few selectors, while the rest of the trunks are in a group which is accessible to a large number of selectors. The individual trunk is always placed on the first contact of the level in the selector bank so that it will be occupied before common trunks are taken. It is a trunking device to relieve a group of trunks which has too much traffic. Sometimes there is more than one individual trunk. Another kind is the intercepting trunk. These are trunks which intercept telephone calls which are going astray. They are subdivided into dead-level trunks, and dead-number trunks. Release trunks are also used in automatic systems. These are the third wire of an automatic trunk and correspond to the sleeve wire of a manual trunk. It is carried by the private bank and private wiper. Toll service trunks are trunks from the toll board to the local switchboard over which the toll operator calls the subscriber and over which the toll connection is set up.

TRU-TINT.—Trade name for photoengraving and color matching lamps manufactured by the Nela Specialties Division of the National Lamp Works of General Electric Co., Nela Park, Cleveland, Ohio.

TUBES, BOILER.—See Boiler tubes.

TUBES, ENTRANCE.—See Bushings, high-tension entrance.

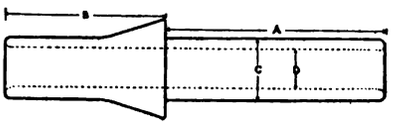
TUBES, GLASS, FLOOR.—Insulating tubes to protect electric conductors where passing through floors, etc., in open wiring systems. They are not used as much as porcelain tubes for this purpose.

TUBES, PAPER.—See Sleeves, paper, for cable conductors.

TUBES, PORCELAIN.—Tubes of unglazed porcelain in varying lengths and provided with an enlarged end. They are used for insulating electric conductors when passing through joists, studs, floor beams, etc. Porcelain tubes are very widely used in knob-and-tube and in open wiring systems.

Manufacturers:

American Porcelain Co., The, East Liverpool, Ohio.
Brunt Porcelain Co., The, P. O. Box 493, Columbus, Ohio. "Brunt."
Canadian Porcelain Co., Ltd., Hamilton, Ont., Can.
Colonial Sign & Insulator Co., Akron, Ohio.
Davidson Porcelain Co., East Liverpool, Ohio.
ELECTRICAL DEVELOPMENT & MACHINE CO., 221 N. 23rd St., Philadelphia, Pa. "Franklin." (See display adv. page 1260.)
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Findlay Electric Porcelain Co., The, Findlay, Ohio.
General Devices & Fittings Co., 441-443 S. Desplaines St., Chicago, Ill.
ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Ill. Manufacturer of electrical porcelain including a complete line of standard porcelain tubes—all kinds and sizes—unglazed, glazed, split, crossover and floor tubes. For further information write for our catalog and see other porcelain classifications and advertising page 1301.—Adv.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Mogadore Insulator Co., The, Mogadore, Ohio.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
PARKER & SON, INC., J. H., Parkersburg, W. Va. Porcelain tubes in all standard sizes and types. Floortubes,



Porcelain Tube

cross-over tubes and headless tubes, split tubes and special shapes and sizes. Curved and curved end tubes are of solid construction only.—Adv.
Southern Electrical Porcelain Co., Inc., Erwin, Tenn.
Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."
Trenle Porcelain Co., The, P. O. Box 493, East Liverpool, Ohio.
Trenton Porcelain Co., 803 E. State St., Trenton, N. J.
Ward Electric Co., Inc., 1411 Walnut St., Philadelphia, Pa.
Wheeling Tile Co., Wheeling, W. Va.

TUBES, PYROMETER.—See Pyrometer tubes.

TUBES, SPEAKING. — See Speaking tubes, flexible; Speaking tubes, rigid.

TUBES, SPLIT.—Insulating tubes usually of porcelain, made in two parts to facilitate assembly on electric conductors in open wiring for crossovers, in joists, etc. They are largely used where the conductor is already in place and cannot be drawn through a one-piece tube.

Manufacturers:

Federal Porcelain Co., The, Carey, Ohio. "Fedco."
Findlay Electric Porcelain Co., The, Findlay, Ohio.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

TUBING, ASBESTOS. — See Asbestos tape, tubing, twine, yarn, etc.

TUBING, BRASS.—See Brass bars, sheets, rods, and tubing.

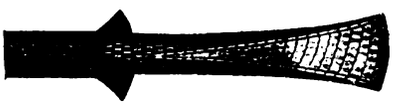
TUBING, COPPER.—See Copper sheets, rods, and tubing.

TUBING FIBER.—See Fiber sheet, rods, tubes and tubing.

TUBING, FLEXIBLE FABRIC OR NONMETALLIC CONDUIT.—Flexible woven fabric tubing having the outer surface saturated with a moisture-repelling compound and furnished in varying diameters and continuous lengths is used quite extensively for furnishing added insulation and mechanical protection to electric conductors, both in concealed and certain sections of open wiring. This form of tubing is known to the trade by several trade names, the most common of which is "loom." It is very useful in wiring finished houses, in wiring around machinery, on automobiles, etc., where a very flexible and nonmetallic conduit is desired.

Manufacturers:

Alphaduct Co., 136 Cator Ave., Jersey City, N. J. "Alphaduct", "Alphaloom."
AMERICAN CIRCULAR LOOM CO., 90 West St., New York, N. Y. "Circular Loom" flexible conduit is made of fibre cord interwoven with strong, tough, cotton yarn, producing a stiff, seamless interwoven wall. Covering this inner tubing is a spirally wound friction tape, over which tough cotton twine is woven. This woven, outer jacket is thoroughly treated with a moisture- and flame-proof compound. "Circular



Loomflex Flexible Conduit

Loom" is clean, light in weight, very flexible and offers the best obtainable fishing surface. It is tough, strong and substantial. It is supplied in 12 standard sizes with inside diameters of 3/8, 1/4, 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, 2 and 2 1/4 ins. "Loomflex," another flexible conduit, embodies a seamless, canvas-like inner tube formed of special fibre cord interwoven with cotton yarn. The

ing to manufacturers please mention the ECTRICAL YEAR BOOK

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interwoven insulating tubing is treated with a moisture- and flame-proof compound, over which is a braiding of light-weight but strong and tough cotton twine. This protective covering is also thoroughly compounded, making a final tubing which is double compounded and doubly efficient. "Loomflex" is easy to cut and fish, clean to handle, extremely flexible and light in weight. It repels moisture, retards combustion, and there is no waste, for it will stand almost any abuse to which it may be subjected. It is furnished in the same inside diameters as "Circular Loom" described above.—Adv.

American Metal Moulding Co., 141-145 New Jersey Railroad Ave., Newark, N. J. "American."
American Wiremold Co., 81-83 Woodbine St., Hartford, Conn. "Wireduct."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J. "Fle-X-Met."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
EASTERN TUBE & TOOL CO., INC., 594 Johnson Ave., Brooklyn, N. Y. "Brookduct", "Ettco."
Empire Mfg. Co., Lockport, N. Y.
Flexible Woven Cable Co., 170 Purchase St., Boston, Mass.
Johns-Manville, Inc., Madison Ave., and 41st St., New York, N. Y.
L. & N. Co., Ltd., The, St. Johns, Que., Can. "Insuladuct."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Flextube" nonmetallic conduit is double compounded, seamless, and interwoven. It is noncollapsible and inseparable and is clean and easy to work with under all conditions. Flextube will stand any amount of hard usage, it does not get brittle in cold, and every foot of every coil can be used. See display adv. pages 1302-4.—Adv.
Saylor Electric & Mfg. Co., 57 18th St., Wheeling, W. Va. "Saylorduct."
Short Electrical Mfg. Corp., Penn Yan, N. Y. "Pila Duct."
Standard Insulation Co., Rutherford, N. J. "Sico."
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triduct."
Tubular Woven Fabric Co., Main and Carver Sts., Pawtucket, R. I. "Duraduct."

TUBING, MICA COMPOSITION. — See cut, plate, rings, sheets, tubing.

TUBING, MICA COMPOSITION. — See Mica composition, sheet, tubing, etc.

TUBING, MISCELLANEOUS.—Tubing is often made of soft or hard rubber, fiber, glass or other insulating material and is used in general electrical practice for the insulation of single wires or groups of small wires. It is useful around machinery and other apparatus where vibration or mechanical injury would soon cause ordinary insulation to be damaged.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Breeze Metal Hose Mfg. Co., 22 Calumet St., Newark, N. J.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Ivins' Tube Works, Ellwood, Oak Lane, Philadelphia, Pa.
Johns-Manville, Inc., Madison Ave. and 41st St., New York, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Welding Co., The, W. 73rd and L. S. & M. S. Railroad, Cleveland, Ohio.
Triangle Conduit Co., 50-52 Columbia Heights, Brooklyn, N. Y. "Triangle."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

TUBING, RUBBER.—See Rubber, hard, rods, sheets, tubes, tubing, etc.; Rubber, soft, tubing, sheets, etc.

TUBING, STEEL, SEAMLESS, BUTTED, ETC.—This tubing of various types and diameters, thicknesses, etc., is much used in the electrical industry for framework for electric vehicles and many other supporting structures. It is also used to a limited extent for interior rigid conduit.

Manufacturers:

Mohegan Tube Co., The, Scott Ave. and Meserole St., Brooklyn, N. Y.
Pittsburgh Steel Tube Co., Beaver, Pa. Rome Mfg. Co., Rome, N. Y. "Rome."
Standard Welding Co., The, W. 73rd and L. S. & M. S. Railroad, Cleveland, O.

TUBING, VARNISHED FABRIC.—Sleeving for insulating purposes made of fabric and impregnated with a varnish or oil to increase its dielectric strength and to exclude moisture. It is used in various places for insulating conductors and portions of windings for coils, etc.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. "Irvington" tubing is flexible made of silk and cotton, in all colors. It is largely used in instrument work and also for insulating lead wires in coils and transformers. Tested to 6,000 volts. It can be furnished in all shades. See display adv. page 1319 for all Irvington electrical products.—Adv.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Mica Insulator Co., 68 Church St., New York, N. Y. "Empire."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "M-R."
Standard Insulation Co., Rutherford, N. J. "Sico."

TUBULAR PRODUCTS CO.—Box 336, Southington, Conn. Manufacturers of silver solder, etc. President, Samuel Munch; vice-president, Walter Weil; secretary, Edgar Weil; treasurer, B. S. Munch.

TUBULAR WOVEN FABRIC CO.—Pawtucket, R. I. Manufacturer of flexible nonmetallic conduit, flexible portable cord, cable and extension lamps. Business established 1911. President and treasurer, William H. Thornley; general manager, W. E. Spracklin; sales manager, H. N. Otis. Main office and factory, Main and Carver Sts., Pawtucket, R. I. Branch offices, 52 Vanderbilt Ave., New York, N. Y.; 549 W. Washington Blvd., Chicago, Ill.; 428 Penobscot Bldg., Detroit, Mich.; 548 Leader News Bldg., Cleveland, Ohio. Sales representatives, Allied Industries, Inc., 279 Minna St., San Francisco, Cal.; 340 Azusa St., Los Angeles, Cal., 1252 1st Ave., S., Seattle, Wash.; A. Hall Berry, 71 Murray St., New York, N. Y.

TUCKER, W. F. & C. F.—191 Franklin Ave., Hartford, Conn. Manufacturers of oiling devices and metal cutting shears. Business established 1900. C. F. Tucker, owner.

TUCKER MFG. CO.—118 Noble Ct., Cleveland, Ohio. Manufacturer of violet ray generators. Business established 1920. President and sales manager, H. A. Tucker; vice-president, F. P. Tucker; secretary, J. R. Tucker; treasurer, F. J. Tucker; general manager, C. S. Tucker.

TUFTEX.—Trade name for rope paper manufactured by the Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

TULC.—Trade name for lubricating oil manufactured by the Universal Lubricating Co., Schofield Bldg., Cleveland, Ohio.

TULIP.—Trade name for sign receptacles manufactured by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

TULITE.—Trade name for miniature double filament incandescent lamp manufactured by the Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J.

TUMBLER SWITCHES.—See Switches, toggle or tumbler, snap.

TUMBLING BARREL.—A barrel or box caused to revolve about an axis, in which metal parts to be electroplated or cleaned are tumbled together, the rubbing against one another giving a sort of polish. Sometimes sand is added and the result is much the same as a sand-blasting operation.

TUNERS, RADIO.—Radio tuners are devices used to produce electrical resonance in circuits of radio frequency in order that the oscillations induced in the receiver antenna may attain their maximum amplitude. Tuners generally consist of variable inductances, which are made in a number of forms. Variable condensers are also used as tuners. Also see Radio telegraph receiving apparatus.

Manufacturers:

American Radio & Research Corp., 21 Park Row, New York, N. Y.
Bowman & Co., A. W., 23 Church St., Cambridge, Mass. (Exclusive distributor, Franklin Sales Co., 25 N. Franklin, St., Chicago, Ill.)
Brooks, George B., 101 N. Main St., Providence, R. I.
Bunnell & Co., J. H., 32 Park Pl., New York, N. Y. "Bunnell."
Clapp-Eastham Co., 139 Main St., Cambridge, Mass.
De Forest Radio Telephone & Telegraph Co., 1415 Sedgwick Ave., New York, N. Y.
Eastern Precision Electrical Instrument Co., 68-71 Observer St., Rockville Centre, N. Y.
GREBE & CO., INC., A. H., 70 Van Wyck Blvd., Richmond Hill, N. H. "Grebe Radio."
Kennedy Co., The Colin B., 140 Second St., San Francisco, Cal.
Liberty Electric Corp., Port Chester, N. Y.
New Era Radio Sales Co., Elmira, N. Y. "Universal."
SIGNAL ELECTRIC MFG. CO., Menominee, Mich. "Signal."
Tresco, 1201 Kahl Bldg., Davenport, Iowa. "Hook'er To Yer Bulb."

TUNGAR.—Trade name for battery-charging rectifiers manufactured by the General Electric Co., Schenectady, N. Y.

TUNG-SOL.—Trade name for miniature incandescent lamps manufactured by the Miniature Incandescent Lamp Corp., 95 8th Ave., Newark, N. J.

TUNGSOL.—Trade name for incandescent vacuum lamps manufactured by the Independent Lamp & Wire Co., 1737 Broadway, New York, N. Y.

TUNGSTEN CONTACT POINTS.—See Points, contact and sparking, platinum, silver, tungsten, etc.

TUNGSTEN FILAMENTS.—See Filaments, incandescent lamp, tungsten.

TUNGSTEN LAMPS.—See Lamps, incandescent, tungsten, gas-filled; Lamps, incandescent, tungsten, vacuum.

TUNGSTEN METAL.—Tungsten is a hard gray metal. Its symbol is W; at. wt., 184.0; sp. gr. 18.85; m. p. 3100° C. Tungsten was formerly produced as a very hard, dark gray powder, and was used principally to produce the alloy known as ferro-tungsten. In 1910 a process was announced for the production of ductile tungsten by rolling, swaging or hammering a heated body of coherent tungsten until it becomes ductile at ordinary temperatures. Since that time it has come to be a very important metal in the electrical industry and is very extensively used in the manufacture of tungsten filaments for incandescent lamps.

Manufacturers:

Fansteel Products Co., Inc., North Chicago, Ill.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Metal & Thermit Corp., 120 Broadway, New York, N. Y. "Tungtabs."

TUNGSTEN WIRE.—Tungsten wire is drawn from tungsten billets and rods rendered ductile by heating and a rolling and swaging process. Its most important application is in the manufacture of filaments for incandescent lamps, for which it is drawn into very fine wire. It is also used as a substitute for platinum contacts in electrical apparatus, making excellent contact points, and for the resistor in certain electric heater elements.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Foote Mineral Co., Inc., 107 N. 19th St., Philadelphia, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, (See display adv. page 1251.)
McJunkin, Paul, 15 E. 40th St., New York, N. Y.

TUNGTABS.—Trade name for metal tungsten manufactured by the Metal &

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hermit Corp., 120 Broadway, New York, Y.

TUPPER MFG. CO.—1122 W. 47th St., eattle Wash. Manufacturer of motor-riven dishwashing machines. President, illiam Tupper; vice-president, William itus; secretary and treasurer, M. W. ongabaugh.

TURBINES, STEAM.—Steam turbines e commercially available in capacities om about 10 hp. up to 75,000 hp. In apacities above 5000 hp., the steam tur-ne is the only steam prime mover in e, with a few exceptions. In central ations, it is used almost entirely above 00 hp. The rapid evolution and employ-ent of the steam turbine is due to its gh thermal efficiency, its low cost per rsepower, its economical space-factor, adaptability for very large powers, its v labor cost for supervision and its nplicity with resulting reliability. Cost to the disadvantage of the turbine for all sizes, however.

iteam turbines are classified as impulse, ction and combined reaction-impulse. ey are again classified as single-pressure i multi-pressure stage. They may be in segregated according to whether y use high pressure or exhaust steam, ng known as high-pressure condensing, n-pressure noncondensing, low-pressure, ed-pressure and bleeder.

he steam turbine is used not only for ring high-speed generators but for op-ting of air compressors, direct-current erators and other slow-speed machin-through reduction gearing. It is be-widely employed for direct connection entrifugal pumps and high-speed ma-ery, such as centrifugal separators, ters, etc. It is also used for ship pro-ion, either connected to the propellers ugh reduction gearing, or driving elec-generators that furnish current to the eller motors.

URBINES, STEAM, EXHAUST AND W-PRESSURE. — Exhaust and low-sure turbines are those operating on spheric pressure or a few pounds e it and exhausting into a vacuum are usually connected to the exhaust ncondensing reciprocating steam en-or to other sources of low-pressure n, but do not connect direct to the s. The use of this type of turbine ite valuable in some existing plants e purpose of increasing the efficiency apacity with a minimum outlay for equipment.

w-pressure turbines are used to drive ators and also for other purposes in nt, such as for some auxiliaries. In nation plants supplying both gas and city they are sometimes used to gas compressors. In such cases they ways driven through reduction gear-This is also true of most turbine-generators for d-c. service. Also rbines, steam.

ufacturers:

-Chalmers Mfg. Co., Milwaukee, s.

dian General Electric Co., Ltd., 212 g St., W., Toronto, Ont., Can.

ERAL ELECTRIC CO., Schenec-y, N. Y. "Curtis." G-E low-pres-e turbines designed to take exhaust am from engines, pumps, air com-ssors, hoists, etc., are of the same eral construction as the high-pres-e turbines and embody all the ad-tages of the Curtis type. (See bines, high-pressure.)—Adv.

lian Westinghouse Co., Ltd., San-and Myler Sts., Hamilton, Ont., . "Westinghouse."

& McCulloch Co., Ltd., The, Galt, , Can.

Turbine Co., Wellsville, N. Y. nomy."

st Engine Co., Indianapolis, Ind. lwest-Wait."

Steam Turbine Corp., Wellsville, . "Moore."

ay Dynamo & Engine Co., 120 tric Ave., Ridgway, Pa.

Y STEAM TURBINE CO., THE, y Sq., Hartford, Conn.

INGHOUSE ELECTRIC & MFG. East Pittsburgh, Pa. (See display pages 1395-1402.)

NES, STEAM, MIXED AND HIGH-RE.—High-pressure turbines are ich operate on full boiler pressure aust to atmosphere or vacuum. essure turbines are those designed normally on low-pressure steam, but in case the low-pressure supply should fail or prove inadequate to carry the load, they are equipped with high-pressure stages to receive steam direct from the boilers. The low-pressure end is always designed to handle a much larger volume of steam than the high-pressure end. Bleeder turbines, which are a form of mixed-pressure turbine, have provision made for taking steam from a stage of the machine a few pounds above atmosphere and using it for heating the plant or for industrial heating service. The steam that is not used in this way continues through the low-pressure stages to the condenser. The high-pressure sections in these turbines are large as compared to the low-pressure end.

Both of the two basic types of turbines, the impulse and reaction, generally consist of more than one stage. Velocity compounding or pressure compounding is employed to give reasonable rotative speeds. Pressure compounding or dividing up the total pressure drop into several stages is used on nearly all of the larger size high-pressure turbines. Curtis turbines usually have from 1 to 20 pressure stages with one or two velocity stages in each pressure stage. The Rateau turbines have from 13 to 22 pressure stages and the Parsons type from 40 to 70 pressure stages.

High and mixed-pressure turbines are made in large sizes and are very widely used in steam power plants, having almost entirely replaced the reciprocating engines. They are generally made in the horizontal type now, although vertical turbines in the medium sizes have been made and are still in use.

In some of the very large sized turbines the pressure stages are separated to the extent that they are divided into two or three independent rotating elements forming a cross-compound or triple-expansion set; in this manner units rated as high as 60,000 to 70,000 kw. have been constructed. Probably the largest single-element units in operation are those of 45,000 kw. capacity. Also see Turbines, steam.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Well Works, The, Aurora, Ill. "American."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Canadian Westinghouse Co., Ltd., Sanford and Myler Sts., Hamilton, Ont., Can. "Westinghouse."

GENERAL ELECTRIC CO., Schenectady, N. Y. "Curtis." The Curtis steam turbine as manufactured by the General Electric Company is distinguished by its low cost of operation and reliable service. Its characteristics which make for economy are: high initial efficiency maintained in service; high steam economy over wide range of load; ability to utilize effectively extreme steam conditions, i. e., high pressure, super-heat, and vacuum, and low cost of supplies, repairs and maintenance. Features which make them reliable are: simple mechanical construction; short shaft and disc type wheels; proper proportion of turbine and generator to each other; and absence of distortion, due to sudden change in internal temperatures. No internal lubrication is necessary, and since the oil is circulated through the bearings in a closed system, the cost of oil is very small. The exhaust steam is thereby free from oil and can be used for heating the boiler feed water, or for heating the building, or for other low pressure industrial purposes. Curtis turbines give the maximum of power with a minimum of floor space and head room. G-E sizes are 10 kw. upward for driving d-c. generators and 100 kw. upward for a-c. generators. A special form is widely used for driving centrifugal pumps, blowers and like apparatus. (Bulletins 42201B and 42010.) See adv. page 1204.—Adv.

Goldie & McCulloch Co., Ltd., The, Galt, Ont., Can.

Kerr Turbine Co., Wellsville, N. Y. "Economy."

Midwest Engine Co., Indianapolis, Ind. "Midwest-Wait."

Moore Steam Turpine Corp., Wellsville, N. Y. "Moore."

Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y. "Power", "Simplex", "S.A."

Ridgway Dynamo & Engine Co., 120 Electric Ave., Ridgway, Pa.

TERRY STEAM TURBINE CO., THE, Terry Sq., Hartford, Conn.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TURBINE, WATER OR HYDRAULIC.—A hydraulic turbine is a water motor consisting of a wheel (often called the "runner") with a number of short curved buckets or pipes attached, arranged to revolve in a fixed case that has a series of guideways or nozzles to direct the water to the buckets or pipes at the most effective angle. Turbines may be classified in several ways, but are usually classified in accordance with the action of the water into reaction and impulse turbines. The reaction turbines are represented by the Fourneyron, Jonval and Francis types, and operate by having the water enter simultaneously through a number of passages around the entire circumference of the wheel. The water is deviated from its original path by the buckets on the runner and as it issues from the buckets, exerts a reactive pressure or force on them that revolves the wheel. The impulse turbines are represented by the Girard wheel and tangential wheels of the Doble and Pelton type. The water is sometimes applied by nozzles to all of the buckets simultaneously or to only a part of them at one time. The momentum of the moving mass of water, or the impulsive force of the impinging stream, is utilized in impulse turbines. Another classification that is commonly used is in accordance with the direction of flow. Radial-flow turbines are those in which the water flows through the wheel in a radial direction. The Fourneyron turbine has the direction radially outward while the Francis turbine is radially inward. Axial-flow turbines have the general direction of the water parallel to the axis of the wheel. The Jonval and Girard wheels are of this type. The type representative of most American reaction turbines is the mixed flow, in which the flow is at first radial and then is diverted to an axial direction.

The first water motors in use in the United States were open wheels of both the breast and overshot type. In the overshot type the water is delivered to the wheel in a sheet at the top, by means of a sluice. The breast wheel has the water delivered at approximately the level of the axis. Both depend chiefly upon gravity action. The first successful hydraulic turbine in this country was installed at Lowell, Mass., in 1844. It was a 75-hp. Fourneyron turbine and had an efficiency of about 78%. Several other turbines were built shortly after that of both the radial and axial or parallel-flow types. About 1860 the Swain and Leffel turbines (mixed flow) were invented, which combined the two flows and secured an inward and downward discharge. This type permitted the installation of a turbine in one-half the space and for one-fifth the cost of a turbine of the same size of the older type. Many turbines of this type were made until about 1878. At this time the "Hercules" wheel, invented by McCormick, was found to give a higher efficiency at part gate opening and to permit the use of a still greater amount of water with the same size wheel. The feature of this wheel was the addition of three sharp ridges to each bucket to assist in guiding the water. Improved designs of other wheels appeared soon afterwards and the tendency since then has been to increase the capacity of the wheel without increasing its diameter. For low heads, up to about 40 ft., the reaction turbines are best as they permit the utilization of the entire head at all times. They can be set very low and will operate efficiently when fully submerged. The impulse turbines require a free discharge and must be set high enough to always be above the tail water. Their use is therefore limited to high-head developments where the height of the back water is only a small percentage of the total head. They have higher efficiencies at part gate or at less than full load and, as most wheels operate under variable loads, this is an important feature.

Plants are now in operation having normal heads as low as 12 ft. A new plant is to be built in California on the Stanislaus River that will operate under a head of 2400 feet, which is probably the highest in the United States and among the highest in the world. The recent development

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of turbines has permitted an enormous increase in size, those recently installed at Niagara Falls, the largest in the world, being rated at 37,500 hp., but actually developing 40,000 hp. continuously. Their efficiency, which is also exceptionally high is in the neighborhood of 93%.

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Barber & Sons, Charles, Meaford, Ont., Can. "Canadian."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Christiana Machine Co., Christiana, Pa. "C.M.C."
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond and Norris Sts., Philadelphia, Pa. "I. P. Morris."
Dow, Inc., L. B., Keene, N. H.
Pelton Water Wheel Co., 19th and Harrison Sts., San Francisco, Cal.
Smith Co., S. Morgan, Lincoln & Hartley Sts., York, Pa. "Smith", "McCormick", "New Success."
Wellman-Seaver-Morgan Co., The, 7000 Central Ave., Cleveland, O "W-S-M."

TURBOLITE.—Trade name for portable lighting and power plant manufactured by the Lucey Mfg. Co., Houston, Tex.

TUBOGENERATORS. — See Generators, lighting and power, a-c., turbo; Generators, lighting and power, d-c., turbo.

TURL IRON & CAR CO., INC., THE.—50 Broad St., New York, N. Y. Manufacturer of industrial railroads, etc.

TURN OVER.—Trade name for electric toaster manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TURNBUCKLES, INSULATED.—Insulated turnbuckles are made in the same way as plain turnbuckles except that one or both of the eyes are either covered with an insulating compound or have an insulator mounted thereon. The insulators used are cylindrical or spool-shaped and are mounted in a fork which has the long stem threaded. This type is used with low-voltage cables, with trolley wires of traveling cranes, with guy wires where it is necessary to insulate them from the ground, etc.

Manufacturers:

Anderson Mfg. Co., Albert & J. M., 289-305 A St., Boston, Mass.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Railway Equipment Co., 2900 Cormany Ave., Cincinnati, Ohio.
Electrose Mfg. Co., 70 Washington St., Brooklyn, N. Y. "Arcover", "Electrose."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Hopewell Insulation & Mfg. Co., Inc., Hopewell, Va.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
MACALLEN CO., THE, 16 Macallen St., Boston, Mass.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TURNBUCKLES, PLAIN.—Turnbuckles are devices used to tighten a rod, support, binding or guy wire or cable, consisting of a wrought iron or cast iron double-stem-body tapped at both ends to receive a right-hand and left-hand screw, respectively, or sometimes having a screw at only one end and a swivel at the other. The body when turned will draw the screws in, thus taking up the slack in the wires or cables attached to the screws. Turnbuckles are used considerably in line construction work, especially for adjusting guys and supports. They are made with an eye at both ends, an eye at one end and a hook at the other, or an eye and clevis combined.

Manufacturers:

Bonney Vise & Tool Works, Inc., Allentown, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Fischer & Hayes Rope & Steel Co., 741-745 W. Van Buren St., Chicago, Ill.
HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)
Marine Hardware-Equipment Co., South Portland, Me.
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Roebling's Sons Co., John A., Trenton, N. J.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.
St. Louis Screw Co., Clarence St., and Bulwer Ave.. St. Louis, Mo.
Strieby & Foote Co., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

TURNBULL ELECTRIC MFG. CO., INC.—1237 Atlantic Ave., Brooklyn, N. Y. Manufacturer of incandescent lamps and lamp coloring compounds. Business established 1919. President, John G. Turnbull; secretary, George R. McKay; treasurer and general manager, Robert S. Turnbull.

TURNER BRASS WORKS, THE.—Sycamore, Ill. Manufacturers of oxyacetylene welding apparatus, name plates, blow torches, etc. Business established 1871. President, treasurer and general manager, William F. Pagel; vice-president, Herbert F. Pagel; secretary, Fred H. Alden; sales manager, Charles F. Masterson. Main office and factory, Sycamore, Ill. Branch office and warehouses, 30 Warren St., New York, N. Y. Sales representative, C. N. & F. W. Jonas, 534 Pioneer Bldg., Seattle, Wash.; 111 New Montgomery Bldg., San Francisco, Cal.; Equitable Savings Bank Bldg., Los Angeles, Cal.; H. D. Shewry, 80 Juneau Ave., Milwaukee, Wis.

TURNER MFG. CO., THE.—Port Washington, Wis. Manufacturer of internal-combustion engines and electric washing machines. Business established 1895. President, F. Bloodgood, Jr.; vice-president and general manager, W. A. Engelhart; secretary and treasurer, W. J. Niederkorn; sales manager, J. T. McCarthy. Factories, Grafton and Port Washington, Wis.

TURNER NEW LINE.—Trade name for blow torches manufactured by the Turner Brass Works, Sycamore, Ill.

TURNPINS, LEAD CABLE AND PIPE.—Smooth hardwood top-shaped tools used for spreading or reaming the lead sleeving used in making splices between lead-covered cables and potheads or cable and bells, etc. Also used by plumbers in reaming lead pipe.

Manufacturer:

LINE MATERIAL CO., South Milwaukee, Wis. (See display adv. page 1278.)

TURNSTILES FOR STATIONS, ETC.—Crossarms or stiles mounted on top of a post and arranged to rotate, usually, in one direction only. Used at exits from railway stations or platforms, and frequently at entrances to amusement parks, bathing beaches, buildings, etc., where large crowds are to be accommodated. They are also used for incoming passengers in some prepay electric railway stations. Entrance stiles are generally equipped with automatic counters.

Manufacturer:

Smith Wire & Iron Works, F. P., Fullerton, Clybourn & Ashland Aves., Chicago, Ill.

TURNTABLES, LOCOMOTIVE, ELECTRICAL EQUIPMENT FOR.—The old fashioned method of moving locomotive turntables by hand has been very generally superseded by the use of electric power, on account of its greater speed, efficiency and convenience. The motor is usually mounted on the table, below the track level, and is operated from a cab built over or alongside it. Rotation of the turntable is effected by means of a pinion operating on a large circular stationary rack, as in the case of drawbridges. The source of power is preferably direct current on account of its greater ease of speed control, but may be alternating current. The electrical equipment includes the motor, which is either a d-c. series or a-c. slip-ring induction motor; the controller; means for conducting the current to the circuits on the table by means of suitably insulated collector rings and brushes; also some means for locking the turntable at any radiating track.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Detroit Hoist & Machine Co., Morrow and Marston Sts., Detroit, Mich.
Nichols & Brother, George P., 2139 Fulton St., Chicago, Ill.

TURTLE.—Trade name for belt fasteners manufactured by the Flexible Steel Lacing Co., 4607-4631 Lexington St., Chicago, Ill.

TUSCAN.—Trade name for automobile tires manufactured by the Tuscan Tire & Rubber Co., Carrollton, Ohio.

TUSCAN TIRE & RUBBER CO.—Carrollton, Ohio. Manufacturer of automobile tires.

TUSUM.—Trade name for duplex sockets manufactured by J. H. Parker & Son, Parkersburg, W. Va.

TWEEZERS, METERMEN'S AND INSTRUMENT WORKERS'.—Small forceps used in handling dial hands, fine wires, springs, pinions and other parts too small or delicate to be readily placed in position by the fingers. They are used for the assembly of watt-hour meters and the great variety of electrical indicating and recording instruments, also for incandescent lamp filament handling and other delicate manipulation.

Manufacturers:

HERBST, PAUL W., Chicago, Ill. We furnish standard patterns for electrical purposes. See display adv. page 1258. —Adv.
SMITH & HEMENWAY CO., Inc., Irvington, N. J. "Red Devil."

20TH CENTURY.—Trade name for motor-driven mixing vats manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

20TH CENTURY.—Trade name for motor-generators manufactured by J. H. Hallberg, 25 W. 45th St., New York, N. Y.

23.—Trade name for insulating tape manufactured by the M. W. Dunton Co., Providence, R. I.

TWIN.—Trade name for receptacles manufactured by the General Electric Co., Schenectady, N. Y.

TWIN.—Trade name for electric water heaters manufactured by the National Stamping & Electric Works, 410 S. Clinton St., Chicago, Ill.

TWIN.—Trade name for dry batteries manufactured by the Twin Dry Cell Battery Co., 2108 Superior Ave., W., Cleveland, Ohio.

TWIN CITY DIE CASTINGS CO.—Talmage and 33rd Aves., S. E., Minneapolis, Minn. Manufacturer of die castings and fixture loops. General manager, Charles G. Adams.

TWIN DRY CELL BATTERY CO., THE.—2108 Superior Ave., W., Cleveland, Ohio. Manufacturer of dry batteries. President, H. R. Palmer; secretary, C. P. Deibel; treasurer, B. C. Tibbits.

TWIN-LITE.—Trade name for duplex socket manufactured by the Hemco Electric Mfg. Co., Inc., 344 E. 40th St., New York, N. Y. (Exclusive distributor, George Richards & Co., 557 W. Monroe St., Chicago, Ill.)

TWIN-MIXER.—Trade name for electric drink mixer manufactured by the H. B. Gibson Co., 38 Park Pl., New York, N. Y.

TWIN-R.—Trade name for small motors manufactured by the American Radio & Research Corp., 21 Park Row, New York, N. Y.

TWIN-TACT.—Trade name for spark plugs manufactured by the Superior Motor Power Co., 75 Spring St., New York, N. Y.

TWINE, ARMATURE WINDING.—Twines find a considerable application in insulation processes as space fillers on armature cores, temporary binding in the winding of coils, insulation for the front end of the commutators and to hold the armature windings rigidly in place. Since twine is naturally of an open or porous nature and would readily absorb moisture, it is important that the pores of the twine be filled or sealed with some suitable moisture-repellant compound of high dielectric properties. The armature winding twines are given a treatment consisting of an impregnation in varnish which renders them more moisture-resistant and greatly increases their dielectric strength.

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Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. "Champion." (See display adv. page 1320.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Mica Insulator Co., 68 Church St., New York N. Y. "Empire."
Mica Insulator Co., Victoriaville, Que., Can.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."

TWINE, ASBESTOS.—See Asbestos, tape, bing, twine, yarn, etc.

TWINE, CABLE-LACING.—Cable-lacing ine is heavy linen twine, usually impregted with a wax compound, and used for cing together groups of wires to form a ble. It is very strong and long lasting d the wax compound is such that by takg special stitches which are partial knots e twine is secured and held firmly. It is so used to make locking stitches on telecone cables and is frequently called "lockstch."

Manufacturer:

KELLOGG SWITCHBOARD & SUPPLY Co., Adams and Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)

TWINLINE.—Trade name for roller arings manufactured by the William E. att Mfg. Co., 190 N. State St., Chicago,

TWINVOLUTE PUMP & MFG., INC.—ewark, N. J. Manufacturer of centrifugal mps. Business established 1912. Presit, W. B. Fair; vice-presidents, H. A. nn and E. F. Fair; secretary and treasr, R. H. Frederick; general manager, A. Dunn. Main office and factory, 216 h St., Newark, N. J. Branch office, 55 liam St., New York, N. Y. Sales repretatives, T. T. Burchfield Co., Philadela, Pa.; Everitt Co., Boston, Mass.; ndard Sanitary Mfg. Co., Cleveland, o; Lawrence Lewis, Baltimore; Ferranti er & Transformer Co., Montreal, Que.,

TWISTED PAIR.—Two small insulated luctors twisted together, but without a mon covering. The conductors of a ted pair are usually substantially insulated so that the combination is really a special form of a cord. Twisted pairs are extensively used in telephone circuits.

TWO BALL.—Trade name for cord adjusters manufactured by the Gund Mfg. Co., LaCrosse, Wis.

TWO-IN-ONE.—Trade name for electric polishing and scrubbing machines manufactured by the John Herr Mfg. Co., 44 N. 4th St., Philadelphia, Pa.

2-IN-1.—Trade name for dolly type electric washing machine manufactured by the Minier Mfg. Co., Minier, Ill.

2 IN 1—Trade name for draft gages manufactured by Precision Instrument Co., 21 Halsey St., Newark, N. J.

TWO-IN-ONE CLEAN-CUT-CLIPPER.—Trade name for motor-driven hair cutter and vibrator manufactured by the Electric Clipper Co., 537 Grand Ave., Kansas City, Mo.

2-1.—Trade name for duplex socket manufactured by the Union Electric Corp., 103 Mott St., New York, N. Y.

TWO PHASE.—This is a term characterizing a generator which develops two electromotive forces differing by one-quarter of a period in phase. On a clock diagram the two e. m. f.'s are represented by equal vectors differing in phase by 90°. Two-phase circuits may be either three-wire or four-wire. They are not as extensively used as three-phase circuits.

TWO-WAY.—Trade name for double-socket plug made by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

TWO-WIRE SYSTEM.—A system of electrical distribution employed in incandescent lighting and light power work in which only two mains and two wires are required. This is the common system used in residence lighting and much single-phase work, although the three-wire system is also used. See Three-wire circuit.

TWYNCONE.—Trade name for friction clutches manufactured by the Link-Belt Co., 329 W. 39th St., Chicago, Ill.

TYCOS.—Trade name for electrical indicating, recording and temperature controlling instruments manufactured by the Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

TYING.—The method of fastening the smaller wires used in overhead line construction to the insulators is called tying. The tie may be an iron or copper wire tie. The iron wire tie is a method of tying iron wire to a glass insulator. The tie wire passes only part way around the insulator, then spirals onto the line wire. It is not suitable for copper wire. The copper wire tie is a method of tying copper wire to an insulator without danger of weakening the line wire. An annealed copper tie wire passes completely around the insulator, then spirals onto the line wire.

TYLER CO., THE W. S.—Cleveland, Ohio. Manufacturer of electric vibrating screens and magnetic separators. President, Proctor Patterson; secretary and treasurer, C. Zimmerman; sales manager, M. P. Reynolds.

TYLER UNDERGROUND HEATING SYSTEM.—855-857 Progress St., Pittsburgh, Pa. Manufacturer of steam traps, water weighing machines, underground pipe covering and other underground heating specialties. Business established 1911. E. B. Tyler, proprietor.

TYNDALL-DE VRIES OZONIZER.—A high-tension apparatus for converting atmospheric air into ozone.

TYPEWRITERS, ELECTRICALLY OPERATED.—Typewriting machines operated by perforated patterns or stencils which control the operation of contact springs in the circuits of electromagnets connected to the individual type bars, enabling the duplication of form letters, etc., at high rates of speed. They are very useful when quantities of form letters are used as in follow-up systems, etc. The stencils are prepared on a special machine which perforates a large sheet in accordance with a code. The advantage of this type is that the machine may be stopped at any place in the form letter to insert a name and address by hand operation, to give a more personal appearance to the letter.

There are also made electric typewriters which in operation resemble the ordinary typewriters, except that the keys are merely touched and not depressed. The operation is completed by the electrical apparatus.

Manufacturers:

Elliott-Fisher Co., Harrisburg, Pa.
Hooven Service, Inc., 117 W. 46th St., New York, N. Y.

TYSON CO.—Canton, Ohio. Manufacturer of motor-driven ice cream freezers.

U

–The letter U is the chemical symbol he element uranium. It is also used times as a symbol for energy, in the joules.

IE-LITE.—Trade name for safety es and circuit breakers manufactured e Cutter Electrical & Mfg. Co., 19th Hamilton Sts., Philadelphia, Pa.

ILING INSTRUMENT CO.—Paterson, Manufacturer of recording and ing instruments. Business established President and treasurer, F. F. Uehlecretary, L. M. Sheridan; sales man-C. C. Phelps. Main office and factory, on, N. J. Branch offices, 71 Broad-New York, N. Y.; 89 State St., Boslass. Coon De Nisser Co., Detroit, 20 W. Jackson Blvd., Chicago, Ill. representatives, Sherman Engineering hiladelphia, Pa.; Advance Machinery enver, Colo.; Frank S. Hitson, San sco, Cal.; John T. Farmer, Montreal, Greens Economizer, Winnipeg, Man.,

CO.—Trade name for electric con devices manufactured by the Union Mfg. Co., 120 Reed St., Milwaukee,

.—Trade name for spark plug manud by the Utility Co., 636 W. 44th w York, N. Y.

ER CIRCUIT BREAKER, INC.—lle, Ky. Manufacturer of controllers ion-picture machines.

MA PHYSICAL APPLIANCE CO.—Lake St., Chicago, Ill. Manufacturer rotherapeutic apparatus.

ULTIMATE.—Trade name for illuminating glassware manufactured by the U. S. Glass Co., Pittsburgh, Pa.

ULTRA-VIOLET RAYS.—These are the rays at the extreme violet end of the visible spectrum and just beyond. Ultra-violet means beyond the violet. Those rays that are close to the border of this spectrum are faintly visible and are not injurious to the skin, although they cause it to fluoresce in the dark. Those of shorter wave lengths and clearly beyond the visible spectrum are, of course, invisible to the eye, but they are injurious to the eye and to the skin generally. Ultra-violet rays are present to a slight degree in the solar spectrum and more or less in the spectra of artificial illuminants, especially arc lamps and mercury-vapor lamps. They are produced most abundantly by mercury-vapor lamps using quartz tubes instead of glass. Quartz is transparent to these rays, while ordinary glass absorbs them. Ultra-violet rays are also called actinic or chemical rays because they stimulate chemical action, especially of photographic plates. They also have important bactericidal properties.

UMBCO.—Trade name for metal boxes and cabinets for electrical purposes manufactured by the United Metal Box Co., 514-516 W. 46th St., New York, N. Y.

UNA.—Trade name for illuminating glassware manufactured by the Gill Glass Co., Amber and Venango Sts., Philadelphia, Pa.

UNA-FON.—Trade name for electrically operated musical bells made by J. C. Deagan, Inc., 1770 Berteau Ave., Chicago, Ill.

UNBALANCED CIRCUITS.—Unbalanced circuits or systems are those in which the separate branches are unequally loaded. In an unbalanced polyphase system the power is pulsating. Compare with Balanced circuits.

UNDAMPED WAVES, RADIO.—Waves transmitted by a radio transmitting station in which the radio frequency wave is of constant amplitude. See Radio telegraph transmitting apparatus.

UNDARK.—Trade name for luminous compounds, switch buttons, plates, etc., manufactured by the Radium Luminous Material Corp., 58 Pine St., New York, N. Y.

UNDER-CONTACT THIRD RAIL.—A method of mounting the conducting rail or third rail in electric railway systems. The rail is supported at intervals by iron brackets which hold suspended insulation blocks by a special clamp, so that the under surface of the rail is presented to make a smooth contact with the upper side of the collecting shoe. This type of rail has the advantage that it may be protected. For manufacturers see Rails, conductor or third.

UNDERCUTTING, COMMUTATOR.—See Commutator slotting.

UNDERGROUND CABLES.—See Cable, lead-covered, light and power; Cable, park or suburban; Cable, telephone and telegraph.

UNDERGROUND CONDUIT.—See Conduit, underground.

UNDERGROUND POWER AND LIGHTING LINES.—See Distribution lines for

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power and lighting. Also see Conduit systems, underground.

UNDERWOOD & UNDERWOOD, INC.—New York, N. Y. Manufacturer of motion picture machines. Business established 1882. President, B. Underwood; vice-presidents, E. Underwood, C. R. Abbott; secretary, E. R. Ross; treasurer, C. N. Thomas, Main office, 417 5th Ave., New York, N. Y. Branch office, Ottawa, Kans.

UNDERWOOD TYPEWRITER CO., INC.—Underwood Bldg., New York, N. Y. Manufacturer of typewriters and electrically operated bookkeeping machines. Branch offices in all principal cities of the United States.

UNDERWRITERS' LABORATORIES, INC.—This corporation, with headquarters at 207 E. Ohio St., Chicago, Ill., was chartered in November, 1901, by the State of Illinois, to establish and maintain laboratory and inspection service on building materials and products, and to enter into contracts with the owners and manufacturers of such materials and products respecting the recommendation thereof to insurance organizations. The work is carried on under the general direction of the National Board of Underwriters. Underwriters' Laboratories, Inc., is conducted for service, not profit.

The work of Underwriters' Laboratories is to secure and make available the best obtainable opinion regarding the merits of materials, appliances and systems in respect to fire, accident, collision and theft hazards.

Equipment for this work includes a large plant at Chicago, a branch testing station in New York City, and agencies and offices for the operation of inspections at factories and labeling of standard products in more than a hundred cities and towns in the United States and Canada, and in London, England. The Chicago plant occupies a three-story and basement building of the best modern fireproof construction, containing about 52,000 sq. ft. of floor space and provided with ample yard space for huts and large testing furnaces.

The plant is kept well supplied with apparatus, much of which is of special design, for the proper performance of all necessary research work and for making laboratory tests in a thorough, systematic, comprehensive and practical way. There are about 150 engineers and assistants on the Chicago staff. Each department is under the direction of an expert of long experience and special training for his particular line of work. The work of the branch laboratory at New York is mainly electrical testing.

Test work that ends when tests on a sample material have been completed is necessarily of limited practical value; the importance of proper check methods on run of goods is obvious. Years of study by Underwriters' Laboratories of this problem of securing quality maintenance led to the establishment of its "Label Service."

When the product of a manufacturer is admitted to the Label Service, following suitable investigation of sample goods, inspection is established in his factory. Inspectors and engineers in the employ of the Laboratories follow the daily run of material through various processes of production and conduct such tests as have been specified, and to goods thus found to be of suitable quality, Underwriters' Laboratories labels are attached. Check tests that can not be conveniently made at the factory are made on samples forwarded by the inspector to headquarters. This service is further reinforced by tests on labeled material purchased from dealers and on samples of labeled product taken out of service and sent in from the field. Thus, for a large class of products, the label on the goods or the absence of it, tells the architect, inspector, builder and property owner whether the product has been inspected and passed.

The publications of Underwriters' Laboratories are as follows: (a) Organization Purpose and Methods; (b) List of Inspected Mechanical Appliances; (c) List of Inspected Electrical Appliances; (d) List of Appliances Inspected for Accident Hazard; (e) List of Inspected Automotive Appliances; (f) Standards on Rubber-Covered Wires and Cords, Fire Hose, Fire Doors, Electric Cabinets and Cutout Boxes, Lightning Conductors, Rigid Conduit, Armored Cables and Cords, Cartridge Enclosed Fuses, Snap Switches, Electric Signs, Panelboards, Knife Switches, Cutout Bases, Soldering Lugs, Flexible Cord, Ground Clamps, Fixture Wire, Electric Ranges, Flexible Nonmetallic Tubing and Heater Cords—now ready for distribution and other standards are in preparation. Note: (b), (c), (d) and (e) revised semiannually and sent free on request; (f) supplied at $1 per copy.

UNGER SLATE CO.—Slatington, Pa. Manufacturer of slate for electrical purposes.

UNIBLADE.—Trade name for motor-driven blowers manufactured by the Batterman-Truitt Co., 736-738 W. Monroe St., Chicago, Ill.

UNIFILAR SUSPENSION.—A suspension used on some senstitive deflecting instruments which consist of a single very fine thread of insulating material, such as a silk fiber.

UNIFORM FIELD.—A term used in referring to a magnetic or an electrostatic field which has the same intensity and direction at every point.

UNILECTRIC CORP.—Detroit, Mich. Manufacturer of farm lighting plants.

UNILETS.—Trade name for conduit fittings manufactured by the Appleton Electric Co., 1703 Wellington Ave.

UNION.—Trade name for lightning arresters manufactured by J. H. Bunnell & Co., 32 Park Pl., New York, N. Y.

UNION.—Trade name for fuses and switch boxes manufactured by the Chicago Fuse Mfg. Co., Laflin and 15th Sts., Chicago, Ill.

UNION.—Trade name for cotton belting manufactured by the Empire Mfg. Co., Lockport, N. Y.

UNION.—Trade name for electric feed cutters manufactured by Heebner & Sons, Lansdale, Pa.

UNION.—Trade name for carboy inclinators manufactured by Horace M. McCord & Co., Inc., 1013 Lumber Exchange Bldg., Minneapolis, Minn.

UNION.—Trade name for speed regulating controllers and motor starters manufactured by the Union Electric Mfg. Co., 120 Reed St., Milwaukee, Wis.

UNION.—Trade name for repulsion-induction, single-phase motors manufactured by the Union Electric Motor & Mfg. Co., Randolph St. and Montgomery Ave., Philadelphia, Pa.

UNION.—Trade name for internal combustion engines manufactured by the Union Gas Engine Co., Kennedy and Boehmer Sts., Oakland, Cal.

UNION.—Trade name for water-tube boilers manufactured by the Union Iron Works, Erie, Pa.

UNION.—Trade name for ornamental lighting posts manufactured by the Union Metal Mfg. Co., Canton, Ohio.

UNION.—Trade name for valves, steam and water pressure regulators and oil meters, made by the Union Water Meter Co., 33 Hermon St., Worcester, Mass.

UNION CLAY PRODUCTS CO.—New Brunswick, N. J. Manufacturer of insulating paints and varnishes.

UNION DRAWN STEEL CO.—Beaver Falls, N. Y. Manufacturer of electric furnace steel

UNION ELECTRIC CO., INC.—Hamilton & Clark Sts., Trenton, N. J. Manufacturer of wiring devices. President, J. D. Mackenzie; vice-president, Duncan Mackenzie; secretary and general manager, W. I. Peacock; treasurer, T. Mackenzie.

UNION ELECTRIC CORP.—103 Mott St., New York, N. Y. Manufacturer of electric heating devices, plugs, sockets, etc. Business established 1918. President, Sidney M. Knapp; vice-president, D. J. Burgin; secretary, Leo Wetzel; general manager, Dean W. Anderson; sales manager, R. B. Richmond. Branch offices, Chicago, Ill.; Philadelphia, Pa.

UNION ELECTRIC MFG. CO.—120 Reed St., Milwaukee, Wis. Manufacturer of electrical controlling devices. President and sales manager, E. F. LeNoir; vice-president, C. A. Rhine; secretary, treasurer and general manager, H. E. Campbell. Sales representatives, Curtis & Carhart, Inc., 150 Chambers St., New York, N. Y; Perkins-LeNoir Co., Inc., Philadelphia, Pa. and Baltimore, Md.; Rutherfoord & Uptegraff, Pittsburgh, Pa.; William G. Merowit, Buffalo, N. Y.; S. C. Dinsmore, Detroit, Mich.; Electrical Machinery Sales Co., 327 S. LaSalle St., Chicago, Ill.; George W. Pleksen, St. Louis, Mo.; Garland-Affolter Engineering Co., San Francisco, Cal., Los Angeles, Cal., Seattle, Wash.; L. B. Gottschall & Co., Dallas, Tex.; S. J. Stewart (Electric), New Orleans, La.; T. W. Findley, Minneapolis, Minn.; R. Notvest, Cleveland, Ohio; New England Appliance Co., Boston, Mass.

UNION ELECTRIC MOTOR & MFG. CO.—Randolph St. & Montgomery Ave., Philadelphia, Pa. Manufacturer of repulsion-induction, single-phase motors. Business established 1917.

UNION ELECTRIC STEEL CO.—Keystone Bldg., Reading, Pa. Manufacturer of electric furnace steel.

UNION ENGINEERING CO., THE.—Cuyahoga Ave. & W. 4th St., Cleveland, Ohio. Manufacturer of electric pumps and power transmission machinery. Business established 1907. President, J. N. Hahn; vice-president and general manager, George J. Hewlett; secretary, Clayton Crouch; treasurer, R. F. Calkins.

UNION GAS ENGINE CO.—Kennedy & Boehmer Sts., Oakland, Cal. Manufacturer of internal-combustion engines. Business established 1885. President and general manager, O. H. Fischer; vice-president, S. H. Page; secretary and treasurer, George W. Emerson.

UNION HARDWARE CO.—Torrington, Conn. Manufacturer of hacksaw frames and battery boxes. President, T. W. Bryant; secretary, C. G. Hoerle; treasurer, F. J. Damon. Main office and factory, Torrington, Conn. Branch office, 99 Chambers St., New York, N. Y.

UNION IRON WORKS.—Erie, Pa. Manufacturer of water-tube boilers, smoke stacks, etc. Business established 1889.

UNION IRON WORKS CO.—Selma, Ala. Manufacturer of boilers, engines and car wheel presses.

UNION LAMP CO.—Union Hill, N. J. Manufacturer of nitrogen lamps. President and sales manager, Charles Levy; secretary and treasurer, Charles Echentille.

UNION MFG. CO.—New Britain, Conn Manufacturer of motor-driven punches and shears, etc.

UNION MFG. CO.—Canton, Ohio. Manufacturer of ornamental lighting posts. Business established 1906. President, C. C. Barrick; vice-president, C. L. Eshelman; secretary, D. C. Barrick; treasurer, L. M. Barrick; sales manager, W. A. Porterfield. Sales representatives, Electric Supply & Equipment Co., Charlotte, N. C.; Mohawk Electric Supply Co., Syracuse, N. Y.; International General Electric Co., New York, N. Y.; Southwest General Electric Co., Dallas, Tex.; Pacific States Electric Co., San Francisco, Cal.; Capital Electric Co., Salt Lake City, Utah; Mountain States Machinery Co., Denver, Colo.; Northwestern Electric Equipment Co., St. Paul, Minn.; Pettingill-Andrews Co., Boston, Mass.; Wesco Supply Co., St. Louis, Mo.; Matthews Electrical Supply Co., Birmingham, la.; Gulf States Electric Co., New Orleans, La.; Carter Electric Co., Atlanta, Ga.

UNION OIL CO. OF CALIFORNIA.—215 W. 7th St., Los Angeles, Cal. Manufacturer of lubricating oil, etc.

UNION PAPER & TWINE CO.—Cleveland, Ohio. Manufacturer of insulating paper, twine, etc. President, W. H. Chatfield; vice-president, C. H. Bicknell; secretary and sales manager, R. Roesch; treasurer and general manager, M. E. Battles. Main office, 125 St. Clair Ave., N. W., Cleveland, Ohio. Branch offices, Akron, Ohio; Lima, Ohio; Toledo, Ohio; Detroit, Mich.; Buffalo, N. Y.

UNION SMELTING & REFINING CO., INC.—New York, N. Y. Manufacturer of solder, anti-friction metals, etc. President, Lionel D. Waixel; secretary and treasurer, Samuel Turkus. Main office, Pulitzer Bldg., New York, N. Y. Branch offices, Chicago, Ill.; Baltimore, Md.; Cleveland, Ohio; Detroit, Mich. Factories, Newark, N. J.; Baltimore, Md.

UNION SPECIAL.—Trade name for power sewing machines made by the Union Special Machine Co., 400 N. Franklin St., Chicago, Ill.

UNION SPECIAL MACHINE CO.—Chicago, Ill. Manufacturer of power sewing machines. Business established 1881. President and treasurer, Francis S. North; vice-presidents, H. A. North, Charles H. Hurlburd; secretary and sales manager, Gerald Mahoney; general manager, Henry A. North. Main office, 400 N. Franklin St., Chicago, Ill. Factories, Chicago, Ill., Stuttgart, Germany. Branch offices, Bos-

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on, Mass.; Philadelphia, Pa.; St. Louis, lo.; Cincinnati, Ohio; Minneapolis, Minn; an Francisco, Cal.; Milwaukee, Wis.; tica, N. Y.; Rochester, N. Y.; Cohoes, . Y.; Amsterdam, N. Y.; 65 Bleecker St., ew York, N. Y.; Montreal, Que., Can., oronto, Que., Can.

UNION SPRING & MFG. CO.—1207 Fulon Bldg., Pittsburgh, Pa. Manufacturer springs, steel castings, journal boxes . President and treasurer, L. G. Woods; neral manager, A. Pancoast; sales manger, F. E. Schaeffer.

UNION STEAM PUMP CO.—Battle eek, Mich. Manufacturer of manhole mps.

UNION SWITCH & SIGNAL CO.—Swisse, Pa. Manufacturer of railway signal systems, block signals, interlocking nals, semaphores, dwarf signals and llar equipment. Main office, Swissvale, Branch office, 122 S. Michigan Ave., cago, Ill.

UNION TOOL CHEST CO., INC.—hester, N. Y. Manufacturer of tool sts. Business established (about) 1900. sident, G. N. Perkins; vice-president, F. Pratt; secretary, G. C. Perkins; surer and general manager, William loyes; sales manager, J. L. O'Connor. n office and factory, 103 Mill St., ester, N. Y. Branch offices and ware-es, 26 Cortlandt St., New York, N. Y.; N. State St., Chicago, Ill. District . 21 Sutter St., San Francisco, Cal.

UNION TWIST DRILL CO.—Athol. . Manufacturer of twist drills and reamers. Business established 1905. dent, J. A. McGregor; vice-president, n MacKay; secretary, J. H. Drury; al manager, H. F. Barrus. Main and factory, Athol, Mass. Branch , 62 Reade St., New York, N. Y.; 11 nton St., Chicago, Ill.

UNION WATER METER CO.—Worcesass. Manufacturer of water, oil and water meters, valves, etc. Business ished 1868. President, H. A. B. dge; secretary, treasurer and genanager, Edward S. Otis; sales man-Donald K. Otis. Main office, 33 Her-t., Worcester, Mass. Branch office, al Estate Trust Bldg., Philadelphia. Sales representative, Power Plant Co., Cleveland, Ohio.

UNION WIRE FRAME CO.—931 W. t., Chicago, Ill. Manufacturer of for lamp shades. Joseph Zarovy, ner.

UNIONS, CONDUIT.—See Conduit, gs, nipples and unions.

UNIPANEL.—Trade name for sectional ttery charging units manufactured Automatic Electrical Devices Co., W. 3rd St., Cincinnati, Ohio.

UNISCOPE CO.—2156 Fulton St., Chica-Manufacturer of motor-driven picture machines. Proprietor, C. J. n.

UNIPARKER.—Trade name for autoignition distributer manufactured Atwater Kent Mfg. Co., 4937 Sten-., Philadelphia, Pa.

UNIPAT.—Trade name for electromedet for physicians manufactured by eyrowitz, Inc., 520 5th Ave., New Y.

UNIPOLE.—Trade name for safety switches tured by the Unit Electric Co., ncisco, Cal.

UNIPOLE ELECTRIC CO.—San Francisco, nufacturer of safety switches.

UNIPOLE MAGNETIC POLE.—A magnetic se strength is such that it will equal and similar pole placed meter away from it with a force ne.

UNIPOWER.—Trade name for gasoline enufactured by the United Engine ing, Mich.

UNIPURE.—Trade name for water filters red by the United Filters Corp., ay, New York, N. Y.

UNIQUE ALLOY STEEL CO.—Canton, nufacturer of electric furnace, ic furnace and other steel. Pres-R. Jones; secretary, J. Paul reasurer and general manager, g; sales manager, H. H. Pleasn office, Canton, Ohio. Branch E. Jackson Blvd., Chicago, Ill.; Ohio; Detroit, Mich.; Indian-; New York, N. Y.; Philadel-Portland, Ore.; San Francisco, use, N. Y.

UNITED AMERICAN METALS CORP.—Brooklyn, N. Y. Manufacturer of babbitt metals, phosphor bronze, solder, etc. President, L. Neusert; secretary and treasurer, A. Hoyt Levy; sales manager, P. J. Kiernan. Branch offices, 1011 Chestnut St., Philadelphia, Pa.; 443 S. Dearborn St., Chicago, Ill.

UNITED CONVEYOR CORP.—Old Colony Bldg., Chicago, Ill. Manufacturer of ash conveyors, tanks, boiler settings, etc. President and general manager, Edgar B. Tolman; vice-president and secretary, J. S. S. Fulton; treasurer, A. B. Reeve.

UNITED ELECTRIC APPARATUS CO.—1529-33 Columbus Ave., Boston, Mass. Manufacturer of electric and steam railroad, telegraph and telephone signal apparatus. Business established 1880. General manager, A. A. Ziegler.

UNITED ELECTRIC CO., THE.—Canton, Ohio. Manufacturer of electric vacuum cleaners. Business established 1909. President, E. A. Langenbach; vice-president, Harry Ross Jones; secretary and treasurer, C. J. Adams; general manager, Fred Otte, Jr. Main office, Canton, Ohio. Branch offices, New York, N. Y.; Chicago, Ill.; Portland, Ore.; Kansas City, Mo.; Dallas, Tex.

UNITED ELECTRIC SUPPLY CO.—1250 Atlantic Ave., Brooklyn, N. Y. Manufacturer of electrical protective devices. President, John A. Thake; vice-president, W. E. Thompson; secretary and treasurer, K. J. Scholl.

UNITED ELECTRIC SUPPLY CO.—Marion, Ohio. Manufacturer of pole measurers.

UNITED ENGINE CO.—Lansing, Mich. Manufacturer of farm lighting plants and gasoline engines. President, C. L. Sprinkle; vice-president, L. J. Munday; secretary and treasurer, J. G. Finkbeiner. Main office and factory, Lansing, Mich. Branch offices and warehouses, Albany, N. Y.; Kansas City, Mo.; Minneapolis, Minn.; Independence, Iowa.

UNITED FILTERS CORP.—New York, N. Y. Manufacturer of water and other filters. President, O. J. Salisbury; treasurer, L. B. McCormick; general manager, E. J. Sweetland; sales manager, H. J. Runyan, Jr. Main office, 65 Broadway, New York. N. Y. Branch offices, Chicago, Ill.; Salt Lake City, Utah; Los Angeles, Cal.; San Francisco, Cal. Factory, Hazleton, Pa.

UNITED IRON WORKS, INC.—Ridge Arcade Bldg., Kansas City, Mo. Manufacturer of motor-driven mining machines.

UNITED LEAD CO.—111 Broadway, New York, N. Y. Manufacturer of lead bars, tubing, etc.

UNITED MACHINE & MFG. CO.—Canton, Ohio. Manufacturer of steam and oil separators. Business established 1918. President and general manager, L. E. Griffith; vice-president and sales manager, H. S. Colby; secretary, J. R. Poyser; treasurer, W. H. Cavnah. Main office and factory, Canton, Ohio. Branch offices, 855 Book Bldg., Detroit, Mich.; 1836 Euclid Ave., Cleveland, Ohio. Sales representatives, Steam Economies, Co., Wooster, Ohio; Rogers-Post-Rogers, Inc., Monadnock Bldg., Chicago, Ill.; Frenkel & Santeby, 604 Mission St., San Francisco, Cal.; Sutor & Co., Los Angeles, Cal.; Van Camp Hardware & Machine Co., Indianapolis, Ind.; Advance Engineering Co., 168 Washington St., New York, N. Y.

UNITED METAL BOX CO.—514-516 W. 46th St., New York, N. Y. Manufacturer of metal boxes and cabinets for electrical purposes. Business established 1919. Partnership, D. Postal and S. Hammer.

UNITED METAL MFG. CO., INC.—27 Shipping St., Norwich, Conn. Manufacturer of brass and bronze castings and fixture fittings and parts. Business established 1896. President, Richard T. Chisolm; secretary, Ralph Royall; treasurer and general manager, C. F. Wells.

UNITED PRINTING MACHINERY CO.—New York, N. Y. Manufacturer of motor-driven printing presses. President, Burt F. Upham; secretary, John B. Gibbons; treasurer, Henry W. Newhall. Main office, 38 Park Row, New York, N. Y. Branch offices, Boston, Mass.; Chicago, Ill.

UNITED SEAL CO.—Columbus, Ohio. Manufacturer of meter seals.

UNITED SHOE MACHINERY CORP.—205 Lincoln St., Boston, Mass. Manufacturer of electric driers, ironing machines, sewing machines and other shoe machinery. Factory, Beverly, Mass.

UNITED SMELTING & ALUMINUM CO., INC.—New Haven, Conn. Manufacturer of babbitt metals, pig metals, solder, etc. Main office and factory, New Haven, Conn. Branch offices, New York, N. Y.; Detroit, Mich.; Pittsburgh, Pa.; Chicago, Ill.

UNITED THEATRE EQUIPMENT CORP.—New York, N. Y. Manufacturer of motor-driven motion picture machines. President and treasurer, H. T. Edwards; vice-president and secretary, J. H. Hallberg; sales managers, W. L. Stern, L. W. Atwater, F. T. Forster. Main office, 25 W. 45th St., New York, N. Y. Branch offices, New York, N. Y.; Boston, Mass.; Philadelphia, Pa.; Pittsburgh, Pa.; Cincinnati, Ohio; Detroit, Mich.; Omaha, Neb.; Minneapolis, Minn.; Cleveland, Ohio; Chicago, Ill.; Oklahoma City, Okla.; St. Louis, Mo. Sales representative, Kansas City Machine & Supply Co., Inc., Kansas City, Mo.

UNITED VACUUM APPLIANCE DIVISION, LANDERS, FRARY & CLARK.—See Landers, Frary & Clark, United Vacuum Appliance Division.

UNITED WASTE MFG. CO.—Troy, N. Y. Manufacturer of wiping waste.

UNITED WIRE & SUPPLY CO.—1497 Elmwood Ave., Auburn, R. I. Manufacturer of brass and copper tubing and solder. Business established 1902. President, George B. Champlin; vice-president, William B. Gladding; secretary and treasurer, Albert E. Stevens; general manager, Henry T. Smith; sales manager, Thomas F. Hughes.

UNITED ZINC SMELTING CORP.—Moundsville, W. Va. Manufacturer of zinc chloride, etc.

U. S.—Trade name for power plant injectors manufactured by the American Injector Co., Detroit, Mich.

U. S.—Trade name for sheet steel for electrical purposes manufactured by the American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa.

U. S.—Trade name for electric dishwashers manufactured by G. S. Blakeslee & Co., Cicero, Ill.

U. S.—Trade name for air pressure gages, valves and brass tubing manufactured by the United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio.

U. S.—Trade name for electric automatic steam iron manufactured by the U. S. Automatic Steam Iron Corp., 414-416 Broadway, New York, N. Y.

U. S.—Trade name for motor-driven cloth cutting machine manufactured by the U. S. Cloth Cutting Machine Co., 414-416 W. Broadway, New York, N. Y.

U. S.—Trade name for electric drills and grinders manufactured by the U. S. Electrical Tool Co., 2480 W. 6th St., Cincinnati, Ohio.

U. S.—Trade name for insulated wires and cables, electrical tapes, rubber tubing, tubes, packing, linemen's gloves and shoes and other rubber products manufactured by the United States Rubber Co., 1790 Broadway, New York, N. Y.

U. S.—Trade name for electric meat slicers manufactured by the U. S. Slicing Machine Co., LaPorte, Ind.

UNITED STATES.—Trade name for rail bonds manufactured by the American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.

UNITED STATES.—Trade name for motor-driven cream separators manufactured by the Vermont Farm Machine Corp., 53 W. Jackson Blvd., Chicago, Ill.

UNITED STATES AIR COMPRESSOR CO.—5300 Harvard Ave., Cleveland, Ohio. Manufacturer of motor-driven air compressors. Business established 1912. President, R. L. Bacher; vice-president and secretary, W. C. Smith; treasurer, G. A. Hunter; sales manager, N. Christensen.

U. S. AUTOMATIC STEAM IRON CORP.—414-416 Broadway, New York, N. Y. Manufacturer of electric and gas automatic steam irons, etc. President and treasurer, N. Komow.

UNITED STATES BRONZE POWDER WORKS, INC.—220 W. 42nd St., New York, N. Y. Manufacturer of bronze powders.

UNITED STATES CHAIN & FORGING CO.—Pittsburgh, Pa. Manufacturer of power transmission chains. President,

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Robert J. McKay; vice-president and treasurer, Thomas J. McKay; vice-president and sales manager, C. M. Power. Main office, Union Arcade, Pittsburgh, Pa. Branch offices, 30 Church St., New York, N. Y.; Monadnock Bldg., San Francisco, Cal.; 30 Euclid Arcade, Cleveland, Ohio; 632 Munsey Bldg., Washington, D. C.; 214 N. 6th St., St. Louis, Mo. Sales representative, William H. Spear Co., 1st National Bank Bldg., Chicago, Ill.

U. S. CLOTH CUTTING MACHINE CO.—414-416 W. Broadway, New York, N. Y. Manufacturer of motor-driven cloth cutting machines. President and treasurer, N. Komow.

UNITED STATES ELECTRIC SIGNAL CO.—West Newton, Mass. Manufacturer of electric railway signaling systems.

U. S. ELECTRICAL MFG. CO.—3rd St. & Central Ave., Los Angeles, Cal. Manufacturer of electric buffers, grinders and motors. Business established 1905. President, Harry G. Steele; vice-president, G. S. Pinney; secretary, treasurer and general manager, Carl E. Johnson; sales manager, F. C. Webber.

U. S. ELECTRICAL TOOL CO., THE.—Cincinnati, Ohio. Manufacturer of electric drills and grinders. Business established 1904. President and general manager, J. A. Smith; vice-president, C. J. Smith; secretary, G. E. Smith; treasurer, G. H. Feltes; general manager, J. A. Smith. Main office, 2480 W. 6th St., Cincinnati, Ohio. Branch offices, New York, N. Y.; Boston, Mass.; Philadelphia, Pa.; Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Chicago, Ill.

U. S. ELECTRO GALVANIZING CO.—32-34 Stockton St., Brooklyn, N. Y. Manufacturer of electroplating and electrogalvanizing equipment.

U. S. EXPANSION BOLT CO.—New York, N. Y. Manufacturer of expansion bolts, conduit clamps, etc. President, J. H. Benedict; vice-president and general manager, L. R. Zifferer; secretary, F. H. Clute; treasurer, H. E. Champion; sales manager, E. W. West. Main office, 139 Franklin St., New York, N. Y. Foundry, Columbia, Pa. Branch offices, Chicago, Ill.; San Francisco, Cal.

UNITED STATES FUSE CO.—Buffalo, N. Y. Manufacturer of refillable fuses.

U. S. GLASS CO.—Pittsburgh, Pa. Manufacturer of illuminating glassware.

U. S. GUTTA PERCHA PAINT CO.—12 Dudley St., Providence, R. I. Manufacturer of protective and insulating paints, etc. President and treasurer, Herbert W. Rice; secretary, Charles W. Eastwood; sales manager, Alex. S. West.

UNITED STATES HAMMERED PISTON RING CO.—Irvington, N. J. Manufacturer of piston rings, milling machinery, etc. President, A. W. Wenzell; vice-president, B. J. Wenzell; secretary, Michael Wenzell; treasurer, H. M. Bailey.

UNITED STATES HARDWARE & MFG. CO.—16 Warren Ave., Pawtucket, R. I. Manufacturer of pole-line hardware. Business established 1920. President and general manager, John D. Sawyer; treasurer, John R. White.

U. S. HEADLIGHT CO.—Letchworth & Dart Sts., Buffalo, N. Y. Manufacturer of headlights and headlight generating sets. President J. J. Kirby, Jr.; vice- president, W. W. Willitts; secretary and treasurer, E. H. Castle; general manager, R. E. Johnson; sales manager, A. E. Briggs.

U. S. INDESTRUCTIBLE GASKET CO.—Fulton & Church Sts., New York, N. Y. Manufacturer of lead gaskets, bars, sheet, etc.

UNITED STATES INDEPENDENT TELEPHONE ASSOCIATION.—An organization of telephone operating and manufacturing companies not owned or controlled by the American Telephone & Telegraph Co. or any of its subsidiaries. In 1916 the National Independent Telephone Association, organized in 1900, and the Independent Telephone Association of America, organized in 1913, were consolidated to form the United States Independent Telephone Association. Its purpose is "to aid the independent telephone industry to furnish to its members information and advice upon all subjects relating to telephony; and to authorize its officers or committees to represent the independent telephone interests before any commission, executive officer, legislative or regulatory body of the United States or any State."

Active membership is limited to independent telephone operating and manufacturing companies. The association has 1000 such members, located in 42 States, and composed of the larger independent companies and practically all of the independent manufacturers of telephone equipment. Associate membership can be held by anyone in the employ of a member company.

Offices are maintained at 19 S. LaSalle St., Chicago, and at 522 Colorado Bldg., Washington, D. C. The association represents its members before all government departments, especially looking after their interests before the Interstate Commerce Commission.

The officers of the association for 1920-21 are: Chairman of the board, E. B. Fisher, Grand Rapids, Mich; president, F. B. MacKinnon, Washington, D. C.; vice-presidents, Frank L. Beam, Mt. Vernon, Ohio, J. B. Earle, Waco, Texas, W. S. Vivian, Chicago, Ill.; secretary-treasurer, C. C. Deering, Des Moines, Ia. The board of directors is composed of these officers and 25 other directors.

U. S. INDICATOR.—Trade name for boiler water level gages manufactured by the L. Steigert Co., Elder & Logan Sts., Cincinnati, Ohio.

U. S. LIGHT & HEAT CORP.—Niagara Falls, N. Y. Manufacturer of electric automobile starters, railroad car lighting systems, storage batteries and arc welders. President, C. O. Miniger; vice-presidents, C. L. Lane, R. H. Van Nest, R. C. Caples; secretary, R. H. Van Nest; treasurer, H. H. Knapp; sales managers, J. A. White, H. A. Mathews, G. L. Kyle. Main office and factory, Niagara Falls, N. Y. Branch offices, 30 E. 42nd St., New York, N. Y.; 411 Kresge Bldg., Detroit, Mich.; 1402 Railway Exchange Bldg., Chicago, Ill.; 316 Dwight Bldg., Kansas City, Mo.; 837 Monadnock Bldg., San Francisco, Cal.; 913 Munsey Bldg., Washington, D. C.

U. S. METAL & MFG. CO.—165 Broadway, New York, N. Y. Manufacturer of iron and steel poles.

UNITED STATES MINERAL WOOL CO.—280 Madison Ave., New York, N. Y. Manufacturer of boiler coverings, etc. Secretary and treasurer, George S. Beith; general manager, Henry Franz.

UNITED STATES REDUCTION CO.—East Chicago, Ind. Manufacturer of aluminum, babbitt metal, copper, etc.

UNITED STATES RUBBER CO.—New York, N. Y. Manufacturer of insulated wires and cables, belting, packing, tires, tubing and other rubber products. Main office, 1790 Broadway, New York, N. Y. Branch offices, for insulated wire, 547 W. Van Buren St., Chicago, Ill.; 201 Devonshire St., Boston, Mass.; 568 1st Ave., S., Seattle, Wash.; Dime Savings Bank Bldg., Detroit, Mich.; 7th & Lawrence Sts., Denver, Colo.; 583 Howard St., San Francisco, Cal.; 308 E. 3rd St., Los Angeles, Cal.; 240 S. 6th St., W., Salt Lake City, Utah.

UNITED STATES SILICA CO.—1970 Peoples Gas Bldg., Chicago, Ill. Manufacturer of sand-blast equipment. President, A. Volney Foster; vice-president, Lewis B. Reed; secretary and sales manager, H. F. Goebig.

U. S. SLICING MACHINE CO.—LaPorte, Ind. Manufacturer of electric meat slicers. Business established 1910. President and general manager, J. C. Woodington; vice-president, Charles Dapp; secretary and treasurer, Gerard Elshout; sales manager, N. R. Roudthaler. Main office and factory, LaPorte, Ind. Branch offices, Chicago, Ill.; New York, N. Y.; Philadelphia, Pa.; Boston, Mass.; Buffalo, N. Y.; Pittsburgh, Pa.; Detroit, Mich.; San Francisco, Cal.

U. S. STANDARD.—Trade name for electric blasting apparatus manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

UNITED STATES STEEL CORP.—71 Broadway, New York, N. Y. President, J. A. Farrell; vice-presidents, D. G. Kerr, J. Reis; secretary and treasurer, R. Trimble. Parent organization of the following subsidiaries, which manufacture iron and steel of all kinds, and steel products, such as wires, steel plates, rails, etc.; Alabama Steel & Shipbuilding Co.; American Bridge Co.; American Sheet Steel Co.; American Steel Hoop Co.; American Steel & Wire Co.; American Tin Plate Co.; Carnegie Steel Co.; Clairton Steel Co.; Federal Steel Co.; Lake Superior Consolidated Iron Mines; National Steel Co.; National Tube Co.; Risdon Iron & Locomotive Works; Schoen Steel Wheel Co.; Shelby Steel Tube Co.; Tennessee Coal, Iron & Railroad Co.; Troy Steel Products Co.; Union Steel Co.; Universal Portland Cement Co.

UNITIZE.—Trade name for electric heating devices made by the S. U. E. Co., 89 Beach St., Boston, Mass.

UNITLITE.—Trade name for industrial lighting fixture manufactured by the Harter Mfg. Co., 522 S. Clinton St., Chicago, Ill.

UNITS, LIGHTING.—See Lighting units, ornamental street; Lighting units, yard, dock, playground, etc.; Lighting units, office and store.

UNITS, RESISTANCE, MISCELLANEOUS.—Resistance units are made up in a number of sizes for various purposes, such as in signal circuits for railways, telegraph and telephone systems, and for many other miscellaneous uses in connection with small motors, vibrators, etc., and in some cases as replaceable units for rheostats or starting boxes.

The units are sometimes made up in special forms adapted to the particular service, and there are also more or less standard forms that may screwed in a medium-base socket or receptacle or in a bayonet socket. Other forms are made to fit in clips like a ferrule type cartridge fuse. Most of these are either mounted on porcelain blocks or disks or in porcelain or molded composition tubes.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "Maxohm."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display ad pages 1292-1293.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Indianapolis Switch & Frog Co., Springfield, Ohio.
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill.
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Sundh Electric Co., 209 Parkhurst St., Newark, N. J.
Ward Leonard Electric Co., Mt. Vernon, N. Y. "Vitrohm."
Weeks Mfg. Co., H. G., Hamilton, Ohio.
Wirt Co., 5221 Greene St., Philadelphia, Pa. "Di-el-ite."

UNITS, RESISTANCE, STANDARD OR PRECISION.—The ohm is defined in terms of the resistance of a standard column of mercury. This is not a convenient form in which to embody the unit, hence, for practical use resistance units are made of a metal of high resistivity and low temperature coefficient in the form of wire or ribbon. An alloy called manganin is usually employed because of its very low temperature coefficient.

In general, standard resistances may be divided into two classes: those used for the measurement of resistance, and those used with potentiometers for measuring currents. The latter are in reality standard shunts. The resistance standards are made in two forms, the N. B. S. and Reichsanstalt. In the N. B. S. form the manganin coil is wound on a metal cylinder baked in shellac. It is attached to a hard rubber top by heavy copper terminals and screwed into a cylindrical metal case which is entirely filled with oil. The case is hermetically sealed and the resistance is checked against a primary standard. N. B. S. standard resistances are regularly made in values of 1, 10, 100, 1000, and 100,000 ohms and are adjusted to an accuracy of 0.01%.

The Reichsanstalt form also is made of manganin wire wound on a metal cylinder from which it is insulated by silk, which is shellacked and baked on it. The wire is double-silk-covered, shellacked and baked at a high temperature. The wire terminals are silver-soldered to copper blocks which in turn are screwed and soldered to heavy nickel-plated copper terminals. The coil is also enclosed in a case which is perforated to permit the entrance of oil as the coils, when in use, are immersed in an oil bath.

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ing to the exposed condition of the coils, ir values are liable to change, especially ocations where wide changes in humid- occur. They are made in the same ies as the N. B. S. form and in addition values of 0.1, 0.01 and 0.001 ohm.

tandard resistances for current measnent are also made of manganin, usualn the form of a ribbon. They have e radiating surfaces and are provided both current and potential terminals. e are designed to be used in oil while rs may be used in air. They are regumade in sizes from 0.1 to 0.00001 ohm, ng current-carrying capacities ranging 0.1 to 3000 amperes.

nufacturers:

neral Radio Co., 11 Windsor St., Cambridge, Mass.

EDS & NORTHRUP CO., 4901 Stenton ve., Philadelphia, Pa.

aefer Bros. Co., 1059 W. 11th St., Chiago, Ill.

t Co., 5221 Greene St., Philadelphia, a. "Di-el-ite."

nall-Waring Co., Mermaid Ave., hestnut Hill, Philadelphia, Pa. "Yaray."

ITS, SYSTEMS OF.—Units for physieasurements may be classified under is heads, but there are three ele- physical entities whose units are ases of other units. The elemental s or fundamental concepts of physilations are length, mass and time, ost physical quantities can be ex- in terms of these. For this reason, its of length, of mass and of time lled fundamental units and all other which can be expressed in terms of re called derived units. For exame unit of velocity is a derived unit, the velocity when unit distance is over in unit time.

stem of units which consists of the ental units and the derived units n these is called an absolute sys- Many of the units of the absolute are inconvenient and standards of an not be constructed, so another known as the practical system has evised. The units in the practical are usually some multiple of the unit. The practical units have n defined in terms of certain defiocrete standards which can be re- with reasonable accuracy.

echanical measurements only three ntal units are necessary, but every system of electrical units requires damental units. The necessity for additional unit arises from the fact identity of mechanical and elecenomena has not been established. our entities taken as fundamental, mechanical and one is electrical. hanical units are those of length, time, and the electrical unit is on a property of the electrostatic magnetic medium. The property dium utilized is the dielectric con- the electrostatic system and the permeability in the electromagem.

olute units used in electrical and measurements are based on two properties or reactions. In one repulsive force between two like d in the other the repulsive force wo like magnet poles are taken es. The former is known as the ic system and the latter as the netic system.

moving charge is surrounded by field, and the motion of a conoss a magnetic field produces a the conductor, electrostatic and netic phenomena are related. n between the units in the two s been determined experimentalbe found in conversion tables.

Electrical Units. There are ms of units used in electrical practice, the absolute electrolute electromagnetic, and the ctromagnetic. The fundamental of the units in either of these e introduced certain inconveni- Many attempts have been viate these inconvenient factors the more common calculations, reason or another these systems me into general use.

tic Units. Electric charges exert traction and repulsion, dependeir nature. The fact that like l each other is the basis of the unit quantity. The electrohave no distinctive names and marily in theoretical investigations. The more common electrostatic quantities are charge, difference of potential and capacitance.

The electrostatic unit of charge or quantity is that quantity which will exert a force of one dyne upon an equal and like quantity at a distance of one centimeter in air. It is sometimes called "statcoulomb."

A unit difference of electrical potential exists between two points when it requires an expenditure of one erg of work to bring a plus unit of electricity from one point to the other point. It is sometimes called "statvolt."

The electrostatic unit of capacitance is that capacitance which requires a charge of one electrostatic unit of quantity to produce one electrostatic unit difference of potential. It is sometimes called "statfarad."

Electromagnetic Units. The basis of the electromagnetic units is the fact that two like magnetic poles repel. A unit magnet pole is defined as that pole which will exert a force of one dyne upon a like and equal pole at a distance of one centimeter in a vacuum. The similarity between the definition of unit electrostatic charge and unit magnet pole is obvious. In one case the force is electrical and in the other it is magnetic. The dimensional formulas differ only in the electric and magnetic properties of the medium.

The electromagnetic system of units may be divided into two groups on the basis of the quantities to be measured. These are electrical and magnetic. The electrical quantities for the measurement of which units are necessary are current, quantity of electricity or charge, electromotive force, resistance, power, work or energy, inductance and capacitance (also formerly called capacity). The absolute units of the above quantities have no distinctive or separate names. They are usually distinguished by the prefix ab to the corresponding practical unit. The practical units of these quantities correspond to those adopted as the International electrical units.

International System of Electrical Units. The London Electrical Conference of 1908 defined the international ohm and international ampere in terms of specified standards. These two, together with the units of length and time, are regarded by some writers as forming the basis of a distinct system. Since the phenomena surrounding the electric current are more familiar and of greater practical importance than electric charges or magnetic poles, the international system is the most convenient and the most used system of electrical units. This international system is based on the practical electromagnetic units, eight of which have been defined by international congresses. These are: ohm, ampere, volt, coulomb, henry, farad, joule and watt (see definition of each of these units under its name).

Magnetic Units. A subdivision under the electromagnetic system of units is that group of units developed particularly for the measurement of magnetic quantities. Part of these units are based directly on the conception of a unit magnetic pole; others derived from these deal with the relations in the magnetic circuit, which is conceived to be analogous to the electric circuit. Practically all these magnetic units are C. G. S. or absolute units, only a few of them being practical units. The principal magnetic quantities for which units have been developed are: Unit pole strength, magnetic field intensity, magnetic flux, magnetic induction, magnetizing force, magnetomotive force, reluctance, permeability, susceptibility, reluctivity. Several of these units have no distinctive name; six have been given the names of gauss, ampereturn, maxwell, gilbert, oersted and weber; definitions of these are given under their respective names.

C. G. S. System of Units. The C. G. S. system of units comprises units for all physical quantities that can be derived from the fundamental units of length, mass and time in which the centimeter, gram and second are used as these fundamental units. The absolute electrostatic and electromagnetic systems of units are C. G. S. units.

Metric Units. The units used in electrical measurements are all based on the metric units which were created in France in 1792 and have been adopted by most of the countries of continental Europe and South America. The metric system of mechanical units is built upon two fundamental units, a unit of length and one of mass. Although an attempt was made to have the unit of length equal 0.0000001 of the length of one-fourth of the meridian that passes through Paris, it is nevertheless an arbitrary unit of length which is defined as the distance between two certain lines on the surface of a platinum-iridium bar preserved at the International Bureau of Weights and Measures at Sievres, France. This length is divided into 100 parts called centimeters (abbreviated cm.). The centimeter is divided into tenths known as millimeters (abbreviated mm.); thus 1mm.= 0.001 meter. The kilometer equals 1000 meters; 1km.=0.621 mile.

The other arbitrary unit is the kilogram, which is a mass of platinum-iridium, also kept at the International Bureau of Weights and Measures; one-thousandth of this mass is called the gram. Also see Mass.

All other metric units are derived from these, as multiples or submultiples of ten. The corresponding standards in the so-called English system are the yard and the pound. One yard equals 0.914 meter and 1 meter equals 1.094 yards. Some other relations are: 1 meter=39.37 ins.; 1 cm.=0.3937 inch; 1 inch=2.54 cm.; 1 kilogram (kg.)= 1000 grams=2.205 pounds (lbs.); 1 lb.= 453.5924 grams.

English Units. The English units in common use can scarcely be called a system of units, for there is no consistent connection or relation between them. The fundamental unit of length is the yard, which at present is defined in terms of the meter, according to the ratio: one yard=3600/3937 meter. The unit of mass in the English system is the pound, which is likewise defined in terms of the international kilogram according to the relation: one pound= 453.59243 grams. The units of volume in the English system bear no simple relations to the unit of length and accordingly these units are not so easily convertible.

UNITS, X-RAY.—See X-ray units or sets, dental.

UNITY.—Trade name for electric carbonators manufactured by the Rud Mueller Mfg. Co., 4310 N. California Ave., Chicago, Ill.

UNIVERNISH.—Trade name for protective varnish manufactured by the Murphy Varnish Co., Chestnut & McWhorter Sts., Newark, N. J.

UNIVERSAL.—Trade name for electric spot welder manufactured by the Automatic Controller & Mfg. Co., 246 Washington Ave., Ogden, Utah.

UNIVERSAL.—Trade name for toggle bolts manufactured by the Barrett Sales Co., 568 W. Washington Blvd., Chicago, Ill.

UNIVERSAL.—Trade name for electric trucks and tractors manufactured by the Cowan Truck Co., Dorchester, Mass.

UNIVERSAL.—Trade name for motor-driven milk bottle fillers and cappers manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

UNIVERSAL.—Trade name for test connectors manufactured by Scott C. Cutter, Oswego, Ill.

UNIVERSAL.—Trade name for wire terminals manufactured by the Economy Mfg. Co., 616 Monroe St., Chicago, Ill.

UNIVERSAL.—Trade name for portable current transformer manufactured by the Esterline-Angus Co., Lemcke Annex, Indianapolis, Ind.

UNIVERSAL.—Trade name for ball bearings made by the Federal Bearings Co., Poughkeepsie, N. Y.

UNIVERSAL.—Trade name for radio receivers manufactured by the Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.

UNIVERSAL.—Trade name for household and industrial electrical appliances manufactured by Landers, Frary & Clark, New Britain, Conn.

UNIVERSAL.—Trade name for measuring tapes manufactured by the Lufkin Rule Co., Saginaw, Mich.

UNIVERSAL.—Trade name for lubricators manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

UNIVERSAL.—Trade name for portable lamp guards and cord adjusters manufactured by the McGill Mfg. Co., Valparaiso, Ind.

UNIVERSAL.—Trade name for battery and test clips manufactured by the Mueller Electric Co., 2135-43 Fairmount Rd., Cleveland, Ohio.

UNIVERSAL.—Trade name for polishing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

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UNIVERSAL.—Trade name for radio apparatus manufactured by the New Era Radio Sales Co., Elmira, N. Y.

UNIVERSAL.—Trade name for enclosed arc lamps manufactured by the New York Engravers' Supply, 230 W. 17th St., New York, N. Y.

UNIVERSAL.—Trade name for automobile plugs, connectors, sockets and sheet metal specialties made by the Pollak Tool & Stamping Co., 81-85 Freeport St., Dorchester, Boston, Mass.

UNIVERSAL.—Trade name for electric hair cutting machine manufactured by the Racine Universal Motor Co., 53 W. Jackson Blvd., Chicago, Ill.

UNIVERSAL.—Trade name for track grinder manufactured by the Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.

UNIVERSAL.—Trade name for current indicators manufactured by the Roller-Smith Co., 233 Broadway, New York, N. Y.

UNIVERSAL.—Trade name for electric heater manufactured by Schaar & Co., 556-558 W. Jackson Blvd., Chicago, Ill.

UNIVERSAL.—Trade name for insulator supports manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

UNIVERSAL.—Trade name for electroplating generators manufactured by the U. S. Electro Galvanizing Co., 32-34 Stockton St., Brooklyn, N. Y.

UNIVERSAL.—Trade name for farm lighting and power plants and storage batteries manufactured by the Universal Battery Co., 3410-3424 S. LaSalle St., Chicago, Ill.

UNIVERSAL.—Trade name for storage batteries and hand lanterns, manufactured by the Universal Carbon Co., 1st St. & Riverside Ave., Dundee, Ill.

UNIVERSAL.—Trade name for incandescent tungsten lamps manufactured by the Universal Electric Lamp Co., Newark, N. J.

UNIVERSAL.—Trade name for arc lamps, rheostats, border lights and footlights manufactured by the Universal Electric Stage Lighting Co., 240 W. 50th St., New York, N. Y.

UNIVERSAL.—Trade name for lightning rods manufactured by the Universal Lightning Rod Co., Hespeler, Ont., Can.

UNIVERSAL.—Trade name for fixture hanger, alcohol blow torch and automobile wrench manufactured by the Universal Mfg. Co., 2633 Randolph St., Lincoln, Neb.

UNIVERSAL.—Trade name for stationary marine motors, generating sets and pumping outfits manufactured by the Universal Motor Co., 39 Ceape St, Oshkosh, Wis.

UNIVERSAL.—Trade name for safety treads manufactured by the Universal Safety Tread Co., 40 Court St., Boston, Mass.

UNIVERSAL.—Trade name for electric washing machines manufactured by the Universal Utilities Corp., Alpena, Mich.

UNIVERSAL.—Trade name for circuit and fuse tester manufactured by the Whitall Engineering Co., 59 W. Main St., Waterbury, Conn.

UNIVERSAL.—Trade name for battery terminal cleaners manufactured by J. G. Xander, 824 Court St., Reading, Pa.

UNIVERSAL BATTERY CO.—3410-3424 S. LaSalle St., Chicago, Ill. Manufacturer of farm lighting plants and storage batteries. President, L. C. Mowry; vice-president and secretary, H. I. Holton; treasurer, A. Silberman; general manager, R. D. Mowry; sales manager, R. S. Mowry.

UNIVERSAL BEARING BRONZE CO.—Winsted, Conn. Manufacturer of lighting fixtures, fixture parts, brass anodes, brass and aluminum castings. J. A. O'Brien, secretary.

UNIVERSAL CARBON CO.—1st St. & Riverside Ave., Dundee, Ill. Manufacturer of storage batteries, commutator brushes, carbons, and hand lanterns. Business established 1913. President and general manager, Nicolas Kribs; vice-president, George J. Noth; secretary, Harry Wolterding; treasurer, William J. Bauerle.

UNIVERSAL CHAIN CO., THE.—Stroudsburg, Pa. Manufacturer of chains, nuts, washers, fixture loops, etc. President and general manager, Charles Robertson; secretary and treasurer, Louis Laupot; sales manager, Peter E. Pollano.

UNIVERSAL CONCRETE PRODUCTS CO.—122 S. Michigan Ave., Chicago, Ill. Manufacturer of concrete poles and posts for street lamps, etc. President, J. H. Hobson; vice-president, F. B. Shannon.

UNIVERSAL ELECTRIC LAMP CO.—Newark, N J. Manufacturer of incandescent lamps.

UNIVERSAL ELECTRIC STAGE LIGHTING CO.—240 W. 50th St., New York, N. Y. Manufacturer of stage and studio lighting apparatus and electrical effects. Business established 1896. Partnership, John H. Kliegl and Anton T. Kliegl.

UNIVERSAL ELECTRIC WELDING CO.—67 6th Ave., Long Island City, N. Y. Manufacturer of electric welders.

UNIVERSAL JUNIOR.—Trade name for milk bottle filler and capper manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

UNIVERSAL LIGHTNING ROD CO.—Hespeler, Ont., Can. Manufacturer of lightning rods. Business established 1909. W. Brewster, general manager. Main office and factory, Hespeler, Ont. Branch offices and warehouses, Kemptville, Ont.; Winnipeg, Man., Can.

UNIVERSAL LUBRICATING CO., THE.—Schofield Bldg., Cleveland, Ohio. Manufacturer of lubricating oil. Edward Dreher, secretary.

UNIVERSAL MFG. CO.—2633 Randolph St., Lincoln, Neb. Manufacturer of fixture hangers, automobile wrenches and blow torches. Business established 1917. President and sales manager, M. H. Wittstruck; vice-president, A. W. Andrews; secretary, C. F. Wittstruck; treasurer and general manager, W. S. Farrar.

UNIVERSAL METAL SPINNING & STAMPING CO., INC.—718 Atlantic Ave., Brooklyn, N. Y. Manufacturer of lighting fixture parts, metal spinnings and stampings. President, Simon Tepfer; secretary, David H. Engelson.

UNIVERSAL MOTOR CO.—39 Ceape St., Oshkosh, Wis. Manufacturer of stationary and marine engines, farm lighting and power plants, and pumping outfits. Business established 1913. President, J. D. Termaat; vice-president, H. E. Fahrney; secretary and treasurer, A. J. Cooper; general manager, E. H. Huesener; sales manager, C. J. Pope.

UNIVERSAL NOVELTY WORKS.—164 5th Ave., New York, N. Y. Manufacturers of electric toys, vibrators, batteries, flashlights, etc.

UNIVERSAL PRODUCTS CO.—Oshkosh, Wis. Manufacturer of farm lighting plants. President, L. E. Willson.

UNIVERSAL RADIATOR.—Trade name for electric body-heating device manufactured by the Sanitarium Equipment Co., Battle Creek, Mich.

UNIVERSAL SAFETY TREAD CO.—Boston, Mass. Manufacturer of safety treads. President, Thomas T. Booth; vice-president, G. Edwin Chapin; treasurer, Howard F. Chapin. Main office, 40 Court St., Boston, Mass. Factory, Waltham, Mass. Branch offices, 711 1st National Bank Bldg., Chicago, Ill.; 120 Liberty St., New York, N. Y.

UNIVERSAL 3 IN 1.—Trade name for shade holders manufactured by the Chicago Electric Products Co, 2730 Lincoln Ave., Chicago, Ill.

UNIVERSAL TOOL & APPLIANCE CO.—373 Broadway, Milwaukee, Wis. Manufacturer of box and cabinet cutters.

UNIVERSAL TUBE CO.—321 W Ohio St., Chicago, Ill. Manufacturer of cash and parcel carrier systems. President, Henry Newgaard; vice-president Charles Schleyer; secretary, Charles Shirk; treasurer and general manager, Joseph Rose.

UNIVERSAL UNAFLOW.—Trade name for steam engines manufactured by the Skinner Engine Co., Erie, Pa.

UNIVERSAL UTILITIES CORP.—Alpena, Mich. Manufacturer of electric washing machines.

UNIVERSAL WINDING CO.—Boston, Mass. Manufacturer of coil winding machines. President, Joseph R. Leeson; vice-president, Edmund W. Converse; secretary, Frederick H. Bishop; treasurer, Robert A. Leeson. Main office, 95 South St., Boston, Mass. Factory, Providence, R. I. Branch offices, New York, N. Y.; Philadelphia, Pa.; Utica, N. Y.; Chicago, Ill.; Charlotte, N. C.; Atlanta, Ga.

UNIVERSALAK.—Trade name for insulating varnish manufactured by the John C. Dolph Co., 168 Emmett St., Newark, N. J.

UNIVERSALMODE.—Trade name for electrotherapeutic apparatus manufactured by the McIntosh Battery & Optical Co., 223-233 N. California Ave., Chicago, Ill.

UNLOADERS, AUTOMATIC, FOR ELECTRIC AIR COMPRESSOR.—To start an air compressor under load requires a starting torque far in excess of that developed in a motor sufficient to operate after starting. Such compressors are therefore equipped with a motor of sufficient power for operation but employ an auxiliary mechanical device, an unloader, which releases the load during starting so as not to overload the motor or impose a very heavy starting load on the line. These automatic unloaders are much used on automatically controlled motor-driven air compressors that have the compressor start and stop so as to keep the air pressure between certain limits.

Manufacturer:

Hale Electric & Engineering Co., 1114 Guardian Bldg., Cleveland, O. "Hale."

UNMOUNTED BELLS.—See Bells, unmounted.

UNMOUNTED GONGS.—See Gongs, unmounted.

UNO.—Trade name for shade holder manufactured by the Arrow Electric Co., 103 Hawthorne St., Hartford, Conn.

UNXLD.—Trade name for chandelier chains made by the National Chain Co., 8th St. & 3rd Ave., College Point, N. Y.

UPCO.—Trade name for farm lighting plants manufactured by the Universal Products Co., Oshkosh, Wis.

UP-RITE.—Trade name for blueprint cabinets manufactured by the Frederick Post Co., 319 S. Wabash Ave., Chicago, Ill.

UPTON MACHINE CO.—St. Joseph, Mich. Manufacturer of electric washing machines. President, L. C. Bassford; vice-president and general manager, L. C. Upton; secretary and treasurer, F. S. Upton.

UP-2-DATE.—Trade name for electric washing machine manufactured by the Thistle Mfg. Co., 5716 Armitage Ave., Chicago, Ill.

URNS, COFFEE, ELECTRIC, RESTAURANT AND HOTEL.—Coffee cooking vessels of large capacity, permanently installed with water pipe connections and provided with electric battery units located beneath or in the bottom of the tank. They are of the same general type as the gas-heated or live-steam-heated appliances commonly used in lunch rooms, coffee shops, restaurants, hotels, etc., and usually are highly finished in nickel. The wattage rating depends on the size of the urn.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)

Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."

National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."

Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."

Weeks Mfg. Co., H. G., Hamilton, Ohio.

URNS, COFFEE, ELECTRIC, TABLE OR HOUSEHOLD.—These are special forms of portable electric household coffee percolators that are provided with a faucet to draw off the coffee, instead of having a long spout to pour it by tipping the pot. Many of these table urns are also more elaborately finished than the pot type percolator, silver plating and special designs to enhance the appearance being sometimes employed. In their percolating features and capacity they are practically the same as the plainer types of electric percolators.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

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EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. This company manufactures four types of urns, each holding nine cups. They come in two designs, plain and panelled. All are constructed of heavy sheet copper,



"Hotpoint" Coffee Urn

lined with silver and finished in polished nickel. Mounted on three footed pedestals; feet fiber tipped; handles and faucet of ebonized wood. Equipped with the famous Hotpoint percolating apparatus and safety switch. The safety switch prevents burnouts, breaking the circuit should the urn boil dry. See display adv. pages 1292-3.—Adv.

NDERS, FRARY & CLARK, New Britain, Conn. "Universal."
tional Electric Heating Co., Ltd., The, 44 Queen St., Toronto, Ont., Can. National."
eks Mfg. Co., H. G., Hamilton, Ohio.
STINGHOUSE ELECTRIC & MFG. O., East Pittsburgh, Pa. (See display dv. pages 1395-1402.)

NS, TEA, ELECTRIC.—This is a portype of highly finished vessel for brewa on the dining table. It is provided flexible cord and attachment plug for ction to the supply circuit and de- with electric heating element limn capacity to 660 watts. The tea is ed in a sieve-like tea ball supported chain through the cover. After the is brought to boiling the current is f and the tea ball lowered into the until the tea is suitably steeped one to three minutes); then the ball in pulled up and the tea is ready to In the tea urn a faucet is usually ed to draw off the tea. If a long is provided requiring tilting of the to pour the tea, the outfit is more alled a tea pot. Whether a tea pot is used, the electric appliance with l is far superior to the old-fashioned tle which was used for boiling the only and required a separate tea steep the tea and finally a sieve to ack the leaves in pouring. These ages have made the electric tea urn ed companion device to the electric percolator. This type of tea urn is nes also called "samovar," from a fuel-heated appliance employing -ball principle.

facturers:

hall, Deane Co., 261-265 W. 36th New York, N. Y. "Deane."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Weeks Mfg. Co., H. G., Hamilton, Ohio.

URNS, WATER, ELECTRIC, RESTAURANT AND HOTEL.—Vertical tanks or vessels used in lunch rooms, restaurants and hotels and provided with electric heating elements designed for furnishing a constant supply of hot water, chiefly for use in making tea and cocoa and for diluting coffee, etc. These urns are almost invariably heavily nickel-plated, both for appearance and to minimize heat radiation. A three-heat switch is provided to regulate the heat.

Manufacturers:

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
Electric Heating & Mfg. Co., Westlake & Republican Sts., Seattle, Wash. "Apfel's."
National Electric Heating Co., Ltd., The, 544 Queen St., Toronto, Ont., Can. "National."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Weeks Mfg. Co., H. G., Hamilton, Ohio.

U S A.—Trade name for polishing wheels manufactured by the Eastern Felt Co., Winchester, Mass.

USACO.—Trade name for motor-driven air compressors manufactured by the United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio.

USALITE.—Trade name for porcelain insulators for high temperatures manufactured by the Stupakoff Laboratories, 6617-6627 Hamilton Ave., Pittsburgh, Pa.

USE.—Trade name for attachment plugs manufactured by the Best Electric Corp., 476 Broadway, New York, N. Y.

USE.—Trade name for expansion bolts, conduit and pipe clamps, pipe hangers, etc., manufactured by the U. S. Expansion Bolt Co., 139 Franklin St., New York, N. Y.

U. S. E. M. CO.—505 W. 42nd St., New York, N. Y. Manufacturer of signaling systems, connectors, push buttons, bells, etc. President and treasurer, T. H. Joseph; vice-president and secretary, D. R. Lovejoy; general manager, F. J. Hendrickson.

USEPLUG.—Trade name for heating device plug manufactured by the Best Electric Corp., 476 Broadway, New York, N. Y.

U. S. JUNIOR.—Trade name for electroplating barrel manufactured by the U. S. Electric Galvanizing Co., 28-34 Stockton St., Brooklyn, N. Y.

USL.—Trade name for electric automobile starters, railroad car lighting systems, storage batteries and arc welders manufactured by the U. S. Light & Heat Corp., Niagara Falls, N. Y.

U. S. N. DECK.—Trade name for protective paint and varnish manufactured by the Billings-Chapin Co., 1153 E. 40th St., Cleveland, Ohio.

USONA MFG. CO., INC., THE.—1 Hudson St., New York, N. Y. Manufacturer of flashlights. Business established 1914. President, A. S. Lyhne; secretary, H. K. Beach; treasurer and general manager, George G. Beers. Factory, Bridgeport, Conn.

UTENCO.—Trade name for electric fireless cookers and household ironing machines, manufactured by the Utensils Co., 303 E. Columbia St., Ft. Wayne, Ind.

UTENSILS CO.—303 E. Columbia St., Fort Wayne, Ind. Manufacturer of electric fireless cookers and household ironing machines. Business established 1920. President and general manager, L. M. Williams; vice-president, A. I. Clifford; secretary and treasurer, W. A. Hobson. Sales representative, C. M. C. Electric Sales Co., 507 Odd Fellow Bldg., Indianapolis, Ind.

U. T. E.-PROCTOR.—Trade name for motion picture machines manufactured by the United Theatre Equipment Corp., 25 W. 45th St., New York, N. Y.

UTICA.—Trade name for nippers and pliers manufactured by the Utica Drop Forge & Tool Co., 2415 Whitesboro St., Utica, N. Y.

UTICA DROP FORGE & TOOL CO.—Utica, N. Y. Manufacturer of nippers and pliers. Business established 1888. President, W. P. White; vice-president and general manager, H. F. Kelleman; secretary and treasurer, Hugh White; sales manager, J. Edward O'Toole. Main office, 2415 Whitesboro St., Utica, N. Y. Branch office, 68 Murray St., New York, N. Y.

UTICA FIRE ALARM TELEGRAPH CO.—Utica, N. Y. Manufacturer of fire alarms. President, A. J. Potter; vice-president, W. H. Pryor; secretary and treasurer, Thomas E. Jones.

UTILAPHONE.—Trade Name for hand set telephones manufactured by the Samson Electric Co., Canton, Mass.

UTILITY.—Trade name for floor polishing, scrubbing, surfacing machines, etc., manufactured by the Kent Vacuum Cleaner Co., Inc., Rome, N. Y.

UTILITY.—Trade name for storage batteries for automobile lighting and starting manufactured by the Utility Battery Co., 123 W. Madison St., Chicago, Ill.

UTILITY.—Trade name for spark plugs manufactured by the Utility Co., 636 W. 44th St., New York, N. Y.

UTILITY.—Trade name for electric household refrigerator manufactured by the Utility Compressor Co., 355-364 Harper Ave., Detroit, Mich.

UTILITY.—Trade name for ground connection clamps manufactured by the Utility Fittings Co., 812 Walnut St., Philadelphia, Pa.

UTILITY BATTERY CO.—123 W. Madison St., Chicago, Ill. Manufacturer of storage batteries for automobile lighting and starting. President, H. L. Wuerfel; secretary, George M. Merker; treasurer, T. C. Frederich. Factory, Mount Prospect, Ill.

UTILITY COMPRESSOR CO., THE.—355-364 Harper Ave., Detroit, Mich. Manufacturer of electric household refrigerators, pumps and air compressors. President, E. R. Hasse; vice-president, J. W. Foster; secretary, G. J. Lehmann; treasurer, T. P. Stephens.

UTILITY FITTINGS CO., THE.—812 Walnut St., Philadelphia, Pa. Manufacturer of ground connection clamps.

UTILITY SHADE CO.—Tenafly, N. J. Manufacturer of lamp shades. Business established 1893. President, James B. Strong; vice-president, William P. Eager; secretary, George W. Conklin; treasurer and general manager, H. A. C. Hellver.

UTOPIA.—Trade name for illuminating glassware manufactured by the Pittsburgh Lamp Brass & Glass Co., 607 Chamber of Commerce Bldg., Pittsburgh, Pa.

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V

V.—The letter V is the chemical symbol for the element vanadium. It is also used as a symbol for potential difference or voltage. The form v is used as an abbreviation for volt and an abbreviation and symbol for velocity.

V. & D. ELECTRIC CO—335 S. Center St., Franklin, Ohio. Manufacturer of incandescent lamps. Business established 1915. President and general manager, John S. Van Horne; vice-president, R. A. Holden, Jr.; secretary and treasurer, D. D. Thirkield. Sales representative, American Appliance Co., 209 S. Meridian St., Indianapolis, Ind.

VAC-M.—Trade name for lightning arresters manufactured by the Michigan Electric Specialty Co., Muskegon, Mich.

VAC-M.—Trade name for lightning arresters manufactured by the National Electric Specialty Co., Toledo, Ohio.

VACULITE.—Trade name for impregnating compound manufactured by the John C. Dolph Co., 168 Emmittee St., Newark, N. J.

VACUNA.—Trade name for portable vacuum cleaners made by the Kent Vacuum Cleaner Co., Inc., Rome, N. Y.

VACUUM CLEANER.—A vacuum cleaner is a machine or device, usually motor-driven, which produces sufficient suction or vacuum to draw dust, dirt, threads, lint, small crumbs and other particles from a rug, carpet, or other surface and deposit them in a bag or other receptacle, or means for discharge into a sewerage system.

The electric vacuum cleaner is one of the important household appliances which are being quite universally adopted. This is shown by the value of their sales, which in the United States in 1914 amounted to $1,300,000. In 1919, this total had reached the sum of $20,000,000 and was estimated at close to $40,000,000 for 1920.

Vacuum cleaning, or suction cleaning as it is often called, has made such rapid headway because it is decidedly superior to the old-fashioned method of cleaning by brooms brushes and so-called carpet sweepers. All these old methods merely loosen and stir up the dust and dirt and throw the finer particles into the air from which they slowly settle back, in the mean time compelling the person who does the sweeping (and others in the vicinity) to inhale clouds of filthy dust. As soon as the electric vacuum cleaner was developed, housewives recognized it at once as not only a means of saving hard and disagreeable labor but of making the household far more sanitary.

Electric vacuum cleaners are made in three principal types, the portable, semi-portable and stationary. Each of these types has a distinct field of service, which is described below. In each type it is possible, by the use of special attachments to clean nearly any kind of household or other furnishings, including rugs, carpets, drapes, portieres, upholstery, mattresses, curtains, bookcases, plate rails, moldings, radiators, etc.

By providing sufficient suction, electric vacuum cleaners may be used even for sucking up dust and dirt from a bare floor, but this is usually beyond the range of the ordinary portable cleaner. The latter is designed to take care of the average kinds of floor coverings usually found in residences. For rugs of delicate weave excessive suction is not desirable. For cleaning rugs or carpets in office buildings, hotels and clubs, greater suction is commonly used, this being obtained from stationary outfits installed in the basement and connected to the various floors by piping systems, or by semiportable sets that can be moved about in the corridors or hallways. The latter type of equipment is also much used for cleaning railroad sleeping, parlor, dining and other passenger cars.

Vacuum cleaning machines have also been developed for street cleaning, usually being of the gasoline-electric type. The straight electric type of street cleaner could be applied very advantageously on streets equipped with overhead trolley wires. Probably the only reason why this has not been done is that municipalities would expect the street-railway companies to provide the equipment and do the cleaning without expense to the community, which is manifestly unfair to the railways which do not bring dirt and litter upon the street. Also see Sweepers, street, electric.

VACUUM CLEANER ATTACHMENTS.—These are the attachments often sold with vacuum cleaners and designed to be used with them for cleaning radiators, bookcases, portieres, mattresses, upholstery, etc. They consist of flexible hose with a coupling or swivel attachment for fastening to the cleaner case directly in front of the fan, or to any outlet in stationary plants. The other attachments are variously shaped nozzles, usually of nickel-plated steel or brass, suited for use with the various furnishings mentioned above; some of these attachments are provided with stationary brushes at the edge of the nozzle. Sets of attachments are sometimes sold separately so that they may be added to a cleaner outfit that was purchased originally without them in the belief that it would be used only for cleaning floor coverings, or to reduce the initial investment cost.

Manufacturers:

American Radiator Co., 816-22 S. Michigan Ave., Chicago, Ill.
Clements Mfg. Co., 609 Fulton St., Chicago, Ill.
ELECTRIC VACUUM CLEANER CO., INC., THE. Ivanhoe Rd., Cleveland, Ohio. See entry under Vacuum cleaners, portable. Also see display adv. page 1298.—Adv.
Electrical & Specialty Supply Co., 9 S. Clinton St., Chicago, Ill.
Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."
Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Morrow Co., The, Waukegan, Ill.
Pneuvac Co., 164 Fremont St., Worcester, Mass.
Ramey Mfg. Co., Columbus, Ohio.
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Torrington Co., The, (National Sweeper Division), Torrington, Conn.
United Electric Co., The, Canton, Ohio.
Wise-McClung Mfg. Co., The, New Philadelphia, Ohio.

VACUUM CLEANER BRUSHES, CASINGS, DUST BAGS, NOZZLES AND OTHER PARTS.—These parts of vacuum cleaners are not always made by the vacuum-cleaner manufacturers, but are made in other factories to their specifications and drawings. The brushes are of three types, either stationary, revolved by the movement of the cleaner or revolved by the motor. Casings are usually made of aluminum or thin steel to give lightness and strength. They are made largely by manufacturers specializing in aluminum castings, etc. Dust bags are fabric bags in which the dust is collected. They are commonly lined with a heavy fabric, or chemically treated to keep the dust from going through. Heavy paper bags have also been used to some extent. The nozzles are also made of aluminum, as a rule, and are made by the aluminum manufacturers.

Some of the vacuum-cleaner manufacturers make these parts for themselves and also supply them to others and for replacement and repair service.

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Manufacturers:

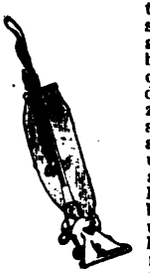
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Electrical & Specialty Supply Co., 9 S. Clinton St., Chicago, Ill.
Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill.
Ramey Mfg. Co., Columbus, Ohio.
Torrington Co., The, (National Sweeper Division), Torrington, Conn.
United Electric Co., The, Canton, Ohio.

VACUUM CLEANERS, PORTABLE.—Portable vacuum cleaners are the light portable outfits designed primarily for use in residences for cleaning rugs and carpets. By means of special attachments and by using a connecting hose they are adapted for cleaning wall hangings, mattresses, upholstery, bookcases, moldings, radiators, etc. The machines consist of a small fractional-horsepower motor, usually enclosed in an aluminum or sheet steel casing. A small steel or other metal fan is driven by the motor within the casing and sucks up the dust and dirt with the air drawn through the carpet or rug and deposits it in a fabric dust bag just above the motor, the air escaping through the fine meshes of the bag. Various nozzles and attachments are used with the outfit. The most common is the nozzle designed for direct use on the carpet or rug lying on the floor. This usually forms an extension of the casing, protruding downward in front so as to be held close to the rug. Most cleaners have small wheels or casters to support the weight of the casing and motor. A brush is quite commonly provided to loosen threads, lint, etc., so that they may be picked up more readily. The brushes are either stationary and just sliding over the upper portion of the rug, or they may be rotated. In the latter case the rotation is imparted either by the motor or by moving the nozzle back and forth over the rug.

In some types of portable cleaners the motor, suction fan and dust receptacle are mounted separately in a casing that can be carried or wheeled about and which is connected to the nozzle by a flexible hose. This type is intermediate between the more customary type described above and the heavier type designated below as semi-portable.

Manufacturers:

Air-Way Electric Appliance Corp., Toledo, Ohio. "Air Way Junior."
APEX ELECTRICAL DISTRIBUTING CO., THE, Cleveland, Ohio. Apex electric suction cleaner. Apex suction is applied evenly across the 13-in. nozzle by reason of the exclusive divided or twin chamber design. The inclined nozzle gets under radiators and low furniture, hooks around table legs, goes up close to baseboards and pokes into corners. Removable stationary bristle brush for picking up thread, hair, lint and litter. Motor housing and nozzle complete in two sections. Weight, 10½ lbs. Swivel type rear wheel. See display adv., page opposite third cover.—Adv.



Apex Electrical Mfg. Co., Ltd., 102-104 Atlantic Ave., Toronto, Ont., Can. "Apex."
Atwood Vacuum Machine Co., 128-30 N. Water St., Rockford, Ill.
Birtman Electric Co., 640 W. Lake St., Chicago, Ill. "Bee-Vac."
Bissell Co., The C., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio. "Bissell."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Clements Mfg. Co., 609 Fulton St., Chicago, Ill. "Cadillac." "Reliable," "Little Ben." "Big Ben."
Delite Mfg. Co., The, Bryan, Ohio. "Delite."
Eclipse Machine Co., The, Sidney, Ohio. "Eclipse."

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EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric appliances. The cleaner is a straight suction cleaner. It is cast aluminum and consists of three main parts only, weighing 12 pounds. The motor is a Universal, horizontal type motor, making 9500 to 10,000 revolutions per minute, developing tremendous suction power. It has a steel fan, with electrically welded blades. The suction nozzle is 13½ ins. wide and can be raised and lowered by a thumb screw. Fitted with a stationary broom type bristle brush. Dust-tight bag. The handle has aluminum pistol grip with switch enclosed. Complete set of attachments. See display adv. pages 1292-3.—Adv.



"Hotpoint" Vacuum Cleaner

ELECTRIC VACUUM CLEANER CO., INC., Ivanhoe Road, Cleveland, Ohio. The "Premier" vacuum cleaner and the "Premier Handy Vac" have many desirable features of construction, designed to provide a permanent cleaning service at an economical operating cost. The Premier Vacuum cleaner has (A) A comfortable pistol-grip handle, equipped with switch for instant starting and stopping. A quarter turn of the knob to the right starts or stops the motor. (B) A 20 foot flexible covered cord, always ready, yet out of the way, which can be folded compactly on metal guides screwed in the handle, when the cleaner is not in use. (C) The bag is of specially woven, finest mill. It retains every atom of dust and dirt until emptied, which is done by simply pulling the clamp off the end of the bag. (D) The bag is disconnected from the cleaner by giving the connection at the bottom a light turn. Another turn will reconnect it tight and dust-proof. (E) The reliable G. E. motor is cooled by means of a small fan, mounted on the armature shaft. This forces the air through the motor and cools it during actual operation. There are no belts or cogs in the machine. (F) The extra wide nozzle of 13¼ ins. width, is tapered at the end which permits it to get into the corners of rooms and stairs. (G) A corrugated adjusting wheel raises or lowers the nozzle to the correct position for greater cleaning efficiency of rugs. (H) There are three non-marring fiber casters which are large and easy going, the rear caster adjusts the height of nozzle. (I) The nozzle revolving rubber brush is driven by air drawn thru slots in the nozzle. It has soft rubber tips that beat and vibrate the carpet, the vibration loosening the imbedded dirt and assisting the powerful suction in rendering efficient cleaning. (J) The handle of the cleaner can be adjusted and locked at any desired position by means of the lock nut, which is very conveniently located. The attachments for the Premier consist of (1) A canvas covered rubber hose. (2) An extension tube, used for reaching walls or high places. One end fits into the hose, and either No. 5 or No. 6 tool on to the other end. (3) Fibre section for connecting hose to either No. 5 or No. 6 tools when extension tube is not used. (4) Tool for connecting hose to cleaner for suction purposes. (5) Tool for cleaning clothes, couches, curtains, draperies, mattresses, etc. (6) A brush that fits on the end of tool No. 5, for cleaning walls, pictures, mouldings, etc. (7) Fibre tube for blowing dirt or dust out of radiators, pianos, drying hair or renovating pillows, or mattresses, etc. (8) A tool for connecting hose to cleaner for blowing purposes. All Premier vacuum cleaners are guaranteed. "Handy Vac" is an entirely new development in vacuum cleaners. It weighs but six pounds, and is as easy to use as an electric flat iron. It may be supported by a strap from the shoulders (see illustration), thus allowing both hands free to direct the cleaning tools. The suction is applied through a 30-in. flexible tube and through a bristle brush upholstery tool. The Handy Vac may also be used for blower purposes and when equipped with a 10-in. floor tool it may be used for cleaning rugs and floor coverings. The G-E. type air-cooled motor is thoroughly tested and guaranteed. Motor housing is of aluminum, expertly fabricated, with a black fibre handle securely fastened to projection. Bag is equipped with a slide-on clamp, easily removed for cleaning. Outfit includes a 20-ft. flexible cord. See display adv. page 1298. —Adv.



"Premier" Vacuum Cleaner



"Premier Handy Vac"

Eureka Vacuum Cleaner Co., Detroit, Mich. "Eureka."

FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. The Federal electric vacuum cleaner is a thoroughly high class machine which can prove its superiority as a dirt remover in actual competitive tests. The revolving brush gets all the surface dirt and does not wear the carpet. The motor used on the Federal cleaner is a universal type with a speed of 10,000 r.p.m. The Federal is made throughout of cast aluminum to give ample strength and durability with minimum weight. See display adv. page 1291.—Adv.



Federal Vacuum Cleaner

GEIER CO., THE P. A., Cleveland, Ohio. The Royal is scientifically designed to clean by air alone. Powerful suction is produced by a high-speed motor, horizontally mounted on large phosphor bronze bearings and so finely balanced with fan as to insure smooth operation, efficiency and durability. Nozzle is 14 ins. wide and built low for convenience, but may be adjusted to any height nap. Handle is of finely nickel-plated steel tubing, shaped for comfort, and with starting-stopping switch at finger's end. Dust bag is made of special close-weave fabric; it may be easily removed to permit attachment of hose-connector for blowing dust out of inaccessible places. —Adv.



Royal Vacuum Cleaner.

Grinnell Washing Machine Co., Grinnell Iowa. "Electric Maid."

Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Guarantee."

Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

Hoover Suction Sweeper Co., The, North Canton, Ohio. "Hoover."

HUGRO MFG. CO., Warsaw, Ind.—The Hugro Airplane electric housecleaner is designed for long life and continuous performance. It has a motor-driven brush that loosens the dirt without beating or wearing the surface of the fabric over which it passes. This brush, combined with high-powered suction, provides all the advantages of both the suction and brush types of sweeper. The Airplane efficiently sweeps, aerates, renovates, cleans and renews the fabric, raising the nap, and brightening the colors by thoroughly collecting the dust and dirt. It is equipped with a reliable motor of reputable make, operating on either a-c. or d-c., 110 volts, 60 cycles or less. Its powerful suction, in connection with its blower and other attachments, make the Airplane housecleaner ideal for speedy and easy cleaning. See colored insert in display adv. section.—Adv.



Motor-driven Brush

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Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."
Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio. "Baby Invincible," "Invincible Junior."
LANDERS, FRARY & CLARK, New Britain, Conn. Light weight machine—only 11 lbs.; powerful motor of moderate speed; heavy air displacement; no belts or shafts; low hung frame



"Universal" Vacuum Cleaner

permits operating under furniture. Finished in Verde Antique. Conveniently located toggle switch and pistol grip handle. Furnished with a 20-ft. flexible cord and attachment plug. Has extra attachments.—Adv.
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Morrow Co., The, Waukegan, Ill.
Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y. "Pittsburgh."
Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa.
Pneuvac Co., 164 Fremont St., Worcester, Mass. "Sweeper-vac."
Production Engineering Corp., 64 Pearl St., Boston, Mass.
Ramey Mfg. Co., Columbus, Ohio. "Rayvac."
Regina Co., The, 47 W. 34th St., New York, N. Y. "Regina."
Sloane, W. & J., 5th Ave. & 47th St., New York, N. Y. "Invincible," "Sloane," "Sloane Handy."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Suction System Cleaning Co., The, Sidney, Ohio. "Princess."
Thurman Vacuum Cleaner Co., Pontiac Bldg., St. Louis, Mo. "Thurman."
Torrington Co., The, (National Sweeper Division), Torrington, Conn.
United Electric Co., The, Canton, Ohio. "Ohio Electric."
Wise-McClung Mfg. Co., The, New Philadelphia, Ohio. "America."
Wright Co., M. S., 164 Fremont St., Worcester, Mass. "Sweeper-Vac."

VACUUM CLEANERS, SEMIPORTABLE OR HEAVY-DUTY.—Semi-portable or heavy-duty vacuum cleaners are used for cleaning in office buildings, hotels, clubs, railroad cars, etc. They consist of a rather large motor (about ½ hp.) and fan, with dust receptacle, motor switch, starter and sometimes hose reel, mounted on a strong truck on wheels so they may be wheeled about on a level floor. The machine develops a high suction and is, therefore, quite heavy, in fact, too heavy to push freely around obstructions to bring it close to the places where the cleaning is desired. A long hose is therefore furnished to attach to the machine and by the use of suitable nozzles, rugs, carpets, upholstery, hangings, and other furnishings may be cleaned in any room, the machine remaining in the hallway or corridor. If used on several floors the machine must be lifted up and down by the elevator in the building.

When used in railroad coach yards and such places, the cleaner is run out on the platform and the electrical connections made by means of special plugs and receptacles conveniently placed along the tracks. The hose and attachments are then carried inside the car and the furnishings cleaned. For exterior use the machine must be of weatherproof type. Such machines have come into extensive use by railroads for cleaning the better type of passenger cars, such as sleepers, diners, parlor and private cars, and in some cases also for day coaches.

Manufacturers:

American Radiator Co., 816-22 S. Michigan Ave., Chicago, Ill. "Arco Wand."
Atwood Vacuum Machine Co., 128-30 N. Water St., Rockford, Ill.
Bissell Co., The F., Toledo-Bissell Mfg. Dept., 226 Huron St., Toledo, Ohio. "Bissell."
Electrical & Specialty Supply Co., 9 S. Clinton St., Chicago, Ill.
General Compressed Air & Vacuum Machinery Co., St. Louis, Mo. "Thurman."
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Vac na."
Landers, Frary & Clark, United Vacuum Appliance Division, Connersville, Ind. "Connersville."
Sloane, W. & J., 5th Ave. & 47th St., New York, N. Y. "Invincible." "Sloane."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thurman Vacuum Cleaner Co., Pontiac Bldg., St. Louis, Mo. "Thurman."
United Electric Co., The, Canton, Ohio. "Ohio-Tuec."

VACUUM CLEANERS, STATIONARY.—Stationary vacuum cleaners are used in large office buildings, hotels, club houses, institutions, apartment buildings and large residences. They consist of a suction fan and motor with accessory equipment usually mounted in the basement or some other suitable place, and a system of piping to provide outlets or rather inlets on each floor or at other convenient points. A long hose is attached by means of a tight-fitting coupling to any outlet and may be used for various cleaning purposes in the different rooms nearest the outlet. The piping system must be very tight, direct and of good size to maintain a good suction. This system entirely eliminates all the dust, as it is all carried out of the room and deposited in a dust box in the basement or discharged into the sewer by a spray of water. In some cases a small control switch is provided near each outlet so that the motor may be started and stopped by remote control. In many buildings where much cleaning of floor and wall coverings is done and it is desired to do this unobtrusively and with complete freedom from dust, the higher installation cost of such a cleaning plant is well warranted, and it is preferable to the portable or semi-portable types of cleaners. The size of the plant depends entirely on the size of the building and the number of nozzles likely to be in operation at the same time.

Manufacturers:

American Radiator Co., 816-22 S. Michigan Ave., Chicago, Ill. "Arco Wand."
Electric Rotary Machine Co., 40 S. Clinton St., Chicago, Ill.
Electrical & Specialty Supply Co., 9 S. Clinton St., Chicago, Ill.
General Compressed Air & Vacuum Machinery Co., St. Louis, Mo. "Thurman."
Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio. "Invincible Junior Truck."
Kent Vacuum Cleaner Co., Inc., The, Rome, N. Y. "Kent."
Knox Co., George S., 513 Pennwood Ave., Pittsburgh, Pa. "Victor."
LANDERS, FRARY & CLARK, New Britain, Conn. "Connersville."
Spencer Turbine Co., The, Hartford, Conn. "Spencer."
Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Thurman Vacuum Cleaner Co., Pontiac Bldg., St. Louis, Mo. "Thurman."

VACUUM GLASS CO.—Lynn, Mass. Manufacturer of X-ray tubes and vacuum glass electrodes.

VACUUM LIGHTNING ARRESTER.—(See Arresters, lightning, telephone and telegraph.)

VACUUM OIL CO.—New York, N. Y. Manufacturer of lubricating oil. Main office, 61 Broadway, New York, N. Y. Branch offices, Fisher Bldg., Chicago, Ill.; Pittsburgh, Pa.; Minneapolis, Minn.; Philadelphia, Pa.; Indianapolis, Ind.; Des Moines, Iowa; Detroit, Mich.

VACUUM PUMPS.—See Pumps, vacuum, electric.

VACUUM SWITCHES.—See Switches, pressure or vacuum operated.

VACUUM TUBE.—See Electron tubes.

VACUUM WASHER CO., THE.—Ripon, Wis. Manufacturer of electric washing machines.

VAIL, THEODORE NEWTON. — An American capitalist, born in Carroll County, Ohio, 1845, and died in Baltimore, Md., 1920. He was educated at the Morristown Academy in New Jersey and, after leaving school, studied medicine for two years with an uncle. He learned telegraphy, and for a time he was an operator in New York. In 1869 he became telegraph operator and station agent of a station on the Union Pacific Railway. Later he became a railway mail clerk, and in 1874 he was advanced to assistant general superintendent, and from 1875 to 1878 he was general superintendent of that service at Washington. In 1878 he took the position of general manager of the American Bell Telephone Co., formed to exploit the newly invented telephone. One of his first achievements was to establish a long-distance telephone line between Providence and Boston. Upon his initiative, improvements were made in telephone equipment and material, so that it was not long before long-distance telephony was widely extended. In 1885 Mr. Vail resigned as general manager of the American Bell Telephone Co., and was elected first president of the American Telephone & Telegraph Co. He resigned this post in 1887. In 1893 he made a trip to South America. He organized an electric street railway at Buenos Aires for British capitalists and for some time had his headquarters in London, returning to America in 1904. In 1907, Mr. Vail again took the presidency of the American Telephone & Telegraph Co., holding this office till shortly before his death. He was also an officer of many other corporations. To Mr. Vail's exceptional organizing power and to his farsighted conception of universal telephone service is due in very large measure the fact that telephone development in the United States greatly exceeds that in all other countries.

VAILE-KIMES CO., THE.—Dayton, Ohio. Manufacturer of electric pumps.

VALBESTINE.—Trade name for valve stem packing manufactured by the General Asbestos & Rubber Co., 27 Cumberland St., Charleston, S. C.

VALENTINE-CLARK CO., THE.—Spokane, Wash. Producer of cedar poles, posts and ties. Business established 1888. President, E. L. Clark; secretary and treasurer, X. W. Van Dervoort; sales manager, Gilbert Willson. Main office, 510 Peyton Bldg., Spokane, Wash. Yards, Minnesota Transfer, Minn.; St. Maries, Idaho. Branch offices, 1008 Spitzer Bldg., Toledo, Ohio; 431 S. Dearborn St., Chicago, Ill.; 732 Security Bldg., Minneapolis, Minn.

VALLEY ELECTRIC CO.—4919-29 Connecticut St., St. Louis, Mo. Manufacturer of motors, generators, buffers, etc. Business established 1914. President and general manager, S. A. Whitten; vice-president, E. C. Ballman; secretary, G. M. Elliott; treasurer, H. Elder; sales manager, J. F. Jones. Sales representatives, D. H. Hindenach, 412 2nd Ave., E., Cedar Rapids, Iowa; E. W. Bruce, 1252 Monadnock Bldg., Chicago, Ill.; C. A. Cotton, 92 Pearl St., Boston, Mass.; J. F. Gerleman, 110 S. 10th St., St. Louis, Mo.; O. Jacobi, 50 Church St., New York, N. Y.

VALLEY IRON WORKS.—Williamsport, Pa. Manufacturers of boiler furnace grates, hand-operated stokers, etc.

VALLEY WASTE MILLS.—La Grange, Ga. Manufacturer of cotton waste. Business established 1915. President, C. V. Truitt; vice-president, S. Y. Austin; secretary, J. A. Perry; treasurer and sales manager, Cason J. Callaway.

VAL-U-LINE.—Trade name for lighting fixtures manufactured by Gaites, Pace & Co., Inc., 204 Willoughby St., Brooklyn, N. Y.

VALVES, ELECTRICALLY OPERATED, STEAM AND WATER.—Electrically operated valves are often installed in rather inaccessible places to control the flow of steam, water or other fluids in pipes. They are also used in many cases to permit easy operation of large valves in power plants, also in bypasses around large valves. One application is to service pipes where steam is furnished by a central plant to commercial or industrial buildings. The valve is located right at the entrance and controls the flow through the meter. The push-button control in these cases may be located in any room or office.

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One of the commonest methods used to erate the valve is the use of a small otor which turns the valve stem by eans of suitable gearing. This style is ed on the larger valves. The valves aced in service pipes are sometimes op- ated by means of a small solenoid with ratchet device turning the valve stem ich permits several steps of several lve openings to be obtained. Other prin- ples are also used, such as a small motor solenoid arranged to wind up or re- se a chain that operates a valve lever.

Manufacturers:

American Thermostat Co., 226 Jelliff Ave., Newark, N. J. "Marvel."
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
CUTLER-HAMMER MFG. Co., THE, 12th St. & St. Paul Ave., Milwaukee, Wis. "Dean." (See display adv. pages 1225-1230).
Davis Regulator Co., G. M., 420 Milwaukee Ave., Chicago, Ill. "Davis."
Dean Ltd., Payne, 103 Park Ave., New York, N. Y. "Dean."
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Far-Operative Valve Co., 2 Rector St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. The type CR9501 solenoid operated valve is suitable for operating steam or air whistles, controlling the application of brakes operated by compressed air or oil, such as are used on large hoists, controlling the flow of fuel fluids to furnaces, etc. This valve may be operated from a distance by means of a snap switch, float switch, thermostat or push button. Coils for all commercial voltages and frequencies can be supplied. For connection to pipes one inch or smaller. See adv. pages 1203-1223.—Adv.



Golden-Anderson Valve Specialty Co., 1214 Fulton Bldg., Pittsburgh, Pa. "Golden-Anderson."
Hempfield Foundries Co., 35th and Charlotte Sts., Pittsburgh, Pa.
H. S. B. W.—Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa. "Cochrane."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity," "World."
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Pratt & Cady Co., Inc., Hartford, Conn. "P. & C."
Ralph Electric Co., 209 Parkhurst St., Newark, N. J.
Examine Commercial Corp., 120 Broadway, New York, N. Y.

VALVES, GATE, GLOBE AND ANGLE.—These valves are extensively used in power plants. The globe valves, the most common in use, have the interior divided into two sections by a wall in which there is a circular opening. This opening is closed or opened by a disk which is raised or lowered into the opening by the valve stem. The gate valve cuts off the flow of the pipes into the valve at right angle, the valve being closed and opened by a wedge-shaped piece attached to the stem which is lowered between the openings so as to close the valve; these valves are used mostly with large pipes. The angle valves differ from globe valves only in that the pipes entering the valve are at an angle with each other.

Manufacturers:

Albany Steam Trap Co., The, Albany, N. Y.
Atherite Co., Inc., John & William Sts., New York, N. Y.
Warren Co., The, Warren, Pa.
Bonney Valve Co., 4057 Park Ave., St. Louis, Mo.
Buckeye Iron & Brass Works, 3rd and Wyandot Sts., Dayton, Ohio.
Central Brass Works, Detroit, Mich. "Capitol."
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que. Can.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Defiance Packless Valve Co., 431 S. Dearborn St., Chicago, Ill. "Defiance Packless."
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.
Fort Wayne Engineering & Mfg. Co., Inc., 6th and Harrison Sts., Fort Wayne, Ind.
Golden-Anderson Valve Specialty Co., 1214 Fulton Bldg., Pittsburgh, Pa. "Golden-Anderson."
Griffiths & Son, James A., 1315-17 Buttonwood St., Philadelphia, Pa.
Hempfield Foundries Co., 35th and Charlotte Sts., Pittsburgh, Pa.
Illinois Engineering Co., Racine Ave., and 21st St., Chicago, Ill. "Eclipse."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Kennedy Valve Mfg. Co., The, Water St., Elmira, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio. "Handy," "Clip," "Victor," "Ferrenewo," "High-Duty."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity," "World."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
McMann & Taylor Co., 104 John St., New York, N. Y.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Nason Mfg. Co., 71 Fulton St., New York, N. Y.
Nelson Valve Co., Chestnut Hill, Philadelphia, Pa. "Nelson."
New Bedford Valve Mfg. Co., New Bedford, Mass. "Whale Brand."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa. "Oilwell."
Page Boiler Co., 815-819 Larrabee St., Chicago, Ill. "Aaball."
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Scott Valve Mfg. Co., Detroit, Mich.
Victory Mfg. Co., 423C Monadnock Bldg., San Francisco, Cal. "Victory."
Walworth Mfg. Co., Boston, Mass. "Walco."
Watson-Stillman Co., The, 40 Dey St., New York, N. Y.
Wheeler Mfg. Co., C. H., Lehigh and Sedgley Aves., Philadelphia, Pa. "C. H. Wheeler."
Williams Valve Co., The D. T., Cincinnati, Ohio.

VALVES, HIGH-PRESSURE.—Valves of this class are made in many of the standard types. They are very ruggedly constructed of such materials and design as to resist the high-pressure of the steam, water or other medium carried in the piping. Heavy ribs and flanges are commonly provided to give additional strength and very special boxes and glands are required to make the valve leakproof. The tendency to use high-pressure steam exceeding 200 lbs. per sq. in. is calling for suitable high-pressure valves.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Aterite Co., Inc., John & William Sts., New York, N. Y.
Brunner Mfg. Co., Broad & Gilbert Sts., Utica, N. Y.
Buckeye Iron & Brass Works, 3rd & Wyandot Sts., Dayton, Ohio.
Burdett Mfg. Co., 309 St. Johns Ct., Chicago, Ill.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. Y.
Burrows Mfg. Co., York, Pa. "Burrows."
Cash Co., A. W., Decatur, Ill.
Champion Pneumatic Machinery Co., 1402 Michigan Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Defender Automatic Regulator Co., St. Louis, Mo. "Defender."
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Golden-Anderson Valve Specialty Co., 1214 Fulton Bldg., Pittsburgh, Pa. "Golden-Anderson."
Griffiths & Son, James A., 1315-17 Buttonwood St., Philadelphia, Pa.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill. "Eclipse."
International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Kennedy Valve Mfg. Co., The, Water St., Elmira, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York, N. Y. "Hancock."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity," "World."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Regulator Co., The, 208-12 S. Jefferson St., Chicago, Ill.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Pierce, Butler & Pierce Mfg. Corp., 282 James St., Syracuse, N. Y.
Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
Victory Mfg. Co., 423C Monadnock Bldg., San Francisco, Cal. "Victory."
Watts Regulator Co., 252 Lowell St., Lawrence, Mass. "Lawrence."

VALVES, MISCELLANEOUS.—Only a few of the more common or general-purpose valves most widely used in power plants have been separately listed. The more special valves, such as atmospheric relief, back-pressure, blowoff, check, non-return, reducing, etc., are included in this classification.

Manufacturers:

American District Steam Co., N. Tonawanda, N. Y. "Adsco."
American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Aterite Co., Inc., John & William Sts., New York, N. Y.
Berry Engineering Co., The, 610-32 Crosby St., Chester, Pa.
Birch Pump Valve Co., 1521-1523 Sedgwick St., Chicago, Ill. ("Birch" pump.)
Boston Belting Co., 80 Elmwood St., Boston, Mass.
Brandt, Randolph, 70 Cortlandt St., New York, N. Y.
Buckeye Iron & Brass Works, 3rd & Wyandot Sts., Dayton, Ohio.
Burroughs Co., Charles, 141-149 Commerce St., Newark, N. J.
Cash Co., A. W., Decatur, Ill.
Cramp & Sons Ship & Engine Building Co., William, I. P. Morris Dept., Richmond & Norris Sts., Philadelphia, Pa. ("Johnson" hydraulic work.)
Crosby Steam Gage & Valve Co., Boston, Mass. ("Johnstone" blowoff, "Branden" pump.)
Davis Regulator Co., G. M., 420 Milwaukee Ave., Chicago, Ill. "Davis."
Eastern Brass Works, 221-23 13th Ave., Newark, N. J.
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.
Elliott Co., Frick Bldg., Pittsburgh, Pa. "Faber."
Equitherm Control Corp., 13 Tillary St., Brooklyn, N. Y.
Everlasting Valve Co., 2 Rector St., New York, N. Y.
Far-Operative Valve Co., 2 Rector St., New York, N. Y.
Fisher Governor Co., The, Marshalltown, Iowa. "Fisher."
Ford Regulator Corp., 405 Broome St., New York, N. Y.
Foster Engineering Co., 109-117 Monroe St., Newark, N. J.
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Hill Pump Valve Co., 4601 Belmont Ave., Chicago, Ill. "Hill."
Homestead Valve Mfg. Co., 134 6th Ave., Homestead, Pa.
Hydraulic Engineering Works, 708 Fulton St., Chicago, Ill.
Illinois Engineering Co., Racine Ave. & 21st St., Chicago, Ill. "Eclipse."
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Kennedy Valve Mfg. Co., The, Water St., Elmira, N. Y.

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Kerr Engine Co., Ltd., The, Walkerville, Ont., Can. (Brass and iron.)
Kitts Mfg. Co., Oswego, N. Y. "Kitts."
Lonergan Co., J. E., 211-215 Race St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio. "Air-Gas-Pop."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can. "McAvity," "World."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
National Steam Specialty Co., 12-14 S. Clinton St., Chicago, Ill. "National."
National Valve & Mfg. Co., Arsenal Station, Pittsburgh, Pa. "Navco."
Nelson Valve Co., Chestnut Hill, Philadelphia, Pa. "Nelson."
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Page Boiler Co., 815-819 Larrabee St., Chicago, Ill. "Aaball."
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich. "Penberthy."
Penberthy Injector Co., Ltd., Windsor, Ont., Can. "Compodisk."
Pierce, Butler & Pierce Mfg. Corp., 282 James St., Syracuse, N. Y.
Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa.
Powell Co., The William, Cincinnati, Ohio. "White Star."
Power Turbo-Blower Co., 347 Madison Ave., New York, N. Y.
Richardson-Phenix Co., 124 Reservoir Ave., Milwaukee, Wis. 'NoKut."
Roots Co., The P. H. & F. M., Connersville, Ind.
Sarco Co., Inc., 229 Broadway, New York, N. Y. "Sarco."
S-C Regulator Mfg. Co., The, Fostoria, Ohio. "S-C."
Schutte & Koerting Co., 1156 Thompson St., Philadelphia, Pa.
Squires Co., The C. E., E. 40th St. & Kelley Ave., Cleveland, Ohio.
Strong, Carlisle & Hammond Co., The, Cleveland, Ohio. "S. C. & H."
Union Water Meter Co., 33 Hermon St., Worcester, Mass. "Union."
United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. "U. S." needle, balanced check and safety.
Victory Mfg. Co., 423C Monadnock Bldg., San Francisco, Cal. "Victory."
Watson & McDaniel Co., 150 N. 7th St., Philadelphia, Pa.
Watson, Frye Co., Ltd., 213-223 Front St., Bath, Me.
Yarnall-Waring Co., Mermaid Ave., Chestnut Hill, Philadelphia, Pa. "Yarway."

VALVES, RADIO.—See Electron tubes.

VALVES, RELIEF.—Relief valves are used in hydraulic power plants having long feeder pipes or penstocks. They are arranged to open with a slight excess of the penstock pressure but close very slowly. Their purpose is to avoid accidental excess pressures and also that produced in the penstock by rapid closing of the turbine gates. They are also used in connection with needle nozzles. (Also see Water hammer.)

VALVES, SAFETY AND THROTTLE.—Safety valves are such as are designed to automatically open when the pressure in the line exceeds a predetermined value. This is accomplished by holding the valve in the closed position by weights, usually through a lever, or by a spring, the pressure in the line raising the valve against this weight or spring. Throttle valves are the valves used on turbines and engines for controlling the steam entering the unit. They are often of special design.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
Ashton Valve Co., Boston, Mass. "S. S. T.", "Ashton."
Aterite Co., Inc., John & William Sts., New York, N. Y.
Buckeye Iron & Brass Works, 3rd & Wyandot Sts., Dayton, Ohio.
Champion Pneumatic Machinery Co., 1402 Michigan Ave., Chicago, Ill.
Consolidated Safety Valve Co., 119 W. 40th St., New York, N. Y.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane, Ltd., 1280 St. Patrick St., Montreal, Que., Can.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Edward Valve & Mfg. Co., The, 1200 W. 145th St., East Chicago, Ind.
Fisher Governor Co., The, Marshalltown, Iowa. "Fisher."
Fort Wayne Engineering & Mfg. Co., Inc., 6th & Harrison Sts., Fort Wayne, Ind.
Hempfield Foundries Co., 35th & Charlotte Sts., Pittsburgh, Pa.
Holland Trolley Supply Co., The, 1623 E. 43rd St., Cleveland, Ohio.
Hydraulic Press Mfg. Co., The, 384 Lincoln Ave., Mount Gilead, Ohio.
Jenkins Bros., 133 N. 7th St., Philadelphia, Pa.
Kennedy Valve Mfg. Co., The, Water St., Elmira, N. Y.
Lonergan Co., J. E., 211-215 Race St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio.
Manning Maxwell & Moore, Inc., 119 W. 40th St., New York, N. Y. "Consolidated."
Mason Regulator & Engineering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
McAvity & Sons, Ltd., T., King St., St. Johns, N. B., Can. "McAvity", "World."
McDonald Mfg. Co., A. Y., Dubuque, Iowa.
McRae & Roberts Co., The, Detroit, Mich.
Scott Valve Mfg. Co., Detroit, Mich. "Goldsmith", "Orme."

VAN.—Trade name for expansion shields manufactured by the Van Expansion Bolt Mfg. Co., 53 W. Jackson Blvd., Chicago, Ill.

VAN BRIGGLE TILE & POTTERY CO., THE.—Colorado Springs, Colo. Manufacturer of portable electric lamps and pottery lamp bases. Business established 1898. President, Ira Lewis; vice-president, A. E. Lewis; secretary and treasurer, J. H. Lewis; general manager, A. F. Gress.

VAN CLEEF BROS.—77th St. & Woodlawn Ave., Chicago, Ill. Manufacturers of friction tape and soldering paste.

VAN DORN ELECTRIC TOOL CO.—Cleveland, Ohio. Manufacturer of motor-driven reamers, portable drills and grinders. Main office, 2978 Woodhill Rd., Cleveland, Ohio. Branch offices, New York, N. Y.; Buffalo, N. Y.; Pittsburgh, Pa.; 527 S. Dearborn St., Chicago, Ill.; Cincinnati, Ohio; Chattanooga, Tenn.; Denver, Colo.; Los Angeles, Cal.; San Francisco, Cal.; Seattle, Wash.; Milwaukee, Wis.; St. Paul, Minn.; Philadelphia, Pa.; Boston, Mass.; St. Louis, Mo.; Detroit, Mich.

VAN EXPANSION BOLT MFG. CO.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of expansion shields, etc. Business established 1910. C. B. Van Antwerp, sole owner.

VAN NORT CARBON BRUSH CO.—1214 Olive St., St. Louis, Mo. Manufacturer of self-lubricating carbon brushes. Business established 1908. E. C. Van Nort, owner.

VAN OSDEL.—Trade name for electric hair cutters manufactured by the Blomfeldt & Rapp Co., 108 N. Jefferson St., Chicago, Ill.

VAN SICKLEN.—Trade name for speedometers manufactured by the Stewart-Warner Speedometer Corp., 1828 Diversey Pkwy., Chicago, Ill.

VANADIUM.—Symbol V; at. wt. 51. A rare metal produced chiefly as ferro-vanadium, but also to a small extent as metallic vanadium. It is used as an alloying element, principally in vanadium steel. It is obtained by reducing the oxide in electric furnaces or by the Thermit process.

VANCOUVER ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—President, W. W. Fraser, 602 Hastings St., West Vancouver, B. C.; secretary-treasurer, R. G. Hargreaves, 422 Pacific Bldg., Vancouver, B. C.

VAPOR LAMPS.—See Lamps, mercury, vapor, etc.; Lamps, vapor, Moore tube, neon, etc.

VAPORPROOF FIXTURES.—See Fixtures, lighting, marine, water-tight and vaporproof.

VAPORSPRAY.—Trade name for pneumatic paint spraying brushes manufactured by the Impulse Tank Co., 2820 N. Spring Ave., St. Louis, Mo.

VARIOMETERS, RADIO.—A continuously variable inductance used in radio circuits. It usually consists of a movable coil forming part of a spherical surface which rotates inside a similar fixed coil, thereby varying the flux interlinkage.

VARLEY LOOP TEST.—A testing method used in locating a cross or ground in a telephone or telegraph line or other multiconductor cable, by using the Wheatstone bridge principle. A loop is formed of one good wire and the faulty wire joined at their distant ends. In the case of a ground, one terminal of the battery is grounded and the other connected to the junction of the ratio arms on the bridge. The rheostat arm thus includes the resistance of the faulty line to the fault, while the unknown arm includes the good wire and the resistance of the faulty line, beyond the fault.

VARNISH, INSULATING. — Insulating varnishes are divided into two classes; baking varnishes, which harden by oxidation when heated artificially, and air-drying varnishes which harden by evaporation of the solvent without the application of heat. Baking varnishes are superior as insulators, as the dielectric resistance of varnishes seems to increase directly with the length of the baking or drying period, the slow varnishes giving the toughest and most elastic film which will stand longer exposure to extreme heat conditions than a hard film. Varnishes used for impregnating windings, etc., are frequently composed of linseed oil with a resinous base. In these varnishes the drying action takes place by the evaporation of the volatile solvent and then the oxidation of the linseed oil and gum. Other varnishes which do not have quite as high a dielectric strength replace the gum base by asphaltum. When used for treating paper and fabrics, the varnish usually has linseed oil and a gum base, although in some cases linseed oil alone is used. There are many forms of varnishes and many compounds of similar nature manufactured under various trade names. In general they are oil and waterproof, not affected by ordinary acids or gases and are heat-resisting to a certain degree.

Manufacturers:

American Di-Electrics, Ltd., 71-75 W. Broadway, New York, N. Y.
Barrett & Co., M. L., 233 W Lake St., Chicago, Ill.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Benolite Co., Inc., 331 4th Ave., Pittsburgh, Pa.
Berry Bros., Detroit, Mich.
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio. "Bilchaco".
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa. "Tomlac."
Brach Mfg. Co., L. S., 127-129 Sussex Ave., Newark, N. J. "Vitolac."
California Paint Co., 11th, 12th & Pine Sts., Oakland, Cal. "Averill."
Calman & Co., Emil, 100 William St., New York, N. Y. "Stic-Lac."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can.
Chase, Roberts & Co., West Ave. & 5th St., Long Island City, N. Y.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J.
Crosby Steam Gage & Valve Co., Boston, Mass. "Crosby."
Dielectric Mfg. Co., St. Louis, Mo. "Dielac". "Dielectrol", "Woodman's."
Dolph Co., John C., 168 Emmett St., Newark, N. J. "Universalak," "Thermolak," "Chinalak."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Franche & Co., C. E., 440 Orleans St., Chicago, Ill. (Shellac varnish.)
General Bakelite Co., 2 Rector St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Globe Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
HILO VARNISH CORP., 1 Gerry St., Brooklyn, N. Y. "Hilo." (See display adv. page 1318.)
Impervious Metal Corp., 421 Wood St., Pittsburgh, Pa.
INTERNATIONAL PAINT CORP., St. Louis, Mo. "Inco Insulite." (See display adv. page 1320.)
IRVINGTON VARNISH AND INSULATOR CO., Irvington, N. J. "Irvington" insulating varnishes are of the highest grade. Furnished in black or yellow—air drying and baking. See display adv. page 1319 for all Irvington electrical products.—Adv.

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Lagonda Mfg. Co., The, Sheridan Ave., Springfield, Ohio.
Martindale Electric Co., The, 11737 Detroit Ave., Cleveland, Ohio. "Handyvar", "Handylac."
Mica Insulator Co., 68 Church St., New York, N. Y. "M. I. C.", "Linolac."
Mica Insulator Co., Victoriaville, Que., Can.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Paterson-Sargent Co., Cleveland, Ohio.
Pittsburgh Insulating Co., 96-100 43rd St., Pittsburgh, Pa. "Pico."
Preston Mica Co., Robert K., 804 Monadnock Block, Chicago, Ill.
Riesenman Mfg. Co., Ltd., Franklin, Pa. "Acid and Alkali Proof Coating."
Robertson Chemical Co., Cleveland, Ohio. "Insulac."
Ruberoid Co., 95 Madison Ave., New York, N. Y. "S-P-C."
Schenectady Varnish Co., Schenectady, N. Y.
Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio. "Ajax."
Standard Insulation Co., Rutherford, N. J. "Sico."
Standard Varnish Works, 90 West St., New York, N. Y.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Stich Bros., 320 5th Ave., New York, N. Y.
Stylon Clay Products Co., New Brunswick, N. J.
Thos. S. Gutta Percha Paint Co., 12 Dudley St., Providence, R. I.
Titan Co., Bridgeport, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wieser & Co., William, 195 William St., New York, N. Y.

VARNISH, PROTECTIVE. — Protective varnishes or finishing varnishes, while they have the same general characteristics and conditions as insulating varnishes described above, are not used because of their insulating properties but to protect the undercoat of insulating varnish against moisture and oil and provide a smooth surface that may readily be cleaned of oil and dirt. They are also used for general decoration and to give a glossy or highly polished surface.

Manufacturers:

Abbett, Inc., H. N., 19 Park Pl., New York, N. Y.
Acme Co., Inc., 331 4th Ave., Pittsburgh, Pa.
Braga-Chapin Co., The, 1153 E 40th St., Cleveland, Ohio. "U. S. N. Deck," "Exo-Flint."
Brenger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Brown & Co., Emil, 100 Williams St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Chemische Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Columbus Varnish Co., The, 264 Cozzins St., Columbus, Ohio. "Columbus."
Cramer Mfg. Co., St. Louis, Mo.
Crane Co., John C., 168 Emmett St., Newark, N. J.
Cromical Chemical Co., 727 Ridgeway Ave., Cincinnati, Ohio.
Dielectric Metal Corp., 421 Wood St., Pittsburgh, Pa.
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y. "Shield Brand."
O'Brien Varnish Co., Chestnut & Mercer Sts., Newark, N. J. "Unish."
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Sherwin-Williams Co., 601 Canal Rd., Cleveland, Ohio. "Ajax."
Standard Varnish Works, 90 West St., New York, N. Y.
Sterling Varnish Co., The, 525-8 Fulton Bldg., Pittsburgh, Pa. "Sterling."
Stuart Color & Chemical Works, 382 Lafayette St., New York, N. Y.
Stich Bros., 320 5th Ave., New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

VARNISHED CAMBRIC.—See Cambric, varnished insulating.

VARNISHED CAMBRIC CABLES.—See Cable, varnished cable, insulated.

VARNISHED TAPE.—See Tape, varnished.

VARNISHED TUBING.—See Tubing, varnished fabric.

VARYLITE.—Trade name for lamp-reducing pull sockets manufactured by the Tremont Products Co., 216 High St., Boston, Mass.

VATER.—Trade name for power plant apparatus manufactured by the Power Plant Specialty Co., Monadnock Block, Chicago, Ill.

VAUGHAN CO.—730-740 N. Franklin St., Chicago, Ill. Manufacturer of motor-driven bone and meat saws. President, Jay W. Vaughan; general manager, Leslie W. Winter; secretary, John H. Miller.

VAUGHN.—Trade name for post hole augers manufactured by Iwan Bros., 1503 Prairie Ave., South Bend, Ind.

VAUGHN MACHINERY CO., THE. — Cuyahoga Falls, Ohio. Manufacturer of motor-driven rubber working machinery, wire drawing machines and insulating compounds. President, C. W. Vaughn; secretary, L. A. Vaughn.

VAULTS, BATTERY.—See Wells, railway signal battery.

VAULTS, CABLE.—See Manholes.

VAWTER.—Trade name for indicating ohmmeter and rail bond tester manufactured by the Thompson Levering Co., 327 Arch St., Philadelphia, Pa.

VAZELITE.—Trade name for lamp adapter manufactured by James S. Pennefather, 358 W. 43rd St., New York, N. Y.

V-B.—Trade name for balata belting manufactured by the Victor Balata & Textile Belting Co., 38 Murray St., New York, N. Y.

V. B. M. CO.—2240 Ogden Ave., Chicago, Ill. Manufacturer of electric washing machines. President, A. E. Bond; secretary, G. A. Mowrer; sales manager, H. C. Clover.

V. B. P.—Trade name for electric meat slicers manufactured by the U. S. Slicing Machine Co., LaPorte, Ind.

V C.—Trade name for cedar poles produced by the Valentine-Clark Co., 510 Peyton Bldg., Spokane, Wash.

VE-LU-SO.—Trade name for commercial lighting unit manufactured by the King Mfg. Co., St. Joseph, Mo.

VECO.—Trade name for transformers manufactured by the Viking Electric Co., 150-152 Chambers St., New York, N. Y.

VECTOR.—A vector is a line whose magnitude, or length, and direction represent a physical quantity. Vectors are combined by the force-parallelogram principle. In the clock diagram the lines representing the maximum values of current and e. m. f. are vectors. Since the fluctuation of alternating currents is well represented by the projection of the vector when it is rotated, such vectors are called rotating vectors. If two alternating e. m. f.'s are in series but differ in phase by an angle θ, their sum is the diagonal of a parallelogram of which the two e. m. f.'s are the adjacent sides. Analytically this is

$$E = \sqrt{E_1^2 + E_2^2 + 2E_1E_2 \cos \theta}$$

where E_1 and E_2 are the component e. m. f.'s and θ is the phase difference. The same relation holds for currents that are out of phase.

VECTOR QUANTITIES.—Vector quantities are physical quantities that have both magnitude and direction, such as velocity, force, etc. Vector quantities may be represented by Vectors; electric currents and e. m. f.'s are not true vector quantities in the light of modern theories of electricity, but magnetic and electric intensities are vector quantities. Vectors are used in representing alternating currents because the projection of the rotating vector fluctuates in the same manner as the sinusoidal alternating e. m. f. or current.

VEEDER MFG. CO.—Sargeant & Garden Sts., Hartford, Conn. Manufacturer of automatic counters, die castings and tachometers. Business established 1895. President, C. H. Veeder; secretary, H. W. Lester; treasurer, D. J. Post; office manager, C. G. Allyn.

VEGETABLE PEELERS.—See Parers and peelers, vegetables and fruit, motor-driven.

VEHICLE, ELECTRIC.—The term electric vehicle is used to designate a passenger or commercial automobile that is propelled by an electric motor deriving its energy from a storage battery. The term "battery-driven" vehicle is sometimes used.

VEHICLES, ELECTRIC, COMMERCIAL, LIGHT AND MEDIUM-DUTY.—This type of car is extensively used for delivery service by department stores, bakeries, ice, ice cream and dairy companies, central stations, laundries, etc. Its ability to "pick up" rapidly makes it especially desirable where traffic is congested, as in the larger cities. Where the stops are many and the hauls short it is more economical than the gasoline truck. The usual limiting mileage is about 50 miles and as the average daily run of city delivery trucks is about 35 miles they operate well within their limit on a daily charge. Where it is desired, it is possible to obtain a longer run and greater speed by means of a boosting charge. If the batteries are alkaline type or thin-plate lead type the charge given in one hour will give them a large part of their full capacity. For the heavier duty trucks, especially those of 2 tons capacity and over, see Trucks, electric, or storage battery.

Manufacturers:

Atlantic Electric Vehicle Co., 893 Freylinghusen Ave., Newark, N. J.
Commercial Truck Co. of America, 5th St. & Hunting Park, Philadelphia, Pa. "C-T."
Couple-Gear Freight-Wheel Co., 1450 Buchanan Ave., S. W., Grand Rapids, Mich.
Ehrlich Electric Truck Co., 839 W. Lake St., Chicago, Ill. "Ehrlich"
Fritchle Electric Co., Denver, Colo.
Lansden Co., Inc., The, Danbury, Conn. "Lansden."
Milburn Wagon Co., The, 3134 Monroe St., Toledo, Ohio.
Oneida Motor Truck Co., Green Bay, Wis.
Terminal Engineering Co., Inc., 17 W. 44th St., New York, N. Y. "Tec."
WALKER VEHICLE CO., 87th & S. State Sts., Chicago, Ill. "Walker." (See display adv. page 1326.)
Ward Motor Vehicle Co., S. Fulton Ave., Mt. Vernon, N. Y. "Ward Electric."

VEHICLE, ELECTRIC, DEVELOPMENT AND STATUS OF.—The first forms of activity in the electric vehicle industry were more or less successful, but spasmodic experimentation in electrically propelled locomotives and vehicles in America, Scotland and England really dates back to about 1836. Due to the low capacity and crude construction of the early storage batteries available after Planté's invention of this type about 1860, there was little progress until about 1880, when the pasted plate type of storage battery was developed simultaneously in America and France, and it can properly be said that the industry as known today was made possible of development by this great battery improvement.

The first American built electric vehicle was of the passenger type and was produced in Boston about 1888. This car could make but 12 miles on a charge. Improved types were brought out at various points until in 1903 a vehicle was produced that was capable of 50 miles on one battery charge. From this time on, the passenger electric has been continually improved in design and appearance and today's product is thoroughly reliable and capable of making upwards of 100 miles on a single charge of the battery.

The first successful American built commercial electric vehicles were of small capacity and began to appear about 1897. Three or four years later, the predecessor of the old General Vehicle Co. became active in manufacturing and selling this type. Some of these early vehicles are still in service, a great many are 12 to 15 years old and some upwards of 18 years. The capacities have gradually increased during the evolution of successful manufacture and operation, until today there are seven principal electric truck manufacturers in the United States producing, with few exceptions, five sizes, namely, ½, 1, 2, 3½, and 5-ton load capacities.

Electric Truck Work. The majority of all city commercial haulage is well within the ability of the electric truck to perform. With its quick "pick-up," it finds its place in "close" or congested traffic where the required mileage is not over 50 miles per day. It may be a surprising fact to many that the actual daily mileage of most city trucks is not over 25 to 35 miles. At present electric trucks are not intended to be used for long runs over poor roads or where high speed must be obtained at any cost.

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Electric trucks are today being used in practically every industry—some of the more notable ones are shown in the following list, which is arranged approximately as to their relative importance to their adaptability and present use:

Express companies,
Department stores,
Central stations,
Bakers,
Ice and ice-cream companies,
Laundries,
Milk and creamery companies,
Wholesale grocers,
Meat packers,
Textiles (various),
Terminals and docks,
Storage warehouses.
United States Government.

The present large installations of electric commercial trucks in these industries were not made because of chance or from sentiment, but from careful analysis of conditions and the maximum satisfaction received from their adoption—an endorsement of no mean proportions.

Electric trucks as now built are designed to give the following approximate speeds:

½ ton up to 15 miles per hour,
1 ton up to 14 miles per hour,
2 ton up to 13 miles per hour,
3½ ton up to 11 miles per hour,
5 ton up to 10 miles per hour.

Until recently, these values were practically identical with the original safe and sane motor truck speed as recommended by the American Automobile Chamber of Commerce. Since the introduction of the pneumatic tire in the motor truck field, the recommended permissible speeds have been slightly increased where pneumatics were used. However, in congested districts the electric truck, with its quicker getaway after a traffic stop, will be found capable of practically covering the same distance in the same time as an equivalent gasoline truck, both doing the same work.

Cost of Operation. The cost of operating electric trucks can be just as easily computed as for any other item of one's business. However, it is not practical to publish actual or estimated costs for general use, as there are too many variable items, governed as well by local conditions, which must be taken into consideration in each case. The following summary or analysis sheet takes into account the principal items which are concerned in complete total operation costs.

OPERATION COST ANALYSIS.

Name .....
Address .....
Period covered .....year
Days per year.....
Miles per day.....
Total miles per year.....

Investment.

	Cost
Chassis	$
Battery	
Body	
Painting	
Special equipment	
War tax	
Total investment, cost	$

Fixed Costs per Year.

Interest (half rate on total cost, account depreciation)	$
Depreciation (10% on total cost, less tires and battery)	
Insurance	
License (state and city)	
Garage (including labor)	
Total fixed costs	$

Maintenance and Operation Costs per Year.

Battery renewals and upkeep—Basis year's guarantee	$
Tire renewals—Basis 10,000-mile guarantee	
Mechanical renewals	
Body repairs including painting	
Electric power @ per kilowatt-hour	
Driver's wages	
Total maintenance and operation	$
Grand total operation cost per year	
Average cost per day	$
Average cost per mile	

A brief explanation of the above items follows:

Investment. One should have no trouble arriving at the total amount of the investment, this being the sum of these costs. The war or excise tax is 3% of the cost price, instead of 5%, if it is for commercial and not for passenger use.

Fixed Costs. Interest is taken at half rate because the total investment is being gradually reduced by charging off the depreciation. Depreciation is conservatively taken on a basis of ten years' life. There are many electric trucks much older and still going strong. Tires and battery costs are not considered here, as they are both in the maintenance account. Insurance will vary according to the local rates and the amount desired to be carried. License fees will be whatever the local town and state require for the size of truck in question.

Garage rent, including labor, will run approximately from $20 per month for the half-ton to $35 per month for the five-ton capacity trucks.

Maintenance and Operation Costs. Battery renewals are figured on a basis of actual battery life guarantee, the same being 1½ to 2 years for lead types, and a 10-year trade-in arrangement for the Edison type. Tire renewal costs are based on actual 10,000-mile electric truck tire guarantees—in practice the mileage attained is generally greater. Mechanical renewals are based on a percentage of chassis cost less tires and battery; 3½% will be sufficient. Body repairs, including painting, will vary with the quality of the maintained job; annual repairs from 5 to 10% of body cost; painting from $75 to $250 accruing generally every other season. Electric power cost will depend on local rates or the owner's own cost of production. The amount necessary to be used may be estimated by using the following table of kilowatt-hours per mile:

Load Capacity	Kw-hr. per mile
½ ton	0.5 to 0.6
1 ton	0.6 to 0.75
2 ton	0.9 to 1.1
3½ ton	1.25 to 1.5
5 ton	1.75 to 2.0

These are average values and are high enough to take into account the loss from changing alternating current to direct current. Driver's wages will vary also with local conditions and wage agreements.

The rest of the computation is obvious—average cost per day being obtained by dividing by number of days operated, and average cost per mile, by number of miles. These cost items are applicable to one truck; it is, therefore, obvious that electric truck fleets would be operated for less in proportion, due to diversity of operation and the greater volume of each item with its accompanying lower costs.

Electric Industrial Trucks. Electric Industrial trucks are a more recent development of a further practical use of the storage battery in transportation. In reality, they are merely electric trucks made in a reduced size and designed for use in factories, warehouses, railroad yards and terminals of all kinds, in fact, practically wherever hand trucks are required. Their original development was principally for load carrying; but as now made they are available also as tractors for hauling trailers, or for a combination of both "carrying" and "hauling" including ofttimes a self-contained hoisting apparatus for loading self or trailers.

The interior handling cost of material and merchandise, due to the large amount of necessary labor, has always been high compared to transportation by rail or local deliveries by motor truck. This affords an unusual opportunity for a saving to be made by properly applied equipment. With this end in view, hand trucks, mule trucks, industrial railways and conveyor systems, etc., have been employed, but due to higher operating costs and lack of flexibility of operation, they have all been outdistanced by the electric industrial truck. It is not uncommon for one of these trucks to replace any number of hand truckers and helpers up to fifteen. Thus, in spite of their high first cost of $1,500 to $3,000 as compared to hand-operated equipment, they have been known to save as much as their original investment in the first four to six months of their operation.

In practice these industrial trucks will be found very powerful and capable of working with full capacity loads on grades of as much as 20 to 25%. A load capacity of 2,000 lbs. has been adopted, governed largely as to size by the narrow and limited operating enclosures, and as to weight by the necessity of instant and positive speed control. Present speeds are 5 to 6 miles per hour, loaded, with an approximate average current consumption of 6 to 10 kilowatt-hours per day.

Thousands of electric industrial trucks and tractors are in use today in the United States and many foreign countries. A great impetus was received in their adoption and use during the recent rush of manufacture incident to the World War.

VEHICLE LAMPS.—See Lamps, vehicle and bicycle.

VEHICLES, ELECTRIC, PASSENGER.—There are four general types of electric passenger vehicles, the enclosed car, roadster, taxicab, and omnibus. The enclosed car is chiefly used as a pleasure car. Its extreme simplicity of operation has led to its extensive use as a lady's car, but it is by no means restricted to that use. It is used to a considerable extent by physicians. The roadster type, though having the appearance of a pleasure car and to some extent used as such, is chiefly employed by stores for special delivery of small parcels and by companies, such as central stations, telephone and gas companies who have a number of men making many calls within a limited area, such as repair men, inspectors, etc. The enclosed and roadster types are best adapted to city use where the stops are frequent and the runs do not exceed 50 miles per day. They have been employed for longer runs, and by giving the batteries a boosting charge during the noon hour, the day's run of the car can be considerably lengthened and the allowable speed increased. By use of alkaline or thin-plate lead batteries the battery can be made to regain a large part of its full charge in one hour's boosting charge.

The electric taxicabs, similar to the gasoline cars built for the same purpose, have been used with success in several large cities in which large fleets of such cabs are in service. The electric omnibus is quite similar to the gasoline or horse-drawn vehicle of the same class. They have many applications, as for transfer of passengers between railroad depots, or between such depots and the business district, or between stations and school grounds, club houses, golf grounds, cemeteries, etc.

Manufacturers:

Berg Electric Car Co., 501 5th Ave., New York, N. Y.
Century Mfg. Co., Detroit, Mich.
Custer Specialty Co., 119-121 Franklin St., Dayton, Ohio. (Children's.) "Custer Car."
Detroit Electric Co., Detroit, Mich.
Fritchle Electric Co., Denver, Colo.
Grinnell Electric Car Co., Detroit, Mich. "Grinnell."
Hupp-Yeats Electric Car Co., Detroit, Mich. "Hupp-Yeats."
Milburn Wagon Co., The, 3134 Monroe St., Toledo, Ohio.
Rauch & Lang, Inc., Chicopee Falls, Mass.

VELLUMESQUE.—Trade name for lamp shades manufactured by the Edward N. Riddle Co., 27 Broadway, Toledo, Ohio.

VELURIA.—Trade name for light density Regent glassware manufactured by the Ivanhoe-Regent Works of General Electric Co., 5716 Euclid Ave., Cleveland, Ohio.

VELVA.—Trade name for illuminating glassware manufactured by the Gill Glass Co., Inc., Amber & Venango Sts., Philadelphia, Pa.

VELVETONE.—Trade name for belt dressing manufactured by the Whitlock Mfg. Co., 1506 W. 112th St., Cleveland, Ohio.

VENN-SEVERIN MACHINE CO.—1327 W. North Ave., Chicago, Ill. Manufacturer of oil engines. Business established 1909. President and general manager, Frank W. Severin; vice-president, Dr. Charles Venn; secretary and treasurer, Theodore H. Venn.

VENNER.—Trade name for time switches manufactured by the Chamberlain & Hookharn Meter Co., Ltd., 243 College St., Toronto, Ont., Can.

VENTI-LITE.—Trade name for combination electric fan and lighting fixture manufactured by the Tecla Co., Inc., Detroit, Mich.

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ENTILATING FANS.—See Fans, ex- it or ventilating, factory, kitchen, etc.; , exhaust or ventilating, school, the- and other auditorium; Fans, mine heavy-duty ventilating.

ENTILATION DUCTS IN ELECTRI- APPARATUS.—See Ducts, air; s, ventilating.

ENTILATORS, CAR, MOTOR- /EN.—Ventilation systems of cars, nding for their operation on the ac- of motor-driven fans may be of the ure or vacuum type, but the latter has been commercially developed nstalled in cars. The vacuum system sts of a motor-driven suction fan, ded with discharge ducts and con- d to a suitable air-tight draft cham- r duct with openings into the car, are provided with regulating damp- there are also intakes located at or the floor line. The intakes are ly so arranged that the incoming air awn through the heating apparatus passing into the car. The action is system is such that the vacuum d by the exhaust fan in the duct, fresh air from the outside through ntakes (and through the cracks the doors, sash, etc.) up through r and the dampered openings into uct, whence it is exhausted by the rough the discharge ducts. Motor- systems are positive in action and e designed to move any desired ty of air, thus obtaining as many nges as may be wanted. They have advantage of considerable first cost harges for upkeep and operation.

ufacturers:

Co., The J. G., 62nd St. & Wood- d Ave., Philadelphia, Pa. "Ex- ist."
Mfg. Co., The, Trumbull St., zabethport, N. J.
Electric Ventilating Co., Crawford . & Diversey Blvd., Chicago, Ill.
rk Cornice & Skylight Works, 9-15 Ave., Newark, N. J. "Four Leaf ver."
Heater Co., The Peter, 1725 Mt. ott Ave., Detroit, Mich.

TILATORS, CAR, NATURAL —Ventilating systems of cars de- for their operation on the action of it of air passing over, across or suitable sheet metal or other fit- e current of air being due only to d of the car, and velocity and di- f the wind. The action of all so- natural" ventilators is due to the a current of air passing across ng to a tube or duct will draw air tube or duct, due to a partial being formed just within the end be and adjacent to the passing air The action is variable, increasing velocity of the air current. Many designs of ventilators of this type , all possessing some merit. The s are largely concerned with va- shape and arrangement of de- ates, grilles, hoods and louvers, ve to direct the stream of ai proper opening and to prevent ts and entrance of the elements. ete system of this type of venti- ally comprises a number of suit- es which may be located on the r at or near the floor line. In s, however, the leakage around floor opening and due to open doors is depended upon to fur- resh air supply. The action of of ventilator, depending on the and the velocity and direction of s, of course, variable, but by the f a suitable number of venti- h of proper size, the average of air currents can be met and results obtained. Most de- sting only of sheet-metal boxes provided with the necessary ectors and hoods, all of which position, require no attention once installed. The first cost ively low and the cost of up- Therefore, they are widely ventilation of cars.

irers:

os. Co., 229-237 Arch St., Phil- Pa.
Heating & Lighting Co., 220 Brooklyn, N. Y. "Gold."
White, Inc., 343 S. Dearborn ago, Ill. "Garland."
ornice & Skylight Works, 9-15 ., Newark, N. J. "Four Leaf
Nichols-Lintern Co., The, 8404 Lorain Ave., Cleveland, Ohio. "N-L."
Railway Utility Co., 151 W. 22nd St., Chicago, Ill.

VENTILATORS, MOTION-PICTURE BOOTH, MOTOR-DRIVEN.—Motion picture booths are almost totally enclosed, consequently some means of ventilation must be provided for the comfort of the operator. For this purpose a small propeller type exhaust fan is usually provided. The fan is so placed that it does not create a draft upon the film or arc, as such a draft might increase the danger of igniting the film and causing a fire.

Manufacturers:

Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
GENERAL ELECTRIC CO., Schenectady, N. Y. See description under "Fans, exhaust or ventilating."—Adv.

VENTILATORS, STREET LAMP.—To provide proper ventilation in street lamps, particularly some of the ornamental types, a ventilator is often provided. This ventilator is generally a small metal cap fitting on the top of the globe, the cap being so shaped and drilled with screened holes as to allow heated air to escape, but excluding moisture or rain and insects.

VENTOLIGHT.—Trade name for street lighting fixtures manufactured by the Line Material Co., South Milwaukee, Wis.

VENTURA.—Trade name for ventilating fans manufactured by the American Blower Co., Detroit, Mich.

VERDELITE.—Trade name for portable electric lamps manufactured by the Faries Mfg. Co., Decatur, Ill.

VERIFAX.—Trade name for insulating tape manufactured by the M. W. Dunton Co., Providence, R. I.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION.—President, C. M. Libby, South Ryegate, Vt.; secretary-treasurer, Alvi T. Davis, Marshfield, Vt.

VERMONT ELECTRICAL ASSOCIATION—Secretary-treasurer, A. B. Marsden, Rutland, Vt.

VERMONT FARM MACHINE CORP.—53 W. Jackson Blvd., Chicago, Ill. Manufacturer of electric cream separators, churns and other dairy equipment.

VERONA TOOL WORKS.—Pittsburgh, Pa. Manufacturers of wrenches, etc. Main office, Oliver Bldg., Pittsburgh, Pa. Factory, Verona, Pa. Branch offices, Chicago, Ill.; Oakmont, Pa.; San Francisco, Cal.; New York, N. Y.

VERTASCOPE.—Trade name for pole measurers manufactured by the United Electric Supply Co., Marion, Ohio.

VERTICAL DIAPHRAGMS.—Vertical porous partitions used in electrochemical cells or primary cells; often made in the form of a vertical cylindrical cup, and then commonly called a porous cup.

VERTICAL ILLUMINATION.—The illumination that falls on a vertical plane as measured in suitable units, usually foot- s paid to horizontal illumination values candle. As a rule, much greater attention especially in ordinary design of lighting installations. For many purposes, such as writing, reading, drafting, etc., on horizontal surfaces, the horizontal illumination is the more important, but a fairly high illumination on vertical surface must also be provided if these are not to be dark and present great contrasts of brightness and shadow. For viewing hanging pictures or mural decorations, vertical bulletin boards or signs, railroad signal, etc., the vertical illumination is the more important than the horizontal. For most purposes both illuminations are necessary, their relative importance varying with the primary object for which the illumination is furnished.

VERY BEST MADE.—Trade name for electric washing machines manufactured by the V. B. M. Co., 2240 Ogden Ave., Chicago, Ill.

VESTA BATTERY CORP.—2100 Indiana Ave., Chicago, Ill. Manufacturer of storage batteries, headlights and generators for automobile lighting. Business established 1897. President, W. S. Perry; vice-president, Lee J. Perry; secretary and sales manager, Fred S. Armstrong; treasurer, Frank J. Freitag; general manager, Ward Perry.

VESTER SONS, INC., ALFRED.—5 Mason St., Providence, R. I. Manufacturer of brass fixture parts and specialties. Business established 1890. President and general manager, J. William Schulze; secretary and treasurer, W. P. Young. Sales representatives, Kerr Sales Agency, San Francisco, Cal.; Harry S. Dani, Minneapolis, Minn.

VESTIBULES, CAR.—Framework, including the necessary sash, doors and fittings which encloses the platforms of cars and provides protection against the weather for the car crew. The first steam-railway cars built had open platforms, and that practice was followed in constructing electric railway cars. The motorman was exposed to the weather when at his controller. To provide protection for the motorman, the first vestibules consisted of sash and framework extending around the front of the car only, and extending from the top of the platform railing to the roof. This vestibuling was later extended to provide for doors at each side of the platform over the steps, the doors on the operating side only being open. A still later development was to keep all platform vestibule doors closed at all times, except when taking on or discharging passengers; this greatly reduces accidents. The car body end was removed, thus making the platforms in effect a part of the car body. This latter plan appears to be the tendency in modern street railway car construction.

Manufacturer:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."

VESUVIUS.—Trade name for spark plugs manufactured by A. R. Mosler & Co., Mt. Vernon, N. Y.

VIANNEY WIRE DIE WORKS.—1 Union Sq., New York, N. Y. Manufacturer of wire drawing dies. Business established 1900. Factories: New York N. Y. and Trivoux, France. President, Urbain Richard; vice-presidents, Marius Vianney and Aimé Reynard; secretary, treasurer and general manager, Marius Vianney; sales manager, V. J. Bouiln.

VIBRATING RECTIFIERS.—See Rectifiers, vibrating or electromechanical type.

VIBRATION GALVANOMETER.—See under Galvanometer.

VIBRATOR APPLICATORS AND ATTACHMENTS.—These are auxiliaries for use with electric vibrators. They fasten to the shaft of the motor and are used for the direct application of the vibrating action to the body. Various forms of applicators, so designed as to be especially suitable for some particular surface, such as the spine, neck, arm or leg muscles, etc.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.
FITZGERALD MFG. CO., THE, Torrington, Conn.
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Knv-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.

VIBRATORS, ELECTRIC, FOUNDRY.—To loosen a pattern in the mold so that it may be withdrawn without damage to the mold, it is lightly tapped or vibrated. This tapping action can be done much more rapidly and delicately by machine than by hand and in many of the larger foundries these small electric hand tools or vibrators are used.

Manufacturers:

Pressed Steel Co., The, 39 8th St., Muskegon, Mich. "L & A."
Vulcan Engineering Sales Co., 1765 Elston Ave., Chicago, Ill. "Hanna."

VIBRATORS, ELECTRIC, MASSAGE, HOUSEHOLD TYPE.—These devices consist of a small light universal motor provided with a suitable handle, and to the shaft of which is attached a small coupling or fitting for holding the various applicators used with such instruments. They are primarily for home treatments where massage is of benefit in relieving certain ailments. Their use is much more effective and less fatiguing than manual massage. These sets are usually furnished with a leather or other neat case within which may also be placed the various applicators provided for the set.

Manufacturers:

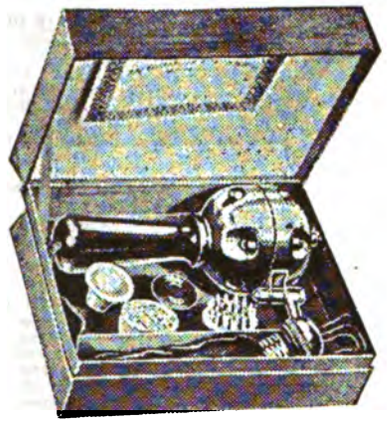
Adbro Mfg. Co., Pittsburgh, Pa. "La Vida."

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ARNOLD ELECTRIC CO., Racine, Wis. Manufacturer of the original portable "Arnold" massage vibrator.—Adv.
Betz Co., Frank S., Hoffman St., Hammond, Ind. "Indiana."
Capital Novelty Co., 138 N. 12th St., Lincoln, Neb. "Three Stroke."
Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill. "Standard."
Drake Electric Works, 3027 Lincoln Ave., Chicago, Ill. "Drake."
Eureka Vibrator Co., 131 W. 42nd St., New York, N. Y. "Vibro-Life."
FITZGERALD MANUFACTURING COMPANY, THE, Torrington, Conn. The Star a-c. vibrator (see first illustration) operates only on alternating current, retails for $5.00. Comes complete with three applicators and is guaranteed for a year. The Star motor vibrator (see second illustration) operates on a-c. or d-c. current and is equipped with a switch in the handle and is furnished in a leatherette covered wooden box with four special applicators. Star vibrators are nationally advertised—window trims, counter cards, booklets and all local dealers' helps are furnished free of charge.—Adv.



Star Electric Vibrator



Star Motor Vibrator

GEIER CO., THE P. A., 5112 St. Clair Ave., Cleveland, Ohio. "Royal."
Gilbert Co., The A. C., Blatchley Ave., New Haven, Conn. "Polar Cub."
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis. "New Life."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Premier."
Nu-System Vibrator Co., Lightner Bldg., Detroit, Mich.
Sanitax Electric Co., 143-147 E. 23rd St., New York, N. Y. "Sanax," "Penetrator."
Schunck & Ogg, 235 Canal St., New York, N. Y. "Ajax," "Fraley."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Gentry," "Knickerbocker," "De Luxe Wayne."
Universal Novelty Works, 164 5th Ave., New York, N. Y. "Vibrosimplex."
Wahl Mfg. Co., Sterling, Ill. "Wahl."

VIBRATORS, ELECTRIC, MASSAGE, PHYSICIANS' AND MASSEURS'.—These devices, though sometimes very similar to the household type, are often made with a larger motor mounted on a pedestal or suspended from a wall bracket, like a dental engine. To the motor is connected a flexible shaft which vibrates the applicator. The applicators, though sometimes larger to conform with the greater power of these devices, are in the main similar to those used with the household devices.

Manufacturers:

ARNOLD ELECTRIC CO., Racine, Wis. "Arnold."
Barbers' Electric Specialty Co., The, 4204 Troost Ave., Kansas City, Mo. "Coffman, The Original."
Betz Co., Frank S., Hoffman St., Hammond, Ind. "Hammond," "Merrill."
Capital Novelty Co., 138 N. 12th St., Lincoln, Neb. "Three Stroke."
Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill. "Standard."
Earl Mfg. Co., Inc., 4332 N. Gratz St., Philadelphia, Pa. "E. Z."
Electric Clipper Co., The, 537 Grand Ave., Kansas City, Mo.
FITZGERALD MFG. CO., THE, Torrington, Conn. (See discriptive advertisement under Vibrators, electric, massage, household type.)
GEIER CO., THE P. A., 5112 St. Clair Ave., Cleveland, Ohio. "Royal."
Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Kochs Co., Theodore A., 659 Wells St., Chicago, Ill. (stand type).
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Moore Electric Corp., 202 S. State St., Chicago, Ill. (Exclusive distributor, Wiebusch & Hilger, Ltd., 106-110 Lafayette St., New York, N. Y.)
Racine Electric Co., Bridge & Ontario St., Racine, Wis.
Sanitarium Equipment Co., Battle Creek, Mich.
Scientific Utilities Co., Inc., 18 E. 16th St., New York, N. Y.
Shelton Electric Co., 16 E 42nd St., New York, N. Y. "Shelton."
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Vivis Mfg. Co., Inc., 1306 1st Ave., Seattle, Wash. "Vivis."

VIBRO-LIFE.—Trade name for electric vibrators manufactured by the Eureka Vibrator Co., 131 W. 42nd St., New York, N. Y.

VIBROPLEX CO., THE.—825 Broadway, New York, N. Y. Manufacturer of telegraphic sending machines. President and general manager, J. E. Albright.

VIBROSIMPLEX.—Trade name for electric vibrators manufactured by the Universal Novelty Works, 164 5th Ave., New York, N. Y.

VICTOMETER.—Trade name for electric indicating tachometers manufactured by Jones-Motrola, Inc., 29 W. 35th St., New York, N. Y.

VICTOR.—Trade name for electric automobile horn manufactured by the American Electric Co., 6401 S. State St., Chicago, Ill.

VICTOR.—Trade name for shade holders manufactured by the Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.

VICTOR.—Trade name for electric blasting apparatus manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

VICTOR.—Trade name for power transmission belting manufactured by the Franklin Cotton Mill Co., N. E. Cor. Plum & Charles Sts., Cincinnati, Ohio.

VICTOR.—Trade name for stationary vacuum cleaners manufactured by the George S. Knox Co., 513 Pennwood Ave., Pittsburgh, Pa.

VICTOR.—Trade name for combination pliers manufactured by Kraeuter & Co., Inc., 583 18th Ave., Newark, N. J.

VICTOR.—Trade name for boiler-tube cleaners manufactured by the Liberty Mfg. Co., Frick Bldg., Pittsburgh, Pa.

VICTOR.—Trade name for insulators manufactured by the Locke Insulator Corp., Maryland Trust Bldg., Baltimore, Md.

VICTOR.—Trade name for valves manufactured by the Lunkenheimer Co., Cincinnati, Ohio.

VICTOR.—Trade name for bolt and rivet clippers manufactured by the Roberts Mfg. Co., Somerville Station, Boston, Mass.

VICTOR.—Trade name for electric dishwashers and meat cutters manufactured by F. G. Street & Co., 132 Nassau St., New York, N. Y.

VICTOR.—Trade name for fuse tongs manufactured by the Volk Electric & Mfg. Co., Inc., Grand Central Terminal, New York, N. Y.

VICTOR.—Trade name for renewable fuses made by the Volk Mfg. Co., Westport, Conn.

VICTOR.—Trade name for steam traps manufactured by the Wright-Austin Co., Detroit, Mich.

VICTOR ANIMATOGRAPH CO.—Davenport, Iowa. Manufacturer of motion-picture machines. Business established 1910. President, A. F. Victor; vice-president, W. R. Weir; secretary and general manager, S. G. Rose; treasurer, D. R. Lane. Main office, 527 W. 4th St., Davenport, Iowa. Branch offices, 38 S. Dearborn St., Chicago, Ill.; 90 West St., New York, N. Y.

VICTOR AUTOXOPHONE.—Trade name for electrically operated phonographs manufactured by the Victor Talking Machine Co.. Camden, N. J.

VICTOR BALATA & TEXTILE BELTING CO.—New York, N. Y. Manufacturer of balata belting. Main office, 38 Murray St., New York, N. Y. Factory, Easton, Pa. Branch offices, 167 N. Market St., Chicago, Ill.; 85 Purchase St., Boston, Mass.; 212 E. 2nd St., Cincinnati, Ohio.

VICTOR ELECTROLA.—Trade name for electrically operated phonographs manufactured by the Victor Talking Machine Co., Camden, N. J.

VICTOR JUNIOR.—Trade name for motor-driven churns manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

VICTOR MFG. CO.—Leavenworth, Kans. Manufacturer of electric washing machines.

VICTOR SAFETY CINEMA. — Trade name for motion-picture machines manufactured by the Victor Animatograph Co., 527 W. 14th St., Davenport, Iowa.

VICTOR STORAGE BATTERY CO.—Rock Island, Ill. Manufacturer of storage batteries and parts. Business established 1914. President, Dick R. Lane; vice-president, George White; secretary and sales manager; B. F. White; treasurer and general manager, T. D. White.

VICTOR TALKING MACHINE CO.—Camden, N. J. Manufacturer of electrically operated phonographs.

VICTOR X-RAY CORP. — 236 S. Robey St., Chicago, Ill. Manufacturer of X-ray and electrotherapeutic apparatus. President, C. F. Samms; vice-president, F. H. Swett; secretary, E. W. Kelly; treasurer, F. A. Wiggin; sales manager, L. B. Miller.

VICTORIA.—Trade name for electrically operated copying machines manufactured by the Regina Co., 47 W. 34th St., New York, N. Y.

VICTORY.—Trade name for leather belting manufactured by the W. D. Allen Mfg. Co., 566 W. Lake St., Chicago, Ill.

VICTORY.—Trade name for polishing wheels manufactured by the Eastern Felt Co., Winchester, Mass.

VICTORY. — Trade name for buffing wheels manufactured by A. P. Munning & Co., Church St., Matawan, N. J.

VICTORY. — Trade name for electric irons manufactured by the Pittsburgh Electric Specialties Co., 451-453 Greenwich St., New York, N. Y.

VICTORY.—Trade name for valves manufactured by the Victory Mfg. Co., 423C Monadnock Bldg., San Francisco, Cal.

VICTORY HAMMERED PISTON RING CO.—494 Mulberry St., Newark, N. J. Manufacturer of piston rings.

VICTORY MFG. CO.—423C Monadnock Bldg., San Francisco, Cal. Manufacturer of valves, oil engines and pipe fittings. President and general manager, Charles S. James; vice-president, H. J. James; secretary and treasurer, E. W. McPherson; sales manager, Arthur E. Biggins.

VIGILANT.—Trade name for feed water regulators manufactured by the Chaplin Fulton Mfg. Co., 28-34 Penn Ave., Pittsburgh, Pa.

VIKING.—Trade name for transformers manufactured by the Viking Electric Co., 150-152 Chambers St., New York, N. Y.

VIKING.—Trade name for electric pumps manufactured by the Viking Pump Co., Cedar Falls, Iowa.

VIKING ELECTRIC CO.—150-152 Chambers St., New York, N. Y. Manufacturer of transformers. Business established 1909. President, A. E. Noble; vice-president, B. D. Carhart; secretary, treasurer and general manager, W. F. Curtis; sales manager, O. J. Fisher.

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VIKING PUMP CO., THE.—Cedar Falls, ...a. Manufacturer of electric pumps. ...sident, W. L. Hearst; vice-president, P. Nielsen; secretary and treasurer, W. Hostrop; manager, George Wyth.

VIKING SIGN CO., INC.—617 8th Ave., ...w York, N. Y. Manufacturer of electric ...s, lighting fixtures, program clocks, re... ...tors, electrical novelties and specialties. ...iness established 1917. President, P. ...uyler Van Bloem; vice-president, L. L. ...us; secretary and treasurer, F. E. ...umy; sales manager, Lawrence K. ...zog. Sales representatives, Quehl Sign ... Cincinnati, Ohio; Roth Sign Co., 98 ...ngfield Ave., Newark, N. J.; Brilliant ... Co., 1035 Ridge Ave., Philadelphia, ... L. F. R. Bellows & Co., Lafayette ..., Detroit, Mich.; F. B. Strough, Brook... ...Ave., Boston, Mass.; Flexlume Sign ... Toronto, Ont., Can., and 35 S. Dear... ...St., Chicago, Ill.

VILLAGE BLACKSMITH FOLKS, THE. ...atertown, Wis. Manufacturers of cable ...ting and pole dressing knives, drills ...wrenches. Business established 1896. ...ident and sales manager, G. H. Lehr... ...vice-president, Charles Reichenbaum; ...tary and treasurer, H. E. Volckmann. ... representatives, W. F. Ritter Co., ...hambers St., New York, N. Y.; H. J. ...han, 5542 W. Adams St., Chicago, Ill.; ... Chubbuck Co., 731 Market St., San ...isco, Cal.

VILLMONT & CO., P. S.—20 W. 22nd ... New York, N. Y., Manufacturer of ...ble electric lamps and shades. Busi... ...established 1910. President and gen... ...manager, Peter S. Villmont. Sales ...sentatives, Myers & Schwartz, San ...isco, Cal.; Andayd Export & Trading ... 206 Broadway, New York, N. Y.

VIMCO MFG. CO., THE.—Milwaukee, ... Manufacturer of motor-driven re... ...ating and ice-making machinery and ... engines. Business established 1867. ...ident, Emil Vilter; vice-president, ...es; secretary and treasurer, William ...lter. Main office, Milwaukee, Wis. ...h offices, 19 E. 24th St., New York, ...; 864 N. Franklin St., Philadelphia, ...731 Monadnock Block, Chicago, Ill.; ...Bennett Court, St. Louis, Mo.; 314 ...e Bldg., Kansas City, Mo.; 519 ... Bldg., Houston, Tex.; 335 Towne ... Los Angeles, Cal.; 28 W. Broadway, ...ake City, Utah.

VIMCO.—Trade name for bell-ringing trans... ...s manufactured by the Bertrand F. ... Co., High & Canal Sts., Trenton, N. ...xclusive distributor, Betts & Betts ...511 W. 42nd St., New York, N. Y.)

VIMETAL.—Trade name for bronze ...ass castings and journal bearings ...ictured by the Bronze Metal Co., 30 ... St., New York, N. Y.

VIMCO MFG. CO., INC.—Buffalo, N. Y. ...cturer of electric sewing machine ...

VIOLIGHT.—Trade name for sewing ...e lights manufactured by the Vimco ...o., Inc., Buffalo, N. Y.

VIOLANA-VIRTUOSO.—Trade name for ...ally operated violin and piano, man... ...ed by the Mills Novelty Co., 221 ...n St., Chicago, Ill.

VIOLET RAY.—Trade name for photo... ...rs' lamp manufactured by the New ...ngravers' Supply, 230-234 W. 17th ...w York, N. Y.

VIOLET-RAY HIGH-FREQUENCY AP... ...US, ELECTRODES AND ATTACH...—Violet-ray apparatus is essen... ...special form of Geissler tube, the ...eing made up into various forms ...odes suitable to application upon ... surfaces. Such application is said ...healing effect for certain ailments. ...tle power is consumed by these ...nd they are made for connection ...ry lighting circuits, both alternat... ...nt and direct current.

...icturers:

... Electric Co., 557 W. Jackson ..., Chicago, Ill. (electrodes).
...o., Frank S., Hoffman St., Ham... ..., Ind.
...ON-DUN CO., 213-217 S. Peoria ...hicago, Ill. World's largest exclu... manufacturers of portable, one ... high frequency generators and ...ment. Manufacture the "Violetta" ...ment; a modern, scientific gen... ..., compactly made in one piece, ... and safe in operation, highly ...nt and recognized by the medical ...sion as a standard electrical ...eutic agent. The "Violetta" ... extensively used in professional ... is very popular for domestic use ...ount of its compactness, simplic... ity of construction and operation and comparatively low cost. In producing the Violetta, the manufacturers have placed a most valuable and powerful curative agent in the hands of the average person. Its use is especially recommended in all cases of rheumatism, sciatica, lumbago, neuritis, skin diseases, or in all cases where increased circulation is desired. In promoting the vigor of atrophied or lazy cells and tissue, it cannot be excelled. Where a sedative effect is desired as in cases of nervousness, insomnia, lack of mental and muscular tone, the glass electrode is placed directly in contact. The current or ray is regulated by a thumb screw while machine is in use. The electrodes are part of the standard equipment and are made in various



The "Violetta"

shapes and sizes to fit the different parts of the body. The entire instrument is combined simply and conveniently in one piece, which insures ease of handling and is a guarantee against breakage. With just ordinary care a machine should last for years. "Violetta" outfit No. 1 for home use includes generator and general electrode for treatment of throat, eyes, scalp, face and body; satin lined, caratol covered carrying case. Uses 110 or 220-volt on either a. c. or d. c. circuit, 32-volt or storage battery current. The Violetta outfits No. 2, No. 3, No. 4, and other styles of violet-ray machines are shown with complete information in elaborate catalog sent upon request to Bleadon-Dun Co., 213 S. Peoria St., Chicago. See display advertisement, page 1295.—Adv.

Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.
Brooklyn Medical Battery & Instrument Co., Inc., 991 Madison St., Brooklyn, N. Y.
Chicago Motor & Vibrator Co., 163-165 N. Wabash Ave., Chicago, Ill. "Standard."
CONTRA-POLE ELECTRIC CO., INC., 1227-1241 Prospect Pl., Brooklyn, N. Y.
Empire Electric Co., Inc., 2227 S. San Pedro St., Los Angeles, Cal. "Rose."
Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y. "Violet-Ray-O."
Halliwell & Co., 62 E. 12th St., New York, N. Y.
Kapota Electric Machines Sales Co., Hyman, 25 W. 42nd St., New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill. "White Cross."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Master Electric Co., 113 S. Jefferson St., Chicago, Ill. "Sine-Flux." "De Luxe."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Medical Appliance Corp., 631 Pennsylvania Ave., N. W., Washington, D. C.
RENULIFE ELECTRIC CO., INC., Marquette Bldg., Detroit, Mich. Manufacturers of a complete line of high frequency violet ray generators of portable type. Seven different models varying in size, and price. The Renulife has the therapeutic properties of the larger machines. Delivers true high frequency currents. The forces of electricity are sent through the body, into every tissue and fibre, without the patient experiencing the slightest sensation other than relief. It gives a pleasant invigoration—a healthy sensation of warmth—makes rich red blood, forcing it through the congested areas—breaks down adhesions and brings about a normal, healthy condition. The



Renulife Violet Ray Generator

curative properties of the Renulife violet ray generator are recognized by leading physicians as a revitalizing power for restoring and preserving the nerve cells of the body. The ozone which is generated is a powerful germicidal and disinfectant. Renulife generators are particularly adapted for use in homes, permitting self-treatment of such ailments as, Rheumatism, Lumbago, Nerve disorders, Scalp and hair treatments, and for treatments of the lungs, throat and nose, as well as purifying the blood. They are also extensively used in beauty parlors for massaging and cleansing the skin. These generators are extremely simple to operate. The strength of vibration is controlled by an adjustment knob. The Renulife attaches to any electric light socket, and is positively safe in service. They will operate on current from 110 to 120 volts, either a-c. or d-c., also may be furnished with coils to operate on 220 or other voltage. Also furnished especially for dry cell batteries.—Adv.

Roche Electric Machine Co., Grand Rapids, Mich.
Rogers Electric Laboratories Co., 2015 E. 65th St., Cleveland, Ohio. "Vitalator."
Shelton Electric Co., 16 E. 42nd St., New York, N. Y. "Shelton."
Tucker Mfg. Co., 118 Noble Ct., Cleveland, Ohio. "Tommy Tucker."
Ultima Physical Appliance Co., 136 W. Lake St., Chicago, Ill. "Sinustat."
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Virazone Co., The, 1111 Absopure Bldg., Detroit, Mich.
Vulcan Electric Co., 239 So. Los Angeles St., Los Angeles, Cal. "Vulcan."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTERN COIL & ELECTRICAL CO., Racine, Wis. Violet rays are today recognized as the greatest single therapeutic agent known to medical science. To build an instrument that would



Virayo No. 1

stand up under the usage given it in the hands of the ordinary person and not to be too cumbersome and expensive, has been the aim of every maker of these instruments. The Virayo No. 1, shown above, is the original handle type Violet-ray machine and embodies every feature that makes it the ideal outfit for family use. We also make outfits specially designed for doctors, beauty parlors, dentists, barbers and chiropractors.—Adv.

VIOLET-RAY-O.—Trade name for high-frequency apparatus manufactured by the Guarantee Electric Products Co., 110-112 W. 40th St., New York, N. Y.

VIOLETTA.—Trade name for violet-ray high-frequency apparatus made by the Bleadon-Dun Co., 213 S. Peoria St., Chicago, Ill.

VIOPTICON.—Trade name for stereopticons manufactured by the Victor Animatograph Co., 527 W. 4th St., Davenport, Iowa.

VI-RAY-O.—Trade name for electrotherapeutic apparatus manufactured by the Western Coil & Electrical Co., 300 5th St., Racine, Wis.

VIRAZONE CO., THE.—1111 Absopure Bldg., Detroit, Mich. Manufacturer of electrotherapeutic generators, high-frequency apparatus, ozonizers and violet ray apparatus. Business established 1920. President and general manager, James W. Ramsay.

VIRDEN CO., THE.—6103 Longfellow Ave., Cleveland, Ohio. Manufacturer of lighting fixtures and fixture parts. Business established 1910. President and treasturer, J. C. Virden; vice-president and secretary, J. C. Virden; general manager,

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W. C. Young; sales manager, R. L. Shrimplin.

VIRGINIA & RAINY LAKE CO., THE.—Virginia, Minn. Producer of wood poles, posts and railway ties. President, Edward Hines; vice-president, William O'Brien; secretary, H. C. Hornsby; treasurer, F. E. Weyerhaeuser, general manager, Thomas S. Whitten; sales manager, F. N. Taylor.

VIRGINIA INDEPENDENT TELEPHONE ASSOCIATION.—President, F. W. Twyman, Charlottesville, Va.; secretary-treasurer, R. M. Coggin, Warsaw, Va.

VIRTUAL VALUE.—Another name for effective value or root-mean-square value. See Effective value. The term "virtual" value is used chiefly abroad.

VISE STRAPS.—See Straps, jack or vise.

VISES, ARMORED CABLE AND CONDUIT.—Clamping tools used by electricians for rigidly holding armored cable or conduit during cutting or stripping operations. These vises usually are portable.

Manufacturers:

Beaton & Cadwell Mfg. Co., New Britain, Conn.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

VISES, BENCH OR MACHINISTS'.—Tools intended for permanent mounting on work benches and of rugged design, for general shop or machinist's use in clamping materials on which filing, fitting or other work is being done. These vises are made in many forms and sizes depending on the general character of the work to be done.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Bonney Vise & Tool Works, Inc., Allentown, Pa. "Champion," "Gipsy."
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Goodell-Pratt Co., Greenfield, Mass.
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Morgan Vise Co., 35 S. Desplaines St., Chicago, Ill. "Morgan."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
North Bros. Mfg. Co., Lehigh Ave. & American St., Philadelphia, Pa. "Yankee."
Nye Tool & Machine Works, The, 108-28 N. Jefferson St., Chicago, Ill.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Western Tool & Mfg. Co., Springfield, Ohio. "Champion."
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y.

VISES, COMBINATION PIPE AND BENDER.—Vises of special form and design having notched jaws to prevent pipe, conduit or other round work from slipping and levers or other attachments for bending pipe, conduit, etc., to any given radius. This combination of two tools in one is especially convenient for the smaller sizes of conduit so much used in house wiring.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Jones Tool Co., 1912 Van Buren Rd., Cleveland, Ohio. "Hercules."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Penn Engineering Co., 2nd & Chestnut Sts., Reading, Pa. "Penn."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Toledo Pipe Threading Machine Co., The, Toledo, Ohio.

VISES, HAND.—Small vises of a portable nature having wingnut clamping screws and intended for use in small work, such as filing, drilling, etc.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Goodell-Pratt Co., Greenfield, Mass.
McAvity & Sons., Ltd., T., King St., St. John, N. B., Can.
Millers Falls Co., Millers Falls, Mass. "Millers Falls."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio. "Giant Handi-Vise," "Griptite" vise holder.
Nye Tool & Machine Works, The, 108-28 N. Jefferson St., Chicago, Ill.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Thompson Machinery Co., Ltd., Grand Bay, Can.

VISES, LINEMEN'S.—Small hand vises, adapted to be carried on a belt or strap, for use by linemen in making repairs, splices, etc.

Manufacturers:

Goodell-Pratt Co., Greenfield, Mass.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."

VISES, MISCELLANEOUS.—This includes various types of vises, not listed under other separate classifications, and adapted to particular purposes, such as automobile and electric vehicle vises, which are of medium size and designed for use by the automobile mechanic; drill-press or milling machine vises for holding work on those machines; jewelers' vises, either of the bench or portable type, etc.

Manufacturers:

Alexander & Cox Co., Ogden & Western Aves., Chicago, Ill.
Athol Machine Co., Athol, Mass. "Athol."
Atkins & Co., E. C., 402 S. Illinois St., Indianapolis, Ind.
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass.
Morgan Vise Co., 35 S. Desplaines St., Chicago, Ill. "Morgan."
Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y. "Trident."
Newman Mfg. Co., 717-21 Sycamore St., Cincinnati, Ohio.
North Bros. Mfg. Co., Lehigh Ave. & American St., Philadelphia, Pa. "Yankee."
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.

VISES, PIPE OR CONDUIT.—Clamping tools intended for temporary or permanent mounting on benches, etc., and equipped with notched or toothed jaws for rigidly clamping pipe, conduit or other round objects and preventing turning during cutting, threading or tapping operations. For large pipe they are made with special means for securing a very firm hold on the pipe without distorting it by excessive or nonuniform pressure.

Manufacturers:

Armstrong Mfg. Co., The, Bridgeport, Conn.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "Wells."
Jones Tool Co., 1912 Van Buren Rd., Cleveland, Ohio.
Martin & Sons, H. P., Owensboro, Ky. "Martin."
McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.
Oil Well Supply Co., 213-215 Water St., Pittsburgh, Pa.
Phoenix Hardware Mfg. Co., 49-53 Illinois St., Buffalo, N. Y.
Walworth Mfg. Co., Boston, Mass.
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y. "Vulcan."

VIT-O-NET MFG. CO.—Chicago, Ill. Manufacturer of electrically heated blankets, jackets and heating pads. President, William F. Craddick; secretary and treasurer, Floyd F. Barnes. Main office and factory, 1225 N. Clark St., Chicago, Ill. Branch office, 23 Flatbush Ave., Brooklyn, N. Y.

VITAE.—Trade name for commutator brushes manufactured by the Le Valley-Vitae Carbon Brush Co., 521 W. 23rd St., New York, N. Y.

VITAL.—Trade name for spark plugs manufactured by the Vital Mfg. Co., Cleveland, Ohio.

VITAL MFG. CO.—Cleveland, Ohio. Manufacturer of spark plugs.

VITALATOR.—Trade name for violet-ray apparatus manufactured by the Rogers Electric Laboratories Co., 2015 E. 65th St., Cleveland, Ohio.

VITOLAC.—Trade name for insulating varnish manufactured by the L. S. Brach Mfg. Co., 127-129 Sussex Ave., Newark, N. J.

VITRE-LITE.—Trade name for lighting reflector manufactured by the Vitreous Enameling Co., 6800 Grant Ave., Cleveland, Ohio.

VITREOUS ENAMELING CO.—6800 Grant Ave., Cleveland, Ohio. Manufacturer of lighting reflectors, etc. President, Samuel Weil; secretary and general manager, Edgar H. Weil; treasurer, Walter M. Weil.

VITRIFYX CO., THE.—2526 W. Congress St., Chicago, Ill. Manufacturer of acid-proof paints and waterproofing materials. Branch office, 1 E. 42nd St., New York, N. Y.

VITRIOL, BLUE.—See Copper sulphate.

VITRO FIRE-FELT.—Trade name for asbestos sheets and blocks manufactured by Johns-Manville, Inc., Madison Ave. & 41st St., New York, N. Y.

VITROBESTOS.—Trade name for asbestos sheets manufactured by Johns-Manville, Inc., Madison Ave., & 41st St., New York, N. Y.

VITROCASE.—Trade name for bell-ringing transformers manufactured by the Killark Electric Mfg. Co., 3940-46 Easton Ave., St. Louis, Mo.

VITROHM.—Trade name for rheostats and resistors manufactured by the Ward Leonard Electric Co., Mt. Vernon, N. Y.

VITROSEAL.—Trade name for wire for sealing into glass manufactured by the Branford Electric Co., 9 Church St., New York, N. Y.

VITROSTEEL.—Trade name for enameled steel reflectors and specialties manufactured by the Benjamin Electric Mfg. Co., 806 W. Washington Blvd., Chicago, Ill.

VIVIS MFG. CO., INC.—Seattle, Wash. Manufacturer of electric hair cutters and vibrators. President, W. E. Johnson; vice-president and general manager, A. H. Findley; secretary, A. B. Challman; treasurer, Martin Ek. Main office, 1306 1st Ave., Seattle, Wash. Branch office, 1024 12th St., Racine, Wis.

VIXEN.—Trade name for automobile wrench manufactured by the Bonney Vise & Tool Works, Inc., Allentown, Pa.

V-K.—Trade name for trolley wheels and harps manufactured by the More-Jones Brass & Metal Co., 3132-44 N. Broadway, St. Louis, Mo.

VLCHEK TOOL CO., THE.—3000 E. 87th St., Cleveland, Ohio. Manufacturer of wrenches, tool kits, etc. President and general manager, F. J. Vlchek; vice-president, W. J. Hunkin; secretary and treasurer, F. S. Macourek; sales manager, C. H. Rock.

V. M. C. BRASS.—Trade name for lighting fixtures and fixture parts manufactured by the Virden Co., 6103 Longfellow Ave., Cleveland, Ohio.

VOGEL.—Trade name for ground clamps manufactured by the Fairmount Electric & Mfg. Co., 59th & Woodland Ave., Philadelphia, Pa.

VOGEL & BROS., INC., WILLIAM.—Brooklyn, N. Y. Manufacturer of sheet metal stampings. President, William H. Vogel; vice-president, Louis H. Vogel; secretary, William Martin Vogel; treasurer, H. M. Edwards. Main office, 37 S. 9th St., Brooklyn, N. Y. Branch office, 180 N. Market St., Chicago, Ill.

VOGT MACHINE CO., HENRY.—Louisville, Ky. Manufacturer of motor-driven refrigerating and ice-making machinery and water-tube boilers.

VOIGHTLANDER & SOHN.—240 E. Ontario St., Chicago, Ill. Manufacturers of photographic lenses.

VOIGT CO.—1741-47 N. 12th St., Philadelphia, Pa. Manufacturer of lighting fixtures, portable electric lamps and lamp bases. Business established 1905. President, Max Voigt; secretary, treasurer and sales manager, Alfred Volker, Jr.; general manager, William J. Voigt. Sales representative, G. M. MacDonough, Box 252, Charlotte, N. C.

VOLK ELECTRIC & MFG. CO., INC.—Grand Central Terminal, New York, N. Y. Manufacturer of renewable fuses and fuse tongs. President, C. S. Randall; vice-president, James O. Corbett; secretary and treasurer, Minder D. Randall. Factories, Bantam, Conn.; Waterbury, Conn.

VOLK MFG. CO., THE.—Westport, Conn. Manufacturer of renewable fuses. Business established 1918. President and treasurer, Charles M. Kemper; secretary, W. Sterling Atwater; general manager, G. E. Keefer; sales manager, F. A. Curry. Main office and factory, Westport, Conn. Branch office and warehouse, 1 Ashburton Place, Boston, Mass. District office, Grand Central Terminal, New York, N. Y. Sales representatives, McCrum & Gillem, 1011 Empire Bldg., Birmingham, Ala.; Williams-Beasley Co., 53 W. Jackson Blvd., Chicago, Ill.; American Manufacturers Agency, Inc., 208 N. Wells St., Chicago, Ill.; George W. Russell, 242 Griswold St., Detroit, Mich.; Charles D. Stempfle, Elmira, N. Y.; H. E. Bloomer, 3205 Vine St., Milwaukee, Wis.; John P. Rockwood, 95 Liberty St., New York, N. Y.; William H. Rue, 310 Finance Bldg., Philadelphia, Pa.; H. Lee Reynolds, First National Bank Bldg., Pittsburgh, Pa.; S. H. Ford, 608 Mutual Bldg., Richmond, Va.; W. R. Patton, 1532 Olive St., St. Louis, Mo.; F. M. Brown, 406 S. Franklin St., Syracuse, N. Y.

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KCAR STORAGE BATTERY CO.—E. 25th St., Chicago, Ill. Manufacturer of storage batteries. President neral manager, J. M. Volkhardt, Jr.; ary, R. E. L. Volkhardt.

T.—The international conference on al units and standards defined the and the ohm in terms of concrete rds. Since there is a definite relatween the ampere, ohm and the volt, lt is defined in terms of this relafollows: The volt is the electrical ce of potential which, when steadied to a conductor whose resistance ohm, will produce a current of one For practical purposes the volt defined as the e.m.f. of the Weston cell. The e.m.f. of the Weston cell is given by the formula E= 0.0000406 (t°—20) volts, where t° is perature in centigrade degrees.

-AMPERE.—A common unit of apower of a circuit. It is the apparer when the potential difference is and the current is one ampere. duct of the volts and amperes gives rent power in volt-amperes. Since rent and true power are identical circuits, d-c. volt-amperes=watts. ng of a-c. generators and transis usually given in kilovolt-am- kilovolt-ampere=1000 volt-amee Power, apparent.

\.—Trade name for electric furd furnace regulators manufactured olta Mfg. Co., Ltd., Welland, Ont.,

, ALESSANDRO.—Born 1745, died Italian physicist, celebrated for eries and inventions in electricity. sor of physics in Italian univerdevoted himself to electrical exand discoveries of great imporalted. He proposed a new theory city at variance with the "anitricity" theory of Galvani, sughat electric power resided in d operated when they were in In 1775 he invented the electrosimple form of condenser. He d the first absolute electrometer. e developed the famous electric battery which bears his name. He e his work carried on to greater ments by Davy, Oersted and He is recognized as the discovrent electricity; in his honor the m.f. has been named the volt.

DYNAMO.—Trade name for n belting manufactured by J. & Sons, 12 N. 3rd St., Philadel-

MFG. CO., LTD.—Welland, Manufacturer of electric furfurnace regulators. President, ; vice-president, Robert Turnary and treasurer, Charles W.

E.—The term voltage is one rring to the electromotive force e of potential in a circuit. It om the practical unit of elecrce, the volt. The current betwo points in a circuit is due s having a different electrical otential"; for this reason the e force or voltage in a circuit rator or battery is sometimes fference of potential across its

, DECOMPOSITION.—The inr of the electric energy necesrolytically decompose a subt a constant for a given kind work being done. In an elecit corresponds to the entire nge from the original electrotrodes to the ultimate prodelectrolytic action, including secondary actions. Numerialuated by dividing by 23,050 alue of the chemical changes the electrolysis, in gramgram equivalent of reaction e Reaction, heat of; and al equivalent of the volt.

DROP.—The voltage drop be points on a conductor in a the product of the current or by the resistance between its considered. By Ohm's drop=I R. The d-c. voltage a generator and the load is product of the load current nce of both wires from the e load. If copper wires are age drop is: e=2x10.4xlxI/A n in feet of one wire bend generator; A=cross-sec- circular mils; I=current in amperes; 10.4=mil-foot resistivity of copper at 70° F.

In a-c. circuits the voltage drop depends upon the reactance as well as the resistance; it equals the product of the current and the impedance. For supply circuits it can be defined as the difference between the e.m.f. at the source and that at the load. Voltage drop is also called potential drop and, when it involves copper conductors, copper drop.

VOLTAGE DROP IN A-C. CIRCUITS.—This is the numerical difference between the generator voltage and the voltage at the point where the voltage is measured. In transmission lines it is the numerical difference between the voltage at the generating and receiving stations. Unless extraneous e.m.f.'s are present, it equals the impedance drop in the line. See Impedance drop.

VOLTAGE REGULATORS.—See Regulators, feeder voltage.

VOLTAGE STABILIZERS.—The purpose of this device is to eliminate the instantaneous variation in voltage when both power and lighting loads are supplied from a single transformer. In any constant-potential distribution system an instantaneous or sustained increase or decrease of current produces a corresponding voltage change which is more or less pronounced, depending on the combined regulation of the line and transformers from which the power is drawn. If the system furnishes energy for both lighting and motors, the changes in voltage may result in lamp flicker, or more or less periodic changes in the candlepower. Hence the use of a stabilizer in cases where such trouble occurs.

The stabilizer is essentially a reactive transformer having a primary through which the motor current flows and a secondary which is connected in series with the lamp load and boosts the lamp voltage by an amount proportional to the voltage drop caused by the starting current of the motor. The stabilizer is provided with an adjustable air gap which permits adjusting the voltage induced in the coil connected in the lighting line.

Manufacturer:

GENERAL ELECTRIC CO., Schenectady, N. Y. The voltage stabilizer developed by this Company will compensate for voltage drops caused by any current that is allowed to flow through one of the stabilizer windings. Consequently, compensation can be made for loads connected with the stabilizer, but not for loads between the stabilizer and the generator. Recommended for use in all cases where the starting of comparatively small motors produces an objectionable lamp flicker. For two-wire and three-wire single phase systems. (Bulletin 45403A.) See adv. pages 1203-1223.—Adv.

VOLTAGES, DISTRIBUTION.—Distribution systems are those operating at voltages below 5000, except that 6600 and 11,000-volt systems are in use for distribution in rural districts in western states. In a-c. systems the feeders and primary mains are operated at 2300 volts if single-phase or two-phase. If three-phase, delta-connected, they are 2300 or 4600 volts or 2300/4000 volts if Y-connected.

The secondary mains are 110 volts, if two-wire; 110-220, if three-wire; and 220 or 440 if for three-phase power. In some cases large mills are operated at 550 volts. In a few cases three-phase Y-connected secondary systems are being operated at 115/200 volts. Voltages below 110 are rarely used for distribution on account of the excessive copper requirements and poor regulation.

VOLTAGES, TRANSMISSION.—The transfer of energy in bulk from point of production to point of distribution is accomplished at voltages ranging from 6600 to 150,000 and higher voltages are in contemplation. Working pressures have been standardized at 6600, 11,000, 13,200, 22,000, 26,400, 33,000, 44,000, 66,000, 110,000, 150,000, and 165,000 and 220,000 (proposed).

VOLTAIC.—An old term used largely in referring to a primary battery, cell or couple or any electrical phenomenon produced by the current from primary (voltaic) batteries.

VOLTAMETERS, COPPER, GAS AND SILVER.—Voltameters are electrolytic cells in which the decomposition of some electrolyte is used as a measure of the quantity of electricity (in coulombs) passed through. They operate on the principle of Faraday's laws. The electrolytes commonly used are copper sulphate, acidulated water, or a solution of silver nitrate. The last is used for the standardization of current-measuring instruments and the ampere is defined in terms of the amount of silver deposited in unit time.

Practically, a better name for this instrument is coulometer or electrolytic ampere-hour meter. The Bastian electrolytic meter is a good example. The electrolyte is a dilute solution of sulphuric acid which is decomposed by the passage of the electric current into hydrogen and oxygen. These are permitted to escape, the drop in the elevation of the liquid being used to measure the ampere-hours supplied. If the gases that escape were collected and measured, they too might be used to measure the ampere-hours. Voltameters can be used on d-c. circuits only. Also see Coulometer.

Manufacturers:

Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.

VOLTAMMETERS, BATTERY OR POCKET.—Voltammeters are instruments combining a voltmeter and ammeter in the same case and are used for measuring either the current or voltage. They are generally instruments of the moving-coil type and have separate binding posts for the voltmeter and ammeter connections. The less expensive instruments operate on the moving-vane principle. Some of the pocket instruments are high-grade instruments with two or three voltage ranges and the same number of current ranges for the ammeter, giving an instrument that may be used for a number of conditions.

Battery-testing instruments are generally used for testing storage batteries for automobile starting and lighting systems, etc., and also for testing dry cells used for ignition purposes.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Advance."
GENERAL ELECTRIC CO., Schenectady, N. Y. The G-E railway signal voltammeters are of the permanent magnet, D'Arsonval type, with connections so arranged that either current or potential can be measured. These voltammeters are small, compact and very substantial, and adequately fulfill the requirements of a small combination instrument for the general testing of railway signals and other apparatus operated with batteries or by low-voltage direct current circuits. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Hoyt Electrical Instrument Works, Penacook, N. H. "Hoyt."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y. "Elite."
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Readrite Meter Works, Bluffton, Ohio. "Readrite."
Roller-Smith Co., 233 Broadway, New York, N. Y. "Handy."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTAMMETERS, DASHBOARD OR VEHICLE.—Voltammeters combining a voltmeter and ammeter in one instrument are sometimes used for dashboard mounting on automobiles or electric vehicles. When used for this purpose, the instrument normally acts as an ammeter, indicating either the charge or discharge rate of the battery. A small button is placed on the instrument, which when pressed completes the connections for the voltmeter and indicates the battery or charging voltage. These voltammeters are usually of the D'Arsonval moving-coil type, ruggedly constructed to withstand the vibration, and are generally mounted in a dustproof metal case with a glass cover. For electric vehicles use it is more common to have separate ammeter and voltmeter elements, both of these being placed side by side in a single case and making a dual instrument of which each element may be permanently connected in circuit. The

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ammeter usually has a zero-center to read charge on one side and discharge on the other.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instrument made up of two miniature D'Arsonval elements mounted on a single base, the covers being separate. (Bulletin 46032.) See adv. pages 1203-1223.—Adv.
Hempy-Cooper Mfg. Co., 418 Archibald St., Kansas City, Mo.
Jewell Electrical Instrument Co., 1650 Wa nut St., Chicago, Ill. "Jewell."
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTAMMETERS, PANEL OR SWITCHBOARD. — Instruments which measure either the current or voltage of a circuit are sometimes mounted on panels or small switchboards for d-c. service, such as for battery charging. They are generally of the moving-coil type, and normally indicate the current flowing in the circuit. A small button placed on the face of the instrument is pressed when it is desired to read the voltage of the circuit. These instruments are made to conform in size and appearance to other panel or switchboard instruments. They usually have but one pointer which moves over a scale calibrated both for volts and amperes.

Manufacturers:

Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Advance."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTAMMETERS, PORTABLE.—Portable voltammeters are used for general testing or laboratory work and provide a single instrument which is self-contained that may have six different working ranges, three for voltage and three for current. They are very handy instruments for this reason, especially for general testing. A special application of portable voltammeters is for electrolysis testing to determine the value of any currents that may be entering or leaving water or gas pipes, cable sheaths or underground structures of any kind.

D'Arsonval moving-coil instruments are mostly used and they are mounted in protecting wooden cases provided with carrying handles. Some of these instruments are very accurate high-grade voltammeters with voltage ranges from a few millivolts to 100 or 150 volts and current ranges up to about 100 amperes. The connections for the different ranges are sometimes obtained by means of a plug switch which is inserted in the desired receptacle, and in other instruments a number of binding posts are provided so that the external connections are readily changed.

Manufacturers:

Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Meters constructed on the D'Arsonval principle and arranged for six capacities and three voltage and current ranges. Contained in a mahogany case. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Pyle-National Co., The, 1334 N. Kostner Ave., Chicago, Ill.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTAPE.—Trade name for insulating tape manufactured by the Res-Pro Insulating Co., Inc., Boston, Mass.

VOLTAX CO.—Bridgeport, Conn. Manufacturer of insulating paints and varnishes.

VOLTMETER MULTIPLIERS. — See Multipliers, voltmeter and wattmeter.

VOLTMETER SWITCHES. — See Switches, switchboard instrument.

VOLTMETERS, AUTOMOBILE AND ELECTRIC VEHICLE.—These are small electrodynamometer or D'Arsonval type instruments designed especially to be simple and rugged to withstand the constant vibration of the vehicle. They are not required to be as accurate as the larger instruments of these types, the accuracy being sacrificed for compactness and ruggedness.

The instruments are mounted in pressed-metal circular cases with glass covers and are suitable for flush mounting on the dashboard of the automobile or vehicle. They are generally from 2 to 3 ins. in diameter. They are made in a number of ranges up to about 120 volts maximum, and with zero-center or zero-left scales.

Manufacturers:

American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instrument construction is a novel application of D'Arsonval permanent magnet type. An excellent example of fine design and high grade instrument work applied to a miniature design. (Bulletin 46045.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y. "Handy Auto."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, BATTERY OR POCKET.—Small rugged instruments used for storage-battery testing in a battery service station or garage or of such size that they may be slipped in a coat pocket and used for general testing purposes. Those intended especially for battery service generally have one terminal in the form of a spike that is placed on one of the battery terminals. The other voltmeter terminal may then be connected by a flexible lead to any other desired battery terminal. These are sometimes made with molded composition cases, so as to be acidproof.

The principle used in most instruments is that of the D'Arsonval or moving-coil instrument. The pocket types are generally mounted in metal cases and have two or more binding posts, depending on the number of voltage ranges.

Battery-testing voltmeters generally have zero-center scales and a range of 3-0-3 volts. The pocket voltmeters often have similar ranges, but are also made with higher ranges up to 150 volts.

Manufacturers:

American Bureau of Engineering, Inc., 1601-1603 S. Michigan Ave., Chicago, Ill. "Ambu."
American Ever Ready Works of National Carbon Co., Inc., Thompson Ave. & Orton St., Long Island City, N. Y. "Eveready."
Bunnell & Co., J. H., 32 Park Place, New York, N. Y. "Bunnell."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can. "Columbia."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Advance."
Etna Electric Works, 410 E. 15th St., New York, N. Y.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments constructed on the Thomson inclined coil principle and designed in such a way that a strong, accurate and exceedingly permanent structure is obtained. The moving elements are mounted in sapphire jewels, while the controlling force, damping and scale, are of equally fine construction. Furnished in 75, 150 and 300-volt sizes. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N .Y.
Hoyt Electrical Instrument Works, Penacook, N. H. "Hoyt."
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Minnesota Storage Battery Co., 208-210 N. 4th St., Minneapolis, Minn.
Mohawk Electric Mfg. Co., 15 Kirk Pl., Newark, N. J. "Rollinson."
National Carbon Co., Inc., Highland & Madison Aves., Cleveland, Ohio. "Columbia."
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Readrite Meter Works, Bluffton, Ohio. "Readrite."
Roller-Smith Co., 233 Broadway, New York, N. Y.
Service Station Supply Co., 30-32 Larned St., Detroit, Mich. "Hyrate Cadmo."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, CONTACT-MAKING.—Strictly speaking, the device known by this name is not a voltmeter but a multicircuit differentially wound contact-making relay and line-drop compensator combined. It is used in connection with automatic voltage-regulating apparatus for feeders and transmission lines. It consists of a solenoid having a number of windings. One winding produces a magnetic flux proportional to the pressure, another carries current in proportion to the load and opposes the flux due to the feeder pressure. This counter force is adjustable by means of taps from the winding. As the load varies the plunger makes contacts which control the voltage-regulating apparatus to maintain a uniform voltage.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. "G-E." (See adv. pages 1203-1223.)
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

VOLTMETERS, ELECTROSTATIC. — The principle of operation of this type of voltmeter is that of attraction and repulsion between electric charges. The essential elements of such instruments are a movable vane or set of vanes and corresponding stationary vanes or quadrants

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ılated from the movable element. When movable and stationary elements are ɔsitely charged the resulting attraction ıes a deflection.

ıey are especially well adapted for suring alternating voltages, but may be used for direct voltages. Some of advantages over other types of volt- ɪrs are their freedom from errors due equency, power-factor, wave form, ex- ıl magnetic fields and self-heating. absorb no energy at ordinary fre- cies and hence have no disturbing in- ces on the circuits to which they are ɔcted.

low-voltage circuits the actuating s are small and hence to measure with a satisfactory degree of ac- y the electrostatic voltmeter must ɔry sensitive and delicate; therefore seldom used for low voltages. For voltages, from 800 volts up, the in- ents are made much more rugged, novable element being pivoted be- jeweled bearings. In order to se- a relatively large actuating force comparatively low voltages, up to olts, Lord Kelvin devised the multi- r form. This consists of a series drants or fixed plates one above the and between them, attached to the s a number of vanes.

type of electrostatic voltmeter con- f a series of fixed and variable con- ı. The operating element is im- in a high grade of oil which in- the insulation, the actuating force same potentials, and also buoys up vable element, thereby diminishing friction.

the Kelvin multicellular and the er type referred to are damped by ɔiction. Some other makes are by a vane moving between the a permanent magnet. These volt- ıre made for potentials as high as ɔolts.

acturers:

ɔan Radio & Research Corp., 21 Row, New York, N. Y.
an General Electric Co., Ltd., 212 St., W., Toronto, Ont., Can.
Electric Co., 434 Shelby St., De- Mich.
ɪAL ELECTRIC CO., Schenec- N. Y. Two types of this instru- are manufactured: the vane type ɔtentials of 3, 5 and 10 kv., and ın type for use up to 50,000 volts. voltmeter is fitted with resistance ıs a protection against excessive ts in case the voltage should er both electrodes. Above 50 kv. here spark gap is recommended. ɔin 46110.) See adv. pages 1203- Adv.
ray Co., 64-70 Johnson St., Ger- vn, Philadelphia, Pa.
ɔ ELECTRICAL INSTRUMENT Norfolk St., Cambridge, Mass.
ılth Co., 233 Broadway, New ɔ. Y.
GHOUSE ELECTRIC & MFG. ɹst Pittsburgh, Pa. (See display ges 1395-1402.)

TERS, MILLI.—These are per- ɔnet movable-coil type instru- ɔfined construction and low re- hey will give a full scale de- potential differences as low as or 20 millivolts. Such low- ruments are subject to tem- ors for which corrections must Instruments of 200-millivolt ɔove requiring no temperature re regularly made, with max- s up to 1 volt. These volt- enerally used for special test- s and laboratory work and e generally of the portable d in a wooden or metal pro- Switchboard millivoltmeters in some cases, and they have about 50 to 800 millivolts. ɔith suitable shunts millivolt- mmonly used as ammeters.

ɪrs:

ɔneral Electric Co., Ltd., 212 W., Toronto, Ont., Can.
ɔestinghouse Co., Ltd., San- ɔyler Sts., Hamilton, Ont., stinghouse."
ɹric Co., 434 Shelby St., De-

ELECTRIC CO., Schenec- Portable instruments con- ı D'Arsonval principle, high very accurate. Made in va- ities. (Bulletin 46044.) See 1203-1223.—Adv.
ɔical Instrument Co., 1650 , Chicago, Ill. "Jewell."
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sticht & Co., Herman H., 15 Park Row, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.
Wilson-Maeulen Co., Inc., 730 E. 143rd St., New York, N. Y.

VOLTMETERS, PORTABLE, A. C.—These are of either the electrodynamometer, movable-vane or induction types. They do not differ essentially from the switchboard instruments of the same types, except in size and portability. They are mounted in wooden cases, as a rule, with a carrying handle on the top. They should always be used in the horizontal position to avoid errors due to unbalancing of the moving element.

Portable voltmeters of this type are used for general testing and laboratory work, especially where high accuracy is desired, most of the instruments being accurate to within ¼ to ½ of 1%. They are generally free from temperature, wave shape, or frequency errors within ordinary limits. The moving elements are always effectively damped to permit instantaneous reading. They are made with ranges up to 750 volts for direct connection to the circuits. Higher voltages may be read by using lower-range voltmeters with suitable potential transformers.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments constructed on the direct-reading dynamometer principle, with good mechanical construction and neat in appearance. Self-contained in capacities ranging from 75 to 750 volts. For voltages above 750 a potential transformer can be furnished. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, PORTABLE, A-C. AND D-C.—Portable instruments for use on either a-c. or d-c. circuits are generally of the electrodynamometer type in the better grades and the hot-wire and movable-vane types in the less expensive forms. They are used for the same purposes as the separate a-c. and d-c. portable voltmeters, mostly for laboratory work and general testing involving either direct or alternating currents. The electrodynamometer type gives very accurate readings and is quite free from errors due to temperature, wave form or frequency variations. These instruments are usually shielded and well damped and have the moving elements mounted on jewel bearings, and the whole unit enclosed in a wooden case. Various ranges up to about 750 volts maximum are used.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. This instrument is of the dynamometer type and is contained in a mahogany case. A small, lightweight, thoroughly dependable instrument. (Bulletin 46018A.) See adv. pages 1203-1223.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Reliance Instrument Co., Inc., 1135 W. Van Buren St., Chicago, Ill. "Reliance."
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MANUFACTURING CO., W. M., 1516 Orleans St., Chicago, Ill. Voltmeters and ammeters, a-c. or d-c., for general commercial or laboratory use.



Welch Volt-Ammeter

High-grade jewel bearing instruments. Guaranteed accuracy 1% of scale. All ranges in portable, lineman's and switchboard forms. Catalog on request. —Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, PORTABLE, D-C.—These voltmeters are almost invariably of the movable-coil permanent-magnet type, also known as the D'Arsonval type. The general construction has a rectangular coil pivoted in the center and rotating between the permanent magnet poles, thus giving two air gaps. Some instruments are made with the coil pivoted on one side so that only a single air gap is obtained. The coil is usually mounted in jewel bearings and is damped so that it makes quick reading possible. Outside magnetic influences are eliminated by surrounding the entire movable element by the permanent magnet.

These instruments are used for laboratory or testing work and they are usually very accurate. They are made self-contained in ranges from 1.5 to 750 volts, mounted in wooden or metal protective cases. Higher voltage ranges are obtained by connecting external multipliers in series, thus giving an exceptionally wide range with one instrument.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Hanson & Van Winkle Co., Ltd., The, Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Central Scientific Co., 460 E. Ohio St., Chicago, Ill.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type DP2 instruments self-contained in capacities up to and including 750 volts and with a resistance of approximately 100 ohms per volt. Double or triple scale instruments in any combination can also be furnished. See adv. pages 1203-1223.—Adv.
Hanson & Van Winkle, Newark, N. J.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Kermel Apparatus Co., Cambridge, Mass.

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Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, PRECISION, CALIBRATING OR LABORATORY STANDARD.—These are of the permanent magnet, movable-coil and electrodynamometer types. The instruments are semiportable, that is, they may be moved, but it is better practice to mount them on a fixed support where they can be checked and used. The principles of operation are the same as for other instruments of the same types, but the instruments are larger, have longer scales, higher resistance and are adjusted to a much higher degree of accuracy. The scales of some of the d-c. instruments have subdivided scales permitting closer reading. One form of the electrodynamometer type has a double scale, one reading in uniform divisions and the other in volts. A vernier enables accurate reading to one-tenth of a division. These instruments are commonly used for calibrating other voltmeters.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Chicago Apparatus Co., 701 W. Washington Blvd., Chicago, Ill. "Milvay."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
GENERAL ELECTRIC CO., Schenectady, N. Y. Type DL combines in one instrument all voltages met with in most d-c. work. Type PL for alternating current is constructed on the dynamometer principle and special construction is employed to maintain a high torque. Instruments with an external multiplier for all capacities. (Bulletin 46044.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, RECORDING OR CURVE-DRAWING.—These are of two types, direct acting and relay. The direct-acting are usually of the permanent-magnet, movable-coil type or electrodynamometer type. The pointer is equipped with some form of siphon pen which traces its movement over a clock-operated chart. On account of the friction of the pen, these instruments do not have a very high degree of accuracy. This is especially true of low-range instruments.

To obviate this difficulty, one maker has attached a lever to the clock mechanism in such a way that at intervals of one minute it presses the pointer against a smoked chart, leaving the pointer free in the meantime. In other instruments an inked ribbon is interposed between the pointer and the paper chart. Such instruments do not record any fluctuations of less than a minute duration.

In the relay type of recording voltmeter, the recording mechanism is operated by a separate source of current through contacts which are actuated by the voltage whose fluctuations are to be recorded.

These voltmeters are made for use on both a-c. and d-c. circuits, generally operating with external multipliers or potential transformers, although the lower voltage circuits permit direct connection.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind. See Instruments, electrical, curve drawing, graphic recording or printing, miscel.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments of the round pattern type having circular charts eight inches in diameter. Furnished for both alternating and direct current up to and including 750 volts. Type CR is made in three sizes, 90-130, 180-260, 450-650 volt capacity. Strip chart instruments with 8-day clocks also furnished in above sizes. (Bulletin 46047.) See adv. pages 1203-1223.—Adv.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

VOLTMETERS, SPECIAL AND MISCELLANEOUS.—Voltmeters are made in some types other than those described herewith to be used for special voltage measurements. Examples of this are the hot-wire voltmeters used on radio and other high-frequency circuits because they are practically not affected by changes in frequency. For some purposes in testing work it is desirable to measure the crest of a wave or the maximum voltage value. Crest voltmeters have been devised for this purpose. They are used with the condenser type bushing of a testing transformer. The principle is that the average value of the half wave of the charging current in a condenser bushing, flowing in and out of the bushing when it is subjected to a voltage strain, is proportional to the crest of the voltage wave.

Manufacturer:

RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.

VOLTMETERS, SWITCHBOARD OR PANEL, A-C.—Voltmeters for a-c. circuits arranged for switchboard mounting are very widely used and have been more standardized than d-c. instruments as regards size, etc. They are almost always made with circular cases and are arranged both for surface and flush mounting. Three types of voltmeters are commonly found. They are the soft iron vane, induction and electrodynamometer types. In addition the electrostatic and hot-wire voltmeters are occasionally used, the former for high voltages and the latter for high frequencies.

All of the three principal types have about the same accuracy. The induction type instruments have a much longer scale for the same diameter case than any of the other type instruments and may be read accurately on the upper parts of the scale. They are usually not affected by ordinary variations in wave form, frequency or temperature.

Because of the voltage of the circuits on which many of these voltmeters are placed they are often operated with suitable potential transformers. The maximum range for direct-connected instruments is about 750 volts; above 350 volts the series resistors are usually externally mounted or potential transformers used.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Midget."
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. A complete line of these instruments similar in general characteristics to a-c. switchboard ammeters for similar service, which see for general description.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
NORTON ELECTRICAL INSTRUMENT CO., THE, Manchester, Conn.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOLTMETERS, SWITCHBOARD OR PANEL, D-C.—Voltmeters for switchboard mounting for use on d-c. circuits are always of the moving-coil permanent magnet type. They are made in a number of forms and sizes for different types of mounting, such as round, fan-shaped and edgewise instruments for either flush or surface mounting and with or without illuminated dials. They vary in size from instruments 3 ins. in diameter to those having a scale approximately 38 ins. long.

Voltmeters of this type are usually made with ranges up to 750 volts, any higher voltage readings being obtained by means of multipliers. In most cases the instruments are only self-contained for the lower voltages, up to about 300 volts, and above that have the multipliers mounted behind the board. In the larger sizes, many voltmeters have illuminated dials, having one or more lamps placed behind the instrument so that the figures and pointer may be seen from a distance.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Connecticut Dynamo & Motor Co., The, Lyons Ave. & Colt St., Irvington, N. J.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Dongan Electric Mfg. Co., 2987 Franklin St., Detroit, Mich.
Eldredge Electric Mfg. Co., 3 Post Office Sq., Springfield, Mass. "Midget."
Ely, C. Upham, 50 Vesey St., New York, N. Y.
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. D'Arsonval construction. High accuracy, rugged, well damped and neat in appearance (Bulletin 46045.) See adv. pages 1203-1223.—Adv.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland, Ohio.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
NORTON ELECTRICAL INSTRUMENT CO., THE, Box V, Manchester, Conn. Manufacturer of voltmeters and ammeters of both direct and alternating current in a variety of sizes for switchboard work.—Adv.
Pignolet, Louis M., 78-80 Cortlandt St., New York, N. Y.
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
Sholder-Excel Mfg. Co., The, Clyde, Ohio.
Somerville Radio Laboratory, 102 Heath St., Somerville, Mass.
WELCH MFG. CO., W. M., 1516 Orleans St., Chicago, Ill.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

VOM BAUR, C. H.—50 Church St., New York, N. Y. Manufacturer of electric furnaces.

VON SCHLEGELL.—Trade name for electric furnaces manufactured by the Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill.

VOORBESTITE.—Trade name for packing manufactured by the Voorhees Rubber Mfg. Co., 20-56 Bostwick Ave., Jersey City, N. J.

VOORHEES RUBBER MFG. CO.—Jersey City, N. J. Manufacturer of mechanical rubber goods. President, J. J. Voorhees; secretary, J. J. Voorhees, Jr.; treasurer, F. D. Voorhees; sales manager, G. F. Covell. Main office, 20-56 Bostwick Ave., Jersey City, N. J. Branch office, 30 Reade St., New York, N. Y.

VORTEX.—Trade name for motor-driven dishwashers manufactured by the Hamilton-Low Co., Jersey City, N. J.

VORTEX. — Trade name for electric pumps manufactured by the Lawrence Pump & Engine Co., Lawrence, Mass.

VOSMAER OZONIZER.—A high-tension apparatus for converting atmospheric air into ozone.

VOSS.—Trade name for electric washing machines manufactured by the Voss Bros. Mfg. Co., Davenport, Iowa.

VOSS BROS. MFG. CO.—Davenport, Iowa. Manufacturer of electric washing machines. Business established 1877.

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ident, W. H. Voss; vice-president, J. Voss; secretary and general manager, K. Voss; treasurer, F. P. Voss; sales ager, E. F. Voss. Sales representa-, Electric Appliance Co., Pittsburgh, Oklahoma City Hardware Co., Okla- City, Okla.; Heyman Weil Co., San cisco, Cal.; R. M. Burton, Seattle, h.; J. H. Ashdown Hardware Co., ipeg, Man.; P. T. Legare & Co., Que- Can.

YLROID.—Trade name for portable ic lamps manufactured by the Fine Product Co., 4311 Grand Blvd., Chi- Ill.

IAY CO.—Marshalltown, Iowa. Man- irer of spark plugs, etc.

ELAND.—Trade name for radio os- rs manufactured by the Leeds & rup Co., 4901 Stenton Ave., Philadel- Pa.

ELAND, B. F.—411 Commonwealth Denver, Colo. Manufacturer of wood rms. Business established 1898. Sole B. F. Vreeland. Mills, Washington egon.

CABESTON.—Trade name for sheet ibestos rope packing manufactured Johns-Pratt Co., 555 Capitol Ave., d, Conn.

CALUN.—Trade name for insulat- tting manufactured by the Ameri- rasive Metals Co., Hudson Terminal New York, N. Y.

CAN.—Trade name for fire alarm nanufactured by J. H. Bunnell & Park Pl., New York, N. Y.

AN.—Trade name for welding id manufactured by the Cortland Compound Co., Cortland, N. Y.

AN.—Trade name for storage bat- anufactured by the Croftan Stor- ery Co., 423-5 W. Queen St., To- nt., Can.

AN.—Trade name for electric eaters manufactured by the In- ous Electric Heater Corp., Root ffalo, N. Y.

N.—Trade name for flue gas instruments manufactured by the B. Pierce Co., 45 N. Division St., Y.

N.—Trade name for soldering te, fluid, acid and sticks manu- by the Vulcan Chemical Co., 1940 St., Chicago, Ill.

N.—Trade name for X-ray and iency electrotherapeutic apparat- by the Vulcan Electric Co., 239 ngeles St., Los Angeles, Cal.

.—Trade name for soot blowers red by the Vulcan Soot Cleaner 0 E. Long Ave., Du Bois, Pa.

.—Trade name for vises, pipe etc., manufactured by J. H. Co., Brooklyn, N. Y.

ASBESTOS MFG. CO.—95 New York, N. Y. Manufacturer tape, packing, paper, etc. Fac- ield, N. J.

CHEMICAL CO. — 1940 W. Chicago, Ill. Manufacturer of alts, paste, fluid, acid and sticks. Business established 1920. President, secretary and treasurer, Frank E. Glassman; vice-president, Frank A. Cahn; sales manager, Adolph M. Glassman.

VULCAN CRUCIBLE STEEL CO.—Aliquippa, Pa. Manufacturer of electric furnace and magnet steel. President S. G. Stafford; vice-president, Joseph A. Kelly; secretary and treasurer, W. A. Campbell. Main office, Aliquippa, Pa. Branch offices, 16 S. Clinton St., Chicago, Ill.; Detroit, Mich.; Boston, Mass.; New York, N. Y.

VULCAN ELECTRIC CO.—239 So. Los Angeles St., Los Angeles, Cal. Manufacturer of X-Ray and high-frequency electrotherapeutic apparatus. Business established 1920. President, I. W. Gleason; secretary, treasurer and general manager, W. W. Sweeney.

VULCAN ELECTRIC HEATING CO.—107 W. 13th St., New York, N. Y. Manufacturer of electric heating devices. Business established 1906. F. J. Holmes, president.

VULCAN ENGINEERING SALES CO.—1765 Elston Ave., Chicago, Ill. Manufacturer of motor-driven foundry equipment. President, P. W. Gates; vice-presidents, H. Woodland, A. F. Jensen; secretary and treasurer, S. K. Stockton.

VULCAN FUEL ECONOMY CO.—829A Transportation Bldg., Chicago, Ill. Manufacturer of insulating paints. Business established 1906. President, George L. Simonds; vice-president and treasurer, Thornton M. Pratt; secretary and general manager, Eugene Murray-Aaron. Factories, Chicago, Ill., and Mishawaka, Ind.

VULCAN IRON WORKS.—730 S. Main St., Wilkes-Barre, Pa. Manufacturers of electric mine locomotives, hoists, coal crushers, etc. Business established 1849. President, S. T. Nicholson; vice-president and treasurer, George Nicholson; secretary, Fred O. Smith; sales manager, George H. Brown. Factories, South Wilkes-Barre and West Pittston, Pa. Sales representatives, Keiser-Geismer Engineering Co., Birmingham, Ala.; Crawford & Cameron, 2218 Farmers Bank Bldg., Pittsburgh, Pa.

VULCAN MFG. CO.—1511 Cypress Ave., Kansas City, Mo. Manufacturer of electric washing machines and motor-driven air compressors. Business established 1905. President and general manager, W. S. Swift; vice-president, A. J. Bauer; secretary and treasurer, W. C. Bauer; sales manager, J. E. Kieth.

VULCAN SOOT CLEANER CO., INC., THE.—Du Bois, Pa. Manufacturer of soot cleaners, superheaters and economizers. President, D. E. Hibner; vice-president and general manager, F. W. Linaker; vice-president and sales manager, G. L. Simonds; secretary, T. M. Bruback. Main office, 20 E. Long Ave., Du Bois, Pa. Branch office, 828 Transportation Bldg., Chicago, Ill.

VULCANIZED FIBER RODS, SHEETS, ETC.—Vulcanized or hard fiber is a hard dense material made principally of paper and cellulose. Cellulose is obtained from cotton rag stock. Zinc chloride and coloring matter are also used in the process. Hard or vulcanized fiber has almost the same properties as the softer more flexible grades ordinarily called "fiber." Impregnation or treatment of vulcanized fiber improves the quality in a marked degree.

Vulcanized fiber is rolled and formed into sheets and rods, and often treated with Bakelite or other molded insulating compounds. Impregnated fiber is also used for conduits for inside construction. The sheets and rods and tubes are also used for various other manufacturing purposes.

Manufacturers:

Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass.
Continental Fibre Co., Newark, Del.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Keystone Fibre Co., Yorklyn, Del.
Mikesell Bros. Co., 156 N. LaSalle St., Chicago, Ill. "Mibroco."
Russell Specialty Mfg. Co., 2944 W. Lake St., Chicago, Ill.
Spaulding & Sons Co., Inc., J., 300 Wheeler St., Tonawanda, N. Y.

VULCANIZERS, ELECTRIC.—Apparatus for treating rubber during vulcanizing operations by the application of heat, regulated in degree and generated in electric heating elements. Such electrically heated vulcanizers have the advantage of absolute and exact control of temperature so as to attain very thorough vulcanization. They have been used in tire repair work and various industrial vulcanizing processes. They are made in various sizes and forms to suit the requirements.

Manufacturers:

Bacon Vulcanizer Mfg. Co., 4065 Hollis St., Oakland, Cal.
Cobb Electric Appliance Co., Lanesville Terrace, Boston, Mass.
Gwynn-Bacon Vulcanizer Co., 2504 Cass Ave., St. Louis, Mo.
Heintz & Co., James C., 1319 Main Ave., Cleveland, Ohio. "Heintz."
Miller, Charles E., Anderson, Ind. "Miller-Anderson."
Premier Electric Co., 3800-3810 Ravenswood Ave., Chicago, Ill. "Premier," "Its-It."
Progressive Shoe Machinery Co., 3116-36 Snelling Ave., Minneapolis, Minn. "Progressive."
Rohne Electric Co., Inc., 2434 25th Ave., S., Minneapolis, Minn. "Rohne."
Shaler Co., C. A., 22 Jefferson St., Waupun, Wis. "5-Minute," "Vul-Kit."

VUL-COT.—Trade name for fiber products manufactured by the American Vulcanized Fibre Co., Wilmington, Del.

VUL-KIT.—Trade name for electric vulcanizer manufactured by the C. A. Shaler Co., 22 Jefferson St., Waupun, Wis.

V. V.—Trade name for conduit fittings and safety switches manufactured by the V. V. Fittings Co., 711 Cherry St., Philadelphia, Pa.

V. V. FITTINGS CO.—Philadelphia, Pa. Manufacturer of conduit fittings and safety switches. President and treasurer, William Gloeckner; vice-president and general manager, James F. Burns. Main office, 711 Cherry St., Philadelphia, Pa. Branch offices, 50 Church St., New York, N. Y.; 308 S. Canal St., Chicago, Ill.

W

tter W is the chemical sym- **element tungsten.** It is used **eneral symbol** for power, ex- **tts, and** for energy or work, **watt-hours.** The Greek letter **hich** resembles the form W, **symbol** for angular velocity, **adians per second.**

rade name for twist drills, **reamers** and wrenches man- **he Whitman & Barnes Mfg. io.**

ade name for wire manufac- **American Steel & Wire Co., St., Chicago, Ill.**

ECTRIC CO.—Chicago, Ill. **of electric** irons and toast- **established** 1909. President, **vice-president** and general **. Waage;** secretary, treas- **manager,** Edward Florence. **S. Jefferson St., Chicago,** Ill. Branch offices, 6 Reade St., New York, N. Y.; Michigan City, Ind.

WABASH.—Trade name for locomotive headlights manufactured by the Star Headlight & Lantern Co., 294 Franklin St., Rochester, N. Y.

WABASH SHADE CO.—426 S. Wabash Ave., Chicago, Ill. Manufacturer of silk lamp shades. President, J. W. Caswell; vice-president, George Sylvester; secretary and treasurer, W. Runyan.

WADE MFG. CO., H. M.—Charlotte, N. C. Manufacturer of store showcases and wall cases.

WADSWORTH ELECTRIC MFG. CO., INC.—Covington, Ky. Manufacturer of meter protective devices and externally operated switches. Business established 1917. General manager, Geo. B. Wadsworth.

WADSWORTH NOVELTY MFG. CO.—Wadsworth, Ohio. Manufacturer of push buttons. Business established 1916. President, Andrew Auble, Jr.; general manager, Victor Moon.

WAFFLE BAKERS, ELECTRIC, HOTEL TYPE.—Cooking utensils usually furnished with double hinged heating surfaces especially designed for baking waffles and provided with electric heating elements of considerable capacity and arranged in banks or sections suitably controlled by switches. These outfits can bake a large number of waffles at a time, if desired, or they may be used for only one or two sections. They have proven very satisfactory in hotels, clubs and restaurants equipped for electric cooking.

Manufacturers:

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
Weeks Mfg. Co., H. G., Hamilton, Ohio.

WAFFLE IRONS, ELECTRIC, HOUSEHOLD.—These are specially designed ap-

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pliances for baking waffles at the table. They are made with two heating surfaces and elements, hinged together, the heating surfaces usually being aluminum grids. They usually consume about 600 watts.

Manufacturers:

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
Standard Stamping Co., The, 1st St. & 7th Ave., Huntington, W. Va. "Armstrong."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WAGENER STEAM PUMP CO., THE.—Canton, Ohio. Manufacturer of acid and steam pumps.

WAGENHALS.—Trade name for electric car headlights manufactured by the Dayton Mfg. Co., Dayton, Ohio.

WAGENHORST & CO., J. H.—704 Dollar Bank Bldg., Youngstown, Ohio. Manufacturers of electric blueprinting machines and arc lamps. Business established 1904. President and treasurer, John P. Young; vice-president J. H. Wagenhorst; secretary and general manager, E. G. Perkins. Sales representatives, Eugene Dietzen Co., New York, N. Y.; Philadelphia, Pa.; Washington, Pa.; New Orleans, La.; Pittsburgh, Pa.; Chicago, Ill.; San Francisco, Cal.; Dodd Co., Cleveland, Ohio; Multi-Color Co., Detroit, Mich.; Buffalo Blue Print Co., Buffalo, N. Y.

WAGNER.—Trade name for motor-driven floor planers, surfacing and polishing machines manufactured by the F. Wagner Machine Works, Laurel Hill, N. Y.

WAGNER, CARL H.—1944 N. Albany Ave., Chicago, Ill. Manufacturer of thermometers and hydrometers. Business established 1897. Sole owner, C. H. Wagner.

WAGNER ELECTRIC MFG. CO.—St. Louis, Mo. Manufacturer of motors, generators, transformers, rectifiers, etc. President and general manager, W. A. Layman; vice-president, Walter Robbins; treasurer, Robert Lee Hedges. Main office, 6400 Plymouth Ave., St. Louis, Mo. Branch offices, 342 Newbury St., Boston, Mass.; 16 Carlton St., Buffalo, N. Y.; 918 S. Michigan Ave., Chicago, Ill.; 20 E. 9th St., Cincinnati, Ohio; 2007 S. Ervay St., Dallas, Tex.; 5919 Woodward Ave., Detroit, Mich.; 701 Union Bldg., Cleveland, Ohio; 922 N. Pennsylvania Ave., Indianapolis, Ind.; 905 E. 15th St., Kansas City, Mo.; 1320 S. Grand Ave., Los Angeles, Cal.; 501 Broadway, Milwaukee, Wis.; 1310 Nicollet Ave., Minneapolis, Minn.; 50 Church St., New York, N. Y.; 1632 Sansom St., Philadelphia, Pa.; 530 Fernando St., Pittsburgh, Pa.; 59 W. Broadway, Salt Lake City, Utah; 159 New Montgomery St., San Francisco, Cal.; 1114 Pioneer Bldg., St. Paul, Minn.; 538 1st Ave., S., Seattle, Wash.; Power Bldg., Montreal, Que., Can.

WAGNER MACHINE WORKS, F. — Laurel Hill, N. Y. Manufacturers of motor-driven floor planers, polishing and surfacing machines. F. Wagner, sole owner.

WAGNER-WOODRUFF CO. — 830 S. Olive St., Los Angeles, Cal. Manufacturer of lighting fixtures. President and general manager, Robert G. Wagner; vice-president, Oscar Schourmer; secretary and treasurer, E. J. Schweitzer.

WAGONS, TOWER, ELECTRIC.—An electrically propelled wagon used on electric trolley railways for repair work on the overhead wires, and provided with a rectangular framework tower, having a telescoping extension. This extension can be raised by suitable mechanism so that men standing on its platform are at the proper elevation to work conveniently on the overhead wiring, such as trolley and span wires, and all the fittings of the aerial contact system. The platform and tower are insulated so that men may safely work on charged overhead wires. The wagon body is provided with tool boxes and bins for carrying the repair parts necessary in the work. Such wagons of somewhat heavier construction and provided with wrecking tools and equipment are called tower wreck wagons.

Manufacturer:

General Vehicle Co., Long Island City, N. Y. "G-V."

WAGONS, TOWER, GASOLINE.—Wagons or trucks propelled by gasoline engine, of the same general type and performing the same functions as described for Wagons, tower, electric. They may be operated over streets or roads not equipped with trolley contact wires.

Manufacturers:

General Motors Truck Co., Pontiac, Mich.
Leonhardt Wagon Mfg. Co., 412 E. Saratoga St., Baltimore, Md.
McCardell & Co., Trenton, N. J.

WAGONS, TOWER, HORSE-DRAWN.—Wagons drawn by horses of the same general type and performing the same functions as above described for Wagons, tower, electric. These also may operate on streets not provided with trolley wires.

Manufacturers:

Leonhardt Wagon Mfg. Co., 412 E. Saratoga St., Baltimore, Md.
McCardell & Co., Trenton, N. J.
Milburn Wagon Co., Toledo, Ohio.

WAHL MFG. CO.—Sterling, Ill. Manufacturer of electric vibrators.

WAHLSTROM TOOL CO. — 5520 2nd Ave., Brooklyn, N. Y. Manufacturer of automatic drill chucks. President, V. J. Wahlstrom; vice-president and general manager, A. B. Phillips; secretary, George E. Nace; treasurer, D. H. Haynes.

WAHMANN MFG. CO., GEORGE H.—520 W. Baltimore St., Baltimore, Md. Manufacturer of incubators, ovens, respirators and resuscitation apparatus, sterilizers and other electrically heated laboratory apparatus. Business established 1910. George H. Wahmann, owner.

WAINWRIGHT.—Trade name for feed water heaters and expansion joints for steam and water pipe lines manufactured by the Alberger Pump & Condenser Co., 140 Cedar St., New York, N. Y.

WAITE & BARTLETT MFG. CO.—Long Island City, N. Y. Manufacturer of X-ray and electrotherapeutic apparatus. Business established 1880. President, Harry F. Waite; vice-president, L. T. Waite; treasurer, H. D. Garretson. Main office and factory, 53 Jackson Ave., Long Island City, N. Y. Branch office, 103 Park Ave., New York, N. Y.

WAKEFIELD BRASS CO., THE F. W.—Woodland Rd., Vermilion, Ohio. Manufacturer of lighting fixtures and fixture fittings, spotlights and other lighting specialties. Business established 1906. President, F. W. Wakefield; secretary and sales manager, G. L. Basil; treasurer, R. G. Kane.

WALD ELECTRIC MFG. CORP.—248-56 N. 10th St., Brooklyn, N. Y. Manufacturer of motors. President, David Wald; treasurer, Albert Wald.

WALDEN-WORCESTER, INC.—Worcester, Mass. Manufacturer of wrenches. President, Lewis E. Bellows; secretary, Lyman H. Bellows; treasurer, Warren S. Bellows. Main office, Worcester, Mass. Branch offices, Monadnock Block, Chicago, Ill.; 295 Broadway, New York, N. Y.; San Francisco, Cal.

WALDMAN, J. J.—64-66 Murray St., New York, N. Y. Manufacturer of fire alarm boxes, wire measuring reels, etc.

WALDO CO.—45 E. 20th St., New York, N. Y. Manufacturer of silk shades, etc.

WALDORF.—Trade name for portable electric lamps manufactured by the Siegel Light Supply Co., 231 Market St., Philadelphia, Pa.

WALDRON ELECTRIC CO.—12957 Merl Ave., Cleveland, Ohio. Manufacturer of bell-ringing transformers. Business established 1915.

WALES.—Trade name for electrically operated bookkeeping and computing machines manufactured by the Wales Adding Machine Co., Wilkes-Barre, Pa.

WALES ADDING MACHINE CO.—Wilkes-Barre, Pa. Manufacturer of electric computing and bookeeping machines. A. N. Smith, general manager.

WALGER.—Trade name for solderless connectors manufactured by S. H. Stover & Co., Chamber of Commerce Bldg., Pittsburgh, Pa.

WALKER & CO., LTD., JAMES.—46 West St., New York, N. Y. Manufacturer of steam packing. Sales representatives, J. & R. Wilson, Inc., San Francisco, Cal.; O. C. Keckley, 318 W. Washington St., Chicago, Ill.

WALKER & PRATT MFG. CO.—31-35 Union St., Boston, Mass. Manufacturer of electric ranges. President, A. W. Walker; treasurer, R. D. Walker; sales manager, A. L. Smith, Jr.

WALKER AXLE CO.—72 W. Adams St., Chicago, Ill. Manufacturer of axles. Factory, East Chicago, Ind.

WALKER BROS. CO.—225 Walton St., Syracuse, N. Y. Manufacturer of heavy-duty and household electric dishwashers. President and general manager, H. B. Andrews; vice-presidents, W. R. Walker and F. A. Walker; secretary and sales manager, R. E. Maurer; treasurer, G. E. Loomis.

WALKER BROS. & HAVILAND.—Philadelphia, Pa. Manufacturers of conduit fittings. President, Hervey S. Walker; vice-president, Henry F. Haviland; secretary and treasurer, H. Newton Walker. Main office, Otis Bldg., Philadelphia, Pa. Branch offices, 18 Vesey St., New York, N. Y.; 112 S. 16th St., Philadelphia, Pa.

WALKER VEHICLE CO.—Chicago, Ill. Manufacturer of electric trucks and tractors. Business established 1903. President, W. A. Fox; vice-president and general manager, G. A. Freeman; secretary, C. E. Smith; treasurer, J. T. Doyle; general sales manager, C. A. Street. Main office and factory, 87th & State Sts., Chicago, Ill. Branch offices, 592 Commonwealth Ave., Boston, Mass.; 3709 Grand Central Terminal Bldg., New York, N. Y.; 22nd & Pine Sts., Philadelphia, Pa.; 336 Ellicott Sq., Buffalo, N. Y.

WALL BRACKETS. — See Brackets, wall, indoor, fixture or lighting; Brackets, wall, outdoor, for insulators.

WALL MFG. SUPPLY CO., P.—705 Preble Ave., Pittsburgh, Pa. Manufacturer of gasoline torches.

WALL PUSH BUTTONS.—See Push buttons, wall.

WALL RECEPTACLES.—See Receptacles, baseboard and wall; Receptacles, duplex wall.

WALL STRAPS.—See Straps, wall.

WALL TELEPHONES —See Telephones, wall, central-battery type; Telephones, wall, magneto type.

WALLACE.—Trade name for portable lamps manufactured by the Greist Mfg. Co., New Haven, Conn., formerly A. C. Penn, Inc., 135 Jackson St., Newark, N. J.

WALLACE & CO., J. D.—Chicago, Ill. Manufacturers of portable bench machines. Business established 1907. President, J. D. Wallace; secretary, C. H. Landis; sales manager, H. L. Ramsay. Main office and factory, 1401-17 Jackson Blvd., Chicago, Ill. Branch offices and warehouses, Boston, Mass.; Pittsburgh, Pa.; St. Louis, Mo.; San Francisco, Cal.; 30 Church St., New York, N. Y. District offices, Philadelphia, Pa.; Buffalo, N. Y.; Detroit, Mich.

WALLACE UNIVERSAL.—Trade name for motor-driven saws and planers manufactured by J. D. Wallace & Co., 1401 W. Jackson Blvd., Chicago, Ill.

WALLACE'S.—Trade name for lightning rods made by the Boston Lightning Rod Co., 7551 Boylston St., Boston, Mass.

WALLINGFORD BROS., LTD. — Perkins, Buckingham, Que., Can. Manufacturer of mica for electrical purposes. Branch office, Ottawa, Ont. Mines, Perkins, Que.

WALRUS MFG. CO.—Decatur, Ill. Manufacturer of showcases for electrical stores.

WALSH & WEIDNER BOILER CO., THE.—Chattanooga, Tenn. Manufacturer of boilers, tanks, towers and structural steel. Business established 1889. President, L. W. Lewellyn; vice-president, E. Y. Chapin; secretary and treasurer, A. H. Chapman; sales manager, S. H. Daniels. Main office and factory, Chattanooga, Tenn. Branch offices, 11 Broadway, New York, N. Y.; 1007 McCall Bldg., Memphis, Tenn.; 908 Hannan Bldg., New Orleans, La.; 72 Fremont St., San Francisco, Cal.

WALSH CO., JOHN F.—170 North St., Pittsfield, Mass. Manufacturer of soldering sticks, commutator brushes and lubricating compounds. John F. Walsh, owner.

WALSH ELECTRICAL SUPPLY CO.—151 W. 18th St., New York, N. Y. Manufacturer of plugs, sockets and insulating materials. President, treasurer and general manager, John F. Walsh; vice-president, James J. Walsh; secretary, Chester N. Rogers; sales manager, John F. Morelli.

WALSH MFG. CO., OWEN.—525-531 W. 26th St., New York, N. Y. Manufacturer of lighting fixtures and portable electric lamps. Business established 1864. Partnership, George Lampart and Oscar Malnck.

WALSH TIE CO.—Minneapolis, Minn. Producer of cedar poles and railway ties. Business established 1920. President, P. R. Walsh; vice-president, J. C. Kirkpatrick; secretary, L. A. Furlong; treasurer, H. S. Gilkey. Main Office, 914 Security Bldg., Minneapolis, Minn. Branch offices, Duluth, Minn. Treating plant, Gilkey, Minn.

WALTER MOTOR TRUCK CO.—227 W. 61st St., New York, N. Y. Manufacturer of electric vehicles and motor trucks.

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'sident, William Walter. Exclusive dis- ıuter, Fink-Dumont-White, Inc., 405 :ington Ave., New York, N. Y.

'ALTHAM MICROMETER DIAL UGE CO.—248 Ash St., Waltham, Mass. ıufacturer of micrometer gages. Frank Randall, sole owner.

'ALTHAM PIANO CO.—Becker Ave. & St., Milwaukee, Wis. Manufacturer of trically operated pianos.

ALWORTH MFG. CO.—Boston, Mass. ufacturer of valves, fittings and tools steam, water, etc. President, Howard ley; vice-presidents, W. P. F. Ayer, V. Little, J. C. Bannister; sales man- L. F. Hamilton. Main office, Boston, . Factory, Kewanee, Ill. Branch of- New York, N. Y.; Seattle, Wash.; delphia, Pa.; 220 N. Desplaines St., ıgo, Ill.

ALZER.—Trade name for electric manufactured by the A & W Electric Co., Cleveland, Ohio.

MPLER.—Trade name for test fix- for all types of automobile electrical ment manufactured by the Dayton notive Specialty Co., 310 E. 2nd St., ın, Ohio.

PAK HOLLOW WARE CO., THE.— koneta, Ohio. Manufacturer of guy rs and fixture crowfeet. Business ished 1901. President, M. L. John- vice-president, F. P. Burgoyne; sec- , treasurer and general manager, J. rnes. Sales representative, The Lima Car Co., Lima, Ohio.

PPLER ELECTRIC CO., INC.—Long City, N. Y. Manufacturer of X- ıparatus. Business established 1897. ffice, 162 Harris Ave., Long Island . Y. Branch office, 173 E. 87th St., ork, N. Y.

D ELECTRIC.—Trade name for commercial vehicles and heavy- rucks manufactured by the Ward Vehicle Co., S. Fulton Ave., Mt. . N. Y.

D ELECTRIC CO., INC.—1411 Wal- Philadelphia, Pa. Manufacturer of al wiring devises. Business estab- 1911. President and general man- hillip H. Ward, Jr.; vice-president McNamara; secretary and treas- ılph P. Ward. Factory, Bridesburg, phia, Pa. Sales representatives, White Co., San Francisco, Cal.; Lilly Electric Co., Louisville, Ky.; Cardin Co., 549 Washington Blvd., Ill.

ENGINEERING WORKS, THE ES.—Charleston, W. Va. Manufac- of water-tube boilers. Business ed 1872. President, treasurer and manager, Charles E. Ward; vice- . Harold M. Ward; secretary, E.

LEONARD ELECTRIC CO.—Mt. N. Y. Manufacturer of rheostats, s and protective devices. Busi- blished 1898. President, Leonard ice-president and general man- f. Burns; secretary and treasurer, ott. Sales representatives, West- ineering Co., Monadnock Block, Ill.; Walter C. Ambos Co., The Cleveland, Ohio; Electric Mate- 589 Howard St., San Francisco, tric Specialties Co., 69 State St., ich.; William M. Tompkins, The hiladelphia, Pa.; W. W. Gaskill, St., Boston, Mass.; George W. Railway Exchange Bldg., St.

MOTOR VEHICLE CO.—Mt. . Y. Manufacturer of electric l vehicles and heavy-duty usiness established 1903. Presi- A. Ward; vice-president, H. B. etary and treasurer and general . C. Boyers; sales manager, H. . Main office and factory, S. ., Mt. Vernon, N. Y. Branch Grand Central Terminal Bldg., N. Y.

L LIGHTING CO.—Detroit, ıufacturer of lighting units.

l.—Trade name for oil filters ed by the Burt Mfg. Co., Ak-

—Trade name for medical bat- factured by the Frank S. Betz n St., Hammond, Ind.

LL BRAIDING MACHINE l Falls, R. I. Manufacturer of g machines. President, Simon ell; vice-president, Arthur A. treasurer, Edwin C. Smith; ager, Carl Christensen.

LLIAN.—Trade name for wire chines manufactured by the Wardwell Braiding Machine Co., Central Falls, R. I.

WARMERS, CHOCOLATE. — Electric chocolate warmers are heaters for warming chocolate used on candy dipping tables. See Tables, chocolate-dipping, electrically heated and equipment for.

WARMERS, FOOD OR ROLL.—Warming ovens or boxes having electric heating units controlled by three-heat switches to regulate the degree of heat and intended for use in restaurants, hotels, clubs, etc., for maintaining a moderate temperature, so that biscuits, rolls, pies and other food may be kept warm until served.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Detroit, Mich. "Triangle Lektrik" baby food warmer, primarily designed for heating infant's food at night. It may be placed alongside of bed, and attached to current by 10-ft. cord furnished with it, having pendant snap switch and lamp socket attachment plug.—Adv.

Blakeslee & Co., G. S., Cicero, Ill. "Blakeslee."

Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric ranges, ovens and appliances. A substantially constructed plate and food warmer, the walls of which are insulated to conserve heat. Fitted with swing type doors of substantial construction. These doors are fitted with center brace, so that when closed they are unusually rigid. Has large compartment fitted with two units, one on each side, of 880 watts each. These units are controlled by three-heat switch. Finished in black enamel, nickel trim. Inside dimensions: 30 ins. wide by 20 ins. high by 17 ins. deep. Over-all dimensions: 35 ins. wide by 31½ ins. high by 20 ins. deep. See display adv. pages 1292-3.—Adv.



"Hotpoint" Food Warmer

Weeks Mfg. Co., H. G., Hamilton, Ohio.

WARMERS, FOOT, INDOOR. — Metal foot rests or stands, having perforated cases, within which are electrical heating units. They are units of high resistance and do not consume a large current, as they are intended for inside use and only give a moderate temperature. They are used especially for old and anemic people, convalescents, etc. The warmer is connected to any convenient wall receptacle or lighting outlet.

Manufacturers:

Branston Co., Charles A., 41-45 Ellicott St., Buffalo, N. Y.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WARMERS, FOOT, OUTDOOR, FOR TRAFFIC OFFICERS, ETC.—Foot warmers for outdoor service are flat ironclad stands, with an enclosed waterproof heating element, and designed for use by traffic officers, watchmen, doormen at hotels and clubs, sentries and guards, etc. The stands are portable, although quite heavy, and the top is provided with corrugations to prevent slipping. A three-heat unit and corresponding heater switch are generally provided so that the heater may be used in moderately cold, cold and extremely cold weather. Heavily protected cord or cable is used for connecting to the supply circuit. These foot warmers add greatly to the comfort of a person whose duty calls for standing many hours in places exposed to severe cold that would otherwise be likely to produce frostbitten or frozen feet.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

EDISON ELECTRIC APPLIANCE CO., INC., 5600 W. Taylor St., Chicago, Ill. Manufacturer of Hotpoint, Hughes and Edison electric ranges, ovens and appliances. An electric foot warmer useful for the house and the office. It is easily operated in electric automobiles.



"Hotpoint" Foot Warmer

Made of steel and finished in polished nickel. Easily carried about by handle. Has cord, attachment plug and interchangeable switch plug. It is 10x12 ins. in size and weighs 5 lbs. See display adv. pages 1292-3.—Adv.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WARMERS, ELECTRICAL, FOR HOSPITAL BLANKETS, BEDPANS, ETC.—These are electrically heated devices generally of the box or oven type, for bringing to a moderately warm temperature, blankets, sheets, pillows, bedpans and other materials placed close to a bed-ridden patient in a hospital. The heating elements are designed to give a mild heat to the articles placed in the warmers, as their object is merely to prevent chilling a patient by placing cool or damp objects in his bed.

Manufacturer:

American Sterilizer Co., Erie, Pa. "American."

WARMERS, MILK, IMMERSION TYPE.—Heating elements hermetically sealed in metal enclosures designed for immersion in liquids, such as milk, broth, water, etc. They are used with small quantities of the liquid, such as a cupful, and are very convenient because of the possibility of their use direct in a tumbler, cup or other vessel, warming the liquid in a short time without bothering with pans or other warming dishes.

Manufacturers:

Betz Co., Frank S., Hoffman St., Hammond, Ind.

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."

EDISON ELECTRIC APPLIANCE CO., 5600 W. Taylor St., Chicago, Ill. Manufacturers of Hotpoint, Hughes and Edison electric appliances. Two styles of immersion heaters can be had, either a straight or curved heating unit. The straight type is manufactured in two sizes, ¾x7 ins. and 1x10 ins. The crookneck style comes in one size only, 6½x8½ ins. Made of copper and brass and finished in polished nickel. Has cord, attachment plug and special contact-plug. See display adv. pages 1292-3.—Adv.



"Hotpoint" Immersion Heater

LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."

Loetscher-Ryan Mfg. Co., Rock Island, Ill.

Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

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WARMERS, MILK, NURSING BOTTLE TYPE.—The nursing bottle type of milk warmer is a cylindrical container having a heating element in the bottom and designed to be partly filled with water. An opening in the top permits a nursing bottle to be inserted and when the current is turned on, the water is quickly heated and this brings the bottle and its contents to the proper temperature in a short time. These appliances are usually furnished with a cover so that when not used as a nursing bottle warmer, they may be used as a water heater. A flexible cord and attachment plug are supplied with the warmers for connection to the circuits.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."
American Sterilizer Co., Erie, Pa.
Betz Co., Frank S., Hoffman St., Hammond, Ind.
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
LANDERS, FRARY & CLARK, New Britain, Conn. "Universal."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WARMERS, MISCELLANEOUS.—There are a large number of purposes for which electric warmers are used in manufacturing, etc. The forms of warmers used vary considerably, depending upon their purpose. Among their uses are for warming wax, paraffin, celluloid, hard rubber, fiber, etc., when it is desired to do machine work on them, or when the wax, paraffin, etc., are to be used in plastic or liquid form. Electric warmers have the advantage of keeping such materials uniformly warm at small expenditure of energy.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Hospital Supply Co., The, 157 E. 23rd St., New York, N. Y. "Climax."
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."

WARMERS, PLATE OR DISH.—Ovens or chambers having electrically operated heating units intended for warming plates, dishes, etc., for hotel or restaurant use. They are also used in some large homes and clubs, the object being to have the dishes warm when the food is placed on them, to prevent too rapid cooling. The oven is arranged with shelves or racks for stacking a large number of plates and dishes in the hotel and restaurant sizes. These warmers are of special value when there is a considerable distance between the kitchen and the dining tables which often results in complaint to waiters that the food is chilled when served, especially with greasy foods, as well as drinks and soups that should be served hot.

Manufacturers:

AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Aves., Detroit, Mich. "American Beauty."
Bramhall, Deane Co., 261-265 W. 36th St., New York, N. Y. "Deane."
Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint." "Edison."
Duparquet, Huot & Moneuse Co., 108-114 W. 22nd St., New York, N. Y.
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint." "Edison." (See display adv. pages 1292-1293.)
Prometheus Electric Co., 511 W. 42nd St., New York, N. Y. "Prometheus."
Superior Electrics, Ltd., Pembroke, Ont., Can. "Superior."
Weeks Mfg. Co., H. G., Hamilton, Ohio.

WARMERS, STEERING WHEEL.—Flexible grips intended to be laced on the rims of steering wheels of automobiles and made with concealed and insulated heating coils designed to be connected to the storage battery on the vehicle. They are not very thick and are tightly laced to the wheel so that they do not interfere in any way with the operation. A comfortable temperature is maintained by their use and freezing or numbness of the hands prevented.

Manufacturers:

Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Interstate Electric Co., 356 Baronne St., New Orleans, La. "Steer Warms."
Rose Mfg. Co., 910 Arch St., Philadelphia, Pa. "Neverout."
Russell Electric Co., 140 W. Austin Ave., Chicago, Ill. "Hold-Heet."

WARMING PADS.—See Heating pads, electric.

WARNER ELECTRIC CO.—Kalamazoo, Mich. Manufacturer of motors.

WARNER ELECTRIC CO.—Muncie, Ind. Manufacturer of telephone ringing machines, electric automobile horns, locks, etc.

WARNER ELEVATOR MFG. CO., THE.—Cincinnati, Ohio. Manufacturer of electric elevators. Business established 1860. President, C. H. M. Atkins; vice-president, E. N. Atkins; secretary, F. N. Temple; treasurer, J. W. Atkins; general manager, A. L. Atkins; sales manager, W. J. Hessler. Main office, 2600 Spring Grove Ave., Cincinnati, Ohio. Branch offices, 113 Warren St., New York, N. Y.; 211 President St., Baltimore, Md.; 241 Union Arcade, Pittsburgh, Pa.; 314 Sloan Bldg., Cleveland, Ohio; 802 Fidelity Trust Bldg., Indianapolis, Ind.; 108 Green St., Dayton, Ohio; 155 S. Forsythe St., Atlanta, Ga.; 66 St. Michaels St., Mobile, Ala.; Atlantic National Bank Bldg., Jacksonville, Fla.; 918 Commerce St., Tacoma, Wash.

WARNER, INC., C. B. & J.—138 W. 14th St., New York, N. Y. Manufacturer of electric lighting fixtures, fixture parts, domes and portable lamps. Business established 1912. President, C. B. Warner; vice-president and general manager, John Rose; secretary and treasurer, Edward Isaac.

WARNER LUMBER CO.—Grand Rapids, Mich. Producer of cedar poles.

WARNO.—Trade name for automobile signals manufactured by Lunoe & Soule, 622 79th St., Brooklyn, N. Y.

WARREN.—Trade name for die stocks made by the Borden Co., Warren, Ohio.

WARREN.—Trade name for water filters manufactured by the New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.

WARREN.—Trade name for axes manufactured by the Warren Axe & Tool Co., Warren, Pa.

WARREN & CO., WALTER G.—1401 W. Jackson Blvd., Chicago, Ill. Manufacturers of lighting fixtures and portable electric lamps. Business established 1906. President and sales manager, Walter G. Warren; vice-president, H. C. Kendel; secretary, treasurer and general manager, B. C. Garrison.

WARREN AXE & TOOL CO.—Warren, Pa. Manufacturer of axes and tools. President, E. E. Allen; secretary, W. A. Kinnear; general manager and treasurer, H. P. Stone.

WARREN CLOCK CO.—Ashland, Mass. Manufacturer of electric clocks. President and general manager, Henry E. Warren; secretary, Alta Dunbar.

WARREN LUBRICANT CO.—Buffalo, N. Y. Manufacturer of lubricating grease. President and treasurer, M. M. Sanderson; vice-president and secretary, Albert J. Squier. Main office and factory, 20-28 Maurice St., Buffalo, N. Y. Branch offices, Los Angeles, Cal.; Warren, Pa.; 27 Coenties Pl., New York, N. Y.; 608 S. Dearborn St., Chicago, Ill.

WARREN STEAM PUMP CO.—Warren, Mass. Manufacturer of steam reciprocating pumps.

WARRIOR.—Trade name for belting manufactured by the Boston Woven Hose & Rubber Co., Box 5077, Boston, Mass.

WARSAW ELEVATOR CO.—P. O. Box 889, Warsaw, N. Y. Manufacturer of electric elevators. Business established 1892. President and treasurer, C. E. Ketchum; vice-president, E. D. Ketchum; secretary, A. E. Ketchum. Main office, Warsaw, N. Y. Branch offices, Buffalo, N. Y.; Rochester, N. Y.; New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Springfield, Mass. Sales representative, Matson Elevator Co., New York, N. Y.

WARWICK.—Trade name for brake chains manufactured by the Newhall Chain Forge & Iron Co., 90 West St., New York, N. Y.

WARWOOD TOOL CO.—Wheeling, W. Va. Manufacturer of track wrenches, etc. Factory, Warwood, W. Va.

WASCO.—Trade name for spark plugs manufactured by the Washington Auto Supply Co., Washington, Ill.

WASH KOSH MFG. CO.—River Drive, Oshkosh, Wis. Manufacturer of electric washing machines. President, J. E. Bolduc; vice-president, Frank Novotny; secretary, William J. Dole; treasurer, Joseph Kostohryz; general manager, R. E. Russey; sales manager, J. Ross Jones. Sales representatives, Hukill Hunter Co., Pittsburgh, Pa.; Petroleum Engine & Mfg. Co., 120 Broadway, New York, N. Y.; Morley Bros., Saginaw, Mich.; B. G. Earl & Co., 56 E. Randolph St., Chicago, Ill.; Haw Hardware Co., Ottumwa, Iowa; Morey Mercantile Co., Denver, Colo.; Seattle Hardware Co., Seattle, Wash.; Holley Mason Hardware Co., Spokane, Wash.; Holbrook, Merrill & Stetson, San Francisco and Los Angeles, Cal.; Baker-Smith Co., Rialto Bldg., San Francisco, Cal.

WASHBURN & GRANGER, INC.—50 Church St., New York, N. Y. Manufacturer of electric ash hoists.

WASHBURN SHOPS, THE.—Worcester, Mass. Manufacturers of electric drill grinders, sensitive drills and drafting tables. Director, W. W. Bird; superintendent, L. W. Rawson; secretary, W. L. Buchanan.

WASHBURNE & CO., E. G.—207 Fulton St., New York, N. Y. Manufacturers of lightning rods. Business established 1853.

WASHERPUMP.—Trade name for electric pumps for washing machines, made by Burleigh, Morrison & Gowing, 80 Boylston St., Boston, Mass.

WASHERS, AIR.—Air washers are used in connection with ventilating and cooling systems. The air is forced through the washing equipment by means of a blower, almost always motor-driven. The washer consists of a number of nozzles so placed that the air is forced through several fine sprays of water. All the dust present in the air is dissolved in or precipitated by the water and falls to the bottom of the tank. Baffle plates are placed in the path of the air so that the moisture will be separated and collected in the tank. By using the air washers in a ventilating system, the humidity may be controlled at will, and a supply of clean cool air is obtained. For special applications, see Air conditioning apparatus; Generator cooling equipment.

Manufacturers:

AMERICAN BRIDGE CO., 30 Church St., New York, N. Y. (See display adv. page 1257.)
Atmospheric Conditioning Corp., 920 Lafayette Bldg., Philadelphia, Pa. "Webster."
Automatic Carbonic Machine Co., 308 N. Michigan Blvd., Chicago, Ill.
Badger & Sons Co., E. B., 75 Pitts St., Boston, Mass. "Badger."
Canadian Blower & Forge Co., Ltd., The, Kitchener, Ont., Can. "Conoidal."
Carrier Air Conditioning Co. of America, 490 Broadway, Buffalo, N. Y.
Claxo Co., The, Iowa City, Iowa.
General Ventilating Co., 162 N. Clinton St., Chicago, Ill. "General."
Hersh Bros. Co., Allentown, Pa. "Lehigh."
Ilg Electric Ventilating Co., Crawford Ave. & Diversey Blvd., Chicago, Ill.
Koven & Bro., L. O., 154 Ogden Ave., Jersey City, N. J.
Massachusetts Blower Co., Howard St., Watertown, Mass. "Massachusetts."
Narowetz Heating & Ventilating Co., 1711 Park Ave., Chicago, Ill.
Philadelphia Belting Co., 601-03 Spring Garden St., Philadelphia, Pa.
Spray Engineering Co., Boston, Mass. "Spraco."

WASHERS, CLOTHES.—See Washing machines, clothes.

WASHERS, DISH.—See Dishwashers, motor-driven, hotel type; Dishwashers, motor-driven, household type.

WASHERS, FIBER.—Fiber washers are flat disks having a hole in the center to permit placing a bolt or screw through the hole. They are used on electrical apparatus under the head of a screw or bolt and under the nut, to insulate it from the rest of the apparatus. Fiber washers are made in a large number of sizes and thicknesses and are generally made on a punch press.

Manufacturers:

American Vulcanized Fibre Co., 522 Equitable Bldg., Wilmington, Del. "Vul-Cot."
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass.
Campbell Fibre Co., Stanton, Del.

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HICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
ontinental Fibre Co., Newark, Del. "Bakelite-Dilecto."
allas Brass & Copper Co., 820 Orleans St., Chicago, Ill.
iamond State Fibre Co., Bridgeport, Pa. "Diamond F."
ominion Asbestos & Rubber Corp., 154 Nassau St., New York, N. Y.
:celsior Leather Washer Mfg. Co., Inc., 921 W. State St., Rockford, Ill. "X-L."
eld & Co., R. B., 10 Clarence St., Worcester, Mass. "Fieldco."
sket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa. "Gasco."
rvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
mphrey, H. W., Unionville, Conn.
eller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
tional Fibre & Insulation Co., Yorkn, Del. "Old Hickory," "Super Seaoned."
oenix Specialty Mfg. Co., 48-50 Duane t., New York, N. Y.
adriga Mfg. & Specialty Co., 213 W. rand Ave., Chicago, Ill.
ulding & Sons Co., Inc., J., 300 Wheeler St., Tonawanda, N. Y.
rn, W. J., 296 Talbot St., London, nt., Can.
mington Fibre Specialty Co., Wilington, Del.

SHERS, LEATHER.—Leather washe flat leather disks with a hole in the . They are used on electrical and machinery, especially where oil is to be present. They provide a soft nsulating washer or cushioning gas- various purposes.

ufacturers:

irn Leather Goods Co., Auburn, Y.
ood Mfg. Co., L. J., Stoneham nch, Boston 80, Mass. "Barwood."
go Belting Co., 113-25 N. Green St., cago, Ill.
go Leather & Mercantile Co., 1848-W. 14th St., Chicago, Ill.
go Rawhide Mfg. Co., The, 1301 on Ave., Chicago, Ill.
nion Asbestos & Rubber Corp., 154 sau St., New York, N. Y.
sior Leather Washer Mfg. Co., Inc., W. State St., Rockford, Ill. "X-L."
& Co., R. B., 10 Clarence St., cester, Mass. "Fieldco."
t Supply Co., The, 1729 Ludlow St., adelphia, Pa. "Gasco."
l & Co., R., 61-69 Carroll St., alo, N. Y.
a Leather Stamping Co., Williams- Pa.
Leather Washer & Mat Co., East , Mass.
lphia Belting Co., 601-03 Spring n St., Philadelphia, Pa.
t Specialty Mfg. Co., 48-50 Duane New York, N. Y.
ga Mfg. & Specialty Co., 213 W. l Ave., Chicago, Ill.
& Sons, J. E., 12 N. 3rd St., lelphia, Pa. "Tannate."
Mfg. Co., Auburn, N. Y. o."
W. J., 296 Talbot St., London, Can.

RS, METAL (BRASS, COPPER, ION, ETC.).—Metal washers of inds are very widely used on and other machinery for placing w and bolt heads, nuts, termi-, etc. They are made in a very ty of sizes, the diameter, thick- size of hole being dependent particular service. The various d each have a special purpose, rength, prevent corrosion, inductivity, resist the action of They are made both as flat s lock washers, having a radial he two ends slightly separated erent planes, to provide a spring a nut is screwed down on the

irers:

N BRASS CO., 414 Meadow erbury, Conn.
Brass Products Co., 105-15 S. St., Pottstown, Pa.
Nut & Bolt Fastener Co., The, & Doerr Sts., Pittsburgh, Pa.
, The Wallace, Bristol, Conn. Made."
olt & Nut Co., Bayonne, N. J.
it Co., 2513 W. 20th St., Chi-

nping & Mfg. Co., 241 Cort- Belleville, N. J.
Bolt Co., Millidale, Conn.
Wrought Products Co., The, St., Cleveland, Ohio.
Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
Electrical Engineers Equipment Co., 35 S. Desplaines St., Chicago, Ill.
Gasket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa. "Gasco."
Globe Iron Roofing & Corrugating Co., Cincinnati, Ohio. (lead).
Guillott Metal Gasket & Supply Co., 24-30 S. Clinton St., Chicago, Ill.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Humphrey, H. W., Unionville, Conn.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Lanz & Sons, Mathew, Pittsburgh, Pa.
Lawrence Shot & Lead Co., 27th & A Sts., Omaha, Neb. (lead).
Mansfield Lock Washer Co., Mansfield, Ohio.
Massachusetts Machine Shop, Inc., 817 Albany St., Boston, Mass.
Milton Mfg. Co., Milton, Pa.
Moran Bolt & Nut Mfg. Co., Main & Florida Sts., St. Louis, Mo.
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Newport Rolling Mill Co., Newport, Ky.
Oliver Iron & Steel Co., 10th & Muriel Sts., Pittsburgh, Pa.
Phoenix Specialty Mfg. Co., 48-50 Duane St., New York, N. Y.
Quadriga Mfg. & Specialty Co., 213 W. Grand Ave., Chicago, Ill.
Richardson Brass Co., The Edbro, 318 N. Holliday St., Baltimore, Md. (brass).
RISDON MFG. CO., THE, Andrew Ave., Naugatuck, Conn.
St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo. (malleable iron).
St. Louis Screw Co., Clarence St. & Bulwer Ave., St. Louis, Mo.
Spafford Machine Screw Works, Inc., Morgan & Market Sts., Hartford, Conn.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.
Thorn, W. J., 296 Talbot St., London, Ont., Can.
Universal Chain Co., The, Stroudsburg, Pa.
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WASHERS, MICA.—Mica washers are used for insulating purposes in connection with binding posts, terminals, etc., on electrical equipment. They are carefully punched from sheets of built-up mica, as a rule, and are made in a number of sizes.

Manufacturers:

American Mica Co., Newton Lower Falls, Mass.
Asheville Mica Co., Biltmore, N. C.
Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Charland, E. W., Tilton, N. H.
CHICAGO MICA CO., Valparaiso, Ind. Micabond washers furnished built to required thickness and to any outside and inside diameters desired. Raw mica washers of random thickness to any outside and inside diameters. For other Chicago Mica Co. products see display adv. page 1320.—Adv.
Consumers Rubber Co., The, 1302 Ontario St., Cleveland, Ohio.
Fillion, Inc., S. O., 68 Murray St., New York, N. Y.
Gasket Supply Co., The, 1729 Ludlow St., Philadelphia, Pa. "Gasco."
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Liberty Mica Co., 79 Sudbury St., Boston, Mass.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Mica Mfg. Co., The, 135 Johnson St., Brooklyn, N. Y.
Phonograph Appliance Co., The, 174 Wooster St., New York, N. Y.
Preston Mica Co., Robert K., 804 Monadnock Block, Chicago, Ill.
Quadriga Mfg. & Specialty Co., 213 W. Grand Ave., Chicago, Ill.
Tar Heel Mica Co., The, Plumtree, N. C.

WASHERS, MISCELLANEOUS INSULATING.—Insulating washers of various kinds are supplied for use on electrical equipment, to insulate bolts and screw heads and nuts from the plates or surfaces to which they are fastened. The materials used for this purpose include rubber, both hard and soft, phenol and other prepared fibers and various prepared papers, fabrics, etc.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Barwood Mfg. Co., L. J., Stoneham Branch, Boston 80, Mass. "Barwood."
BOOTH FELT CO., INC., 463-467 19th St., Brooklyn, N. Y. See Felt, Cushions, Gaskets, Wicks, etc. Also Display Pages 1309 and 1325.—Adv.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
Diamond Rubber Co., The, Akron, Ohio.
Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."
Field & Co., R. B., 10 Clarence St., Worcester, Mass. "Fieldco."
INTERNATIONAL INSULATING CORP., 25 W. 45th St., New York, N. Y.
INTERNATIONAL MICA CO., 37th & Brandywine Sts., Philadelphia, Pa. "Imico."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
Standard Insulation Co., Rutherford, N. J. "Sico."
Thorn, W. J., 296 Talbot St., London, Ont., Can.

WASHERS, TRACK RAIL.—These are iron washers used on the rail-joint bolts securing two lengths of rail together. The washers are large and heavy and are sometimes of the lock washer type, as the frequent vibration tends to loosen up the nuts if ordinary washers are used. The lock washers are split and provide a spring action which keeps the nut tight. Washers are used between the bolt head and fish plate and also between the nut and plate.

Manufacturer:

National Lock Washer Co., 40 Hermon St., Newark, N. J. (lock type).

WASHING MACHINE CYLINDERS AND TUBS.—These are the parts of a washing machine in which the clothes and water are retained. The cylinders are made of either wood or metal. In the case of a wooden cylinder, hard maple or cypress is generally used and the cylinder is usually made with solid end pieces and the sides constructed of slats, with a small space between the slats, and having holes drilled in them also, to provide for movement of the clothes and free circulation of water. Metal cylinders are sometimes made in a similar manner having perforated sides. Solid copper, galvanized steel, nickel-zinc, etc., are used for the cylinder. The tubs are what are sometimes called the body. In the cylinder type machine they enclose the cylinder and hold the water. The tubs are made of both wood and the metals described above for cylinders. Some washers do not have cylinders and the tubs are then used to hold both the clothes and water. Cypress is commonly used for these wooden tubs and it is often cut to size and shipped to washing machine manufacturers ready for assembling.

Manufacturers:

Kirk & Blum Mfg. Co., 2846 Spring Grove Ave., Cincinnati, Ohio.
Mateer & Co., F. W., 226-232 W. Ontario St., Chicago, Ill.
MODERN LAUNDRY MACHINE CO., 1414-20 E. 19th St., Kansas City, Mo.
Stephenson Mfg. Co., South Bend, Ind. (wood).
Voss Bros. Mfg. Co., Davenport, Iowa.

WASHING MACHINE GEARS. — See Gears and pinions, washing machine.

WASHING MACHINE MOTORS.—See Motors, washing machine.

WASHING MACHINE PARTS NOT OTHERWISE LISTED.—This classification is intended for those parts of washing machines that are not always made by the washing machine manufacturer, and that are not otherwise listed. These include such articles as clutches, belts, pulley wheels, casters, special frame castings, etc. Also see Gears and pinions, washing machine; Motors, washing machine.

Manufacturers:

Hanson Clutch & Machinery Co., The, Tiffin, Ohio.
Lincoln Brass Works, 2067 12th St., Detroit, Mich. (drains).

WASHING MACHINE WRINGERS.—See Wringers for electric washing machines.

WASHING MACHINES, BOTTLE, ELECTRIC.—Electrically operated bottle washing machines are made in a number of styles and sizes for washing from a few bottles to 10,000 per hour. They are used largely in dairies and other bottling works. The smaller sized washers are motor-driven machines having one or more brushes

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on the end of rotating shafts. The brushes are of such size as to pass readily into the bottle and rotate at a high speed.

The large size washers usually are constructed so that the water is forced into the bottle under a high pressure. The bottles are fed into the machines in cases, the bottle being in an inverted position and are automatically rinsed with water and washed and sterilized. The water under pressure is supplied by centrifugal pumps which force it through a series of jets.

Manufacturers:

Burrell & Co., Inc., D. H., Little Falls N. Y. "Simplex."
Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. "Fort Atkinson."
Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill.
Electric Specialty Co., Stamford, Conn. "Esco."
Piedmont Electric Co., Asheville, N. C. "Peco."

WASHING MACHINES, CLOTHES, HOUSEHOLD, DEVELOPMENT AND STATUS OF.—During the past few years the electric washing machine, or clothes washer, has become one of the most popular electrically operated devices for home use. At present these devices represent perhaps a greater total investment on the part of the home owners than any other single device. In fact, in some homes they represent a greater investment than all the rest of the installation even including the wiring.

Electric washing machines for home use first appeared upon the market about 1905. Prior to that time considerable advancement had been made in the adoption of mechanical methods of washing through the introduction of large commercial laundry machines and numerous small hand-operated washers for home use. In addition many other small devices to lighten the labor of washing, such as hand-operated vacuum cups, had also been brought out.

However, with the exception of the large commercial machines which will not be considered further in this article, the advance that had been made consisted chiefly in improving the principle of washing.

This principle of washing may be simply stated as follows: "Any washable fabric may be cleansed of all dirt, grease and all other foreign substances that have not had some chemical effect on the fabric by repeatedly forcing warm water mixed with a soap solution through the meshes or weave of the fabric. In the application of this principle the warm water expands the fiber of the fabric thereby loosening and dissolving the dirt which is carried off by the motion of the water as it is forced through the fabric. The addition of the soap simply hastens this action of dissolving and loosens the dirt and grease."

This is the principle by which all washing machines cleanse and the difference one finds in the various types of machines is only a difference in the method of applying this principle.

Even the old-fashioned scrubboard depended upon this principle of cleansing, that is, the corrugations of the board simply provide a means of forcing the water through the clothes but in applying it the rubbing feature is so prominent that it was generally believed that it was this rubbing action that washed. At the time of the introduction of the electric washing machine this belief had become so strong that it was an extremely difficult matter to overcome it. Even today we find many women who still contend that clothes cannot be washed without rubbing.

This was perhaps the greatest problem that early manufacturers had to face. To overcome it has required years of intensive educational effort in advertising, demonstrating and salesmanship. And as was stated, there are still many who will not accept it despite the success that the washing machine has met with, which simply goes to show that the field is by no means covered as yet.

Shortly after the first electric machine appeared several other makes were also put upon the market. In comparison with the washing machines of today these early types of course seem woefully impractical and inefficient but in justice to these early manufacturers it must be said that although they lacked beauty and practicability of design, their products certainly embodied a high quality of materials and workmanship that has helped a great deal in the later advancement of the industry. Many of the earliest models are still giving faithful service and many more would be had not the owners preferred to replace them with later models.

Soon after the introduction of the first models the manufacturers recognized the possibilities and many advantages of an electrically operated clothes wringer in connection with the washing machine. Since then practically all machines have been equipped with this accessory which has been a prominent factor contributing to the success of the industry.

For the first eight or nine years the electric washing machine enjoyed a steady healthful growth of such dimensions that it would be considered remarkable were it not so greatly overshadowed by the demand during the past few years. During this time the various manufacturers perfected their designs, improved their distribution, laid their merchandising plans and continued to carry the washing machine story into the home.

The year 1914 may be said to mark the end of the development stage of the electric washing machine. About this time new makes, models and types were brought out that were more convenient, effective and efficient than any of the previous models. These later models form the basis of most of the machines in use today.

The introduction of these later models served to stimulate the demand to a very great extent and many new manufacturers rapidly came into the field. In an incredibly short time the industry was growing by leaps and bounds.

Then the war started, causing a great scarcity of household help and a radical change in living conditions which forced the acceptance of many new ideas and devices for the conservation of labor. By this time the electric washing machine was an established product whose usefulness and effectiveness were generally known and which through the adoption of the time payment plan was comparatively easy to purchase. Some idea of the regard with which they were held at this time may be had from the fact that the War Labor Board classed the washing machine industry among the essential industries. The manufacturers and dealers redoubled their efforts and the public quickly responded to such an extent that the demand for these devices was one of the outstanding features of the growth of the entire electrical industry during these years.

At present there are about 110 concerns engaged in the manufacture of electric washing machines. Sixty-five of these comprising all the larger and more prominent concerns have organized into the American Washing Machine Manufacturers' Association and through this association are grouping their efforts along educational lines. The total volume of business done by this industry during 1920 exceeded $85,000,000. It is estimated that there are already 2,500,000 washing machines in use in this country but the field is by no means saturated as yet nor has this industry reached the peak of its growth.

By far the greater portion of the machines now being sold are sold through electrical dealers and specialty shops, many of which are the outgrowth of former electrical shops. The department stores and hardware dealers have also made considerable progress with these devices and though distribution through these sources will undoubtedly continue to grow, the distribution through electrical channels has been brought to a point which will give the electrical dealer a decided advantage in the future.

The majority of the electric washing machines on the market today are wholesome examples of electrical and mechanical perfection. They are built to give satisfactory and lasting service with a minimum of care and attention, and are extremely safe and simple to operate. The cost of operation is very small, less than three cents an hour being claimed by most manufacturers, and maintenance cost is practically nothing.

Any of the different types will wash clothes and while there is a difference in the efficiency of the various methods employed all of them represent such a tremendous improvement over the old fashioned washboard that the purchaser is bound to be satisfied.

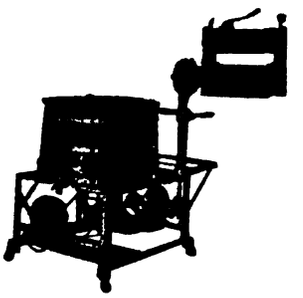
WASHING MACHINES, CLOTHES, HOUSEHOLD, DOLLY TYPE.—The dolly type washing machine was perhaps the first type successfully adapted for home use. Its use dates back several years before the advent of the electrically operated washing machine, the first dolly machines being operated by hand power.

The method of applying the washing principle in this type is very simple and in several respects its action resembles the scrubboard method although actually the two have little in common. However this apparent relation caused this type to be more readily accepted by women in the early days.

The washing in the dolly type is done in a round tub of wood or metal having a hinged top. The dolly is a round flat device about 10 to 14 inches in diameter having four short legs resembling a sawed-off milking stool. This dolly is suspended flatwise by a rod though the cover and the mechanism causes it to revolve a certain number of times in one direction then reverse and revolve in the other direction. The legs which are round and smooth catch the clothes in the tub and carry them around, back and forth through the water thus cleansing them.

Manufacturers:

ALTORFER BROS. CO., Peoria, Ill. The A B C "Alco." All mechanism is underneath the tub, entirely out of range of clothes or person of the operator—a safety feature that appeals greatly to women. The tub is made of 1¼-in. staves, larger and of greater overstrength than most other makes. The frame is extra heavy and rigid. The



"Alco" Electric Washer

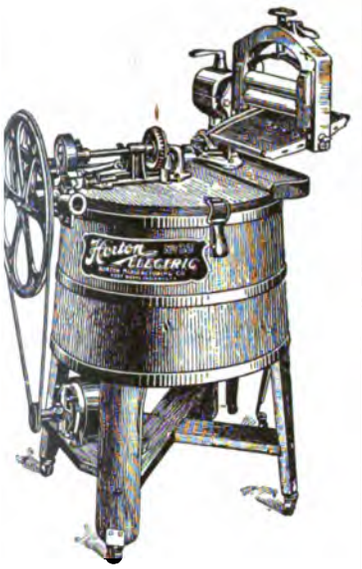
dolly drives from underneath, eliminating all unnecessary parts and lost motion. All gears are machine cut, the wringer locks in any position; ¼-hp. motor. The "Alco" is very economical in first cost, and is built throughout for quiet-running, dependable service. Single and double-tub models. See display advertisement on page 1297.—Adv.

Automatic Electric Washer Co., Inc., Newton, Iowa. "Automatic."
Beatty Bros., Ltd., Fergus, Ont., Can. "TimeSaver."
Blackstone Mfg. Co., The, Jamestown, N. Y. "Blackstone."
Brammer Mfg. Co., H. F., Davenport, Iowa. "O. K. Electric," "O. K. Bench."
Camp Bros. & Co., Washington, Ill.
Challenge Co., Batavia, Ill. "King."
Clarinda Lawn Mower Co., Clarinda, Iowa. "Clarinda."
Connor & Son, Ltd., J. H., Ottawa, Ont., Can. "Connor."
Delite Mfg. Co., The, Bryan, Ohio. "Delite."
Dexter Co., The, Fairfield, Iowa. "Duchess."
Easiest Way Manufacturing Co., The, Sandusky, Ohio. "Easiest Way."
Getz Power Washer Co., Morton, Ill. "Getz."
Globe Mfg. Co., Perry, Iowa. "Quicker Yet."
Grinnell Washing Machine Co., Grinnell, Iowa. "Laundry Queen."
HAAG BROS. CO., Peoria, Ill. "Nuway," "Ideal," "Blue Ribbon," "Haag Twin."
Hirschy Co., The, 259 S. 1st Ave., E., Duluth, Minn. "Hirschy."
HORTON MANUFACTURING CO., THE. Ft. Wayne, Ind.—The Horton electric washer is sturdily built, and provides an ideal washing service for the home. It operates silently, and washes thoroughly. The tub is made of fine cypress—noted for its sanitary qualities and endurance. The motor, specially

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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designed, is both powerful and economical. The swinging wringer offers the desirable advantage of operation in any position. It has a steel frame; tension screw to regulate the pressure;



Horton Electric Washer

ety trigger, which separates the ers instantly in an emergency; and eversible waterboard. The Horton give years of dependable service, ı but little care.—Adv.

on Electric Washer Co., Emery-, Cal. "Johnson."
Washing Machine Co., Wolcott, "King."
Mfg. Co., Reading, Pa. "Queen."
Co., Ltd., W. A., Hespeler, Ont., "Miss Simplicity."
g Co., The, Newton, Iowa.
ald & Willson, Ltd., 347 Yonge Toronto, Ont., Can. "Trojan."
ws Mfg. Co., Bloomington, Ill. dows."
ın Washing Machine Co., Muske-Mich. "Muskegon."
Mfg. Co., Meyersdale, Pa. "Home l."
Mfg. Co., Minier, Ill. "2-in-1."
inute Mfg. Co., Newton, Iowa. Minute," "Laundry Maid."
Co., Wells H., Streator, Ill. ıtor."
Wash Machine Mfg. Co., The, . Pearl St., Cincinnati, Ohio. ess."
Sewing Machine Co., Belvidere, Happy Day."
Washer Co., Sandusky, Ohio. ısky."
mplement & Carriage Co., Mo- "Black Hawk."
Machine Co., De Kalb, Ill. ıs," "Simplex," "Submarine."

) MANUFACTURING CO., THE, mitage Ave., Chicago, Ill. The Date" washing machine oper- the dolly type principle, and is l with a ⅛-hp. electric motor able make. The principal fea- ıbodied in its construction are: eavy iron frame with folding d. (2) A large cedar tub, hav- ıpacity of six sheets. (3) All ears are machine cut, insuring n life. (4) A swinging wringer ay be locked in four different (5) The wringer has a sper- rsing attachment which per- rollers to operate in either as desired. The wringer may from one position to another wringing between tub and asket. (6) The driving gears s in mesh; there is no clutch it of order. (7) All driving re double bearings, insuring d noiseless running. (8) The mounted on heavy casters, easy moving of washer to on. The simplicity of con- durability and reliable per- obtained, together with an economical washing service thus assured, make the "Up-2-Date" clothes washer, a very desirable appliance for



"Up-2-Date" Electric Washer

use in homes and small institutions. See display adv. page 1298.—Adv.

Turner Mfg. Co., The, Port Washington, Wis.
Voss Bros. Mfg. Co., Davenport, Iowa. "Voss."
Wayne Mfg. Co., 124 Sidney St., St. Louis, Mo.
Wenzelman Mfg. Co., Galesburg, Ill.
White Lily Mfg. Co., Davenport, Iowa. "White Lily," "White Way," "De Luxe."
Woodrow Mfg. Co., Newton, Iowa. "Rust-Proof," "Woodrowasher."

WASHING MACHINES, CLOTHES, HOUSEHOLD, OSCILLATING OR RECIPROCATING TYPE.—This type of electric washing machine has been constantly increasing in popularity during the last few years due, to a certain extent, to the fact that many of the more progressive manufacturers who have recently come into the field have adopted it.

In this type the clothes and water are placed together in a metal or wood container having round, elliptical or crescent shaped sides, or, as in the reciprocating type, oblong sides with curved ends. This container is free from any interior mechanism and is usually smooth except in some cases where large corrugations are provided in the bottom. A removable top provides the means of loading and unloading.

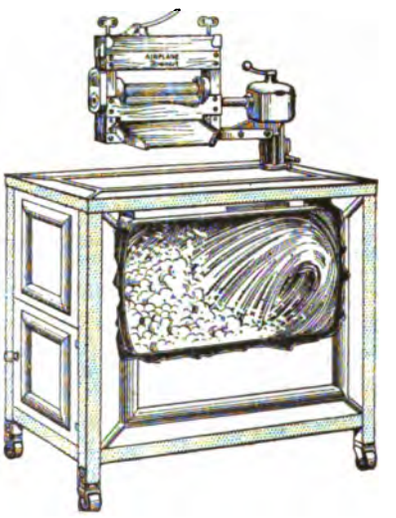
In the oscillating type the mechanism causes the container to swing up and down on a center axis. In this way the clothes and water are thrown from end to end, the water being forced through the clothes at each swing of the container, which is usually about 100 times a minute.

In the reciprocating type the container is moved rapidly back and forth on a stationary runway thus affecting an action virtually the same as in the oscillating type.

Many of the manufacturers of these types have recently adopted an enclosing cabinet for the machines which in addition to affording complete protection from all moving parts greatly improves the appearance of the machine.

Manufacturers:

Air-Way Electric Appliance Corp., Toledo, Ohio. "Air Way."
Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill. "Butterfly."
ALTORFER BROS. CO., Peoria, Ill. "ABC Super Electric." (See display adv. page 1297.)
Apex Appliance Co., 3223 W. 30th St., Chicago, Ill.
APEX ELECTRICAL MFG. CO., THE, 1067 E. 152nd St., Cleveland, Ohio. "Rotapex. (Exclusive distributor, Apex Electric Distributing Co., 1089 E. 152nd St., Cleveland, Ohio.)
Apex Electrical Mfg. Co., Ltd., 102-104 Atlantic Ave., Toronto, Ont., Can. "Rotapex."
Automatic Electric Washer Co., Inc., Newton, Iowa. "Automatic."
Blackstone Mfg. Co., The, Jamestown, N. Y. "American Classic."
Blue Bird Division, Davis Sewing Machine Co., Dayton, Ohio. "Blue Bird."
Bluffton Mfg. Co., Bluffton, Ohio. "Woman's Friend."
Boss Washing Machine Co., Cincinnati, Ohio. "Boss," "Champion."
Brantford Washing Machine Co., Ltd., 72 Colburne St., Brantford, Ont., Can. "Airplane," "Locomotive."
Buckeye Prima Co., The, Sidney, Ohio. "Prima."
Cadillac Washing Machine Co., 325 W. Ohio St., Chicago, Ill. "Cadillac."
Chicago Dryer Co., 2210 N. Crawford Ave., Chicago, Ill. "Chicago."
Coffield Washer Co., The, Dayton, Ohio.
Coffield Washer Co. of Canada, Ltd., 121 S. James St., Hamilton, Ont., Can.
Domestic Laundry Equipment Co., 224 W. 26th St., New York, N. Y. "Domestic." "Duplex."
Easiest Way Mfg. Co., The, Sandusky, Ohio. "Easiest Way."
FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill. "Federal." (See display adv. page 1291.)
Finucane Co., The Bernard E., 296 Franklin St., Rochester, N. Y. "Rainbow."
Folsom-Miller Co., 130 Sycamore St., Milwaukee, Wis. "Electro-Thermo."
Getz Power Washer Co., Morton, Ill. "Getz."
GILLESPIE-EDEN CORP., 7 Dey St., New York, N. Y. "Eden." (See display adv. page 1296.)
Gillespie-Eden Corp., Ltd., The, 266 King St., W., Toronto, Ont., Can. "Eden."
Grinnell Washing Machine Co., Grinnell, Iowa. "Laundry Queen."
HAAG BROS. CO., Peoria, Ill. "Haag."
Huenergardt Co., The, 19th & Vine Sts., Lincoln, Neb. "Monitor."
HUGRO MFG. CO., Warsaw, Ind. The Airplane electric washer, cabinet design, illustrated below, is an attractive, carefully constructed machine, designed to offer maximum utility with a minimum consumption of space. When washer is closed, all parts which would suggest its real use are hidden from view by a plain flat top that can be used for any of the purposes common to a small kitchen table. This top may be used for carrying the ironing board, after the washing has been done. The clothes are carried in a boiler of solid sheet copper, which has no internal projections likely to injure the most delicate fabrics. When in use, the boiler has a reciprocating motion, given by an eccentric on a shaft which is driven by a ¼ hp., quiet-running motor, which costs only a few



Airplane Electric Washer

cents per day for operation. The contents of the boiler are kept at any desired temperature by means of a gas heating attachment located directly beneath; this heating arrangement makes it possible to boil, wash and thoroughly sterilize the clothes with a minimum of handling. The motion of the boiler is vigorous enough to cleanse the heaviest woolens, yet the action of water will not tear or injure the most delicate laces. The motion of the water causes direct action on both sides of the clothes, and quickly works all foreign matter out of the fabric. The boiler, being made of solid sheet copper, cannot rust or corrode if left wet; consequently it will never spot or stain clothes. The opening in top of boiler is very large, which provides for the convenient handling of clothes. The wringer, which is a part of the regular equipment, can be attached or detached quickly, adjusts to any desired position and locks in place. Wringer is also

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equipped with a safety "release" device that permits pressure to be instantly taken off the rollers, which prevents tearing off buttons, hooks and eyes, lace, etc. All moving parts are enclosed; practically impossible to injure the operator or to get grease on the clothes. Wringer rollers, which run equally well in either direction, are of high grade rubber and have steel cores. Motor and wringer are powerful and substantial enough to wring heaviest bed clothes, small rugs, sweaters, etc. Only handling of clothes necessary is feeding into wringer. The washer is carefully finished and will harmonize with any kitchen or laundry, the color combination being especially attractive. Equipped with heavy steel casters, and can be moved easily to any part of room. All parts guaranteed to be mechanically perfect. The Airplane Electric Washer is the strongest, sturdiest, best built, fastest and longest lasting electric washer on the market. Has been tested and approved by the New York Edison Co. and the New York Tribune Institute. Besides the Airplane electric washer, this company manufactures the Airplane electric housecleaner and other electrical household appliances. See colored insert in adv. display section.—Adv.

Judd Laundry Machine Co., 122 S. Michigan Ave., Chicago, Ill.
Locomotive Electric Washing Machine Co., The, Belleville, Ill. "Locomotive."
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Manufacturers Distributing Co., 403 Fullerton Bldg., St. Louis, Mo. "Pollyanna."
McDonald & Willson, Ltd., 347 Yonge St., Toronto, Ont., Can. "Trojan."
Michigan Washing Machine Co., Muskegon, Mich. "Electric Lady."
Miller Mfg. Co., Meyersdale, Pa. "Success."
Minier Mfg. Co., Minier, Ill. "Kill Kare."
Niagara Appliance Co., 29 W. Lake St., Chicago, Ill. "Niagara."
1900 Washer Co., 215 Clinton St., Binghamton, N. Y. "Cataract."
Overton Mfg. Co., R. M., Waterloo, Iowa. "Overton."
Pittsburgh Gage & Supply Co., 30th St. & Liberty Ave., Pittsburgh, Pa. "Gainaday."
Pittsfield Machine & Tool Co., Hawthorne Ave., Pittsfield, Mass. "Berkshire."
Press Co., Wells H., Streator, Ill. "Streator."
Princess Wash Machine Mfg. Co., The, 433 E. Pearl St., Cincinnati, Ohio. "Princess."
Raymond Co., The, Saugatuck, Conn.
Sidney Washing Machine Co., The, Sidney, Ohio. "Sidney."
Smith Mfg. Co., The Philip, Sidney, Ohio. "Gold Seal."
Sunbeam Domestic Appliance Co., Evansville, Ind. "Surf."
Sunny Line Appliances, Inc., 4058 Beaufait Ave., Detroit, Mich. "Sunnysuds."
Superior Machine Co., De Kalb, Ill. "Sterling," "Superior."
Upton Machine Co., St. Joseph, Mich. "Upton."
Voss Bros. Mfg. Co., Davenport, Iowa. "Sea Wave."
Vulcan Mfg. Co., 1511 Cypress Ave., Kansas City, Mo. "Bauer."
Wayne Mfg. Co., 124 Sidney St., St. Louis, Mo.
Wenzelman Mfg. Co., Galesburg, Ill. "Supreme," "Sani-Copper."

WASHING MACHINES, CLOTHES, HOUSEHOLD, PLUNGER OR VACUUM TYPE.—In the plunger or vacuum type washing machine we have again the application of an old and accepted method of cleansing to a modern device.

In this type the washing is done in an upright cylinder of wood or metal. The plunger or vacuum cup is suspended from the top of this cylinder. This vacuum cup is simply a cone or funnel-shaped piece of metal. There may be either one large cup or several smaller ones operated from the same rod. In operation, the cup, or cups, is raised and forced down again into the water about 60 times a minute. The suction or vacuum created by the cup as it is raised lifts the clothes through the water letting them go as it nears the top. On the downward stroke the clothes are again forced through the water and partially squeezed out at the bottom. Usually as the plunger raises it also turns a little thus increasing the cleansing action and bringing all the clothes in the container into action.

Manufacturers:

Almetal Mfg. Co., The, 7227 Manchester Ave., St. Louis, Mo. "Almetal." (Exclusive distributor, Manufacturer's Distributing Co., 403 Fullerton Bldg., St. Louis, Mo.)
American Gas Machine Co., Albert Lea, Minn. "Oscillator."
Arora Co., Inc., 46 E. 41st St., New York, N. Y. "Arora Quality."
At Last Washer Co., Perry Iowa. "At Last," "Kibby's Liza Jane."
Barlow & Seelig Mfg. Co., Ripon, Wis. "Big 3."
Beebe Mfg. Co., Minneapolis, Minn. "Beebe."
Bell Washer & Wringer Co., The, 1051 Power Ave., Cleveland, Ohio. "Aerobell."
Blackstone Mfg. Co., The, Jamestown, N. Y. "American Classic."
Dexter Co., The, Fairfield, Iowa. "Climax," "Packard," "Cruiser," "Fairfield."
Getz Power Washer Co., Morton, Ill. "Getz."
Home Utilities Co., 320-326 N. May St., Chicago, Ill. "Klymax."
Laundryette Mfg. Co., 1190 E. 152nd St., St. Louis, Mo. "Laun-Dry-Ette."
National Sewing Machine Co., Belvidere, Ill. "Happy Day."
Puffer-Hubbard Mfg. Co., Minneapolis, Minn. "Daylight."
Rue-Nelson Mfg. Co., Inc., 1153 16th Ave., S. E., Minneapolis, Minn. "Rue."
Schuyler Electric Co., Berkeley, Cal. "Common Sense."
Sieben Merchandising Co., 614 Gumbel Bldg., Kansas City, Mo. (combination dolly and vacuum). "All In One."
Silent Washer Co., Clintonville, Wis. "Sunbeam."
Standard Washing Machine Co., 1100 E. 55th St., Chicago, Ill. "Thermo."
Syracuse Washing Machine Corp., 507 E. Water St., Syracuse, N. Y. "Easy."
TRI PLEX VACUUM ELECTRIC WASHING MACHINE CO., INC., THE. Main office and factory at Pekin, Ill. Manufacturers of the "Tri Plex" the machine you've had in mind. The last word in vacuum washers. This machine is equipped with three vacuum funnels which go up and down alternately, forcing hot suds through the mesh of the clothes 200 times a minute. The vacuum cups tip at the end of the stroke, pulling the clothes around in the tub and allowing dirt and grease



"Tri Plex" Electric Washer

to bubble to the surface. The most attractive, durable, noiseless and reasonably priced washing machine on the market. Also the only alternating three cup vacuum washer on the market. Triple efficiency, covers every inch of clothes surface. Made with white cedar tub, full one inch finished stave and also copper tub. Swinging reversible wringer, worm drive.—Adv.
Vacuum Washer Co., The, Ripon, Wis. "National."
Victor Mfg. Co., Leavenworth, Kans. "Wonder."
Voss Bros. Mfg. Co., Davenport, Iowa. "Voss."
WASH-KOSH MANUFACTURING CO., Oshkosh, Wis. The washing principle in the Wash-Kosh is the vacuum cup. It is very efficient, and at the same time, very gentle on the clothes. One large, square vacuum cup is used; this makes a quarter-turn at each stroke. This results in a slow rotation of the clothes which are guided in under the cup by the octagon corners of the tub. On the down strokes, steam and suds are driven through the fabrics and the dirt extracted by the powerful vacuum on the up-stroke. The copper tub, completely enclosed by the cabinet, has double walls which keep the water hot. A settling chamber is provided at the bottom which traps the sediment and dirt. Easy access to all working parts is provided by good sized doors in the handsomely finished all-steel cabinet. Other features are the unit assembly of driving mechanism, slip clutch which fully protects the motor from burn-out and swinging wringer. There is absolutely no noise or vibration with this model and the graceful lines of the machine appeal to every housewife.—Adv.
Wayne Mfg. Co., 124 Sidney St., St. Louis, Mo.

WASHING MACHINES, CLOTHES, HOUSEHOLD, PUMP OR SPRAY TYPE.—In the pump or spray type washing machine the clothes are placed in a perforated cylinder operating in a container. This cylinder is free to turn in either direction but no mechanism is provided to revolve it. The water is put into the container and the clothes into the cylinder. In the bottom of the container a small propeller operates by a shaft running through a bushed opening. As the propeller revolves at a high rate of speed it agitates the water forcin....g it through the clothes and at the same time revolves the cylinder thus increasing the action.

Manufacturers:

Geyser Electric Co., 5008-18 Bloomingdale Ave., Chicago, Ill. "Geyser."
Lombard, White Co., 38 Harlow St., Worcester, Mass.

WASHING MACHINES, CLOTHES, HOUSEHOLD, REVOLVING AND REVERSING CYLINDER TYPE.—The revolving and reversing cylinder type is in reality an application of the larger commercial laundry type washer for home use.

The machine for this type consists of a perforated cylinder of wood or metal which operates in a larger container. The container is partly filled with water and the clothes are placed in the cylinder. The inside of the cylinder is free from any obstructions except for a number, usually five, rounded slats, called lifters, which are fastened to the outside edge of the cylinder and revolve with it.

As the cylinder revolves these lifters carry the clothes up out of the water and drop them back into it again as they near the top. After the cylinder has revolved a certain number of times in one direction, usually between five and eight, it reverses and revolves an equal number of times in the opposite direction.

A special feature claimed for this type is that as the dirt is flushed out of the clothes it falls to the bottom of the container and does not again come into contact with the clothes.

Manufacturers:

ALTORFER BROS. CO., Peoria, Ill. The "ABC Super Electric" combines the action of the oscillating or rocking tub washers, with the cylinder type of construction. The oscillating action, on the one hand, insures the maximum



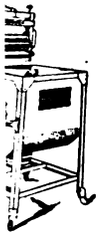
"A B C Super Electric"

amount of agitation. Unlike those washers that revolve numerous times or continuously in one direction, it prevents rolling or wadding of the clothes in the cylinder, thereby permitting the free circulation of the sudsy water through the meshes of the fabrics to force out the embedded dirt. On the

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ther hand, the cylinder construction ermits the loosened dirt particles to ass out through the numerous perfora- ons to settle at the bottom of the ub. This makes it impossible for the irt to be ground back into the clothes wringing. Moreover, the lifting and pping of the clothes, squeezing out e dirt particles, also embodies in the illest measure the principle found in e vacuum or "stomper" type of wash- s. The cylinder of the "ABC Super lectric" makes one complete revolu- on—and then reverses. This forces e sudsy water through the soiled bries 44 times each minute. The re- rsal is accomplished by a patented ringless segment gear and pitman, so oothly that a pencil will stand on d upon the lid without toppling, so ietly that the ear detects only the 't flop of the fabrics, and the slosh the water. These are unfailing signs unusual sturdiness and rare simplic- of construction, and a pledge that "ABC" will render long and faithful vice. Motor: ¼ horse power; terproof; controlled by convenient h-button switch. Frame: 1½ inch h-test structural angle-steel. Tub: mco" rust-resisting galvanized iron. eavy tin-lined copper, according to iel. Cylinder: Choice of (1) selected d white maple, or (2) zinc; holes ntersunk and embossed; (No other al cylinder has this feature.) Gears: hine-cut; running in heavy oil; encased and silent in operation. ial keystone-shaped rubber-and- belt drive—greatly superior to r types of drive. Nothing to get of order. Tension adjustable by a e thumb-screw. Wringer: Swing- ype; can be locked and operated in position; safety release. Capacity: sheets or the equivalent. See dis- advertisement on page 1297.—Adv.

ELECTRICAL DISTRIBUTING THE, Cleveland, Ohio. "Rotapex" Unitized electric clothes washer. The control comprises only: (1) motor with friction clutch; (2) worm and gear transmission; (3) cylinder operating mechanism; (4) wringer control. ¼ h.p. ball bearing, cool-running motor of splash-proof design, 1800 r.p.m. universal jointed main shaft. All bearings enclosed in water-tight casings. The self-reversing perforated r revolves 5½ times in each n. 18 in. diameter by 18¾ ins. See display adv., page opposite over.—Adv.



LD ELECTRICAL MFG. CO., , Ill. Manufacturers of the d, "The Better Washer",—is

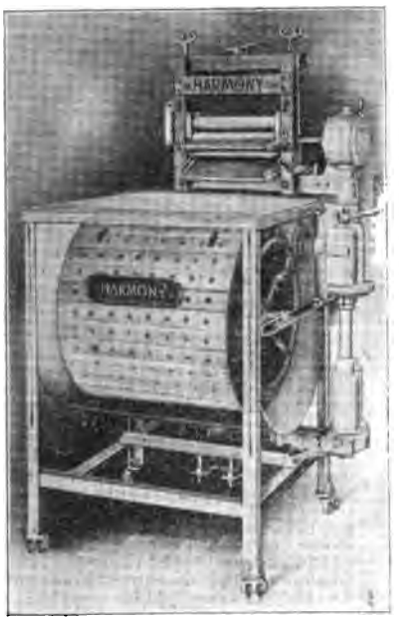


hold Electric Washer

nd motor driven, for the ital, hotel, club, sanitarium . It is of the revolving, re- linder type, and makes 4½ revolutions, giving an effective, cleansing agitation. The framework, built of galvanized steel, is protected against rust by the application of three coats of enamel. It has a strong, efficient, 12-inch swinging wringer. The tubs are furnished in copper, specially treated to prevent corrosion, or of galvanized steel. The inner cylinder, made of metal, has a capacity of eight sheets. Wringer and cylinder can be operated separately or simultaneously. The operating mechanism is entirely enclosed, and lubricated by grease packed in water-tight casing. All grease or oil cups, belts, chains, cranks are eliminated. All mechanism is enclosed in a one-piece cast iron housing. All bearings are babbitted and gears are machined. "The Better Washer" can be obtained from leading merchants.—Adv.

Central Mfg. Co., 2525 Montgomery St., St. Louis, Mo. "Humanity."

CLARK-CADLE-HARMON CORP., Rochester, N. Y. The "Harmony" washer and wringer are designed with particular reference to strength. The frame



"Harmony" Washer and Wringer

is constructed of angle iron, electrically welded. The cylinder is made of selected white cork pine, which, because of its peculiar grain structure, absorbs very little water, and therefore does not hold dirt. Within the cylinder are four ribs to keep the clothes in motion. Cylinder revolves 6½ times in each direction, and as the clothes are lifted up they drop, thus causing compression from their own weight, which forces the hot suds through the mesh of the clothes and cleans them without any outside force. The wringer, made of the best-grade rubber, has rollers full 11 ins. wide, and is equipped with a safety release. Wringer also swings and may be locked in any one of five different positions. The waterboard is reversible. Wringer may be operated from either side. The outlet cock has triple-threaded screw, which opens quickly to full capacity. A ¼-hp. Westinghouse motor gives an ample surplus of power and operates washer and wringer simultaneously or independently. The "Harmony" has a capacity of 8 sheets. When supplied with a galvanized tub, it is finished in heavy blue-white enamel. When copper tub is specified, finish is also blue-white enamel, except tub, which is of highly polished copper. All working parts are carefully inclosed, and washer cannot start until the safety lever has been depressed. The main driving shaft is provided with a friction clutch, which takes care of any overload in wringer or cylinder. Descriptive literature furnished by manfacturer on request.—Adv.

Fortier Electric Mfg. Co., Tulsa, Okla. "Rapid Electric."

FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. The Federal electric washer. Its double wave-like washing action cleans the clothes quickly and thoroughly without harming them in the least. Washes all articles from fine laces to heavy blankets. Made from Armco iron, which resists rust. Its dainty blue and white scheme of enamel decoration makes an instant appeal to the housewife. Absolutely safe—all moving parts enclosed. Has many other features, including special Roto-Phor wringer. See display adv. page 1291.—Adv.

GILLESPIE EDEN CORP., New York City, Manufactures the Eden electric washing machine. An appliance used for the rapid and economical washing of the family soiled clothes. This washing machine is very carefully assembled from accurately steel cut gears, Armco Iron tub, Gillespie made wringer, motor and castings. Every effort is made to manufacture a machine mechanically satisfactory and dependable through the course of its usefulness, and as an evidence of the standard maintained the Eden enjoys the enviable reputation in the trade as being the greatest labor-saving, time-saving and money-saving appliance ever produced for the home. The exclusive Sediment Zone found only on the Eden contributes principally to the success of the machine enabling the clothes to be continually flushed in clean water; the released dirt being trapped in the Sediment Zone. This feature alone is important enough to conclusively influence a prospect to purchase an Eden. The rotating, reversing washing principle is a mechanical duplicate of the method of washing delicate laces as practiced by women throughout the ages and therefore is sound in practice. A perforated zinc cylinder, with thousands of small holes suspends the clothes within the center of the water and allows detached dirt to filter through to the sediment zone. Mention may be made of the motor clutch, which prevents the blowing of fuses or over heating of the motor. Other excellent features are embodied in the construction of the Eden that should be investigated before purchasing a competitive electric washing machine. The Gillespie Eden Corporation also manufacture gray iron castings, wringers, extractors and motors. See display advertisement on page 1296.—Adv.

Hogan-Spencer-Whitley Co., 1052 W. 12th St., Erie, Pa. "Trojan."

Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."

LANDERS, FRARY & CLARK, New Britain, Conn. All moving parts entirely inclosed, but easily accessible by removing side panel. Combines the advantages of both oscillating and revolving types. Control is simple, handy and easily operated. Automobile type construction; no belts nor chains. Accurately cut gears, silently running in light motor grease. Mechanism will not require lubrication for several years.—Adv.



"Universal" Washer

When writing to manufacturers please mention the E M F ELECTRICAL YEAR BOOK

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MARLOW MFG. CO., Cleveland, Ohio. The Marlow is an electric washing and drying machine made with a brass wash cylinder which has a capacity of 12 sheets; travels 2600 lineal ft. per



Marlow Electric Washing and Drying Machine

min., reversing every fourth revolution. Copper centrifugal dryer makes 1500 r. p. m. Machine is constructed of vitreous enamel throughout. Adaptable to homes and institutions.—Adv.

MODERN LAUNDRY MACHINE CO., Kansas City, Mo. The Mola Electric Washer is of the cylinder type, automatically reversing every fourth revolution. Body and cylinder made of heavy galvanized iron or copper. Frame is made of steel angles double riveted and welded. It is equipped with posi-



Mola Electric Washer

tive-five-position swinging wringer, with long machined bearing and steel angle brace which absolutely prevents sagging. Patented safety release on wringer. Special gas heater to heat water and keep it at the proper temperature. Two levers in convenient reach of the operator at all times controls action of the wringer and cylinder. All working parts are enclosed and run in hard oil. Oversize standard motor used large enough to run washer and wringer at same time. The mechanism in the Mola is simple in constuction, noiseless in operation, and of long life. All gearings are slow speed and the highest speed gear is a cut steel worm gear. Large double wheel swivel castors make it easy to move the machine.—Adv.

Rochester Washing Machine Corp., 87 Franklin St., Rochester, N. Y. "Highlander."

Vulcan Mfg. Co., 1511 Cypress St., Kansas City, Mo. "Bauer Electric" or "Faultless."

White Lily Mfg. Co., Davenport, Iowa. "White Lily de Luxe."

WASHING MACHINES, CLOTHES, HOUSEHOLD, REVOLVING CYLINDER AND SPECIAL TYPES.—In addition to the foregoing standard types there are several machines on the market which, while they offer no essentially new methods, are interesting variations of these methods.

One of the most popular is a type in which the cylinder reverses after each revolution. By this method of application it is claimed to possess all the advantages of the revolving-reversing cylinder type and the oscillating types combined. Another uses a cylinder which does not reverse but runs continually in the same direction. Still another has a perforated tub, shaped and operating like the oscillating type but which is located in an outside container holding the water.

There are also some types in use which use standard laundry tubs as the outside container. In this type the washing machine consists simply of the moving parts to fit in the tub.

Manufacturers:

American Appliance Products Co., 1231 W. Madison St., Chicago, Ill. "American Maid."

Cadillac Washing Machine Co., 325 W. Ohio St., Chicago, Ill. "Cadillac."

CLARK, CADLE, HARMON CORP., 1139 University Ave., Rochester, N. Y. "Harmony."

Crystal Division, Mallory Industries, Detroit, Mich. "Crystal."

DEXTER-REYNOLDS MFG. CO., 128 N. Wells St., Chicago, Ill. Manufacturers of the "Sanitary" Electric Washing Machine. This is a late development of electric washing machine, being a type in which the cleaning mechanism is placed in a standard laundry tub. It is driven by a 1/5 hp. motor, direct connected by worm gear to a shaft terminating in a speed reduction gear, which causes the agitator to revolve at about sixty revolutions per minute. The agitator is made up of two metal corrugated blades tilted at forty-five degree angles, the shaft to which these blades are connected penetrating the bottom of the tub through a water-seal bushing, assuring a non-leakable connection. The driving mechanism also operates a stationary wringer at the left of the tub and permits the user to employ the second tub for rinsing purposes without changing the position of the wringer. Both tubs are completely covered with special wood covers, the one above the washing machine compartment being in two sections, allowing the operator to raise the smaller section, without stopping the motor, in case it is necessary to place additional clothes in the tub. The operation of the machine is as follows: As the agitator blades revolve, their lower ends pick up the clothes and the force of the revolution carries them to the tops of the blades and drops them against the sides of the tub which also have a corrugated surface. This takes the place of the rubbing motion ordinarily employed in washing clothes and forces the water through the meshes of the clothes. Inasmuch as the ordinary type laundry tub is used, one is not bothered with hauling water to the machine and draining it off later, since the ordinary plumbing connections are made. It also eliminates moving the washing machine over to the tub when it is necessary to wring the clothes since the double compartment tub furnishes a convenient place. After the washing is done, the agitator can be easily removed, converting the machine to an ordinary wash-tub again. The manufacturer furnishes this machine complete, including the tubs, or will furnish the operating mechanism, which may be installed in any standard laundry tub. For further information see display advertisement on page 1224. —Adv.

Fosston-Carpenter Co., 473 Cleveland Ave., N., St. Paul, Minn. "New Liberty."

Maytag Co., The, Newton, Iowa.

Rochester Rotary Washer Co., 87 Franklin St., Rochester, N. Y. "Rochester."

Rochester Washing Machine Corp., 87 Franklin St., Rochester, N. Y. "Highlander."

Sechler Implement & Carriage Co., Moline, Ill. "Black Hawk."

Star Washing Machine Co., 549 Quincy St., Chicago, Ill. "Silver Star."

Universal Utilities Corp., Alpena, Mich. "Universal."

V. B. M. Co., 2240 Ogden Ave., Chicago, Ill. "Very Best Made."

Win-Her Washer Co., 814 Tuttle St., Des Moines, Iowa. "Win-Her."

WASHING MACHINES, CLOTHES, LAUNDRY OR HEAVY-DUTY TYPE.—The heavy-duty or commercial laundry machines rely entirely upon the revolving-reversing cylinder method of cleansing and as a matter of fact, this type machine employed the method years before the introduction of the household size. The cylinder in these machines is usually very large and is located in a cylindrical container which holds the water. The motors used are proportionately larger than the household size and may be either belted or direct connected to the cylinder.

Manufacturers:

Apex Appliance Co., 3223 W. 30th St., Chicago, Ill.

Dexter Co., The, Fairfield, Iowa. "Duplex."

Henrici Laundry Machinery Co., 61 W. Selden St., Mattapan, Boston, Mass.

Hurley Machine Co., 24 E. Jackson Blvd., Chicago, Ill. "Thor."

International Equipment Co., 352 Western Ave., Boston, Mass.

Judd Laundry Machine Co., 122 S. Michigan Ave., Chicago, Ill.

MARLOW MFG. CO., 1836 Euclid Ave., Cleveland, Ohio.

Mateer & Co., F. W., 226-232 W. Ontario St., Chicago, Ill.

Raymond Co., The, Saugatuck, Conn.

Rochester Rotary Washer Co., 87 Franklin St., Rochestery, N. Y. "Rochester Rotary."

Willey Co., Inc., The, 1222 Race St., Philadelphia, Pa.

WASHING MACHINES, MISCELLANEOUS, ELECTRIC.—These are electrically operated machines used for washing other things than clothes, bottles and dishes. They are used in hotels, clubs, restaurants, etc., for washing vegetables, fish and oysters, etc. They are also used on dairy farms for washing milk cans and in other food product factories for washing cans. In various industrial processes, metal parts are also washed in electrically operated washing machines. These vary in construction and operating principle, depending on the purpose in view.

Manufacturers:

Berthold Electrical Mfg. Co., 127 S. Green St., Chicago, Ill. (For washing factory equipment.) "Berthold."

Creamery Package Mfg. Co., The, 61-7 W. Kinzie St., Chicago, Ill. (milk cans). "20th Century," "CP."

Crescent Washing Machine Co., New Rochelle, N. Y. ("Crescent" metal parts washing machine.)

Davis-Watkins Dairymen's Mfg. Co., North Chicago, Ill. ("Progress" can washer.)

Furman-Fisher Corp., 30 Church St., New York, N. Y. (Vegetable and oyster for hotels, etc.).

Sprague Canning Machinery Co., 222 N. Wabash Ave., Chicago, Ill. (Vegetable.)

WASHINGTON.—Trade name for automatic oil and gas separators for power plant use manufactured by the Petroleum Iron Works Co., Drawer 539, Sharon, Pa.

WASHINGTON.—Trade name for spark plugs manufactured by the Washington Auto Supply Co., Washington, Ill.

WASHINGTON AUTO SUPPLY CO.—Washington, Ill. Manufacturer of spark plugs, etc.

WASHINGTON SLATE CO.—Slatington, Pa. Manufacturer of slate for electrical purposes.

WASHKOSH.—Trade name for electric washing machines manufactured by the Washkosh Mfg. Co., Oshkosh, Wis.

WASTE CANS.—Metal containers having self-closing lids and feet to raise them from the floor, designed for storing unused or oily waste and thus prevent danger of fire from dropping matches or spontaneous combustion. They should be provided in all factories, generating stations and substations where waste is used.

Manufacturers:

Diamond State Fibre Co., Bridgeport, Pa. "Diamond F."

National Marine Lamp Co., The, Forestville, Conn.

Safety Fire Extinguisher Co., The, 291-93 7th Ave., New York, N. Y.

WASTE, COTTON, OILING AND WIPING.—A close intermixture of separate soft cotton fibers of various lengths assembled in large bundles, from which various amounts are taken as desired for wiping oil from machinery and generally cleaning around machines and machine parts. While cotton waste has been used for packing bearings in connection with lubrication, it is not altogether satisfactory for

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irpose because of a tendency to pack
er and drop away from the bearing.

ufacturers:

op Mfg. Co., The Robert, 157 W. 6th
, South Boston, Mass.
eley & Son, John, 1089 Germantown
e., Philadelphia, Pa.
enter & Co., George B., 440 N. Wells
Chicago, Ill.
lton Engine Packing Co., 54-56
nson St., Hamilton, Ont., Can.
ian-Corr Mfg. Co., 312 Market St.,
ladelphia, Pa.
Co., Dexter P., Indian Orchard,
s.
ith, John J., 1338-1344 N. Front
Philadelphia, Pa.
ial Waste Co., Philadelphia, Pa.
l Waste Mfg. Co., Troy, N. Y.
Waste Mills, La Grange, Ga.

E, WOOL, LUBRICATION. — A
itermixture of separate woolen
ers in a large bundle or mass.
aste is used for packing the oil
car trucks and railway motors.
ste is first soaked in lubricating
hen allowed to drip till the excess
ained off. It is then packed into
r journal boxes of trucks so as to
nst the underside of the car axle
provides lubrication for the axle
ng. It prossesses a spongy nature
uses it to retain its shape and
for considerable periods of time.
ed for motors it is treated as
l then packed into the oil boxes
acles, where it bears against the
e lubricated, such as armature
ar axle. Lubricating oil is then
e oil boxes. A separate chamber
boxes shows the oil level so that
e kept at the proper height.
action serves to maintain a flow
through the waste and against
ng shaft or axle and thence into
g.

DEMAGNETIZERS.—See De-
's, watch.

MEN'S SIGNAL BOXES.—See
tchmen's signal.

**MEN'S TIME DETECTORS
CORDERS.**—See Detectors,
time (for mechanical detect-
Clocks, electric, watchmen's
ling.

—A compound of hydrogen gas
gas, two volumes of hydrogen
me of oxygen, H_2O. It freezes
nd boils under normal atmos-
ure at 100° C. It is practically
ctor of electricity when pure.
nce of water to the electrical
n only be realized when we
at nearly all of the electrical
mercially produced is derived
lling water to give steam for
ors or engine-driven gener-
using the energy of falling
droelectric plants.

OOLING.—A means of carry-
produced in a machine or ap-
surrounding the parts which
the rise in temperature by a
ater circulation. One of the
n applications is to large
which are often cooled by
ling coil of continuous tubing
he top of the case and circu-
through it.

OLED MACHINE.—A water-
ine is one which depends
circulation of water for the
s heat. It ofen is provided
water-circulating coils or
is purpose.

LTERS AND PURIFIERS.
ses equipment used in power
ering and removing impuri-
spension in water to be used
purposes. The filters con-
ber of screens of fine mesh
the sand, dirt and foreign
s material passes the filter
is provided it forms an in-
olid matter when heated in
ttling tanks are also used
d before filtering.
water for boiler purposes is
rd or corrosive, it requires
ent more elaborate than
and purifiers. For such
Feed-water purifiers; Evap-
plant; Water-softening ap-
ee Feed water, boiler.
are also made in smaller
ses, such as filtering water
urposes in manufacturing
stations, telephone ex-
d before distilling for use
. These small filters are
with unglazed porcelain
tubes or cylinders as the filtering medium instead of screens.

Manufacturers:

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. "American."
American Utilities Co., St. Joseph, Mich. "Barnes."
Blackburn-Smith Corp., The, 107 W. 40th St., New York, N. Y.
General Scientific Equipment Co., North Philadelphia, Pa.
Graver Corp., East Chicago, Ind.
Griscom-Russell Co., 2141 West St. Bldg., New York, N. Y. "Reilly Multiscreen."
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Cochrane."
International Filter Co., 1st National Bank Bldg., Chicago, Ill. "Hot-Flow."
Mueller Mfg. Co., Ltd., W. H., Sarnia, Ont., Can.
New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J. "New York," "Continental," "Jewell," "Warren," "Hyatt."
Ozone Co. of America, 416-418 4th St., Milwaukee, Wis.
Permutit Co., The, 440 4th Ave., New York, N. Y.
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Roberts Filter Mfg. Co., 6th & Columbia Sts., Darby, Pa.
R. U. V. Co., Inc., The, 165 Broadway, New York, N. Y.
United Filters Corp., 65 Broadway, New York, N. Y. "United."
Waterbury Mfg. Co., 236 Grand St., Waterbury, Conn.

WATER HAMMER.—When the gate or valve in a penstock or pipe is suddenly closed there is a change in pressure head due to the change in velocity which sets the column of water in the pipe into vibration or oscillation. This condition is called water hammer and is a source of great danger in a long penstock, such as for a water-power plant. Several waves succeeding each other by an interval approximately equal to the vibration period of the pipe, may cause a pressure, especially at the bends, which no possible strength of penstock could withstand. (For preventive measures, see Standpipe, also Valves, relief.)

WATER HEATERS AND URNS.—See Heaters, electric, water (five types); Urns, water, electric, restaurant and hotel.

WATER KING.—Trade name for leather belting manufactured by the Southern Belting Co., 602-608 S. Peters St., New Orleans, La.

WATER LEVEL GAGES.—See Gages, boiler water level; Gages, water level, electrically operated.

WATER PUMPING SYSTEMS. — See Pumping systems, water, electropneumatic.

WATER PUMPS.—See under Pumps, of which many classes and types are listed, especially Pumps, water.

WATER RHEOSTAT.—A device used for absorbing the energy developed in a generator while under test, or as a protective resistance for other apparatus while testing. It consists of a large wooden box or barrel containing water in which two metal electrodes are immersed. The position of the electrodes may be shifted to vary the resistance. Special forms of water rheostats are also used for the control of large motors. See Rheostats, water or liquid.

WATER SOFTENING APPARATUS.—Water softening apparatus is used in the treatment of boiler feed water to remove most of the salts carried in solution, which form an incrustation of solid matter or "scale" when the water is boiled. Such scale is very objectionable in steam boilers of power plants. The principal salts found are calcium, magnesium and iron carbonates, bicarbonates and sulphates. Treating the water for bicarbonates is usually accomplished by boiling it, when the salts are decomposed. Treating water containing the other impurities is a more elaborate treatment and the apparatus used is varied. It consists of tanks and equipment for treating the water and precipitating the impurities. Sodium carbonate (Na_2CO_3) and lime (CaO) are often used for this purpose. The clear water is drawn off from the precipitated salts in the softening apparatus and is then supplied to the feed-water heater; the precipitate is periodically cleaned out from the treating tanks.

Manufacturers:

Graver Corp., East Chicago, Ind.
H. S. B. W.-Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa. "Sorge-Cochrane."
International Filter Co., 1st National Bank Bldg., Chicago, Ill. "Hot-Flow."
Mason Regulator & Enginering Co., Ltd., The, 135-53 Dagenais St., Montreal, Que., Can.
New York Continental Jewell Filtration Co., E. Centre St., Nutley, N. J.
Permutit Co., The, 440 4th Ave., New York, N. Y.
Power Plant Specialty Co., Monadnock Block, Chicago, Ill. "Vater."
Roberts Filter Mfg. Co., 6th & Columbia Sts., Darby, Pa.
Scaife & Sons Co., William B., Pittsburgh, Pa. "We-Fu-Go," "Scaife."

WATER STERILIZERS.—See Sterilizers, electric, water, circulating; Sterilizers, electric, water, noncirculating.

WATER STILLS.—See Stills, electrically heated; Stills, water, steam or fuel-heated.

WATER-TIGHT BELLS. — See Bells, marine.

WATER-TIGHT BUZZERS.—See Buzzers, electric, marine.

WATER-TIGHT FIXTURES.—See Fixtures, lighting, marine, water-tight and vaporproof.

WATER-TIGHT PUSH BUTTONS.—See Push buttons, marine and water-tight.

WATER-TIGHT RECEPTACLES.—See Receptacles, weatherproof and water-tight.

WATER-WHEEL GENERATORS.—See Generators, lighting and power, a-c., water-wheel; Generators, lighting and power, d-c., water-wheel.

WATER WHEELS.—A form of hydraulic motor, now practically obsolete except for irrigation purposes. The term was originally applied to the large open overshot, breast and undershot wheels, and is now occasionally applied to the runner or rotor of a hydraulic turbine. Impulse turbines, such as of the Pelton type, are often called water wheels. (Also see Turbines, water or hydraulic.)

WATER-WITCH. — Trade name for leather belting manufactured by N. Palmer & Co., Bridgeport, Conn.

WATERBURY.—Trade name for wet batteries manufactured by the Waterbury Battery Co., 30 Church St., New York, N. Y.

WATERBURY BATTERY CO., THE.—30 Church St., New York, N. Y. Manufacturer of wet batteries. President and treasurer, C. B. Schoenmehl; vice-president and general manager, E. E. Hudson; secretary and factory manager, M. L. Martus.

WATERBURY BUTTON CO.—Waterbury, Conn. Manufacturer of sockets, switches, molded insulation, electrical novelties, etc. Business established 1812. Vice-president, Ralph H. Smith; secretary, W. F. Kaynor. Main office, 835 S. Main St., Waterbury, Conn. Branch offices, 1140 Broadway, New York, N. Y.; 68 Essex St., Boston, Mass.; 230 S. Wells St., Chicago, Ill.; 435 Mission St., San Francisco, Cal.; 11 Richmond St., W., Toronto, Ont., Can.

WATERBURY MFG. CO.—Waterbury, Conn. Manufacturer of fixture fittings, switch and receptacle plates, screws, bolts and other brass products. Business established 1837. President F. S. Chase; treasurer and general manager, C. W. Henger; sales manager, R. O. Palmer. Main office and factory, 236 Grand St., Waterbury, Conn. Branch offices, 7 S. Dearborn St., Chicago, Ill.; 200 Fifth Ave., New York, N. Y.; Stephen Girard Bldg., 12th & Chestnut Sts., Philadelphia, Pa.; Engineers Bldg., Cleveland, Ohio; 502 Kresge Bldg., Detroit, Mich.; Farmers Bank Bldg., Pittsburgh, Pa.; 225 Sharon Bldg., San Francisco, Cal.

WATERIDE.—Trade name for waterproof leather belting manufactured by the F. Raniville Co., 241-247 Pearl St., Grand Rapids, Mich.

WATERPROOFING MATERIALS.—These materials are used for waterproofing various apparatus and joints, cloths and other fabrics. For treating the fabrics a special compound is used, sometimes an oil, in other cases a wax. The material

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is usually thoroughly impregnated with the compound. In other cases the compounds and materials are used for sealing up joints. The joints are sometimes packed with jute or hemp impregnated with tar or pitch. Wood and other porous materials are often boiled in oil, paraffin and other waterproofing compounds to keep out moisture and thus improve the dielectric strength, or to exclude acids, alkalies or other injurious liquids, especially around storage batteries, electroplating and other electrochemical cells or tanks.

Manufacturers:

Barnard & Co., B. S., 31 Union Sq., New York, N. Y. "Hercules."
Barrett Co., The, 17 Battery Pl., New York, N. Y.
Billings-Chapin Co., The, 1153 E. 40th St., Cleveland, Ohio. "Driwal," "Bilchaco."
Binswanger & Co., B., 829-835 N. 3rd St., Philadelphia, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Celite Products Co., 1134 Van Nuys Bldg., Los Angeles, Cal. "Celcote."
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Elaterite Paint & Mfg. Co., W. 11th & Market Sts., Des Moines, Iowa. "Des Moines Elaterite."
Flexible Compound Co., Inc., The, 3607 Haverford Ave., Philadelphia, Pa. "Flexible Compound."
Fulton Bag & Cotton Mills, Atlanta, Ga.
Lehon Co., The, W. 44th St. & Oakley Ave., Chicago, Ill.
Mogul Co., 41 W. 39th St., New York, N. Y.
O'Brien Varnish Co., Washington & Johnson Sts., South Bend, Ind.
Smooth-On Mfg. Co., Jersey City, N. J. "Smooth-On."
Union Paper & Twine Co., 125 St. Clair Ave., N. W., Cleveland, Ohio.
Vitrifyx Co., The, 2526 W. Congress St., Chicago, Ill.

WATERSOFT.—Trade name for water softening compounds manufactured by the Fred G. Clark Co., 1087 W. 11th St., Cleveland, Ohio.

WATIGHT.—Trade name for vapor-proof and water-tight receptacle and lighting fixture manufactured by the Electric Appliance Co., 701-709 W. Jackson Blvd., Chicago, Ill.

WATKINS, FREDERICK A.—565 W. Washington St., Chicago, Ill. Manufacturer of telephone mouthpieces. Proprietor, Frederick A. Watkins.

WATSON.—Trade name for motors, generators, grinders and fans manufactured by the Mechanical Appliance Co., Milwaukee, Wis.

WATSON & MC DANIEL CO.—150 N. 7th St., Philadelphia, Pa. Manufacturer of steam traps and valves. President, James P. Watson; secretary and treasurer, James Watson.

WATSON CO., H. F.—Erie, Pa. Manufacturer of asbestos paper, boiler and pipe coverings, etc. Main office and factory, Erie, Pa. Branch offices, Chicago, Ill.; Boston, Mass.

WATSON, FRYE CO., LTD.—213-223 Front St., Bath, Me. Manufacturer of brass and bronze castings and valves. President and treasurer, Scott R. Frye; vice-president, Orrin F. Frye; general manager, Edmund P. Briggs.

WATSON MUSIC CO.—St. Joseph, Mo. Manufacturer of electrically operated pianos.

WATSON-STILLMAN CO., THE.—40 Dey St., New York, N. Y. Manufacturer of car wheel presses, valves, packings, etc. President, Edwin A. Stillman; vice-president, Carl Wigtel; secretary, A. P. Neuin; treasurer, J. D. Brooks; general manager, L. Brown.

WATT.—The practical unit of electric power or rate of doing work in a circuit. A watt equals one joule per second, or the work done in a noninductive circuit by a current of one ampere under a potential of one volt. One watt equals 10^7 (or 10,000,000) absolute units of electric power. In relation to mechanical power, 1 watt = 0.737 foot-pound per second, or 1/746 horsepower. Since the watt is a rather small unit, the kilowatt, which equals 1000 watts, is more commonly used. The watt was named after James Watt, inventor of those far reaching improvements in steam engines that ushered in the age of mechanical and electrical power. (See Power, electric; Joule; Kilowatt; Watt, James.)

WATT, JAMES.—A Scottish engineer (born 1736, died 1819) after whom the unit of electric power is named. He early took to mechanical and engineering pursuits and at the age of 21 was appointed mathematical instrument maker at Glasgow University. He also made surveys and reports on river and harbor improvements. In 1764 he conceived the idea of building a condenser separate from the steam engine cylinder. Until then the steam was condensed by means of a jet of cold water forced into the cylinder at the end of the stroke; this alternate heating and cooling of the cylinder required about three times as much steam as after Watt's development of the separate condenser. He was engaged in the manufacture of steam engines for about 26 years, during which he also invented the engine governor and the compound type of engine. He also invented other mechanical devices and chemical products.

WATT-HOUR.—A common practical unit of electrical energy. It equals the energy passed in one hour in a circuit whose power is constantly one watt. The watt-hour is therefore equivalent to 60×60 or 3600 watt-seconds. A still more common unit is the kilowatt-hour; 1 kw-hr. = 1000 watt-hours. It should be noted that one watt-hour represents an amount of electrical energy that may be used in a period different from one hour and at a rate different from one watt. It merely means that during the time considered a summation of the watt-seconds used would amount to 3600. For instance, a 10-watt lamp operated for 6 minutes uses one watt-hour of energy, since 10 watts × 360 seconds = 3600 watt-seconds = 1 watt-hour. (See also Watt; Watt-second.)

WATT-HOUR METER.—An instrument for measuring or integrating the electrical energy passed through a circuit or appliance for any length of time and recording the total on dials in units of watt-hours or kilowatt-hours. Such instruments are most commonly referred to merely as "meters" (in England as "electricity meters") because they meter the electricity supplied just as a gas meter measures the gas supplied during any period, such as a month. (For principles, construction, principal types used, and makers of such meters, see Meters, watt-hour.)

WATT-HOUR METERS.—See Meters, watt-hour (several types).

WATT-SECOND.—The practical unit of electrical energy. It equals the energy passed per second where the power is one watt; it also equals one joule of work done in a second. Since this is a small unit, simple multiples of it (the watt-hour and the kilowatt-hour) are commonly used. If the power is constant, the energy in watt-seconds for any period of time is found by multiplying the power in watts by the time in seconds. If the power is varying, the energy is usually found by a meter that integrates the work done in the consecutive seconds, but records the total in watt-hours or kilowatt-hours. (See Energy, electrical; Watt; Watt-hour; Kilowatt-hour; Watt-hour meters.)

WATTAGE.—A fairly common expression for the power in an electric circuit or appliance in terms of watts or kilowatts. It may be the actual power input or output at a particular instant, or the rated power under certain assumed standard conditions of voltage, current and power-factor. The actual wattage can be measured directly by means of a wattmeter. The rated wattage is the normal power output capacity of generators or transforming devices, or the input capacity of current-consuming devices; examples are: A 250-kw. generator, 75-watt incandescent lamp, 550-watt pressing iron.

"WATTLESS" COMPONENT OR CURRENT.—In alternating-current circuits, when the current and voltage are not in phase, one component of the current is in quadrature with the voltage and does not contribute energy to the circuit. This component is often known as the "wattless" current or component as distinguished from the active, energy or working component of the current. The term "wattless" current is a misnomer, however, because such currents generate heat in the conductors they traverse and consume some power or watts in doing so. The A. I. E. E. Standardization Rules do not approve the terms "wattless" component or wattless current. The proper name for this current is reactive or quadrature current or reactive component of the current in a circuit.

WATTMETER. — An instrument for measuring the power or wattage of a circuit or appliance. It depends for its principle of operation upon the interaction of two coils or elements, one commonly called the current coil which is connected in series with the circuit or appliance being measured, the other called the potential coil which is connected across the test circuit. Thus the currents in these coils are proportional to the current and potential of the appliance under test and their joint action is proportional to the average products of the instantaneous current and potential or to the average instantaneous power, which is the true or actual power. To secure suitable interaction between the two coils or elements, wattmeters usually employ either the electrodynamometer or the electromagnetic (or iron-vane) principles. Wattmeters are divided into two main classes: Indicating, which indicate on a dial at any instant just what power is then being measured; recording, curve drawing or graphic, which make a permanent record on a suitably ruled circular or rolled sheet showing the true power at any instant during the test period. Recording wattmeters must not be confused with integrating watt-hour meters, which integrate the instantaneous energy continuously and record the total on dials in watt-hours or kilowatt-hours; such meters have often been incorrectly called recording wattmeters. Wattmeters may also be divided into three principal classes according to the kind of circuit on which they are used: direct-current, single-phase and polyphase; also into several classes according to the nature of the testing to be done, such as portable, laboratory, switchboard types, etc. Makers and some details of the principal types of wattmeters are given below.

WATTMETERS, ELECTROSTATIC.—This is essentially a quadrant electrometer and a noninductive resistor, to the terminals of which the quadrants are connected. In making readings the resistor is connected in series with the load and the needle is successively connected to the two terminals of the load. From these two readings the power can be calculated. A highly developed connection, which obviates the second reading, is used by the National Physical Laboratory of England for calibrating commercial instruments. It has not come into extended use in this country. It is primarily a laboratory instrument for research.

WATTMETERS, HOT-WIRE. — This form of wattmeter contains two hot wires, one carrying a current proportional to the sum of the line voltage and the drop at the terminals of a shunt carrying the load current, and the other current proportional to the difference of the line voltage and the shunt drop. It is of little importance in measuring power at low frequencies. It may be of service in the approximate measurement of power in high-frequency circuits.

WATTMETERS, PORTABLE, D-C. AND SINGLE-PHASE.—To permit temporary tests of the power of a circuit or appliance to be made easily, wattmeters are made that are compact, light and readily portable. They are often used to test the actual load on motors, to show the power consumption of lamps, household appliances, etc. To increase their adaptability for a wide range of tests portable wattmeters frequently are equipped for several ranges and provided with corresponding sets of terminals suitably marked to facilitate quick connection to the test circuit. For further increasing the range it is necessary to use multipliers and shunts on d-c. circuits and potential and current transformers on a-c. circuits.

Portable wattmeters are practically all of the electrodynamic type. Formerly the induction type was also made portable, but as it was subject to the limitation of a fixed frequency and large temperature coefficient, it is no longer made in portable form. The principle of operation of the electrodynamic wattmeter is the same as that of the Siemens' electrodynamometer. It consists of a fixed coil and a movable coil. The former is of large wire and carries the load current. The movable coil is attached to a staff which is pivoted between jewel bearings and has its motion opposed by spiral springs; in series with it is connected a resistor, just as in a voltmeter; when in use this circuit is connected across the line and carries a current proportional to the voltage. The torque resulting from the reaction of the currents in the two

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ls is proportional to their product and ıce to the power. In the torsion-head e of wattmeter the torque, due to the rents is counterbalanced by turning a d which winds up a spring attached to movable coil.

lanufacturers:

anadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
anadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ENERAL ELECTRIC CO., Schenectady, N. Y. Type P-3 instruments contained in mahogany carrying cases. Single phase wattmeters made in capacities up to and including 200 amp. and 750 volts; wattmeters with double-current windings arranged for series multiple connection can be furnished with 2.1 ratios up to and including 30/60 amp. Type P and P-2 Thomson inclined coil instruments, designed for use on a-c. circuits, but can be used with good results on d-c. circuits by making reversed readings. Wattmeters are made self-contained in capacities up to 200 amp. and 500 volts. Also single-phase wattmeters for low power-factor measurements. (Bulletin 044.) See adv. pages 1203-1223.—Adv.
ell Electrical Instrument Co., 1650 alnut St., Chicago, Ill. "Jewell."
en-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
WSON ELECTRICAL INSTRUMENT ., 4 Norfolk St., Cambridge, Mass.
er-Smith Co., 233 Broadway, New rk, N. Y.
STINGHOUSE ELECTRIC & MFG. ., East Pittsburgh, Pa. (See display v. pages 1395-1402.)
on Electrical Instrument Co., Wav- Park, Newark, N. J.

TMETERS, PORTABLE, POLY-.—The polyphase wattmeter contwo wattmeter elements with their e elements on a common spindle. special precautions are taken in ction, the fixed coil of one element act with the movable coil of the ement. In some graphic meters no ecautions are taken, but in high-portable polyphase wattmeters a e screen is interposed between the or each element is enclosed in a magnetic shield.
ase wattmeters are used prinor testing purposes, to determine er input to a motor, appliance or r the output of a generator, and al laboratory purposes. They are self-contained for voltage ranges 0 volts; above that both current ntial transformers are required. ments where the two elements nearly equal in all respects so indications on low power-factor alanced loads will be accurate, inding posts are generally prohese permit connections for the oltage and current ranges and it the use of one element of the t on d-c. circuits, and on single- and three-wire and two-phase four-wire circuits.

turers:

General Electric Co., Ltd., 212 St., W., Toronto, Ont., Can.
Westinghouse Co., Ltd., San-Myler Sts., Hamilton, Ont., Can.
L ELECTRIC CO., Schenec-. Y. Polyphase wattmeters of types and sizes. These are de-with other portable instruboth a-c. and d-c., in Bulletin See adv. pages 1203-1223.—Adv.
ay Co., 64-70 Johnson St., Gern, Philadelphia, Pa.
ith Co., 233 Broadway, New . Y.
HOUSE ELECTRIC & MFG. st Pittsburgh, Pa. (See display es 1395-1402.)
lectrical Instrument Co., Wav-k, Newark, N. J.

TERS, PORTABLE, TEST-OARD.—These are more corrotating standard watt-hour Meters, watt-hour, portable standard."

TERS, PRECISION, CALI-OR LABORATORY STAND- are semiportable electrodyeters of either the torsion-movable-coil type. The prinration are the same as those ble forms. They are, howaccurate and have a wider igher accuracy is secured by refinement in construction and design. These instruments are designed primarily for laboratory power measurements of high precision. They are usually arranged for several current and voltage ranges. Two of the most used American-made precision wattmeters are of the movable-coil type, each having a long subdivided scale facilitating closer reading. Two others are of the torsion-head type.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
GENERAL ELECTRIC CO., Schenectady, N. Y. Indicating electro-dynamometer type. Highly accurate. Designed for precision work. (Bulletin 46048.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Queen-Gray Co., 64-70 Johnson St., Germantown, Philadelphia, Pa.
RAWSON ELECTRICAL INSTRUMENT CO., 4 Norfolk St., Cambridge, Mass.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

WATTMETERS, RECORDING OR CURVE-DRAWING.—Recording wattmeters have a wattmeter element whose pointer has a stylus or pen for making a permanent record on a ruled paper sheet that is steadily moved by a clock mechanism. The record is either a circular disk or continuous roll wound on a cylinder, in either case being ruled off with time in the direction of the record's movement, and watts or kilowatts crosswise thereto. The record shows how the power actually varied throughout the period covered. Therefore recording wattmeters are very frequently used for determining the fluctuations of load on motors, generators, groups of machines or distribution feeders. One important application is to determine the load variation or output of any particular motor-driven machine or group of machines over a complete cycle of operations or over a definite time period. A graphic wattmeter connected to indicate the input to the motor also gives a very good indication of the machine output and is by far the most simple and accurate method of obtaining data on a complete cycle. When used to measure the load on separate feeders, a special form of wattmeter called totalizing wattmeters may be used. They combine the action of as many as 12 instruments in separate circuits and transmit the motion to a single recording device which totals the output on all circuits.

Recording wattmeters are made in both the direct-acting and relay forms for both single-phase and polyphase circuits. The direct-acting are invariably of the electrodynamic type with some form of siphon pen as all other graphic instruments; the chart is likewise moved at a uniform rate by a clock mechanism.

Manufacturers:

BRISTOL CO., THE, Waterbury, Conn. (See display adv. page 1286.)
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
ESTERLINE-ANGUS CO., THE, Lemcke Annex, Indianapolis, Ind. See Instruments, electrical, curve drawing, graphic recording or printing, miscellaneous.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments constructed on the direct-reading dynamometer principle and furnished in either a-c. or d-c. types. Special features in construction include suspension of moving element, special design of pen and paper feeding mechanism, damping device, scales, and unusually high torque. (Bulletin 46047.) See adv. pages 1203-1223.—Adv.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WATTMETERS, SWITCHBOARD, D-C. AND SINGLE-PHASE.—Switchboard wattmeters for d-c. service are of the electrodynamic type essentially the same as the portable instruments. A-c. switchboard wattmeters are of both the electrodynamic and induction types. The induction wattmeter operates on exactly the same principle as the induction watt-hour meter. They are inherently less accurate than the electrodynamic wattmeters, but for switchboard use they have the advantage of simple construction, ruggedness, high torque, and long scale. They have the disadvantages of being limited to only one frequency and relatively high temperature coefficient. Their accuracy is also affected by variations in wave form. While they are entirely suitable for switchboard service, they should not be used on any tests requiring accurate measurements.

Wattmeters are not provided on switchboards nearly as frequently as voltmeters and ammeters. This is because most circuits are constant-potential circuits. If the circuit voltage is practically constant and the power-factor is very high and also fairly constant, the circuit ammeter gives a reasonably good indication of the load. On d-c. circuits and on a-c. incandescent lighting circuits this is true, so that a wattmeter is regarded as superfluous. When the power-factor is uncertain and is likely to be low or when the circuit voltage fluctuates widely as well as the current, the ammeter no longer gives a dependable indication of the power load; in such cases a wattmeter is necessary to show the actual power.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Electrodynamometer type. Capacities self contained up to and including 200 amp. 750 volts. For circuits in excess of 1,150 volts, 200 amp. current transformers are supplied. Potential transformers used on a-c. circuits above 750 volts. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.
Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill. "Jewell."
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

WATTMETERS, SWITCHBOARD, POLYPHASE.—Switchboard type polyphase wattmeters have practically the same construction and characteristics as portable polyphase wattmeters. They are made in both the electrodynamic and induction types. They are usually designed for direct connection to circuits up to about 750 volts and in current capacities as high as 100 amperes. Above these values both current and potential transformers must be used. In appearance and size they conform to other standard switchboard instruments. Polyphase wattmeters are not used on all switchboards, as with most loads the ammeters give a reasonably good indication of the load. See discussion under d-c. and single-phase switchboard wattmeters above.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Canadian Westinghouse Co., Ltd., Sanford & Myler Sts., Hamilton, Ont., Can. "Westinghouse."
Ferranti Meter & Transformer Co., Ltd., 26 Noble St., Toronto, Ont., Can.
GENERAL ELECTRIC CO., Schenectady, N. Y. Instruments of horizontal edgewise pattern which indicate on a single scale the total energy of the system, regardless of the conditions of load. Furnished in current capacities up to 60 amp. and potential capacities up to 650 volts, without transformers. For use on circuits above 60 amp. or 650 volts a transformer will be furnished. (Bulletin 46046.) See adv. pages 1203-1223.—Adv.
Roller-Smith Co., 233 Broadway, New York, N. Y.
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Weston Electrical Instrument Co., Waverly Park, Newark, N. J.

WATTS REGULATOR CO.—252 Lowell St., Lawrence, Mass. Manufacturer of steam and water specialties. Business established 1874.

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WAUGH.—Trade name for dental X-ray units manufactured by the Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

WAUKEGAN CHEMICAL CO.—Waukegan, Ill. Manufacturer of metal lacquers, lamp coloring compounds, etc. President, Dr. Rudolph Breves; vice-president, Emory H. Wilder; treasurer and sales manager, Casper Apeland.

WAVE LENGTH, RADIO.—Radio stations are classified according to the wave length of the electromagnetic wave radiated. Wave length and frequency are connected by the formula: Wave length equals velocity of propagation divided by frequency, in which the velocity of propagation is the same as for light, namely, 30,000,000 meters per second. Amateur transmitting stations must use wave lengths of 200 meters or less. Most commercial ship work is carried on a 600-meter wave or sometimes a 300-meter wave. High-power transoceanic and transcontinental traffic is carried on wave lengths which commonly range from 5000 to 17,000 meters. The highest power transmitting stations generally use the longer wave lengths.

WAVE METERS, RADIO.—Instruments for measuring the wave length radiated by a radio transmitting or receiving circuit. It consists of a special circuit containing a known capacitance and inductance. This circuit is calibrated in terms of the wave length in meters of the electromagnetic wave it will radiate when oscillating at its own natural frequency. In use, the wave meter is adjusted to resonance with the circuit to be calibrated at which time the wave length of the two circuits is the same. The wave meter must, therefore, contain a detector or current indicating device to indicate resonance if the oscillations are set up in the circuit to be calibrated, or it must contain a method of setting up oscillations in the wave-meter circuit if the uncalibrated circuit is equipped with a detector. This latter function is generally accomplished by the aid of a buzzer.

Manufacturers:

DeForest, Lee, Inc., 451 3rd St., San Francisco, Cal.
Doolittle Co., F. M., 817 Chapel St., New Haven, Conn.
General Radio Co., 11 Windsor St., Cambridge, Mass.
Simon, Emil J., 217 Broadway, New York, N. Y.

WAVE PROPAGATION OF ENERGY.—When a disturbance produced in a medium is propagated through it, a wave, or a train of waves, is said to travel through the medium. Each particle of the medium in turn undergoes periodic changes. The propagation of disturbances in this manner is known as wave motion. Water waves, sound, light, heat radiation and electric waves are illustrations.

The particles of the medium do not move forward, but each oscillates about a fixed position. There is, however, a flow of energy in the direction of travel of the waves which is practically the most important feature of the wave motion.

When a particle in an elastic medium is displaced, work has to be done upon it and it acquires potential energy. If allowed to vibrate freely about its original position, the elastic forces impart to it velocity and its kinetic energy increases at the same time it is losing its potential energy. When it reaches the center of its path, its energy is all kinetic. On account of its inertia, its motion continues beyond the center and its kinetic energy is again changed into potential energy. At the same time energy is imparted to the neighboring particles through the agency of the forces holding the particles together. Each particle is caused to vibrate just a little behind its neighbor and energy is passed from particle to particle.

When the vibratory motion of the particles is at right angles to the direction of motion of the waves, the waves are said to be transverse. If the particles move parallel to the direction of travel of the waves, the waves are said to be longitudinal. Waves made by shaking one end of a long rope are transverse. Sound waves are longitudinal.

The distance traveled by the wave in one second is called its velocity. The distance between adjacent particles in the same relative position and moving in the same direction is called a wave length. This corresponds to the distance from crest to crest, or trough to trough, in water waves. The wave length may also be described as the distance the wave travels during one vibration. It follows that the velocity is the product of the wave length by the number of waves passing a point per unit time. This latter number is known as the frequency.

In electric waves electric and magnetic forces are produced in the ether perpendicular to the direction of propagation of the waves and perpendicular to each other. These forces vary periodically in magnitude and direction and energy is transmitted through the medium. Light and heat waves, as well as the waves used in radio communication are of this type. The fundamental difference between them is the difference in wave length, which depends on frequency of oscillation. All travel in free space with the same velocity, 186,000 miles or 300,000 kilometers per second.

Sound waves in gases and liquids are longitudinal waves of compression and rarefaction in the medium. The velocity of sound depends on the properties of the medium in which it travels. In air, at freezing temperature, the velocity is about 1090 ft. of 332 meters per second.

WAVERS, HAIR, ELECTRIC.—Electric hair wavers are used for placing "permanent" waves in women's hair. They consist of a number of individual heating elements of cylindrical form, sometimes suspended from a metal ring or chandelier, with a counterweight attached to the suspension cord. The hair is wrapped around them and a metal cap placed over it and the current turned on. The counterweights serve to lift the heating coil off the head so that the weight and heat of the various elements is not excessive. Some manufacturers make a special form of curling iron that is often called a waver also, but is different from the permanent wavers. For such and for other simple curlers, see Curling irons, electric.

Manufacturers:

Canadian Edison Appliance Co., Ltd., Downie St., Stratford, Ont., Can. "Hotpoint," "Edison."
EDISON ELECTRIC APPLIANCE CO., INC., 5660 W. Taylor St., Chicago, Ill. "Hotpoint," "Edison." (See display adv. pages 1292-1293.)
Frederick, Inc., E., 665 5th Ave., New York, N. Y.
Le Bijou Specialties, 186 N. LaSalle St., Chicago, Ill. "S & N," "Supedo," "N W. 2."
NORTHERN ELECTRIC CO., 542 St. Clair St., Chicago, Ill. "Service."
Pelouze Mfg. Co., 232 E. Ohio St., Chicago, Ill.
Permanent Wave Machine & Supply Co., 465 Greenwich St., New York, N. Y. "Keen."
Slaughter & Co., William E., 1716 S. Michigan Ave., Chicago, Ill. "Parisian."
Thome, Mathias, 22 W. Monroe St., Chicago, Ill.

WAVES AND WAVE FORMS.—In alternating-current work, if the successive instantaneous values of current or voltage during one or more cycles be plotted against time as the horizontal ordinate, a curve of more or less regular wave shape is produced. The wave assumed in ordinary alternating-current circuits is the sine wave. With this wave certain relations are true; the mean effective value, also called the root-mean-square value or simply the effective value, is equal to the maximum value or the amplitude of the wave divided by $\sqrt{2}$; or equal to 0.7071 E_{max}. The mean or average value is equal to the maximum value divided by π—2 or equal to 0.6366 E_{max}. The ratio between the effective and average values, called the form-factor, is equal to 1.11 for sine waves. Where both the current, I, and the voltage, E, vary according to the sine law, the power P-IE cos θ, where cos θ is the power-factor.

In actual practice, sine waves are not always obtained and these relations do not hold true. Some generators do not give a pure sine wave, but include harmonics, which gives a complex wave. See Alternating wave form.

WAX, BEES'.—See Beeswax.

WAX, FILLING AND SEALING.—See Compounds, battery sealing; Compounds, cable, junction box, pothead and transformer, filling and sealing.

WAX MELTERS.—See Melters, wax, electrically heated.

WAX, MISCELLANEOUS, NOT OTHERWISE LISTED.—Waxes have many important uses in the electrical field. They are very useful for treating fabrics of various kinds, either the sheet form or as tubing, or treating woven sheaths on cable and cotton insulation on wires. In the latter case it prevents the fraying or unraveling of the cotton that occurs when a wire is cut. On some cables it is used for similar purposes and also for waterproofing purposes. There are many special synthetic waxes produced for various specific purposes. Some have exceptionally low freezing points and high boiling points or other desirable properties, thus making them especially suitable for many purposes where unusual requirements are to be met.

Manufacturers:

Condensite Co. of America, Grove St. & Erie R. R., Bloomfield, N. J. "Halowax."
Smith & Nichols, Inc., 121 Maiden Lane, New York, N. Y.

WAX, PARAFFIN.—See Paraffin.

WAX, SATURATING AND FINISHING, FOR WIRE INSULATION.—Wax is a term applied to any of a class of natural plastic substances composed of carbon, hydrogen and oxygen in varying proportions. There are several forms of wax, such as beeswax, carnauba wax, Chinese wax, etc. These different waxes are sometimes mixed to give different degrees of hardness when dry, and material to be impregnated is boiled in the compound. Silk and cotton-covered wires are frequently treated in this way to make them waterproof. It is also used in connection with weatherproofing compounds on wires having cotton braids, as it permits a smooth hard surface with a dull polish.

Manufacturers:

Bartlett, Inc., H. N., 19 Park Pl., New York, N. Y.
Cochrane Chemical Co., 432 Danforth Ave., Jersey City, N. J.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Electric Insulation & Varnish Co., Ltd., New Toronto, Ont., Can.
Insulating Materials Co., 5133 Wesson Ave., Detroit, Mich. "Imco."
Mitchell-Rand Mfg. Co., 18 Vesey St., New York, N. Y.

WAX, SEALING.—See Sealing wax.

WAXING AND FINISHING MACHINES, FLOOR, MOTOR-DRIVEN.—These motor-driven finishing machines are used for smoothing, finishing and polishing new hardwood floors in dance halls, homes, stores, etc. They are also used for sanding worn floors and for refinishing and polishing waxed or varnished floors. The motor-driven equipment is commonly used with the motor mounted in a vertical position. For waxing floors and rubbing or polishing, interchangeable circular brushes are attached to the motor and driven at a high speed. This method is much quicker and less expensive for large floors than the hand method. The sanding and finishing machines consist of rolls covered with sandpaper and driven at a fairly high speed.

Manufacturers:

INTERNATIONAL FLOOR MACHINE CO., 151 W. 36th St., New York, N. Y. "International." See descriptive advertisement under Rubbing and polishing machines, motor-driven.—Adv.
KELLEY ELECTRIC MACHINE CO., 111-119 Dearborn St., Buffalo, N. Y.

WAY.—Trade name for pole-line hardware manufactured by the St. Louis Malleable Casting Co., 7701 N. Conduit Ave., St. Louis, Mo.

WAY CLEANSER CO., THE.—Sandusky, Ohio. Manufacturer of electric street sweepers.

WAYNE.—Trade name for bell-ringing transformers manufactured by the General Electric Co., Schenectady, N. Y.

WAYNE MFG. CO.—124 Sidney St., St. Louis, Mo. Manufacturer of electric washing machines. Business established 1900. President, George E. W. Luehrmann; vice-president, Guy Fulton; secretary and general manager, A. D. Luehrmann; treasurer, E. H. Luehrmann; sales manager, Norton Schuyler.

WAYNE OIL TANK & PUMP CO.—Fort Wayne, Ind. Manufacturer of oil burning, filtration, storage systems and pumps. Business established 1892. President, W. M. Griffin; vice-presidents, W. F. McGuire, H. C. Berghoff; B. F. Geyer; sec-

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ry, C. G. Guild; treasurer, E. A. Zern; ral manager, B. F. Geyer; sales man- E. J. Gallmeyer. Branch offices, ny, N. Y.; Alexandria, La.; Atlanta, Baltimore, Md.; Boston, Mass.; Buf- N. Y.; Chicago, Ill.; Cincinnati, Ohio; eland, Ohio; Columbus, Ohio; Dallas, Denver, Colo.; Detroit, Mich.; Grand ds, Mich.; Great Falls, Mont.; Indian- s, Ind.; Jackson, Miss.; Kansas City, Los Angeles, Cal.; Louisville, Ky.; phis, Tenn.; Minneapolis, Minn.; New ns, La.; New York, N. Y.; Oklahoma Okla.; Omaha, Neb.; Philadelphia, Pittsburgh, Pa.; Richmond, Va.; ester, N. Y.; Salt Lake City, Utah; Francisco, Cal.; Toledo, Ohio; Wash- n, D. C.

B. & E.—Trade name for electric fuges manufactured by Williams, n & Earle, Inc., 918 Chestnut St., lelphia, Pa.

B. G.—Trade name for fuse protec- for telegraph and telephone instru- manufactured by Foote, Pierson & Inc., 160-162 Duane St., New York,

D.—Trade name for insulating paint factured by the Dielectric Mfg. Co., uis, Mo.

AREVER.—Trade name for rubber ts manufactured by the Faultless r Co., Ashland, Ohio.

ATHERPROOF RECEPTACLES.—eceptacles, weatherproof.

ATHERPROOF SOCKETS.—See s, weatherproof.

ATHERPROOF WIRE.—See Wire, rproof; also Wire, slow-burning, rproof.

VER SPECIALTY CO.—6344 Aurelia ittsburgh, Pa. Manufacturer of g paste. Business established 1905. l manager, Carter Weaver.

B.—Trade name for electric fur- manufactured by the Webb Elec- rnace Corp., 30 Church St., New Y.

B BROS. BELTING CO.—Kansas o. Manufacturer of leather belting.

B ELECTRIC FURNACE CORP.—ch St., New York, N. Y. Manufac- f electric furnaces.

BING.—See Tape, cotton surgical y binding and webbing.

ER.—Sometimes 10^8 or one-hun- illion maxwells are used as the unit etic induction. This unit is called er.

ER.—Trade name for porcelain manufactured by the Weber Elec- Schenectady, N. Y. (Exclusive or, Henry D. Sears, 30 Boylston ton, Mass.

ER & MORGAN.—1336 Michigan icago, Ill. Manufacturers of auto- esters.

ER CHIMNEY CO., THE.—Chica- fanufacturer of reinforced concrete s and towers. President, Richard ; vice-president, Charles P. Wood- secretary and treasurer, Bernard er. Main office, 1452-56 McCor- g., Chicago, Ill. Branch offices, k, N. Y.; Philadelphia, Pa.; Pitts- .; Boston, Mass.; St. Louis, Mo.; City, Mo.; New Orleans, La.; Tex.; Minneapolis, Minn.; Salt y, Utah; Los Angeles, Cal.; Den- .; Seattle, Wash.; San Francisco, anta, Ga.; Portland, Ore.; Van- r. C.; Montreal, Que., Can.; Win- an., Can.

ER ELECTRIC CO.—Schenectady, fanufacturer of porcelain sockets. distributor, Henry D. Sears, 30 St., Boston, Mass.

T PER SQUARE CENTIMETER. onding to the unit weber for in- he weber per square centimeter nes used as the unit of flux den-

SHOW CASE & FIXTURE CO. ton St., Los Angeles, Cal. Man- of store showcases, etc.

ER.—Trade name for air condi- pparatus made by the Atmos- nditioning Corp., 920 Lafayette ladelphia, Pa.

ER.—Trade name for lamp guard red by the Hamblin & Russell Worcester, Mass.

ER.—Trade name for carriage ster and lamp guard manufac- tured by Frank W. Morse, 289 Congress St., Boston, Mass.

WEBSTER.—Trade name for feed water heater manufactured by Warren Webster & Co., Camden, N. J.

WEBSTER & CO., WARREN.—Camden, N. J. Manufacturers of feed water heaters, etc.

WEBSTER & PERKS TOOL CO., THE.—Center & Jefferson Sts., S. E., Springfield, Ohio. Manufacturer of grinding, polishing, threading and special tapping machinery. Business established 1892. President and general manager, H. Voges, Jr.; vice-president, F. G. Wacker; secretary and treasurer, H. A. Dieh; sales manager, P. A. Schaefer.

WEBSTER ELECTRIC CO.—Clark St. & De Koven Ave., Racine, Wis. Manufacturer of ignition outfits. Business established 1909. President, T. K. Webster; vice-president, B. V. Becker; secretary and treasurer, S. A. Loeb; general manager, E. A. Hawkins; sales manager, E. M. Ford.

WEBSTER MFG. CO.—Tiffin, Ohio. Manufacturer of elevating, conveying and power transmission machinery. President, F. F. Shaw; vice-president and general manager, H. T. Burton; secretary and treasurer, E. S. Clark. Main office and factory, Tiffin, Ohio. Branch offices, 90 West St., New York, N. Y.; 141 Milk St., Boston, Mass.; McCormick Bldg., Chicago, Ill.

WEDGES, ARMATURE.—See Pegs or wedges, armature slot.

WEED.—Trade name for chain-jack for automobiles, etc. manufactured by the American Chain Co., Bridgeport, Conn.

WEEHAWKEN TUNGSTEN LAMP CO.—Weehawken, N. J. Manufacturer of incandescent lamps.

WEEKS, NELSON.—214 State St., Brooklyn, N. Y. Manufacturer of lighting reflectors.

WEEKS MFG. CO., F. A.—93 John St., New York, N. Y. Manufacturer of telephone mouthpieces, etc.

WEEKS MFG. CO., H. G.—Hamilton, Ohio. Manufacturer of electric cooking and heating appliances. Business established 1916. H. G. Weeks, sole owner. Sales representative, Baker-Smith Co., Rialto Bldg., San Francisco, Cal.; Maritime Bldg., Seattle, Wash.

WE-FU-GO.—Trade name for water purification and softening apparatus manufactured by the William B. Scaife & Sons Co., Pittsburgh, Pa.

WEIGHING MACHINES, BOILER FEED WATER.—These are machines installed in the boiler-feed line to weigh automatically the water supplied to the boilers. They may operate to hold the water in a tank until it is full, when a tripping device closes the valve and weighs the contents, or a float switch is operated to close the valve and record the weight of the water in a container.

Manufacturer:

Tyler Underground Heating System, 855-857 Progress St., Pittsburgh, Pa. "Tylers."

WEIGHING MACHINES, ELECTRICALLY OPERATED OR CONTROLLED.—These are machines often used for weighing small amounts of chemicals, powders, salt, etc., at the time they are placed in boxes, cartons or bags. They are operated by an electric motor which drives the packages on a moving belt until they come under a spout. They are filled by the material in the spot, and when the proper amount is in the package the flow from the spout is stopped. This may be accomplished mechanically or by electrical means. The electrically operated machines are also used for other purposes, such as weighing products on moving belts, etc.

Manufacturers:

American Machinery Co., Inc., 330 N. 12th St., Philadelphia, Pa. "American."

Robins Conveying Belt Co., 13 Park Row, New York, N. Y.

WEIGHING MACHINES, MISCELLANEOUS.—These are weighing machines not electrically operated, used for various purposes in power plants and in connection with other electrical apparatus and manufacturing processes. For the power plants there are some types of coal weighing equipment, known as machines. These receive the coal from the storage bunkers and weigh it and record the weight automatically before the coal is spouted to the grates. Also see Scales, coal.

In the manufacturing industry, weighing machines are used for counting purposes in various places. They weigh material coming from a traveling conveyor, and the material is placed on another conveyor to go to its next operator. There are other miscellaneous uses also.

Manufacturers:

Electric Weighing Co., 180 13th Ave., New York, N. Y.

RELIANCE WEIGHING MACHINE DIVISION, STEARNS MOTOR MFG. CO., Ludington, Mich. "Reliance." (See display adv. page 1315.)

WEIGHT OF COAL.—Bituminous coal in solid lump form weighs from 70 to 80 lbs. per cu ft.; anthracite from 85 to 100 lbs. per cu. ft. When broken up into ordinary commercial sizes the weight is usually from 50 to 55 lbs. per cu. ft., for bituminous and from 53 to 58 for anthracite. These values are of interest in estimating the capacity of coal bunkers or the amount of coal in a pile or bunker. The values depend on the size of the lumps.

WEIGHTS, CORD, TELEPHONE SWITCHBOARD.—Telephone switchboard cord weights are used on manual type switchboards to pull the cord down automatically, so that when released from a jack the cord returns to its proper place with only the plug extending above the keyboard. The weights generally have a small grooved metal wheel either fixed or movable, with a guard so that when the cord is threaded through it will always run in the groove of the wheel. The side part of the guard extends down below the wheel, forming a flat rectangular box or container. This is filled with lead or some other heavy material. The weight is always hanging on the cord and tends to keep it so there is no slack above the keyshelf.

Manufacturer:

KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)

WEINMAN PUMP MFG. CO., THE.—270-280 Spruce St., Columbus, Ohio. Manufacturer of motor and steam-driven pumps. President and manager, W. N. Weinman; vice-president, P. W. Holstein; secretary, H. L. Bachman; treasurer, George A. Shontung.

WEIR FROG CO.—Cincinnati, Ohio. Manufacturer of electric railway, mine and industrial track work. Business established 1882. Main office, Station H, Cincinnati, Ohio. Branch offices, 809 Munsey Bldg., Washington, D. C.; Starks Bldg., Louisville, Ky.; 605 Taylor Ave., N., Pittsburgh, Pa.; 43 Cedar St., New York, N. Y.

WEIR TITAN.—Trade name for frogs and ties manufactured by the Weir Frog Co., Station H, Cincinnati, Ohio.

WELCH MFG. CO., W. M.—1516 Orleans St., Chicago, Ill. Manufacturer of laboratory supplies and electrical indicating instruments. Business established 1880. President, W. M. Welch; vice-president and general manager, C. M. Holmes.

WELD-A-CAST.—Trade name for welding flux manufactured by the Cortland Welding Compound Co., Cortland, N. Y.

WELDERS, ELECTRIC, ARC.—There are a number of arc welding outfits on the market. The differences are mostly in the design of the electrical apparatus and cannot be briefly described. The outfit for direct current consists of a motor-generator, dynamotor or balancer. This apparatus converts the source of supply to the proper voltage and current values for the operation of the arc. A control panel gives the necessary changes in current for the different degrees of work and in certain cases provides for sufficient current to employ the carbon arc for cutting. The a-c. outfit consists of a static transformer which serves the same purposes as the motor-generator or dynamotor in d-c. outfits. In this case connections are arranged so that current may be available for cutting purposes. Many of these outfits are made portable by being mounted on a truck.

Manufacturers:

Allan Mfg. & Welding Corp., 163 Adams St., Buffalo, N. Y.

AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio. "Automatic."

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Blaw-Knox Co., Farmer's Bank Bldg., Pittsburgh, Pa.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Electric Arc Cutting & Welding Co., 152-58 Jelliff Ave., Newark, N. J. "Alternarc."
Electric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. This company has developed arc welding equipment to meet almost every condition where it is possible to join metals by means of the electric arc. Described in Bulletin 48932A. The Constant Energy Generator Sets are primarily single operator units, designed for metallic electrode welding only, but may be used intermittently for carbon electrode welding provided the arc voltage does not exceed 35 volts, and the current does not exceed approximately 50 per cent of rating. The generator is so designed that it normally gives a no-load or "striking" voltage of 60 volts, which, when the arc is established, automatically decreases to the required arc voltage. This characteristic entails a great saving in energy and materially assists the operator in making a successful weld. Balancer sets of the constant energy type, suitable for operation only when direct current at a potential of 110 to 125 volts is available, are also designed with the same characteristics. The Constant Potential Sets are built in capacities of 400, 500 and 600 amp. at 60 volts, and 800, 1,000 and 1,250 amp. at 75 volts. One or more operator panels may be supplied with each equipment to meet the service requirements. The Resistor Type consists primarily of a resistance with suitable voltage and current taps, so that it may be connected directly to any d-c. circuit of a potential of 600 volts or less, and deliver the proper welding voltage. Designed primarily for use on electric railway lines, where it is not convenient or practicable to operate the more efficient welding generators. See "Welders, Automatic," for a description of the automatic type recently developed by this company. G-E welding accessories include electrode holders for metallic and carbon electrodes, extra flexible cable for attaching to electrode holders, face masks and head shields. See adv. pages 1203-1223.—Adv.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "Zeus."
Indianapolis Switch & Frog Co., Springfield, Ohio. "Indianapolis."
Lincoln Electric Co., The, E. 38th St. & Kelley Ave., Cleveland, Ohio.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.
Reliable Tractor & Engine Co., The, Portsmouth, Ohio. "Reliable."
Siemund Wenzel Electric Welding Co., 30 Church St., New York, N. Y. "Siemund-Wenzel."
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y. "Plastic-Arc."

WELDERS, ELECTRIC, AUTOMATIC.—Recently much experimental work has been accomplished in the production of machines which automatically weld by means of the metallic arc. These tools are manufactured in several types. One of these is stationary to which the pieces to be welded are fed; another is a portable hand tool resembling an air hammer. Many interesting characteristics of the electric arc differing from those found in manual welding have been observed in the development of these machines. The importance of this work will be recognized when it is considered that greater speed may be maintained, efficiency in the deposition of the electrode material may be controlled, and the results of finished work may be more consistent.

Manufacturers:

GENERAL ELECTRIC CO., Schenectady, N. Y. The G-E automatic arc welder will operate continuously for hours at a time and will make a more uniform, more successful and more rapid weld than can be made manually. It can be used on d-c. circuits only and may be operated from any G-E generator or from any constant potential d-c. source of power. Particularly adapted to building up worn or under-sized shafts, welding seams of tanks or tubes, and similar work. (Booklet B-3575.) For information on other G-E welding equipment see "Welders, Electric, Arc."—Adv.



G. E. Automatic Arc Welder

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WELDERS, ELECTRIC, BUTT.—This consists of a machine made with water-cooled clamping jaws which bring the two pieces to be joined under pressure. The clamps and the butting pieces close the secondary circuit of a transformer which is usually integral with the machine. As the two pieces are pressed together a burr is formed at the jointure which enables the operator to judge when the weld has been made.

Manufacturers:

Agnew Electric Welder Co., Milford, Mich.
Federal Machine & Welder Co., The, Dana Ave., Warren, Ohio. "Federal."
National Chain Co., 8th St. & 3rd Ave., College Point, N. Y.
Reliable Tractor & Engine Co., The, Portsmouth, Ohio. "Reliable."
Universal Electric Welding Co., 67 6th Ave., Long Island City, N. Y. (Special)
Winfield Electric Welding Machine Co., Warren, Ohio.

WELDERS, ELECTRIC, CHAIN.—This outfit is a modification of the butt welding set. The same electrical apparatus is employed and the interest lies chiefly in the ingenious mechanical design whereby rods are fed to the machine. By means of cams, eccentrics, time trips, etc., the links are heated, bent and then brought to the clamping jaws and welded. The whole process is automatic and the chain as an exceptionally high-quality finished article comes from the machine.

Manufacturer:

National Chain Co., 8th St. & 3rd Ave., College Point, N. Y.

WELDERS, ELECTRIC, PORTABLE.—Portable welding outfits are usually of the arc type and mounted with control panel and other electrical apparatus on a truck so that they may be readily brought close to the work to be done. Many of the combined electric welding and cutting outfits are also made portable. Track rail welders, see below, are always portably mounted on a car.

Manufacturers:

Allan Mfg. & Welding Corp., 163 Adams St., Buffalo, N. Y.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
BURKE ELECTRIC CO., 12th & Cranberry Sts., Erie, Pa.
Electric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
GENERAL ELECTRIC CO., Schenectady, N. Y. G-E arc welding sets are made both stationary and portable. For general description see "Welders, Electric Arc."—Adv.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "Zeus."
Indianapolis Switch & Frog Co., Springfield, Ohio. "Indianapolis."
Matthews Engineering Co., Sandusky, Ohio.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.
Reliable Tractor & Engine Co., The, Portsmouth, Ohio. "Reliable."
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)
Wilson Welder & Metals Co., Inc., 253 36th St., Brooklyn, N. Y. "Plastic-Arc."

WELDERS, ELECTRIC, RAIL.—Two methods are in use, one similar to butt welding and the other to arc welding. The former requires conversion of the 500 or so volts direct current of the trolley line to a suitable voltage (usually by means of a synchronous converter and stepdown transformer), and the latter requires a d-c. motor-generator for reducing the trolley voltage to the arc requirements. The apparatus for the former method must be sufficiently heavy to provide the necessary pressure on the clamping jaws. These outfits are usually mounted on a car. (Also see Welding, rail.)

Manufacturers:

Allan Mfg. & Welding Corp., 163 W. Adams St., Buffalo, N. Y.
AUTOMATIC ELECTRICAL DEVICES CO., 120-122 W. 3rd St., Cincinnati, Ohio.
Electric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
Indianapolis Switch & Frog Co., Springfield, Ohio. "Indianapolis."
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Railway Track-Work Co., 3132 E. Thompson St., Philadelphia, Pa.

WELDERS, ELECTRIC, SEAM.—This outfit is essentially like the butt and spot outfits, except that the current is carried to the material by rollers under pressure. These rollers pass along the seam, thus continuously producing a weld.

Manufacturers:

Agnew Electric Welder Co., Milford, Mich.
Allan Mfg. & Welding Corp., 163 W. Adams St., Buffalo, N. Y.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.

WELDERS, ELECTRIC, SPOT.—As the name implies, the pieces to be welded are brought to the machine and a row of spots made as if rivets were used. The apparatus, though changing in form for the size of work or material employed, consists of a transformer (or two) integral with the machine and a set of water-cooled copper electrodes. When these electrodes are brought upon the materials to be joined pressure is applied (usually compressed air). Alternating current is used for butt, spot and seam welding, as the requirements call for a low potential (about 2 volts) and a high current.

Manufacturers:

Agnew Electric Welder Co., Milford, Mich.
Automatic Controller & Mfg. Co., 246 Washington Ave., Ogden, Utah. "Universal."
Eveland Electric Riveter Co., 509 West End Trust Bldg., Philadelphia, Pa. "Eveland."
Federal Machine & Welder Co., The, Dana Ave., Warren, Ohio. "Federal."
Pacific Electric Welder & Mfg. Co., Renton, Wash.
Taylor Welder Co., The, Warren, Ohio.
Universal Electric Welding Co., 67 6th Ave., Long Island City, N. Y. (Special).
Winfield Electric Welding Machine Co., Warren, Ohio.

WELDING ALLOYS OR MIXTURES.—These are alloys and mixtures used to facilitate the welding of various materials. They are designed with such materials as to give a compound or alloy that will weld at a lower temperature than is ordinarily obtained. The material is used for such things as heating elements that have been burned out, and other broken metallic parts. These alloys are also used for a variety of heavy work, such as welding rails, shafting, broken castings, etc., or for making various welds where electrical power is not available or where it is not expedient to use it because of the small amount of welding to be done.

Manufacturers:

Carricite Co., The, 5436 Ferdinand St., Chicago, Ill. "Carricite."
Cortland Welding Compound Co., Cortland, N. Y. "Climax," "Cherry Heat," "Borax-ette," "Vulcan."

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Metal & Thermit Corp., 120 Broadway, New York, N. Y. "Thermit."

WELDING AND CUTTING OUTFITS, ELECTRIC.—These outfits are usually ortable arc welding sets provided with ng cables so that the arc may be used r cutting apart steel members in a col-osed building, bridge, stack or other ucture, for cutting scrap iron to lengths at can be easily fed into furnaces, or melting and cutting off small pieces metal etc. Since the same arc may used for welding, such outfits serve a al purpose and are very useful in many nts. They are required to have large pere capacity to cut the heavier metals.

Manufacturers:

ilan Mfg. & Welding Corp., 163 W. Adams St., Buffalo, N. Y.
lectric Arc Cutting & Welding Co., 152-58 Jelliff Ave., Newark, N. J. "Alternarc."
lectric Railway Improvement Co., The, 2070 E. 61st Place, Cleveland, Ohio.
ENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich. "Zeus."
dianapolis Switch & Frog Co., Springfield, Ohio. "Indianapolis."
iasl-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
eliable Tractor & Engine Co., The, Portsmouth, Ohio. "Reliable."
andard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
S. Light & Heat Corp., Niagara Falls, N. Y. "USL."
ESTINGHOUSE ELECTRIC & MFG. O., East Pittsburgh, Pa. (See display dv. pages 1395-1402.)
lson Welder & Metals Co., Inc., 253 6th St., Brooklyn, N. Y. "Plastic-Arc."

ELDING AND CUTTING OUTFITS, -ACETYLENE.—See Oxy-acetylene ng outfits.

ELDING CARBONS.—See Carbons, ng.

ELDING, ELECTRIC, REVIEW AND 'US OF.—Like all applied science, ic welding phenomena were first ved by the scientist. Curiously these cteristics of the electric current were rily utilized for other purposes, thus park caused by the breaking of the it finally developed into the arc lamp he intense heat produced by the ob-ion of the flow of current developed the incandescent lamp. From the tories of the physicist came the mental principles upon which the ce of electric welding is founded and fundamentals give two distinct to the processes now employed, resistance (spot, butt and seam) g and arc welding.

resistance method of welding oc- the attention of Elihu Thomson years ago and the outcome of his h brought into the industries the ary machinery for performing butt, nd seam welding.

he other hand, arc welding did not its development in the laboratory, as taken in hand by practical men plied to those industries where its ess was a source of profit. The e of the arc process was for repair in which field for certain classes k it has at present no competitor. lly from its development in the arc he carbon arc was first employed s found successful for the joining of nk steel (1/16 and 3/32 inch). For greater thickness a melt rod was l to give the additional metal with o effect the jointure. The carbon cess thus proved very convenient filling of large holes in steel cast-d the heating of large areas.

s but a step from the carbon arc metallic. A special composition electrode, was substituted for the f carbon and thus three points of y were gained, i. e., less current less area of heat, and the ment of the melt rod as the metal-rode furnished the added metal.

are metallic electrode process was ed about 1895, by a Russian named ff. A modification of this process, now used almost entirely in Eng-as brought forward several years Arthur Strohmenger, of London. dification consisted of a covering metallic electrode intended to the weld from oxidation. A slag med from the materials of the which, though molten during the process, hardened upon cooling and required to be chipped off after the deposited metal had cooled. Kjellberg, of Sweden, another investigator, used a special covering which formed a gas to prevent oxidation but which left no slag.

In the United States the covered-electrode processes were hardly known before the World War and the practice had settled into a confined adherence to the bare metallic electrode. All apparatus in this country with few exceptions will permit only the use of bare electrodes.

Principal Systems. Although there are many processes for the joining of the soft metals which in time may be applicable to heavy steel structures, today the consensus of opinion is that the resistance and arc methods are best for this latter purpose and hold out the best promise to new construction work of the future. Of these two methods it may also be stated that spot welding and metallic arc welding are the most easily applied to the shipbuilding and other industries having heavy steel members to join.

Of the modifications of these two processes much work of development is yet requisite to settle the vexed questions connected with the applicability to shipbuilding and other heavy service. However, the trend today is to a more extensive use of the metallic arc (either bare or covered) and spot welding in shop production. The development of heavy spot welding for ship fabrication was immensely advanced by the demonstrations made by the U. S. Shipping Board; Emergency Fleet Corp. in 1918-19, and the conclusions deduced from the results obtained confirm the belief that, with proper adjustments in shop production and further detail developments of the apparatus, it will produce remarkable savings in time, labor and money. Three heavy spot welding machines were designed and built for the purpose of this experiment and they functioned in so practical a manner that there can remain no doubt that with such apparatus heavy steel jointures may be safely made. The comparison of their performance with similar riveted joints indicates likewise a remarkable reduction in the weight of steel that is normally specified by ship classification societies today.

However, spot welding machines are large and expensive. They would only be applicable to the shop work in bridge and shipbuilding works. This process has not yet been considered possible for use in the actual putting together of the structures as is now done with rivets. These points turn the attention of the manufacturer towards arc welding. In this process the apparatus is not so expensive, the devices necessary for the local application of the arc are more in the nature of tools, being flexible, portable, and able to be brought into close quarters. Hence the arc process is now being vastly extended from the repair field to that of new construction and so far, though poor workmanship has retarded it, its success is being quietly admitted.

Application to Shipbuilding. In 1915 a partially electrically welded motor boat was launched at Ashtabula Harbor, Ohio. This boat was about 42 ft. long and was used in the severe service of a repair boat doing duty in the winter when ice conditions made such operations very serious for such craft. All reports have shown that the welded joints stood the abuse of service better than the riveted joints. In 1918 the British Admiralty built a cross-channel barge for the carriage of munitions which was electrically welded throughout. This experiment was for a comparison with similar riveted barges. The covered metallic arc process was used. A strict accounting was made as to the cost, labor, and saving. These items were all favorable to welding. Although there were a few leaks upon the first loading the barge has been reported as successful and satisfactory in every way. Towards the close of the war work was started in England on a 150-ft. coastal steamer. It is reported recently that, though work on this vessel had been delayed, it is now completed; no reports are at present available of its performance. Various attempts were made in the United States for the demonstration of an all-welded ship, but the plans as laid out were interrupted by signing of the armistice.

The progressive shipbuilders of this country used electric welding quite extensively during the war to hasten shop production and a number of shipbuilding companies are now adopting the process both in the fabricating shops and for the attachment of fittings. A good deal of time and labor is required in the angle smith shop of a shipyard to weld the angle bars in shape for attachment to the other members of the structure. Much economy of time and money is effected by cutting the angle bar and then joining the parts by means of metallic arc welding. The full advantages of electric welding cannot be obtained by applying it to the present design of steel ships, as this design requires a greater weight of steel and many pieces, due to the riveting methods. It remains therefore to either adopt the welding process for the saving on individual jobs, such as mentioned above, or to plunge into the general adoption of the process and design the ship to be electrically welded. That this can be done is admitted by Lloyd's Register of Shipping; this classification society has published rules and regulations for such procedure and will class such construction upon approval by it of the process to be used.

General Applications. In steel foundries electric arc welding is employed to correct the defects caused by sand spots, blow holes, and shrinkage cracks. Many similar repairs are found in manufacturing concerns using motor-operated tools, so that worn shafting, bolt holes, sliding cams, small tools, and many parts of large tools can be quickly repaired by this process. Steel mills are also adopting it for the repair of the wobblers in the rolling mill and to even the surfaces of the rolls.

In railroad repair shops the following partial list of jobs gives a rough idea of its extensive use: Repairing engine side rods, brake fulcrums, eccentric cranks, side frames, boiler flues, fire boxes, mud rings, engine crossheads, bumper beams, brake shoe heads, piston crossheads, motion frames, yokes, spokes of wheels, building up flanges on wheels, etc.

The saving of this method in railroad repairs is roughly estimated as 50 to 60%. The Chicago, Rock Island & Pacific Railway made special cost records when it introduced electric welding and two examples will show the nature of the saving in dollars: To repair wheel spokes by the old method costs $1276.80, by electric welding $85.08; filling worn spots by the old method $2677.80, by the electric arc $329.60.

Marine repairs have for a number of years been made with the electric arc, especially those connected with boilers, rudder posts, and small portions of the hull. In fact some marine engineers now insist upon electric welding for boiler repairs in preference to the older methods. Here should also be mentioned the remarkable repairs made through the use of the electric arc to the damaged interned German ships taken over by the U. S. Government upon entry into the war. This work was performed so expeditiously that it was completed in most cases prior to the other work on the ship.

In street railway equipment the building up of worn rails, worn parts of crossovers, worn down parts of armature shafts, repair of side frames of trucks, gear cases, etc., is done with the electric arc. Defects in forgings are corrected so that a good appearance is given to the finished article by depositing metal from the electrode. Arc welding has also been largely used in general boiler shops, and shipbuilders are now employing it in the manufacturer of marine boilers. The building of tanks, vats, tumbling barrels, wagon tanks, oil stills, etc., is the beginning of a long list of applications in manufacturing lines. The building of tanks for transformer cases for retaining the cooling oil has long been done by the carbon or metallic arc process and the fact that such cases have been in service for many years makes the advocates of the process secure in their belief in its satisfactoriness.

Cutting with the Arc. It is possible to cut steel with either the carbon or metallic arc. The manufacturers of apparatus do not always include the connection for this work, as the use of the electric arc for this purpose is limited. For the demolition of steel structures or the cutting of scrap iron for fitting pieces into the furnace it has its advantages, but for new construction work it does not permit of closely following a straight line, nor leaving a clear or workable edge on the materials cut.

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Future Prospects. Undoubtedly the future of electric welding is very favorable. Its use in the repair shops of some of the large railroads of this country has proven that for this class of work it is not only satisfactory and passes severe inspection, but as a national factor for the increased transport of freight in time of emergency it has helped solve an important economic problem. That is to say, by means of the electric arc, which may be readily taken to the machinery to be repaired, which does not require that other important parts be torn apart in order to do the work and which makes a firm and solid jointure in a short time, it is evident that more freight cars and more freight locomotives will be kept available. This useful service and the investigations only briefly referred to above, as well as the work now being performed in many of the shipyards, force the conclusion that the electric welding of heavy steel is a safe, sound and economical method.

From its application to shipbuilding the step is easy to the bridge and steel building industry. Recently a fairly large steel building has been joined entirely by the metallic arc process. At the present time there has come no adverse report regarding this operation. Certainly to those who know the safety factors that are employed in the calculations of ship design, the use of electric welding in shipbuilding assures it a place in all other industries dealing with like materials.

WELDING ELECTRODES.—See Electrodes, welding.

WELDING FLUX.—Welding flux is used to prevent the formation of oxide on the parts being welded. The compounds used for this purpose are often similar to those used when soldering or brazing. Borax is one of the best welding fluxes, but there are other special compounds and substitutes for borax that accomplish the result equally well.

Manufacturers:

Admiral Welding Machine Co., The, 413-415 E. 15th St., Kansas City, Mo. "Admiral."

ALLEN CO., INC., L. B., 4519-29 N. Lincoln St., Chicago, Ill. "Allen."

Anti-Borax Compound Co., Fort Wayne, Ind. "Anti-Borax," "E-Z," "Crescent."

Canadian National Carbon Co., Ltd., Hillcrest, Park, Toronto, Ont., Can.

Carbic Mfg. Co., Duluth, Minn. "Carbic."

Century Tool & Metal Co., 180 N. Market St., Chicago, Ill. "Delman."

Cortland Specialty Co., The, 176 Railroad St., Cortland, N. Y. "Banner."

Cortland Welding Compound Co., Cortland, N. Y. "Weld-a-Cast."

General Welding Co., 355-57 14th St., Hoboken, N. J. "Ideal."

Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."

International Oxygen Co., 796 Frelinghuysen Ave., Newark, N. J. "I. O. C. System."

Modern Engineering Co., 23rd & Walnut Sts., St. Louis, Mo. "Meco."

Phillips-Laffitte Co., The, Pennsylvania Bldg., Philadelphia, Pa. "Laffitte."

Prest-O-Lite Co., 533 N. Capital St., Indianapolis, Ind.

Prest-O-Lite Co., of Canada, Ltd., Hillcrest Park, Toronto, Ont., Can.

Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.

Standard Gas Products Co., 216 Ivy St., Atlanta, Ga.

WELDING GENERATORS.—See Generators, welding.

WELDING MACHINES, ELECTRIC.—See Welders, electric. (8 types).

WELDING PENCILS AND RODS.—See Electrodes, welding.

WELDING, RAIL.—The joints of electric railway tracks are frequently welded, especially where the tracks are located in paved streets. This not only improves the running surface and reduces the maintenance work but also increases the electrical conductivity of the rails and does away with bonding, which is an important factor where the rail is used as a part of the return circuit. Track joint welds may be divided into two general classes; those in which the weld is made by means of an electric current and those in which the weld is made by means of molten metal. Electric welds are usually made by welding plates to the web of the rail, either by passing a strong electric current through the plates and rail until an intense heat is generated and then applying great pressure to the heated parts, or by means of the electric arc. In the latter case the plates are welded to the rail web by depositing metal along the edges of the plates by means of the arc. In the case of welds made with molten metal a mold is first placed around the joint and then the molten metal poured into the mold. This molten metal may be obtained from a portable cupola or by means of the thermit process.

WELDING RECEPTACLES.—See Receptacles, welding.

WELDING TRANSFORMERS.—See Transformers, welding.

WELDING WIRE.—See Wire, welding.

WELDOGRAPH.—Trade name for oxyacetylene welding machines manufactured by the Davis-Bournonville Co., Jersey City, N. J.

WELDTRODE.—Trade name for arc welding electrode manufactured by the Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.

WELLER, S. A.—Zanesville, Ohio. Manufacturer of pottery lamp bases.

WELLER MADE.—Trade name for elevating, conveying and power-transmitting machinery manufactured by the Weller Mfg. Co., 1820 N. Kostner Ave., Chicago, Ill.

WELLER MFG. CO.—Chicago, Ill. Manufacturer of elevating, conveying and power-transmitting machinery. Business established 1886. President and treasurer, F. J. Weller; vice-president and sales manager, W. H. Kent; secretary, A. L. Weller; general manager, L. A. Dalton. Main office and factory, 1820-1856 N. Kostner Ave., Chicago, Ill. Branch offices, New York, N. Y.; Boston, Mass.; Baltimore, Md.; Pittsburgh, Pa.; San Francisco, Calif.; Salt Lake City, Utah. Sales representatives, F. J. Conrad, 219 2nd Ave., West Cedar Rapids, Iowa; A. F. Miller, 304 2nd St., Jackson, Mich.; P. W. Alling, Citizens Bldg., Cleveland, Ohio; C. M. McFarland, 711½ Main St., Dallas, Tex.; Charles F. Walther, Dime Bank Bldg., Detroit, Mich.

WELLINGTON GLASS CO.—Cumberland, Md. Manufacturer of illuminating glassware.

WELLMAN-SEAVER-MORGAN CO., THE.—Cleveland, Ohio. Manufacturer of water wheels, electric mining, coke-drawing, rubber working, furnace charging machines, cranes, hoists, etc. Business established 1855. President and general manager, E. S. Church; vice-presidents, S. H. Fitkin, George W. Burrell; secretary and treasurer, W. H. Cowell; sales manager, H. P. Glidden. Main office, 7000 Central Ave., Cleveland, Ohio. Factories, Cleveland and Akron, Ohio. Branch offices, 522 5th Ave., New York, N. Y.; 1237 Race St., Denver, Colo.; 302 American Trust Bldg., Birmingham, Ala.; Rialto Bldg., San Francisco, Cal.

WELLS.—Trade name for motor-starting switches manufactured by the Wells-Morris Mfg. Co., 90 2nd St., San Francisco, Cal.

WELLS-MORRIS MFG. CO.—90 2nd St., San Francisco, Cal. Manufacturer of motor-starting switches. G. F. Wells, manager.

WELLS, RAILWAY SIGNAL BATTERY.—These are wells used to contain the batteries used in railroad signaling. Large concrete wells, resembling a huge jar, are sometimes used for the purpose. They are often installed at the base of signal bridges, or other important semaphore signals, or along the track to supply current to each block or section.

WENDNAGEL & CO.—660 W. 22nd St., Chicago, Ill. Manufacturer of tanks for power plants. Partnership, William Wendnagel and Eugene Wendnagel.

WENZELMAN MFG. CO.—Galesburg, Ill. Manufacturer of electric washing machines.

WESCHE ELECTRIC CO., B. A.—1622-28 Vine St., Cincinnati, Ohio. Manufacturer of motors.

WESCO.—Trade name for farm lighting plants manufactured by the Western Cable & Light Co., Baldwin, Wis.

WESEL MFG. CO., F.—70 Cranberry St., Brooklyn, N. Y. Manufacturer of motor-driven printing presses.

WESIX.—Trade name for electric heating appliances manufactured by W. Wesley Hicks, 660 Market St., San Francisco, Cal.

WESRAD.—Trade name for radio instruments manufactured by the Western Radio Electric Co., 550 S. Flower St., Los Angeles, Cal.

WEST PENN STEEL CO.—Brackenridge, Pa. Manufacturer of sheet steel for electrical purposes. President and general manager, Julian Burdick; vice-president, John McGinley; secretary, W. W. Ford; treasurer, J. E. Ober; sales manager, G. R. Fink. Main office and factory, Brackenridge, Pa. Branch offices, 501 5th Ave., New York, N. Y.; 1263 Peoples Gas Bldg., Chicago, Ill.; 2212 Dime Bank Bldg., Detroit, Mich.

WEST POINT BOILER & TANK WORKS.—23rd & Smallman Sts., Pittsburgh, Pa. Manufacturers of oxyacetylene welding outfits, etc.

WEST VIRGINIA-KENTUCKY ASSOCIATION OF MINE, MECHANICAL AND ELECTRICAL ENGINEERS.—Organized 1921. President, J. H. Edwards; secretary and treasurer, Herbert Smith, Huntington, W. Va.

WESTERN.—Trade name for lighting reflectors manufactured by the Western Reflector Co., 1221 W. Madison St., Chicago, Ill.

WESTERN APPLIANCE MFG. CO.—1405 L. C. Smith Bldg., Seattle, Wash. Manufacturer of electric ironing machines. President, C. N. Biggs; vice-president, T. H. Vanasse; secretary, C. M. Mercer.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.—Organized in 1905. The membership includes representatives of the principal electrical inspection departments operating in central western districts of the United States. Approximately one-half of the members are municipal inspectors, the other half represent underwriters' bureaus. A few members from outside the local territory of the organization have been taken in because of the absence of similar associations in other parts of the United States and Canada. Membership is of two classes, active and associate. Officers for 1921-22 are: President, James H. Fenton; first vice-president, O. M. Frykman; second vice-president, F. O. Everts; secretary-treasurer, William S. Boyd, 175 W. Jackson Blvd., Chicago, Ill. These officers with five other members constitute the Executive Committee.

The objects of the Association are to improve the methods of controlling the electrical hazard, to obtain and circulate information on the subject, to establish a more efficient and uniform practice in supervising the installation and maintenance of electrical wiring and apparatus through the active co-operation of those engaged in the work. Most of the activities of the Association center in the work of 22 standing committees, appointed to investigate and report upon various matters of interest to the members. General meetings are held once a year, usually during the last week in January.

The principal achievements of the Association are: Helped to establish uniformity in the interpretation of the National Electrical Code; promoted ordinances creating conduit wiring districts in most of the larger cities in the central western United States; developed a rational motor wiring table which has been almost universally adopted; initiated the work of preparing special rules for theater wiring; improved the regulation of electric signs; stimulated co-operation between electrical inspectors and electrical contractors, public service companies and electrical manufacturers; enlisted the co-operation of architects in the preparation of a list of details comprising specifications for building wiring; reduced the electrical hazard in show windows to a minimum through co-operation with display men and window trimmers; broadened the view of the electrical inspector, stabilizing his work. The Association has also given its member a better understanding of the problems involved in joint construction of pole lines, the grounding of transformer secondaries, eliminated substandard rubber-covered wire from the Middle West, focused attention on public safety, improved the manner of handling elevator wiring and equipment, and helped to foster harmony in the electrical industry in the Middle West.

WESTERN CABLE & LIGHT CO.—Baldwin, Wis. Manufacturer of farm light-

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ig plants, storage batteries, lightning conducting cables, etc.

WESTERN COIL & ELECTRICAL CO. -300 5th St., Racine, Wis. Manufacturer f electrotherapeutic apparatus. Business stablished 1916. President and general anager, John Wiechers; vice-president, r. Ralph E. Rugh; secretary and treaser, W. Turnor Lewis. Sales representive, Charles O. Nelson, 347 Madison Ave., ew York, N. Y.

WESTERN ELECTRIC CO., INC.—New ork, N. Y. Manufacturer of lightning resters, cables, switchboards, switches. ansmitters, selective calling systems and her telephone equipment. Business estabhed 1870. President, G. D. DuBois; e-presidents, H. A. Halligan, W. P. lley, A. L. Salt, H. F. Albright; secrey, G. C. Pratt; treasurer, J. W. John n; general sales manager, F. A. tcham. Main office, 195 Broadway, New rk, N. Y. Factory, Hawthorne, Ill. anch offices and warehouses, Providence, I.; Buffalo, N. Y.; Newark, N. J.; New ven, Conn.; Syracuse, N. Y.; Brooklyn, Y.; Baltimore, Md.; Youngstown, Ohio; rfolk, Va.; Charlotte, N. C.; Savannah, ; New Orleans, La.; Birmingham, Ala.; ksonville, Fla.; Indianapolis, Ind.; nd Rapids, Mich.; Milwaukee, Wis.; roit, Mich.; Nashville, Tenn.; Columbus, o; Duluth, Minn.; St. Paul, Minn.; nphis, Tenn.; Oklahoma City, Okla.; iston, Tex.; Salt Lake City, Utah; Oak l, Cal.; Portland, Ore.; Spokane, Wash.; oma, Wash. District offices, Boston, s.; Philadelphia, Pa.; Pittsburgh, Pa.; mond, Va.; Atlanta, Ga.; Chicago, Ill.; eland, Ohio; Cincinnati, Ohio; Omaha, .; Minneapolis, Minn.; St. Louis, Mo.; sas City, Mo.; Dallas, Tex.; Denver, .; San Francisco, Cal.; Los Angeles. ; Seattle, Wash.

ESTERN ELECTRIC WORKS.—21? St., Portland, Ore. Manufacturer of ches, switchboards, panelboards and ch and cutout boxes. Business estabd 1900. Copartnership, W. O. Fouch E. M. Fouch.

ESTERN ELECTRO-MECHANICAL INC.—465 2nd St., Oakland, Cal. ufacturer of battery testers.

ESTERN FIRE APPLIANCE CO.—Market St., San Francisco, Cal. Manurer of fire extinguishers.

ESTERN IRON & FOUNDRY CO.—ita, Kans. Manufacturer of motor- n bar shears. President, J. F. War- vice-president, F. J. Anthony; sec- and treasurer, J. Q. Warren; man- Henry Anthony.

STERN LUMBER & POLE CO.—709 n Bldg., Spokane, Wash. Producer lar poles and posts. President, W. avitt; secretary, G. A. Clark.

STERN MACHINERY CO.—Los An- Cal. Manufacturer of gas and oil s. Main office and factory, 900 N. St., Los Angeles, Cal. Branch of- San Francisco, Cal.; Bakersfield, Tucson, Ariz.; Phoenix, Ariz.; Casa e, Ariz.

TERN METAL MFG. CO.—El Paso, Manufacturer of metal flumes for purposes. President, F. W. Sew- ecretary and treasurer, C. L. Greg-

TERN PUMP CO.—Moline, Ill acturer of electric pumps. Factory, ort, Iowa.

TERN RADIO ELECTRIC CO.—Flower St., Los Angeles, Cal. Manu- of radio instruments. Business hed 1919. President, H. J. New- neral manager, L. E. Taufenback.

TERN REFLECTOR CO.—1221 W. St., Chicago, Ill. Manufacturer of reflectors and electric signs. Co- hip, William A. Maher and F. M

TERN SAFETY MFG. CO.—247 t., San Francisco, Cal. Manufac- switches, switchboards, panel- switch and cutout boxes. Presi- Rieker; vice-president, L. M. ; secretary, treasurer and general C. F. Parker; sales manager, A .

ERN SCREW PRODUCTS CO.—Broadway, St. Louis, Mo. Manu- of gears, screws and metal stamp- usiness established 1911. Presihn T. Soy; vice-president, Ferl Warner; secretary and treasurer, J. B. Miller.

WESTERN SOCIETY OF ENGINEERS.—One of the oldest engineering societies in the United States, having been organized in Chicago in 1869. It has a membership of over 2500, comprising engineers in all branches of the profession, of which a considerable number are electrical engineers. One to three or more meetings are held weekly (except during the summer) by the Society or its several sections Two of the most active sections are the Electrical Section and the Telephone, Telegraph and Radio Section. The Society concerns itself chiefly with the technical advancement of its members and also with the promotion of engineering in general; one of its most active committees is the Public Affairs Committee, which studies and reports on all public matters of an engineering character. The executive officers of the Society for 1921-22 are: President, Charles H. MacDowell; first vice-president, J. L. Hecht; second vice-president, Frank F. Fowle; third vice-president, W. B. Shapiro; treasurer, Homer E. Niesz; secretary, E. S. Nethercut. The Society maintains headquarters at 1735 Monadnock Block, 53 W. Jackson Blvd., Chicago, Ill. Its library and reading room, as well as all regular meetings are open to the public.

WESTERN TOOL & MFG. CO., THE.—Springfield, Ohio. Manufacturer of spanner wrenches, vises and other tools. President, O. H. Hyde; vice-president and treasurer, Henry Morris; secretary, J. W. Themayne.

WESTERN UNION.—Trade name for pole hole shovels manufactured by Paul W. Herbst, 180 N. Dearborn St., Chicago, Ill.

WESTINGHOUSE, GEORGE.—An American inventor and manufacturer, born at Central Bridge, N. Y., 1846, and died in New York City, 1914. He entered the machine shop of his father, a manufacturer of agricultural implements, and at the age of 15 designed a rotary engine. He served in the Union Army in 1863-64, and in 1864-65 was assistant engineer in the United States Navy, after which he studied at Union College for two years. His first invention was a railroad frog, in 1865. In 1868 he introduced the Westinghouse air-brake, which has since been developed to a remarkable degree of efficiency. It is generally acknowledged to be one of the most important safety devices applied in railroading. In 1883, Mr. Westinghouse patented a system of railway signaling. The Westinghouse Electric Co. was organized in 1886 and this grew into the Westinghouse Electric & Mfg. Co. in 1891. This company is one of the largest electrical manufacturers in the world. The importance of its developments in electrical machinery and appliances, the wide extent of its activities and the high standard of its products are due very largely to the extraordinary organizing ability of Mr. Westinghouse and his prophetic appreciation of the importance of electrical developments.

WESTINGHOUSE ELECTRIC & MFG. CO.—East Pittsburgh, Pa. Manufacturer of motors, generators, electrical indicating and recording instruments, control apparatus, high-tension protective and switching equipment; cooking, heating and labor-saving appliances; street and industrial lighting equipment; lightning arresters; pole-line hardware; wiring devices; farm lighting plants; fans; locomotives; insulators; pumps and other electrical equipment. Business established 1886. President, E. M. Herr; vice-presidents, L. A. Osborne, H. P. Davis, C. A. Terry, H. D. Shute, Walter Cary, H. T. Herr; secretary, James C. Bennett; treasurer, H. F. Roeetz; vice-president in charge of operations, H. P. Davis; vice-president in charge of sales, H. D. Shute. Main office, East Pittsburgh, Pa. Factories, Newark, N. J.; Mansfield, Ohio; East Pittsburgh, Pittsburgh, Derry and South Philadelphia, Pa.; South Bend, Ind. Branch offices and warehouses, Candler Bldg., Atlanta, Ga.; 121 E. Baltimore St., Baltimore, Md.; Rice Bldg., Boston, Mass.; Ellicott Square Bldg., Buffalo, N. Y.; 52 E. Broadway, Butte, Mont.; Kanawha National Bank Bldg., Charleston, W. Va.; Commercial Bank Bldg., Charlotte, N. C.; Conway Bldg., Chicago, Ill.; Traction Bldg., Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Exchange Bldg., Dallas, Tex.; Gas and Electric Bldg., Denver, Colo.; Dime Savings Bank Bldg., Detroit, Mich.; Mills Bldg., El Paso, Tex.; Union Nat'l Bank Bldg., Houston, Tex.; Crear-Leshe Bldg., Kansas City, Mo.; I. N. Van Nuys Bldg., Los Angeles, Cal.; Maison Blanche Bldg., New Orleans, La.; City Investing Bldg., New York, N. Y.; Widener Bldg., Philadelphia, Pa.; Union Bank Bldg., Pittsburgh, Pa.; 300 N. Broadway, St. Louis, Mo.; Walker Bank Bldg., Salt Lake City, Utah; 1st National Bank Bldg., San Francisco, Cal.; Alaska Bldg., Seattle, Wash.; 3rd & Elm Sts., Cincinnati, Ohio. District offices, Brown-Marx Bldg., Birmingham, Ala.; Bluefield, W. Va.; Riebold Bldg., Dayton, Ohio; 608 Securities Bldg., Des Moines, Iowa; Alworth Bldg., Duluth, Minn.; Traction Terminal Bldg., Indianapolis, Ind.; Union Terminal Warehouse, Jacksonville, Fla.; Miner's Bank Bldg., Joplin, Mo.; Paul Jones Bldg., Louisville, Ky.; Exchange Bldg., Memphis, Tenn.; 1st National Bank Bldg., Milwaukee, Wis.; Metropolitan Life Insurance Bldg., Minneapolis, Minn.; Northwestern Bank Bldg., Portland, Ore.; Chamber of Commerce Bldg., Rochester, N. Y.; University Bldg., Syracuse, N. Y., Immigration Bldg., Tucson, Ariz.; Ohio Bldg., Toledo, Ohio; Hibbs Bldg., Washington, D. C.; Miner's Bank Bldg., Wilkes-Barre, Pa.

WESTINGHOUSE LAMP CO.—New York, N. Y. Manufacturer of lamps. President, E. M. Herr; vice-president, Walter Cary; secretary, J. C. Bennett; treasurer, T. J. Illing; general manager, T. G. Whaling; sales manager, Elliot Reid. Main office, 165 Broadway, New York, N. Y.. Factories, Middletown, Conn.; New York, N. Y.; Brooklyn, N. Y.. Bloomfield, N. J.; Milwaukee, Wis.; Trenton, N. J. Branch offices carrying stock. Candler Bldg., Atlanta, Ga.; 136 Federal St., Boston, Mass.; Conway Bdg., Chicago, Ill.; 510 W. 23rd St., New York, N. Y.; Alaska Bldg., Seattle, Wash.; Traction Bldg., Cincinnati, Ohio; Swetland Bldg., Cleveland, Ohio; Cotton Exchange Bldg., Dallas, Tex.; Widener Bldg., Philadelphia, Pa.; 708 Keith Bldg., Syracuse, N. Y.; Gas and Electric Bldg., Denver, Colo.; Dime Savings Bank Bldg., Detroit, Mich.; 1012 Baltimore Ave., Kansas City, Mo; 801 Van Nuys Bldg., Los Angeles, Cal.; Union National Bank Bldg., Pittsburgh, Pa.; Boatmen's Bank Bldg., St. Louis, Mo.; Metropolitan Life Bldg., Minneapolis, Minn.; 1st National Bank Bldg., San Francisco, Cal.; 833 Maison Blanche Bldg. New Orleans, La. District offices, Ellicott Sq., Buffalo, N. Y.; Traction Terminal Bldg., Columbus, Ohio; Exchange Bldg., Memphis, Tenn.; Majestic Bldg., Milwaukee, Wis.; 331 Southern Bldg., Washington, D. C.

WESTINGHOUSE TRACTION BRAKE CO.—Pittsburgh, Pa. Manufacturer of motor-driven air compressors, brakes, whistles, air compressor controllers, adjusters, governors, etc. Business established 1901. President, A. L. Humphrey; vice-presidents, W. S. Bartholomew and C. A. Rowan; secretary, H. C. Tener; treasurer, S. C. McConahey; general manager, G. W. Wildin; sales manager, W. S. Bartholomew. Main office, Pittsburgh, Pa. Factories, Wilmerding, Pa., and Milwaukee, Wis. Branch offices, 165 Broadway, New York, N. Y.; 522 Munsey Bldg., Washington, D. C.; 200 Westinghouse Bldg., Pittsburgh, Pa.; 827 Railway Exchange Bldg., Chicago, Ill.; 634 Endicott Bldg., St. Paul, Minn.; 702 Tramway Bldg., Denver, Colo.; 709 McIntyre Bldg., Salt Lake City, Utah; 40 Columbian Bldg., 112-14 6th St., Topeka, Kans.; 818 Columbus Savings & Trust Bldg., Columbus, Ohio; 1407 Boatmen's Bank Bldg., St. Louis, Mo.; 4808 Main St., Houston, Tex.; 220 Southern Pacific Bldg., San Francisco, Cal.; Securities Bldg., Seattle, Wash.; Pacific Electric Bldg., Los Angeles, Cal.

WESTINGHOUSE UNION BATTERY CO.—Swissvale, Pa. Manufacturer of batteries for automotive ignition, lighting and starting, house lighting, car lighting and signal installations. Business established 1920. President, D. F. Crawford; vice-president and general manager, T. R. Cook; secretary and treasurer, T. S. Grubbs; sales manager, T. A. Guild.

WESTON CELL.—See Standard cells.

WESTON, EDWARD.—An American electrical engineer, inventor and manufacturer, born in London, England, 1850. After studying medicine in England, he came to the United States in 1870 and became chemist to a nickel-plating company. He improved the process of nickel-

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plating, made investigations in electricity, and in 1875 established at Newark, N. J., the first factory devoted exclusively to the manufacture of dynamo-electric machines. He made particular study of incandescent and arc electric lighting and patented many devices for both systems, notably an improved carbon filament for incandescent lamps, and a system of high power incandescent lamps. In 1888 Dr. Weston formed the Weston Electrical Instrument Co., of which he has been president to date; this company was one of the first manufacturers in this line and has remained one of the leading ones. Among his inventions are an extensive series of improved instruments for electrical measurements which have attained international reputation for accuracy and general efficiency, also the Weston standard cell which is used as a standard of electromotive force. Dr. Weston was one of the founders of the American Institute of Electrical Engineers of which he was president in 1888.

WESTON ELECTRICAL INSTRUMENT CO.—Waverly Park, Newark, N. J. Manufacturer of electrical instruments. Business established 1888. President, Edward Weston; vice-presidents, John R. Hardin, Edward F. Weston; secretary and sales manager, Caxton Brown; treasurer, W. H. Yawger; general manager, Edward F. Weston.

WET BATTERIES.—See Batteries, primary, wet, closed-circuit; Batteries, primary, wet, open-circuit.

WET BATTERY OR WET CELL.—The original type of primary battery. See Batteries, also Batteries, wet.

WET GALVANIZING.—See Electrogalvanizing.

WETZLER, S.—34 Union Sq., New York. N. Y. Manufacturer of adjustable lighting fixtures.

WEYERHAEUSER SALES CO.—Sandpoint, Idaho. Producer of cedar poles and posts. L. S. Case, general manager. Main office, Sandpoint, Idaho. Branch offices, Spokane, Wash.; Denver, Colo.; St. Paul, Minn.; Chicago, Ill.

WHALE BRAND.—Trade name for angle and globe valves manufactured by the New Bedford Valve Mfg. Co., New Bedford, Mass.

WHALEY & CO., J. A.—118 5th Ave., New York, N. Y. Manufacturers of portable electric lamps, lamp shades, etc.

WHARTON, JR., & CO., INC., WILLIAM.—Easton, Pa. Manufacturers of special track work for electric and steam railroads.

WHEAT.—Trade name for electric mine lamp manufactured by the Koehler Mfg. Co., Marlboro, Mass.

WHEATSTONE BRIDGES.—See Bridges, Wheatstone, laboratory standard; Bridges, Wheatstone, portable.

WHEEL GUARDS, CAR.—See Guards, steel, street car.

WHEEL GUARDS, TROLLEY.—See Guards, trolley.

WHEEL PIT.—The chamber in which a water wheel is set in a water-power plant. Suitable gates are provided to separate it from the headrace to which it is normally connected by means of the penstock.

WHEEL PRESSES.—See Presses, car wheel, hydraulic.

WHEEL-TILT.—Trade name for automobile locks manufactured by the Warner Electric Co., Muncie, Ind.

WHEEL TRUING BRAKE SHOE CO., THE.—219 Tuxedo Ave., Detroit, Mich. Manufacturer of brake shoes. President and general manager, J. M. Griffin.

WHEELER, SCHUYLER SKAATS.—An American inventor, electrical engineer and manufacturer, born at New York, 1860. He was educated at Friends Seminary, Keble Hall, and Columbia College. He left college in 1881 to become assistant electrician for the Jablochkoff Electric Light Co. In 1883 he joined the United States Electric Light Co., but soon after left it to become one of Edison's engineering staff in charge of the work at the first station, 1882, when the incandescent light was first introduced. Dr. Wheeler contributed many of the controlling mechanical and electrical devices adopted. Later he erected the station apparatus at Fall River, Mass., and Newburgh, N. Y., where he was stationed as superintendent of the Newburgh Edison Co. He then became electrician of the Herzog Teleseme Co., and in 1886 was appointed electrician and manager of the C. & C. Electric Motor Co., the first concern established for the regular manufacture of electric motors. In 1888 he and Professor Crocker organized the firm of Crocker & Wheeler, which was shortly incorporated as the Crocker-Wheeler Motor Co. of New York, and eventually as the Crocker-Wheeler Co., Ampere, N. J., of which he has been president since 1889. Dr. Wheeler has been prominent in the development of the electric motor and especially in the direct application of motors to driving tools. He was appointed electrical expert of the Board of Electrical Control of New York from 1888 to 1895. He invented numerous electrical and mechanical devices, such as the electric elevator, electric fire engine, series-multiple motor control, paralleling of dynamos, etc. He received the John Scott medal of the Franklin Institute in 1904 for the invention of the electric fan in 1886. In 1900 he purchased in London and brought to this country the Latimer Clark Library, the largest collection of rare electrical books in existence, and presented it to the American Institute of Electrical Engineers, forming the foundation of its library in the United Engineering Societies Bldg., New York City. He was president of the A. I. E. E. in 1905-06 and was the author of the code of professional ethics for engineers adopted by the A. I. E. E. in 1912.

WHEELER-BALCKE.—Trade name for wood cooling towers manufactured by the Wheeler Condenser & Engineering Co., Carteret, N. J.

WHEELER-BARNARD.—Trade name for steel cooling towers manufactured by the Wheeler Condenser & Engineering Co., Carteret, N. J.

WHEELER CONDENSER & ENGINEERING CO.—Carteret, N. J. Manufacturer of condensing and vacuum equipment for power plants. Business established 1891. President and general manager, J. J. Brown; vice-president and sales manager, H. S. Brown; secretary, A. W. P. Kramer; treasurer, Thomas Bostock. Main office and factory, Carteret, N. J. Branch offices, Singer Bldg., New York, N. Y.; 1st National Bank Bldg., Chicago, Ill.; 141 Milk St., Boston, Mass.; 1310 Land Title Bldg., Philadelphia, Pa.; 1336 Oliver Bldg., Pittsburgh, Pa.; 1251 Pierce Bldg., St. Louis, Mo.; 901 4th National Bank Bldg., Cincinnati, Ohio; 1718 California St., Denver, Colo.; Sheldon Bldg., San Francisco, Cal.; 313 Atlas Block Bldg., Salt Lake City, Utah; Van Nuys Bldg., Los Angeles, Cal.; Mutual Life Bldg., Seattle, Wash.; 406 Commercial Bank Bldg., Charlotte, N. C.; 1101 Henney Bldg., New Orleans, La.; 3rd National Bank Bldg., Atlanta, Ga.

WHEELER MFG. CO., C. H.—Philadelphia, Pa. Manufacturer of electric vacuum pumps, feed water heaters, condensers, etc. Main office, Lehigh & Sedgley Aves., Philadelphia, Pa. Branch offices, New York, N. Y.; Boston, Mass.; Chicago, Ill.; Pittsburgh, Pa.; Cleveland, Ohio; Charlotte, N. C.; New Orleans, La.; San Francisco, Cal.; Seattle, Wash.

WHEELER REFLECTOR CO.—159 Pearl St., Boston, Mass. Manufacturer of reflectors and street lighting fixtures. Business established 1881. President, H. C. Hawks; treasurer, Russell Burrage. Factory, Burrage, Mass.

WHEELING TILE CO.—Wheeling, W. Va. Manufacturer of electrical porcelain. President, Samuel O. Laughlin; vice-president, C. R. Hubbard; secretary and treasurer, J. B. Youngson.

WHEELS, BUFFING.—Buffing wheels are wheels supplied for attaching to a motor shaft, thus making an electric buffer. They are used largely by electroplaters for buffing and finishing after plating. Buffing wheels usually are made of buff leather, muslin, canvas, or other fabrics and consist of a large number of layers glued and tightly clamped together between end plates so that the edges of these disks are used for the buffing; the clamped set of disks is called a buff and is ready to be mounted on a spindle or mandrel. Buffing wheels are also extensively used for belt drive from a line shaft, such as in group drive by a motor. For self-contained electric buffers, see Buffers, electric.

Manufacturers:

Bennett-O'Connell Co., 3600 S. Morgan St., Chicago, Ill.

Buettner Co., The Charles H., 1924-1926 W. 8th St., Cincinnati, Ohio.

Burns Supply Co., E. Reed, 21-27 Jackson St., Brooklyn, N. Y.

Canadian Hanson & Van Winkle Co., Ltd., The, Toronto, Ont., Can.

Divine Bros. Co., Utica, N. Y.

Hanson & Van Winkle, Newark, N. J.

Munning & Co., A. P., Church St., Matawan, N. J. "Invincible," "Premier," "Red E," "Triplex," "Victory."

WHEELS, CABLE REEL.—These are very large wheels, generally 6 ft. high, designed to hold any size cable reel used in overhead or underground line construction. The wheels are provided with a reel bar or axle, which is placed through the cable reel, and also an adjustable tongue for drawing. They assist materially in handling heavy and bulky cable reels.

Manufacturers:

Brooklen Underground Electrical Mfg. Co., Glenside, Pa. "Bee Line."

HALLETT IRON WORKS, Harvey, Ill. "Hallett." (See display adv. page 1254.)

WHEELS, ELECTRIC RAILWAY CAR AND LOCOMOTIVE.—Metal wheels may be forged or cast in one piece or have fixed centers and removable wearing rims or tires. They are further classified as spoke wheels or plate wheels, the former being cast with spokes and the latter having a solid plate or disk connecting the hub and outer rim or tire. Railway wheels have a radially projecting rim of metal along one edge of the tire or tread which is called the flange. The flanges are on the inside faces of the tires and serve to prevent the wheels running off the rails. The tread, or portion of the wheel bearing on the track rails, is tapered so that the tendency is for the flanges of the wheels in rolling along to remain as far as possible from the sides of the rail heads and thus prevent side lash and excessive wear. Wheels are forged in one piece from slabs of rolled steel, cast in one piece from cast iron or cast steel, or have hub and spokes with inner rim cast in one piece and fitted with an outer wearing rim or tire. Wheels are also made consisting of cast hub, double steel plates for center, and outer removable rim or tire.

The tires on built up wheels are variously held in position on the centers, such as by shrinking on and pressing on, and are further secured by different arrangements of bolting, lock rings, keys, etc.

Street-railway systems largely use one-piece wheels, either cast iron or forged steel, the cast iron wheels being generally of the spoke type while steel wheels have solid plates or webs. Locomotive wheels are of two types, the spoke-center renewable rim, and the solid one-piece wheel. The driving wheels, requiring usually a special center, are generally of the spoke design, while the guiding wheels are of the solid type.

Manufacturers:

American Pulley Co., The, 4200 Wissahickon Ave., Philadelphia, Pa. "American."

Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.

Cherry Tree Machine Co., Cherry Tree, Pa.

Fuller-Lehigh Co., Fullerton, Pa.

Griffin Wheel Co., N. Sacramento Blvd. & C. & N. W. Tracks, Chicago, Ill.

Standard Steel Works Co., 500 N. Broad St., Philadelphia, Pa. "Standard."

WHEELS, ELECTRIC VEHICLE AND TRUCK.—These are wheels used on the electrically operated passenger and commercial vehicles and trucks. For pleasure cars either wooden or wire spoke wheels are used while for trucks the heavy spoke or solid steel wheels are most common. In general, these wheels correspond closely to those of other types of automobiles used for similar purposes, except that the rim is adapted to the kinds of tires used on the electrics.

Manufacturers:

Dayton Steel Foundry Co., Dayton, Ohio. "Dayton."

Detroit Pressed Steel Co., 6660 Mt. Elliott Ave., Detroit, Mich. "Disteel."

Jones & Co., Inc., Phineas, Newark, N. J. "Jones."

Warner Electric Co., Muncie, Ind.

WHEELS, GRINDING.—Grinding wheels are supplied for extensive use in electrical and other manufacturing plants. The wheels are usually of stone, emery or of a prepared abrasive, such as carborundrum,

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They are furnished for mounting on motor-driven spindle on a grinding machine or bench grinder or for belt drive. They are made in numerous grades and is suited for the wide variety of work which they are used. This includes gh or coarse grinding of castings, forg-, etc., fine grinding of surfaces, tools, ery, etc.; grinding before polishing and roplating, etc. For the various types complete electrically driven grinders. Grinders, electric.

anufacturers:
rasive Co., James & Fraley Sts., Philadelphia, Pa.
ME ABRASIVE CO., 2221-23 Orchard St., Chicago, Ill. "Acme."
nadian Hanson & Winkle Co., Ltd., The, Toronto, Ont., Can.
stern Felt Co., Winchester, Mass. "Independence," "U S A," "X L," "Victory," "Pearl," "Jewel."
rdner Machine Co., Beloit, Wis.
nson & Winkle, Newark, N. J.
rton Co., Worcester, Mass. "Alundum," "Crystolon."
manol Chemical Products Co., 636-78 W. 22nd St., Chicago, Ill. "Redmanol."
les & Co., H. A., 97 Oliver St., Boston, Mass. "Ottoman."

HEELS, POLISHING.—These wheels used on various forms of polishing ment and are made in many sizes ble to their varied uses. The com- materials used for these wheels are leather and wire. The cloth and er wheels are made up of circula- ns usually stitched together and held y by metal plates or disks on the of the polisher when in use.

ufacturers:
nett-O'Connell Co., 3600 S. Morgan ., Chicago, Ill.
ns Supply Co., E. Reed, 21-27 Jackn St., Brooklyn, N. Y.
adian Hanson & Winkle Co., Ltd., ie, Toronto, Ont., Can.
ne Bros. Co., Utica, N. Y.
iner Machine Co., Beloit, Wis.
son & Winkle, Newark, N. J.
ning & Co., A. P., Church St., Matan, N. J. "Eclipse," "Monarch," Universal."

EELS, TROLLEY.—Small grooved of cast copper with solid or spoke s which roll on the trolley wire and the current for the motor and other cuits. Trolley wheels may be from ins. in diameter at the groove and tal is of such composition as to be and malleable and give reasonably earing life. They run on an axle car- a fork-shaped casting called the nd are provided with a bushed bear- designed as to require infrequent lu- n. The current taken from the con- re by the trolley wheel is conducted t by contact springs of high-con- y metal that are riveted to the nd bear on the hub faces of the This method is necessary in order vent as far as possible pitting of olley wheel axles, which results any considerable current passes them.

facturers:
et Trolley Harp Co., 404 Mitchell ., Springfield, Ohio. "Bayonet."
bia Machine Works & Malleable Co., Atlantic Ave. & Chestnut St., oklyn, N. Y.
ic Materials Co., The, North East,

ic Railway Equipment Co., 2900 nany Ave., Cincinnati, Ohio.
a Co., The, North East, Pa.
an Mfg. Co., Halsted St. & 48th Chicago, Ill.
Machine Shops, Logan, W. Va.
ins Co., J. F., Box 447, Gardiner,

d Trolley Supply Co., The, 1623 E. St., Cleveland, Ohio.
al Electric Co., 302 Kanawha Nal Bank Bldg., Charleston, W. Va. ional."
Co., R. D., Pittsburgh, Pa.
BRASS CO., THE, Mansfield, Ohio. mine trolley wheels are made of bronze, generously used. Users hem "Double life wheels."—Adv.
Car Mfg. Co., Ltd., Ottawa, Ont.,

Metal Works, 153-159 1st St., San isco, Cal.
Brass Works, The, Kalamazoo,

Metal Co., Bellefonte, Pa.
NGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. (See display adv. pages 1395-1402.)

WHICH WAY.—Trade name for traffic directing signal manufactured by the Wright Traffic Signal Co., Cincinnati, Ohio.

WHIPPERS, CREAM.—See Cream whippers, motor-driven.

WHIRLPOOL.—Trade name for electric drink mixers manufactured by the Hamilton-Beach Mfg. Co., 1301-39 Rapids Drive, Racine, Wis.

WHIRLPOOL.—Trade name for electric dishwashing machines manufactured by the Whirlpool Mfg. Co., 1629 Chestnut St., Philadelphia, Pa.

WHIRLPOOL MFG. CO.—1629 Chestnut St., Philadelphia, Pa. Manufacturer of electric dishwashers.

WHIRLWIND.—Trade name for electric forge blowers manufactured by the Premier Emergency Corp., 767 3rd Ave., New York, N. Y.

WHIRLWIND.—Trade name for electric fans manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WHISPERING.—Trade name for telephone mouthpieces manufactured by Frederick A. Watkins, 565 W. Washington St., Chicago, Ill.

WHISPERING MOUTHPIECE.—Trade name for telephone mouthpiece manufactured by the Colytt Laboratories, 565 W. Washington St., Chicago, Ill.

WHISTLES, AIR, ELECTRIC, MISCELLANEOUS.—Electrically operated air whistles are sometimes used where motor-driven or other air compressors furnish a ready supply of compressed air for the whistle as well as for other purposes. Electric remote control for a solenoid-operated whistle valve may then be provided. In some cases where the whistle is to be used quite frequently a special motor-driven blower may be used, in which case remote control for the motor is used and the valve dispensed with. Aside from their use on high-speed electric railways, electric whistles are adapted for all purposes for which steam whistles have been used, such as for starting and stopping signals, fire drills and general fire alarms, hoisting signals, program or other special signals, etc., that must be heard over an extensive plant area or throughout a town. For other types of loud-sounding signals see Sirens, electric; Horns, electric.

Manufacturers:
AUTOMATIC ELECTRIC CO., 1001 W. Van Buren St., Chicago, Ill.
FEDERAL ELECTRIC CO., 8700 S. State Street, Chicago, Ill. The Federal electric siren with its peculiar screech ranging from a rumbling groan to a piercing shriek, is heard loud and clear above ordinary and unreliable signals, such as steam whistles and bells. Always ready for instant use. Made to give long satisfactory service. Made in various styles and sizes for both exterior and interior use. See display adv. page 1291.—Adv.
KLAXON CO., Newark, N. J.
Russell Electric Co., Danbury, Conn. "Treco."
Standard Electric Mfg. Co., 925-941 Wrightwood Ave., Chicago, Ill.

WHISTLES, AIR, FOR ELECTRIC RAILWAY CARS AND LOCOMOTIVES.—Devices producing sound to warn of the approach of cars or trains and consisting of brass tubes provided with suitable exhaust opening so designed that the passage of compressed air through them causes a sound to be emitted. The tone and volume of the sound produced depend on the dimensions of the tube, and various operating conditions quite different types of whistles. High-speed operation of cars or trains requires the use of a warning device that is arrestive in effect and which can be heard at considerable distances and above ordinary noises. Through long years of successful use on steam railways, the whistle has proven itself the best device for the purpose. It is therefore used in high-speed electric railway service. Whistles on electric cars being operated by compressed air instead of steam, considerable skill is required in their design in order that the requirements of tone and carrying power can be met and at the same time provide for the economical use of air.

Manufacturers:
Inter-State Tool & Mfg. Co., Inc., 3419-21 Rutger St., St. Louis, Mo.
OHIO BRASS CO., THE, Mansfield, Ohio. "O-B."
Westinghouse Traction Brake Co., Pittsburgh, Pa.

WHISTLES, SPEAKING TUBE.—See Speaking tube fittings.

WHISTLES, STEAM, ELECTRICALLY CONTROLLED.—These are standard steam whistles provided with solenoid or electromagnetic control of the valve. This permits remote control to be effected, also automatic time control. For use on steamers during fogs when fog signals must be sounded at definite and regular intervals, electric control is especially advantageous, as it is easily regulated, entirely automatic and reliable. Time switches can be arranged to sound the whistle accurately at the proper time of starting and stopping work in factories, mills and other large industrial pants, thus eliminating the unreliability when this is left to be done by hand. In other cases remote control without timing features proves advantageous, especially when the whistle is located far from the point at which control is most desirable.

Manufacturers:
HOLTZER-CABOT ELECTRIC CO., THE, 125 Amory St., Boston, Mass.
KLAXON CO., Newark, N. J.
Lunkenheimer Co., The, Cincinnati, Ohio.

WHITAKER MFG. CO.—409 S. Green St., Chicago, Ill. Manufacturer of pliers, screw drivers, spark plugs and wrenches. President and treasurer, J. O. Whitaker; vice-president and secretary, C. A. Swanson; vice-president, W. R. Gillette.

WHITALKS.—Trade name for bowl hangers manufactured by the J. H. White Mfg. Co., 111 N. 3rd St., Brooklyn, N. Y.

WHITALL ENGINEERING CO., THE.—59 W. Main St., Waterbury, Conn. Manufacturer of circuit and fuse testers. President, Charles P. Whitall; secretary, treasurer and general manager, Paul S. Whitall.

WHITCOMB-BLAISDELL MACHINE TOOL CO.—Boston, Mass. Manufacturer of motor-driven lathes. Main office, 53 Franklin St., Boston, Mass. Factories, Hyde Park and Worcester, Mass. Branch offices, New York, N. Y.; Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Indianapolis, Ind.; Worcester, Mass.

WHITE AND WHITE ROTARY.—Trade name for electric sewing machines manufactured by the White Sewing Machine Co., 7821 St. Clair Ave., Cleveland, Ohio.

WHITE CO., H. C.—North Bennington, Vt. Manufacturer of electrical post card projectors. President, Hawley C. White, vice-president and treasurer, Harrie C. White; secretary, Clarence C. White. Main office and factory, North Bennington, Vt. Branch offices, New York, N. Y.; San Francisco, Cal.

WHITE CO., THE L. & I. J.—143 Perry St., Buffalo, N. Y. Manufacturer of linemen's axes, knives, etc. Business established 1837. President, W. S. Walls; vice-president, John W. Van Allen; secretary, Frank H. Hamilton; treasurer, R. T. Thompson.

WHITE CO., THE O. C.—17-21 Hermon St., Worcester, Mass. Manufacturer of lighting fixtures and portable electric lamps. Business established 1893. President and treasurer, Otis C. White. Sales representatives, Frederick Rall, 38 Murray St., New York, N. Y.; William P. Crockett Co., 411 S. Jefferson St., Chicago, Ill.

WHITE CROSS.—Trade name for electric household appliances manufactured by the Lindstrom, Smith Co., 3212-3238 W. Lake St., Chicago, Ill.

WHITE DIAMOND.—Trade name for metallic shade manufactured by the J. H. White Mfg. Co., 111 N. 3rd St., Brooklyn, N. Y.

WHITE ELECTRICAL SUPPLY CO., T. C.—1122 Pine St., St. Louis, Mo. Manufacturer of insulators. Established 1914 President, treasurer and general manager, W. H. White; vice-president, E. T. White; secretary and sales manager, O. K. White. Sales representative, American Manufacturers Agency, 208 N. Wells St., Chicago, Ill.

WHITE HOPE.—Trade name for photo-engravers' lamp manufactured by the New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y.

WHITE LEAD.—A basic carbonate of lead, approximately the composition $2PbCO_3.Pb(OH)_2$. It is widely used as a

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white paint and in making tight joints, especially in piping and pipe fittings. It may be manufactured electrolytically by anodic oxidation of lead in a sodium carbonate solution in accordance with the Luckow process. A 1.5% solution of a mixture of 80% sodium chlorate and 20% sodium carbonate is electrolyzed with a soft lead anode and a hard lead cathode, using a current density of about 0.5 amp. per sq. dm. Carbon dioxide is passed through the solution to replace that removed by the reaction. The anode is converted to white lead at its surface and falls to the bottom of the cell.

WHITE LIGHT.—Trade name for color-matching lamps manufactured by the New York Engravers' Supply, 230-234 W. 17th St., New York, N. Y.

WHITE LILY.—Trade name for electric washing machine manufactured by the White Lily Mfg. Co., Davenport, Iowa.

WHITE LILY DE LUXE.—Trade name for electric washing machine manufactured by the White Lily Mfg. Co., Davenport, Iowa.

WHITE LILY MFG. CO.—Davenport, Iowa. Manufacturer of electric washing machines. President and general manager, Sam T. White; vice-presidents, W. R. Weir and Dick R. Lane; secretary, A. T. Blakemore; treasurer, Charles H. Tappert; sales manager, Sam J. White.

WHITE MFG. CO., J. H.—111 N. 3rd St., Brooklyn, N. Y. Manufacturer of lighting fixtures, fixture fittings and parts, lighting reflectors, metal stampings, etc. Business established 1899. President, vice-president and general manager, Frank H. White; secretary, H. B. White; treasurer, J. M. White; sales manager, Walter R. Kahns.

WHITE MFG. CO., THE S. S.—Philadelphia, Pa. Manufacturer of electric dental laboratory apparatus. Business established 1844. President, Frank H. Taylor; vice-president, Dr. E. C. Kirk; secretary, R. L. Vaill; treasurer, T. E. Hinkson; commercial manager, R. O. Bailey. Main office, 211 S. 12th St., Philadelphia, Pa. Factories, Princess Bay, Staten Island, N. Y.; Frankford, Philadelphia, Pa. Branch offices and warehouses, Grant Bldg., Atlanta, Ga.; 120 Boylston St., Boston, Mass.; 7 Union Sq., West, New York, N. Y.; 356 Fulton St., Brooklyn, N. Y.; 104 S. Michigan Ave., Chicago, Ill.; 331 Madison Ave., New York, N. Y.; 12th & Broadway, Oakland, Cal.; 135 Stockton St., San Francisco, Cal.

WHITE OPAL.—Trade name for nitrogen lamps manufactured by the Union Lamp Co., Union Hill, N. J.

WHITE SEAL.—Trade name for rod packings manufactured by the Dominion Asbestos & Rubber Corp., 154 Nassau St. New York, N. Y.

WHITE SEWING MACHINE CO.—7821 St. Clair Ave., Cleveland, Ohio. Manufacturer of electric sewing machines. President and general manager, W. W. Chase; vice-president and secretary, A. S. Rodgers; treasurer, J. C. Sanderson. Factories, Cleveland, Ohio; Guelph, Ont., Can.

WHITE STAR.—Trade name for valves manufactured by the William Powell Co., Cincinnati, Ohio.

WHITE STEEL SANITARY FURNITURE CO.—Grand Rapids, Mich. Manufacturer of electrically lighted shaving mirrors.

WHITE-STOKES CO., INC.—150 W. Lake St., Chicago, Ill. Manufacturer of motor-driven cream whippers. President, H. O. Stokes; vice-president and treasurer, H. W. Chamberlain; secretary, C. A. White; sales manager, H. E. Watson.

WHITE WAY.—Trade name for electric washing machine manufactured by the White Lily Mfg. Co., Davenport, Iowa.

WHITELITE ELECTRIC CO.—368-70 Broome St., New York, N. Y. Manufacturer of incandescent lamps. Business established 1914. Factories, New York, N. Y., and Hoboken, N. J.

WHITING CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution, using a mercury cathode with automatic intermittent removal of the sodium amalgam from the cell.

WHITING CO., INC., H. S.—104 E. 41st St., New York, N. Y. Manufacturer of lighting fixtures, color-matching lamps and lighting reflectors. President and treasurer, H. S. Whiting; vice-president and secretary, N. J. Peabody.

WHITING FOUNDRY EQUIPMENT CO.—Harvey, Ill. Manufacturer of electric traveling cranes and complete foundry equipment. Business established 1891. President and treasurer, J. H. Whiting; secretary, T. S. Hammond; general manager, B. H. Whiting; sales manager, R. H. Bourne. Main office, Harvey, Ill. Branch offices, 570 Penobscot Bldg., Detroit, Mich.; 1224 Fulton Bldg., Pittsburgh, Pa.; 140 S. Dearborn St., Chicago, Ill. Sales representatives, Seeger Machine Tool Co., Atlanta, Ga.; Wonham, Bates & Goode, Inc., Boston, Mass.; Manufacturers Selling Agency, Birmingham, Ala.; R. J. Thomas, Cleveland, Ohio; S. G. Elbe, Denver, Colo.; Eccles & Smith, Los Angeles, Cal., Portland, Ore., San Francisco, Cal.; Dominion Foundry Supply Co., Montreal, Que., Can. Toronto, Ont., Can.; S. R. Vanderbeck, Philadelphia, Pa.; H. B. Wilson Co., St. Louis, Mo.; F. E. Arnold, Salt Lake City, Utah; W. R. Hendrey & Co., Seattle, Wash.; Robinson, Cary & Sands, St. Paul, Minn.; B. C. Equipment Co., Vancouver, B. C., Can.; H. A. Gillis, Washington, D. C.; Wonham, Bates & Goode, Inc., 17 Battery Place, New York, N. Y.

WHITLOCK COIL PIPE CO.—Hartford, Conn. Manufacturer of evaporators, feed water heaters, condensers, high-pressure pipes, etc. President, C. E. Beach; secretary and treasurer, J. L. Goodwin.

WHITLOCK MFG. CO., THE.—1506 W. 112th St., Cleveland, Ohio. Manufacturer of belt dressing and illuminated house numbers. Business established 1908.

WHITMAN & BARNES MFG. CO.—Akron, Ohio. Manufacturer of twist drills, reamers, drop forgings and wrenches. Business established 1854. Factories, Akron, Ohio; Chicago, Ill.; St. Catharines, Ont., Can.

WHITNEY, WILLIS R.—A noted American chemist and physicist, born at Jamestown, N. Y., 1868. Directly after his graduation from Massachusetts Institute of Technology in 1890, he became instructor in chemistry at this institute. Two years later he went to Germany to take up graduate studies at the University of Leipzig, from which in 1894 he received the degree Ph. D. He then resumed his former instructorship at M. I. T., where in 1900 he was advanced to assistant professor of chemistry. In 1904 Dr. Whitney was tendered the position of director of the Research Laboratory of the General Electric Co., at Schenectady, N. Y., of which he has remained the head continuously. This laboratory is believed to be the largest and best equipped laboratory maintained by any industrial or commercial organization in the world. In it is conducted the original and most difficult research work associated with the development of new electrical apparatus and processes. Among the countless achievements of this laboratory organization under Dr. Whitney's direction have been the production of squirted tungsten lamp filaments, the later production of drawn-wire tungsten filaments of much more rugged type, the development of the gas-filled tungsten lamp with greatly enhanced efficiency, low-tension and high-tension types of electron-tube rectifiers, improved forms of X-ray tubes, etc. Since 1915 Dr. Whitney has been a member of the Consulting Board of the United States Navy and is a very active member of the National Research Council. In 1910 he was president of the American Chemical Society and in 1911 of the American Electrochemical Society. In 1916 he was awarded the Willard Gibbs Medal by the former organization.

WHITNEY & SON, INC., BAXTER D.—Winchendon, Mass. Manufacturer of motor-driven wood shapers, saw bench, planers, boring machines, etc. Business established 1837. President, W. M. Whitney; treasurer, M. L. Foster; general manager, R. D. Emery. Main office and factory, Winchendon, Mass. Branch offices, New York, N. Y.; Greensboro, N. C.

WHITNEY CO., F. E.—65 Sudbury St., Boston, Mass. Manufacturer of electric organ blowers and ice cream freezers. Manager, W. A. Lister; treasurer, I. E. Whitney.

WHITNEY MFG. CO.—Hartford, Conn. Manufacturer of power transmission and other chains.

WHITTINGHAM.—Trade name for motor starters manufactured by the Automatic Switch Co., 154 Grand St., New York, N. Y.

WICKES BOILER CO., THE.—Saginaw, Mich. Manufacturer of boilers for power plants. Business established 1908. President, W. J. Wickes; vice-president and general manager, E. C. Fisher; secretary, F. H. Payne; treasurer, H. T. Wickes. Main office and factory, 502 N. Water St., Saginaw, Mich. Branch offices, 1716 West Street Bldg., New York, N. Y.; 76 W. Monroe St., Chicago, Ill.; 1218 Empire Bldg., Pittsburgh, Pa.; 1116 Penobscot Bldg., Detroit, Mich.; 736 Henry Bldg., Seattle, Wash.; 201 Devonshire St., Boston, Mass. Sales representatives, Baumes-McDevitt Machinery Co., St. Louis, Mo.; George F. Day & Son, 402 Rialto Bldg., San Francisco, Cal.; Carpenter & Hillman, Birmingham, Ala.

WICKES BROS.—512 N. Water St., Saginaw, Mich. Manufacturer of electric blueprinting machines. Branch office, 736 White-Henry Bldg., Seattle, Wash.

WICKWIRE BROS.—Cortland, N. Y. Manufacturer of wire rods. Business established 1873. President, C. C. Wickwire; vice-president, A. F. Stilson; secretary, F. R. Wickwire; treasurer, E. Stilson.

WICKWIRE SPENCER STEEL CORP.—Worcester, Mass. Manufacturer of wire rope clips, machinery guards, guy clamps, wire rods, etc. Main office, Worcester, Mass. Branch office, Buffalo, N. Y. District offices, 256 Franklin St., Boston, Mass.; 120 Broadway, New York, N. Y.; 237 N. 6th St., Philadelphia, Pa.; Book Bldg., Detroit, Mich.; 33 W. Austin Ave., Chicago, Ill.; 429 Mayo Bldg., Tulsa, Okla.; 111 Townsend St., San Francisco, Cal.

WIEDERHOLDT CONSTRUCTION CO.—Bank of Commerce, St. Louis, Mo. Manufacturer of power plant chimneys.

WIESE ELECTRICAL APPLIANCE CO.—Milwaukee, Wis. Manufacturer of electric cigar lighters, etc.

WILCO.—Trade name for platinum and silver contact points, sheet, wire, etc., and thermostatic metal, manufactured by the H. A. Wilson Co., 97 Chestnut St., Newark, N. J.

WILCOX.—Trade name for radio telegraph and telephone apparatus manufactured by the Wilcox Laboratories, Inc. 131 S. Fairview Ave., Lansing, Mich.

WILCOX LABORATORIES, INC., THE.—131 S. Fairview Ave., Lansing, Mich. Manufacturer of radio telegraph and telephone apparatus. Business established 1919. President and general manager, Chester M. Wilcox; vice-president and sales manager, Leslie G. Wonch; secretary and treasurer, Bessie B. Wilcox.

WILDERMAN CELL.—An electrolytic cell for the production of alkali and chlorine from brine solution, using a mercury cathode and mechanical agitation to transfer the sodium amalgam from the cathode compartment for decomposition.

WILDMAN MFG. CO.—Norristown, Pa. Manufacturer of electric cloth cutting machines. President, F. B. Wildman; vice-president, H. C. Coleman; treasurer, E. R. Roberts; general manager, Kenneth Howie.

WILE ELECTRIC FURNACE CO.—Pittsburgh, Pa. Manufacturer of electric furnaces.

WILFLEY.—Trade name for electrically operated ore concentrators manufactured by the Mine & Smelter Supply Co., Denver, Colo.

WILGO.—Trade name for toy telegraph sets, motors, etc., manufactured by the Wilcox Laboratories, Inc., 131 S. Fairview Ave., Lansing, Mich.

WILKINSON CO., WILLIAM H.—West Medway, Mass. Manufacturer of oiling devices and oil cups. John Shury, sales manager.

WILL & BAUMER CO.—Syracuse, N. Y. Manufacturer of lamp shades, beeswax, etc. Main office, Syracuse, N. Y. Branch offices, New York, N. Y.; Boston, Mass.; Chicago, Ill.

WILLARD.—Trade name for storage batteries manufactured by the Willard Storage Battery Co., 246-286 E. 131st St., Cleveland, Ohio.

WILLARD STORAGE BATTERY CO.—Cleveland, Ohio. Manufacturer of storage batteries. President, T. A. Willard; vice-president and general manager, R. C. Norberg; secretary and treasurer, H. J. Stiles. Main office and factory, 246-286 E. 131st St., Cleveland, Ohio. Branch offices, Atlanta, Ga.; 2524 S. Wabash Ave., Chi-

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:o, Ill.; 2022 Jackson St., Dallas, Tex.; troit, Mich.; 25 W. 11th St., Indian- olis, Ind.; 36-40 S. 10th St., Minne- olis, Minn.; 418-20 W. 125th St., New k, N. Y.; 1380 Bush St., San Francisco, .; Chester Ave. & E. 23rd St., Cleve- d, Ohio.

VILLCOX & GIBBS SEWING MA- INE CO.—New York, N. Y. Manufac- er of electric sewing machines. Presi- t and treasurer, J. Parmly; secretary, A. Swart. Main office, 658 Broadway, v York, N. Y. Branch offices, 321 N. vard St., Baltimore, Md.; 363 Boylston Boston, Mass.; 218 Livingston St., oklyn, N. Y.; 121 N. Wabash Ave., ago, Ill.; 213 W. 9th St., Los An- s, Cal.; 23 Academy St., Newark, N. 1709 Chestnut St., Philadelphia, Pa.; Sutter St., San Francisco, Cal.; 209 10th St., St. Louis, Mo.; Fulton & 4th . Troy, N. Y.

ILLEY.—Trade name for electrically en tools, generators and motors made he James Clark, Jr., Electric Co., Inc., W. Main St., Louisville, Ky.

ILLEY CO., INC., THE.—1222 Race Philadelphia, Pa. Manufacturer of or-driven laundry machinery. Presi- . I. F. Willey; secretary, D. H. Burt. ories, Columbia, Pa.; South Wildham, .

ILLEY-WRAY ELECTRIC CO.—118 rd St., Cincinnati, Ohio. Manufactur- generators and motors. Business es- shed 1915. Partnership, F. W. Willey F. L. Wray.

LLIAMS.—Trade name for electric erators manufactured by the Elec- l Refrigerating Co., Inc., 130 E. 15th New York, N. Y.

LLIAMS.—Trade name for coal ers manufactured by the Williams it Crusher & Pulverizer Co., 2701 roadway, St. Louis, Mo.

LLIAMS.—Trade name for pipe ding machines manufactured by the ms Tool Corp., Erie, Pa.

LLIAMS.—Trade name for valves factured by the D. T. Williams Valve 'incinnati, Ohio.

.LIAMS & CO.—901-37 Pennsylvania Pittsburgh, Pa. Manufacturers of rods, ingots, etc.

.LIAMS & CO., C. K.—Easton, Pa. facturers of powdered soapstone, ils, etc. President and treasurer, C. lliams; secretary, James B. Neal.

LIAMS & CO., J. H.—Buffalo, N. Y. acturers of wrenches, vises and tools. President, J. Harvey Wil- vice-president, A. D. Armitage; ry and treasurer, William A. Wat- Executive office, 187 Richards St., yn, N. Y. General office, 187 Vul- ., Buffalo, N. Y. Factories, Brook- Y.; Chicago, Ill.; Buffalo, N. Y.; harines, Ont., Can. District offices. 120th St., Chicago, Ill.; 187 Thor- ., St. Catharines, Ont., Can.; 167 nd Bldg., Detroit, Mich.; Monad- ldg., San Francisco, Cal.

.IAMS, BROWN & EARLE, INC.— stnut St., Philadelphia, Pa. Manu- of electric motion picture ma- blueprinting machines, X-ray ap- stereopticon and projection equip- nd laboratory supplies. Business ed 1885. President, Henry S. Wi- vice-president, William A. John- ecretary and treasurer, Morris eneral manager, Peter Abrams.

AMS CRUSHER & PULVERIZER Louis, Mo. Manufacturer of coal Business established 1871. Presi- F. Williams; vice-president, Hoyt ; secretary and treasurer, George ll. Main office and factory, 2701 lway, St. Louis, Mo. Branch of- an Francisco, Cal.; Old Colony icago, Ill.; New York, N. Y.

AMS CYPRESS CO., LTD., F. B. on, La. Producer of crossarms, pins and poles. President, F. B. vice-president, C. S. Williams; and treasurer, L. K. Williams.

riting to manufacturers please mention the ELECTRICAL YEAR BOOK

WILLIAMS FOUNDRY & MACHINE CO.—56-66 Cherry St., Akron, Ohio. Manufacturer of friction clutches. Business established 1884. President and general manager, F. E. Holcomb; vice-president, S. F. Ziliox; secretary and sales manager, William J. Slater; treasurer, G. C. Dietz.

WILLIAMS, FRED M.—919 E. 13th St., Brooklyn, N. Y. Manufacturer of screw and bolt head sealing cement.

WILLIAMS MFG. CO., INC.—125 W. 35th St., Los Angeles, Cal. Manufacturer of spotlights. E. R. Millar, general manager

WILLIAMS PATENT CRUSHER & PULVERIZER CO.—St. Louis, Mo. Manufacturer of coal crushers and pulverizers. Business established 1895. President, Milton F. Williams; secretary and treasurer, George F. Cottrill; sales manager, M. J. Williams; general manager, A. F. Williams. Main office, St. Louis, Mo. Branch offices, Old Colony Bldg., Chicago, Ill.; New York, N. Y.; Philadelphia, Pa.; Richmond, Va.; Cleveland, Ohio; Detroit, Mich.; San Francisco, Cal.

WILLIAMS RE-LART LAMP CO.—426 S. Throop St., Chicago, Ill. Manufacturer of portable lamps and lamp shades. Business established 1917. President and treasurer, H. A. Williams; vice-president, Frances Smulski; secretary, Philip Sultan; general manager, O. W. Nelson; sales manager, R. C. Streeter. Sales representatives, G. Spindler & Son, 430 Ryan Bldg., St. Paul, Minn.; R. C. Streeter, 115 N. Monroe St., Muncie, Ind.; Kaufman Co., 327 W. 2nd St., Los Angeles, Cal.; George Borgefeldt & Co., 16th & Irving Sts., New York, N. Y.

WILLIAMS TOOL CORP.—Erie, Pa. Manufacturer of pipe threading machines. President, Horace W. Davis; vice-president, Leslie S. Hall; secretary and treasurer, Kenneth H. Clapp. Factories, Erie, Pa.; Brantford, Ont., Can. Branch offices, 56 Pine St., New York, N. Y.; Brantford Ont., Can.

WILLIAMS VALVE CO., THE D. T.—Cincinnati, Ohio. Manufacturer of steam traps and separators and other steam specialties. President, Robert E. Mullane; vice-president, Frank X. Pund; secretary, A. G. Muhlhauser; treasurer, Harry J. Ernst.

WILLIAMSBURG FLINT GLASS CO.—260 Boerum St., New York, N. Y. Manufacturer of illuminating glassware.

WILLIAMSON & CO., R.—Washington & Jefferson Sts., Chicago, Ill. Manufacturers of lighting fixtures and portable electric lamps. President and treasurer, Charles E. Ummach; vice-president, D. Williamson; secretary, James Williamson; general manager, C. E. Verhunce.

WILLSON GOGGLES, INC.—Reading, Pa. Manufacturer of goggles for all purposes. Main office and factory, Reading, Pa. Branch offices, Bush Terminal Sales Bldg., New York, N. Y.; Magee Bldg., Pittsburgh, Pa.; Mallers Bldg., Chicago, Ill.; Sachs Bldg., San Francisco, Cal.; 23 Scott St., Toronto, Ont., Can.

WILLYS LIGHT DIVISION OF THE ELECTRIC AUTOLITE CORP.—Toledo, Ohio. Manufacturer of farm lighting and power plants. President, C. O. Miniger; vice-president, A. E. Buchenberg; treasurer, J. H. Housholder; sales manager, W. H. Roberts.

WILMARTH CO., T. W.—227-229 W. Huron St., Chicago, Ill. Manufacturer of lighting fixtures. President, T. W. Gilmore; secretary, W. E. Joy; treasurer, Louis McDonald.

WILMARTH SHOW CASE CO.—Grand Rapids, Mich. Manufacturer of showcases, etc. for stores. President and general manager, O. B. Wilmarth; secretary and sales manager, Edmund Morris; treasurer, H. C. Wilmarth. Main office and factory, 1544 Jefferson Ave., Grand Rapids, Mich. Branch offices, 45 W. 39th St., New York, N. Y.; 609 Chamber of Commerce, Pittsburgh, Pa.; 1642 Arapahoe St., Denver, Colo.; 123 N. 13th St., Philadelphia, Pa.; 18 E. 33rd St., Savannah, Ga.; 99 Chauncy St., Boston, Mass.; 166 Kinsey Ave., Cincinnati, Ohio; 212 Terry Bldg., Roanoke, Va.; 1230 Majestic Bldg., Detroit, Mich.; 1116 Washington Ave., St. Louis, Mo.

WILMINGTON FIBRE SPECIALTY CO.—Wilmington, Del. Manufacturer of fiber sheets, rods, tubes and other fiber products. Main office, Wilmington, Del. Mills, New Castle, Del. Branch offices, New York, N. Y.; Chicago, Ill.; Detroit, Mich.; Cleveland, Ohio; San Francisco, Cal.; St. Paul, Minn.; Cincinnati, Ohio; St. Louis, Mo.; Boston, Mass.; Milwaukee, Wis.; Toronto, Ont., Can.

WILSON AND WILSON ROTARY.—Trade name for motor-driven sewing machines manufactured by the A. G. Mason Mfg. Co., 7817 St. Clair Ave., N. E., Cleveland, Ohio.

WILSON, MRS. CATHERINE V.—541 Virginia Park, Detroit, Mich. Manufacturer of stands for electric pressing irons. Business established 1919. Factory, Toledo, Ohio.

WILSON CO., THE H. A.—97 Chestnut St., Newark, N. J. Refiner and worker of gold, platinum and silver and manufacturer of thermostatic metal and other welded bi-metallic products. President, H. A. Wilson.

WILSON IRON REST.—Trade name for stands for electric pressing irons made by Mrs. Catherine V. Wilson, 541 Virginia Park, Detroit, Mich.

WILSON-MAEULEN CO., INC.—730 E. 143rd St., New York, N. Y. Manufacturer of galvanometers, pyrometers and voltmeters. Business established 1906. President and general manager, C. H. Wilson; vice-president, C. E. Wilson; secretary, C. J. Brown; treasurer, S. S. Brown. Sales representatives, Nightingale & Baker, 163 W. Washington St., Chicago, Ill.; M. K. Epstein, Empire Bldg., Philadelphia, Pa.; D. J. Crowley, Dime Bank Bldg., Detroit, Mich.

WILSON RUBBER CO., THE.—Canton Ohio. Manufacturer of linemen's rubber gloves. President, John S. Willis; vice-president and general manager, Fred J Wilson; secretary and treasurer, Wendell Herbruck. Main office and factory, 1216 Garfield Ave., S. W., Canton, Ohio. Branch offices, 15 Park Row, New York, N. Y.; 5353 N. Western Ave., Chicago, Ill.; 312 S. Clark St., Chicago, Ill.; 530-532 Howard St., San Francisco, Cal.

WILSON WELDER & METALS CO., INC.—Brooklyn, N. Y. Manufacturer of electric welding equipment. Business established 1915. President, T. B. Hasler; vice-presidents, D. H. Wilson and S. A. Douglas; secretary, treasurer and sales manager, Claude Hartford; general manager, S. A. Douglas. Main office, 253 36th St., Brooklyn, N. Y. Branch offices, 809 Kresge Bldg., Detroit, Mich.; Ohio Wilson Welding & Repair Co., 315 Society for Savings Bldg., Cleveland, Ohio; Wilson Welder & Repair Co. of Pa., 2233 Vine St., Philadelphia, Pa. Sales representatives, Charleston Electrical Supply Co., Charleston, W. Va.; Eccles & Smith Co., 241 S. Los Angeles St., Los Angeles, Cal.

WILT TWIST DRILL CO. OF CANADA, LTD.—Walkerville, Ont., Can. Manufacturer of twist drills. General manager, H. N. Reynolds.

WIMCO.—Trade name for radio equipment manufactured by the Wireless Mfg. Co., 619 4th St., N. W., Canton, Ohio.

WIN-HER.—Trade name of electric washing and ironing machines manufactured by the Win-Her Washer Co., 814 Tuttle St., Des Moines, Iowa.

WIN-HER WASHER CO.—814 Tuttle St., Des Moines, Iowa. Manufacturer of electric washing and ironing machines. Business established 1919. President and general manager, Guy S. Brewer; vice-president, C. W. Graham; secretary and treasurer, Frank R. Stehm.

WINCHES, ELECTRIC.—Electric winches are motor-driven devices used especially on shipboard for coiling up a rope and hoisting. They consist of one or more heavy drums on which the rope is wound, and as the drum is turned by the motor the pulling or hoisting effect is obtained. The motor is generally connected through reduction gearing, as the drum of the winch does not revolve very fast. These are special forms of windlasses.

Manufacturers:

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Dake Engine Co., Grand Haven, Mich.
Erie Hoist Co., The, 1908 Holland St., Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa. "Flory."
Gilbert-Grant Co., The, Grand Central Terminal, New York, N. Y.
Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y.
Maine Electric Co., Inc., The, 35 Commercial St., Portland, Me.

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Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC CO., 527 W. 34th St., New York, N. Y. Sprague Electric Winches are built with either vertical or horizontal drums. Vertical winch,



Vertical Winch



Horizontal Winch

illustration at left, with vertical Gypsy head. Capacity one to six tons. Direct Current and Alternating Current. Principal uses: Car pullers, warping ships and barges, pulling trucks up inclines, etc. Horizontal winch, illustration at right, with horizontal drum. Capacity one to four ton. Principal uses: Car pullers, pulling material up inclines, etc. Sprague Products, see display adv. pages 1306-7.—Adv.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WALKER VEHICLE CO., 87th & S. State Sts., Chicago, Ill. "Walker." (See display adv. page 1326.)

WINCHESTER.—Trade name for flashlights and flashlight batteries manufactured by the Winchester Repeating Arms Co., New Haven, Conn.

WINCHESTER OPTICAL CO.—Horseheads, N. Y. Manufacturer of motor driven bench grinders.

WINCHESTER REPEATING ARMS CO.—New Haven, Conn. Manufacturer of flashlights and flashlight batteries. President, J. E. Otterson; vice-president and secretary, Henry Brewer; vice-president, F. G. Drew; treasurer, R. E. Anderson.

WIND, ELECTRIC.—When a pointed conductor is highly charged with electricity the density at the end becomes so great that the air surrounding the point becomes charged or electrified and is at once repelled. This leaves a space into which the unelectrified air rushes to take its place and is in turn repelled. This phenomenon is called an electric wind and exists as long as the charge is present on the conductor.

WIND ELECTRIC CO.—St. Paul, Minn. Manufacturer of farm lighting and power plants. Incorporated 1920. President, George Manikowske; vice-president, A. E. Morrison; secretary and treasurer, Leon Durocher. Main office, 1957 St. Anthony Ave., St. Paul, Minn. Branch office, Wyndmere, N. Dak.

WINDERS, ELECTROMAGNET.—Electromagnet winders, or magnet winders as they are commonly called, are machines on which electromagnet coils are wound. Magnet winders are usually quite small machines, made for handling fine magnet wire. They are necessarily smooth running and the bobbins or spools must be accurately centered to provide a uniform tension on the wire as it is wound on. Magnet winders are usually motor or power-driven, although some foot-power winders are also used. They consist of the driving spindle and mechanism, a control, usually operated by a treadle, and a device for holding the spool of wire being used. A counter is sometimes provided on this type of winder and those described below to show the number of turns that have been wound on the coil.

Manufacturer:

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

WINDERS, PLAIN COIL.—Plain coil winders may be used to wind a great variety of forms of coils. They are usually more complete than the magnet winders described above, often being made similar to a lathe. A motor-driven headstock, provided with a chuck or with a center, is a common arrangement. Belt drive is also used on some machines. A tailstock that may be adjusted quickly is fastened to a short and rather heavy lathe bed. This bed serves to reduce vibration, besides maintaining the accuracy of the centers. A spool-holding device is placed on the front of the machine.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Electrical Manufacturers Equipment Co., 712 Postal Telegraph Bldg., Chicago, Ill. "Segur."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WINDERS, WIRE.—Wire winders are machines used to wind wire into various shaped coils and on spools and reels. They are used by wire manufacturers and by others who draw the wire to the size they desire. As the wire comes from the drawing bench it is wound into these coils or, in the case of fine wire, wound onto spools or small reels. Special forms of wire, such as square magnet wire and ribbon wire, require special provision in the form of a guide to prevent twisting of the wire in winding it on the spool or reel.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WINDING MACHINES, ARMATURE COIL.—See Armature coil winding machines.

WINDING MACHINES, COIL.—See Coil winding machines.

WINDING MACHINES, FOOT-POWER.—Foot-power winding machines are made for use in factories, laboratories and shops where only a limited amount of coil winding is done. They consist of a treadle connected through a crank to a grooved pulley wheel of rather large size. This has a belt running over it and turning a small wheel on the spindle at a high speed. The spindle is usually provided with a handwheel for use in regulating the speed when starting and stopping. They are used principally for winding small coils. Counters are commonly provided on this and the other types of winding machines described below; those show the number of turns that have been wound on the coil.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WINDING MACHINES FOR PREPARING FINE COTTON AND SILK FOR WIRE INSULATION.—These are machines on which the silk and cotton yarn are prepared for use on wire as insulation. They consist of thread-twisting machines in which the long fibers are joined into a thread. Several of these threads are then wound onto one bobbin at a time. The number depends upon the kind of insulation desired, with silk three or four or more strands or threads are grouped, with cotton the threads are usually larger but the number may be the same. When these threads are wound onto the bobbin together they are ready for use on the insulating machine. The threads are applied in groups and are placed on the wire side by side.

WINDING MACHINES FOR PREPARING YARN FOR WIRE-BRAIDING MACHINES.—These winding machines are similar to those described above for winding silk and cotton yarn for wire insulation. The yarn is twisted together into threads and in this machine is wound on the bobbin as a single thread. When used on the braiding machine several such spools of thread are used simultaneously.

WINDING MACHINES, HAND.—Hand winding machines are used in shops and laboratories where only a small number of coils are occasionally wound. They are merely spindles to which a handwheel is attached, and provided with a center or chuck for mounting a bobbin or core for the coil to be wound on. The wire used is usually carried on a spool mounted on the front of the bench.

Manufacturers:

Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WINDING MACHINES, MOTOR OR POWER-DRIVEN.—Motor and power-driven winding machines are used in factories where a large number of coils are wound. The motor-driven machines usually have the motor directly connected to the headstock. A variable speed motor is used, the control of which is effected by a foot-operated switch and rheostat. These machines are usually constructed like a lathe with a cast iron bed and sliding tailstock. The other types of power-driven machines are usually driven by belt from a line shaft. Some of the motor-driven machines are also driven by belt as the motor may be mounted on the floor.

Manufacturers:

Becker Electric Works, 3055 Lincoln Ave., Chicago, Ill.

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

O. K. Clutch & Machinery Co., Columbia, Pa. "O. K."

Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."

WINDINGS, GENERATOR AND MOTOR.—Generator and motor windings consist of several distinct types for the armature, while for the field coils the difference is mainly in the method of connection. A general classification and discussion of the various methods of armature winding is given under the heading, Armature winding, which see. Some of the principal types of windings are also defined below.

Chain Winding. An alternating-current armature winding whose coils have the appearance of being interlinked somewhat like a chain. It is a single layer winding, a side of a coil completely filling a slot. It is used at times for high-voltage machines.

Chord or Fractional Pitch Winding. An armature winding in which the sides of a coil are separated a distance less than that from one pole to a corresponding point on the next. This type of winding reduces the length of the end connections and, in a-c. generators, may improve the shape of the voltage wave.

Closed-Coil Winding. An armature winding which forms a closed circuit about the armature, commonly used in d-c. machines. Closed-coil windings are subdivided into parallel and series windings, also called (on account of their appearance) lap and wave windings, respectively. See Lap winding, Wave winding, Armature winding.

Concentric Winding. A type of armature winding used mostly in single-phase motors in which the coils are placed in slots concentrically about the center of each pole.

Deri Winding.—A field winding together with a compensating winding on a field frame of the nonsalient pole type for a d-c. machine. The compensating winding neutralizes the magnetizing action of the armature winding by producing an equal and opposite magnetomotive force.

Drum Winding. An armature winding placed on the external cylindrical surface of a rotating armature core, or on the internal cylindrical surface of a stationary armature core. Also see Armature winding.

Field Winding. The winding in which a current produces the useful magnetic field of a machine. A field winding may constitute a circuit independent of the armature winding, as in separately excited machines; a circuit in parallel with the armature, as in shunt generators and motors; in series with the armature, as in series machines; or a combination of series and shunt windings, as in compound machines.

Lap Winding. A type of armature winding in which the successive conductors lap back over each other. Lap windings may be of the open-circuit type as used in most a-c. generators, or of the closed-circuit type as used on d-c. generators. Lap windings of the closed circuit type are multiple-circuit windings, having as many circuits as there are poles or a multiple thereof.

They are correspondingly designated as simplex, duplex, triplex, etc., a duplex lap winding, for example, having twice as many circuits as there are poles.

Multiplex Winding. An armature winding consisting of two or more independent windings having no electrical connection with each other except through the brushes bearing on the commutator.

Open-Coil Winding. An armature winding which does not form a closed circuit around the armature. This type is now seldom used on d-c. armatures, but is very common for a-c. machines.

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Ring Winding. An armature winding laced on a core in the form of a ring. The active conductors usually lie on the outside of the ring and the return conductors are passed through the inside of the ring. This type of winding is rarely used now.

Series-Parallel Winding. A wave winding for an armature having four or more circuits in parallel. See below under, Wave Winding.

Simplex Winding. A d-c. armature winding, which forms only one closed circuit about the armature.

Thompson-Ryan Winding. A compensating winding placed in the pole faces of d-c. machines to counteract the armature reaction. This winding is connected in series with the armature and its magnetomotive force is practically equal and opposite to that of the armature, thus eliminating any magnetizing action of the armature.

Two-Circuit Winding. A winding on a d.c. armature which has only two circuits through it for any number of poles. It is a simplex wave, or series, winding.

Two-Layer Winding. An armature winding in which a side of one coil occupies the bottom of a slot and that of another coil the top of the slot, thus forming two layers in all slots.

Wave Winding. A type of armature winding so named because of the wave-shaped appearance of lay of the conductors when viewed from the outside of the armature. Wave windings are also called series windings, because of the greater number of conductors in series than in multiple, or lap winding. Direct-current wave windings have two or a multiple of two circuits through them independent of the number of poles of the machine. When the number of circuits is more than two, it is sometimes called a series-parallel winding.

WINDLASSES, LAMP LOWERING.—A windlass is a machine for hoisting or hauling. Those used for lamp lowering and raising consist of a small drum on which the lowering rope is coiled. They are sometimes provided with a removable crank handle or with a locking device so that the drum may be turned only by authorized persons. These windlasses have been used largely for lowering arc lamps suspended over the center of a street. Now they are used also for the incandescent lamps employed in similar locations, and for high-hung incandescent lamps in shops, gymnasiums, etc.

Manufacturer:

ADY ELECTRIC & MFG. CO., 42 Center St., New Britain, Conn.

WINDMAN.—Trade name for clamps manufactured by the Windman-Goldsmith, Inc., 399-403 East Ave., Perth Amboy, N. J.

WINDMAN-GOLDSMITH, INC.—399-403 East Ave., Perth Amboy, N. J. Manufacturers of outlet box covers, receptacles, switches, cutouts and all screw shell fittings. President and sales manager, D. Goldsmith; vice-presidents, Rose Goldsmith, Minnie Windman; treasurer and general manager, Philip Windman.

WINDMILLS FOR DRIVING GENERATORS.—Windmills are sometimes employed for driving special generator outfits for lighting on farms. They do not differ from the ordinary windmills used for pumping water, having a long vertical shaft which through suitable gearing may be used to drive the generating equipment at the ground level. The steel towers which are commonly used may form the side support or a steel housing that is provided with generator protection.

Manufacturers:

Dempster Mfg. & Engine Co., Freeport, Ill. "Dempson."

Fairbanks Electric Co., 1957 St. Anthony Ave., St. Paul, Minn. "Aerolite."

WINDOW LIGHTING FIXTURES.—See Fixtures, lighting, window and showcase.

WINDOW LIGHTING REFLECTORS.—See Reflectors, showcase and show window.

WINDOW SPRINGS.—See Springs, burglar alarm contact.

WINSOR WEBBING CO.—Beverage Ave., Pawtucket, R. I. Manufacturers electrical tapes. Business established 1903. President, J. Henry Thorpe; vice-president, John S. Merchant; secretary and treasurer, H. Ross Matthews.

WINFIELD ELECTRIC WELDING MACHINE CO.—Warren, Ohio. Manufacturer of electric welding and riveting machines. President, W. C. Winfield; vice-president, R. A. Cobb; secretary and treasurer, J. H. Ewalt; sales manager, A. E. Hackett. Main offices and factory, Warren, Ohio. Branch offices, 1017 Engineers Bldg., Cleveland, Ohio, 1150 People's Gas Bldg., Chicago, Ill.; 1217 Dime Bank Bldg., Detroit, Mich.; 12 Pearl St., Boston, Mass.; 50 Church St., New York, N. Y.

WINFORD MFG. CO.—306 Alaska Bldg., Seattle, Wash. Manufacturer of electric brooders.

WING MFG. CO., L. J.—352 W. 13th St., New York. Manufacturer of electric fans, blowers, regulators and turbines. Business established 1903. President and general manager, Alfred E. Seelig; vice-president, Harry S. Wheller; secretary and treasurer, Victor H. Carples; sales managers, Harry S. Wheller and Victor H. Carples.

WING-SCRUPLEX.—Trade name for electric exhaust and ventilating fans manufactured by the L. J. Wing Mfg. Co., 352 W. 13th St., New York, N. Y.

WINGO.—Trade name for grease cups manufactured by the Lukenheimer Co., Cincinnati, Ohio.

WINK-A-LITE.—Trade name for thermal flasher manufactured by the Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

WINKLER-REICHMANN CO.—4801 S. Morgan St., Chicago, Ill. Manufacturer of loud-speaking telephones. Secretary and general manager, Frank Reichmann.

WINSTED EDGE TOOL WORKS, THE.—Winsted, Conn. Manufacturer of drawing knives and other tools. President, treasurer and general manager, J. A. Norton; vice-president, L. W. Tiffany; secretary, R. E. Maher.

WINTER BROS. CO.—Wrentham, Mass. Manufacturer of taps and dies. President and manager, J. E. Winter; secretary, Milford E. Bliss; treasurer, F. J. Smith. Main office and factory, Wrentham, Mass. Branch offices, 106 S. Jefferson St., Chicago, Ill.; 1404 Real Estate Exchange Bldg., Detroit, Mich.

WINZE.—Trade name for electric mine hoist manufactured by the Wellman-Seaver-Morgan Co., 7000 Central Ave., Cleveland, Ohio.

WIRE.—Technically, a wire is slender rod or filament of drawn metal. It is slender in the sense that its length is great as compared with its diameter. This definition restricts the term wire to a solid and bare wire. In electrical work, however, the term wire is applied broadly to include some stranded wires and many kinds of insulated wire, but all of relatively small diameter. Where it is desired to distinguish between protecting covering the term "conductor" is used to refer to the inner conducting part or each such part or wire proper, if there are several, and the term "insulation," "sheath" and "armor" to the electrical and mechanical coverings.

Electrical wires are classified in many different ways. One of the most important is subdivision into solid and stranded wires; the latter type is composed of a group of very small wires used as a single wire. If such a stranded wire is very large, or if there are grouped together under one outer covering a number of conductors insulated from each other, then the combination is called a cable. If a stranded wire is made very flexible and usually if it has two or three conductors grouped together and substantially insulated to withstand wear, it is commonly called a cord. Thus the three principal classes of metallic electrical conductors are called wires, cables and cords. For further description of the latter two, see Cable, also Cord.

Other terms often used in wire practice are the following: A strand is one of the individual wires or groups of wire, of any stranded conductor; the term strand is also used to refer to a stranded steel wire used to support or guy electric wires or poles or as a ground wire; for this type see Strand, galvanized steel. A twin wire consists of two small insulated conductors laid parallel and having a common covering. A twisted pair consists of two small insulated conductors twisted together without a common covering; several twisted pairs may, however, be assembled into a cable, as is very commonly done in telephone cables.

The sizes of electrical wires of all metals, except iron and steel, are generally given in the American Wire Gage (formerly called Brown & Sharpe Gage). Steel and iron wire sizes are generally given in the Birmingham Wire Gage.

Manufacturers of wire usually classify and list their products by their intended use as much as by their important features of construction. Since both methods are used, the following classifications are likewise based on service, material and character of insulation. For a description of wire manufacture see wire and cable manufacture.

WIRE, ALUMINUM.—Aluminum, which ranks second to copper in its importance as an electrical conductor, may be worked with about the same ease as copper and is drawn into wires of the same size and characteristics as copper. Aluminum wire is made in both the solid and stranded forms and is often employed for power transmission lines. Its conductivity is less than that of copper, being about 61% of the International annealed copper standard. Aluminum wire is hardly ever used for overhead construction as solid wire and when stranded is frequently reinforced with steel to give additional tensile strength. Used on transmission lines, its light weight permits longer spans and does not require as many towers and insulators. Also see Aluminum.

Manufacturers:

Aluminum Co. of America, 2400 Oliver Bldg., Pittsburgh, Pa.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West Toronto, Ont., Can. "Canada."

Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."

Matthews & Brother, Inc., W. N., 2912 Easton Av., St. Louis, Mo.

Mirete Metal Co. of Mass., Inc., 225 Main St., Springfield, Mass.

WIRE AND CABLE MANUFACTURE.—The manufacture of wire for electrical purposes is one of the basic and most important branches of the electrical industry, because every electrical project, no matter how large or how small, involves the use of wire, cable or cord in some form. The importance and value of this branch are shown by the fact that in 1920 the estimated wire and cable production in the United States was about $168,000,000.

In the manufacture of wire, cable and cord the processes are about the same for all types and for all metals used. Copper is by far the most important conductor metal from the electrical standpoint. All metals are received in about the same size billets. The billets are heated in a furnace and removed and passed through a rolling mill several times to obtain what is called rod. This "rod" may be about ¼ inch in diameter and approximately ¼ mile long. The rod is then ready for the wire drawing process. So far the process has been with the heated metal, but the drawing and other remaining operations are usually with cold metal.

Drawing. In drawing wire, the rod is pulled through a number of steel dies in a series or line, each die being slightly smaller than the preceding one, so that the diameter of the wire is reduced accordingly. The wire is wound over drums or mandrels between each set of dies to provide a uniform pulling tension. In some of the larger sizes the wire is drawn to its final size in one pull or "draft" through the wire-drawing machine. Smaller wires do not permit this and at intermediate stages the wire must be removed from the machine and carefully annealed. In this manner it is possible to draw very fine wire, some of the smallest sizes being drawn through diamond dies.

Cabling and Insulating. Most of the wire and cable used for electrical purposes is insulated. In this process the methods used for the various kinds of wire and cable are different. Cable is usually formed from several individual wires or strands which are twisted or cabled together into one large stranded conductor. These conductors are then treated in a manner similar to the individual wires. A rubber covering is usually added and either a braided weatherproof covering or a lead sheath. Sometimes two or three or more such insulated conductors are again cabled together with a jute filler to make multiple-conductor cable.

A lead sheath is applied to much cable, after a layer of tape has been added. In applying this sheath the cable is forced or pulled through a lead press, passing through a guide block in the rear. It goes through a chamber in which molten lead is contained under a high pressure. Its tem-

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perature is carefully regulated so that a very slight decrease will cause the lead to solidify. An accurate die is arranged so that the cable passes centrally through the chamber and a uniform continuous sheath of lead is forced onto it, the sheath solidifying just as it leaves the die and touches the cable core.

Rubber-insulated wire is very widely used. In its manufacture the bare copper wire is generally tinned or run through a bath of molten tin to give it a protective coating and prevent corrosion by the sulphur in the rubber. The rubber coating is applied in two ways. One of these resembles very much the method of applying a lead sheath. The rubber is maintained in a plastic state and the wire forced through a die so that a uniform continuous coating is applied. In the other method the rubber is applied in strips cut from large sheets of the rubber. The wire is run between grooved rolls, and a strip of rubber is folded onto the wire and pressed together making a seam at one side. In the vulcanizing process which follows, the seam is kneaded together so that the insulation at that point is about the same as at all others. A protective braid is usually applied and impregnated and this coating rendered smooth and hard by polishing with wax.

Smaller wires such as magnet wire, etc., do not have a rubber coating. The insulation is provided by enamel or silk or cotton. The enamel is applied by a special machine in a heated state and the wire passed over a number of rollers in long lengths to afford an opportunity for drying. Silk or cotton insulation are sometimes used with enamel and more often separately. The cotton or silk yarn is specially prepared and wound onto the wire as it is pulled through a revolving head. Several servings may be applied while the wire is in one machine by having the revolving heads separated slightly. Often wire of this kind is impregnated with a moisture-repelling compound.

Further details of the most important machines used in wire manufacture will be found under separate headings below.

WIRE AND CABLE, MARINE AND NAVAL.—Wire and cable used on shipboard requires special protection against the action of salt water and salty air and against water of condensation formed in conduits passing through compartments at different temperatures. The best grade of high-conductivity copper is used for the conductors and special attention is given to the quality and thickness of the rubber and tape insulations. These wires are installed in conduit in the vessel interior or in protected places. For exposed deck work or wiring in the lower portions of the vessel a lead-covered steel-armored cable is used. The rubber-covered wire is covered with a continuous sheath of lead and then a cotton braid is wrapped over the lead. The armor is then applied in either a basket weave of soft galvanized steel wire or a tight helical wrapping of soft steel wire. There are modifications in design to suit the various places where the cables are laid, for example, leaded without armor, armored without lead and simply the rubber insulation without lead or armor. Also see Cord, flexible, deck or marine.

WIRE, ANNUNCIATOR OR OFFICE.—Copper conductors of small size (Nos. 14 to 22 A. W. G.) insulated with one or more layers of cotton usually applied in opposite directions. Annunciator wire is usually impregnated with paraffin and is used for running bell, buzzer, annunciator and other signal circuits in dry places, such as offices, hotels and homes. What is called office wire usually has one or more winds of cotton and a braided covering. It is impregnated with moistureproof compounds, and is used for inside connection of telephone and telegraph instruments, and also for signal systems.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of black core or damp proof annunciator wire, as well as the regular line of annunciator wire.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (See display adv. page 1249.)
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I. "I. X. L."
Gottschalk Mfg. Co., John W., Philadelphia, Pa.
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."
National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y.
National India Rubber Co., Bristol, R. I.
New England Electrical Works, Lisbon, N. H.
Okonite Co., The, Canal St., Passaic, N. J.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
PHILLIPS WIRE CO., Pawtucket, R. I. "Phillips."
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "Paracore" annunciator or bell wire is electrically efficient, both in workmanship and material. Company also manufactures dampproof office wire of high grade.—Adv.

WIRE, ANTENNA, AND ANTENNA CORD.—Stranded conductors, usually of phosphor-bronze, intended particularly for the spans between towers for radio telegraph and telephone stations. Phosphor-bronze is used for this purpose, as high tensile strength and durability are required. Antenna cord consists of stranded conductors cabled together with strong cotton thread and sometimes having a cotton braid, which is saturated with weather-proofing compound.

Manufacturers:

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Copper Clad Steel Co., Rankin, Pa. "Copperweld."
Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
New England Electrical Works, Lisbon, N. H.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, N. Y. "U. S."

WIRE, ARMATURE BANDING OR BINDING.—Bare tinned steel wire of high tensile strength used for wrapping motor and generator armatures to prevent the centrifugal force due to high speeds from dislodging the conductors. Tensile strengths as high as 350,000 lbs.. per sq. in. are obtained in some of the best grades of banding wire, but such strength is required only on motors or generators of unusual size and high speed. Bronze wire is also used in some cases.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of tinned steel armature binding wire for use in binding armatures of motors and dynamos.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Central Steel & Wire Co., 119-127 N. Peoria St., Chicago, Ill. "Cisco."
CHICAGO MICA CO., 11-21 Water St., Valparaiso, Ind. (See display adv. page 1320.)
DOWNEY CO. GILBERT H., 7 S. 17th St., Philadelphia, Pa.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Seneca Wire & Mfg. Co., Fostoria, Ohio. "Seneca."

WIRE, ARMORED.—See Cable, armored; also Cord, flexible, armored.

WIRE, ASBESTOS-COVERED. — Copper conductors provided with insulation of felted or woven asbestos fiber and impregnated with a cementing compound. It is used extensively for winding magnet coils or other electrical apparatus of moderate voltages where the generation of considerable heat in the windings would deteriorate other insulations, excepting mica, but where the cost of mica insulation is not warranted.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of asbestos covered wire.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Eectric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. All "Deltabeston" wires made by the D & W Fuse Works are asbestos-insulated, rendering them heat and vaporproof, with the assurance given to the user that improved service is bought with Deltabeston. Deltabeston Magnet Wires can be furnished in round sizes from No. 0 through No. 20, and in a great variety of square and rectangular sizes. Because of its heat-resisting qualities, Deltabeston magnet wire makes an excellent wire for rewinding coils of motors subject to heavy service, for rewinding arc lamp coils, headlight coils, and for almost any repair work where apparatus is operated under high temperatures. Deltabeston Fixture Wires are furnished with plain asbestos finish or with a cotton or silk braid over the asbestos. Single-conductor and two-conductor fixture wires are listed as standard. These wires are recommended for use in wiring Type "C" lighting fixtures and other devices where the heat is so intense that rubber-covered wires would deteriorate rapidly. Deltabeston Switchboard Wire is a solid conductor, asbestos-insulated, furnished with a hard asbestos braid. Its application is self-explanatory. Deltabeston Motion-Picture Cable is an extremely flexible wire, insulated with standard Deltabeston insulation, and finished with a hard asbestos braid. Deltabeston Stove Wire is furnished in practically the same manner as switchboard wire. It is very generally used for the wiring of electric ranges, ovens, etc. Deltabeston Heater Cord is an asbestos-insulated, flexible cord, designed for use in connection with electric flatirons and other domestic heating devices. Can be furnished either with a cotton braid or an asbestos braid. The asbestos insulation does not deteriorate with age, nor does it break down under heat.—Adv.
Driver-Harris Co., Harrison, N. J.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. "Salamander." (See display adv. page 1251.)
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. and Warwick St., Brooklyn, N. Y.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Rome Electrical Co., Rome, N. Y.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

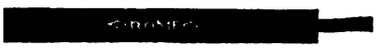
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Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, AUTOMOBILE IGNITION.—Stranded copper conductors provided with rubber compound insulation of high quality and extra thickness, with or without an outer braid, and used for the distribution of high-tension currents to the spark plugs of internal-combustion engines, specially on automobiles.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a very complete line of ignition wires and cables for automobiles, motor boats, and airplanes. These wires and cables are made in a great variety of styles and sizes, evolved from an extended experience in the manufacture of wires and cables of all kinds. They represent not only the latest advanced construction, but set a standard of excellence that will strongly appeal to the great army of automobile and gas engine users.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Cranford Electric Co., 9 Church St., New York, N. Y. "Endurite."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
DIDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
Electrical Alloy Co., The, Morristown, N. J. "Magno."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Ittschalk Mfg. Co., John W., Philadelphia, Pa.
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" primary cable is made with 41 strands of No. 30 wire (tinned copper), insulated with new code rubber, covered with two braids and finished with several coats of enamel varnished baked on. For other Indiana Rubber & Insulated Wire Co.'s products, see display advertisement on pages 1235-1239. —Adv.
Jose, Frank W., 289 Congress St., Boston, Mass.
Konite Co., The, Canal St., Passaic, N. J. "Okonite."
Packard Electric Co., Warren, Ohio. "Packard," "Packard Junior."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
ROME WIRE CO., DIAMOND BRANCH, Buffalo, N. Y. Where it is necessary to a wire to withstand high voltages from the distributor to the spark gs or from the coil to the distributor, or to transmit any high-tension rrent around an automobile, our line ignition cables answers the pur-





Rome Ignition Cable

e. Owing to different methods of ying these wires, either through or metal tubes, or being carried , we furnish either plain rubber-red cables or cables having a single braid or cables having double braid. In cases where our high-tension wires are furnished with either single or





Rome Ignition Cable

double braid the outer braid has our "Diamond Crown Finish." See display adv., page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Splitdorf Electrical Co., 98 Warren St., Newark, N. J.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Tubular Woven Fabric Co., Main & Carver St., Pawtucket, R. I.
UNITED STATES RUBBER CO., 1790 Broadway, N. Y. "U. S."

WIRE, AUTOMOBILE LIGHTING.—Copper conductors usually composed of tinned strands of small size and insulated with rubber or varnished cloth, with an outer covering of one or more layers of braided cotton. The braids are usually impregnated with special moistureproof compounds to resist the action of water, oil, etc., which is encountered in automobile wiring.

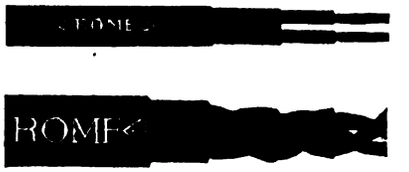
Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. This company has given the closest attention to and has perfected a very complete line of wires used in electric lighting, starting and ignition systems for automobiles. Send for our descriptive bulletin.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Bourn Rubber Co., 58 Warren St., Providence, R. I.
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" multiple conductor primary and lighting cable is made with 1, 2, or three conductors, as desired. Single conductor cables run from size 16 to 8 B. & S., having from 26 to 165 strands of No. 30 wire. "Paranite" starting cable, is made in sizes 6 to 00 and has double braid cover. No. 6 has 133 strands of No. 27 wire, No. 00 has 259 strands No. 23 wire. This company also makes the "Peerless" double braid starting cable and "Peerless" auto cable. See display advertisement on pages 1235-1239.—Adv.
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Otter Mfg. Co., Inc., 243-45 W. 17th St., New York, N. Y. "Individual Container."
Packard Electric Co., Warren, Ohio. "Packard," "Packard Junior."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons So., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
ROME WIRE CO., DIAMOND BRANCH, Buffalo, N. Y.—Owing to the fact of the voltage used in automobile lighting is all low tension current, it is not necessary to have a heavy rubber wall to insulate the copper conductor. In



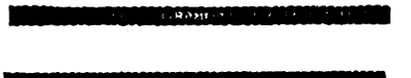
Rome Lighting and Starting Cables

our lighting cables we have used a rubber wall of sufficient quality and thickness to meet the demands that will be made upon it. Over the rubber insulation is placed a glazed cotton braid with our "Diamond Crown" finish. In order to withstand chafing and abrasion to a greater degree than our single braid is able to offer, and for the benefit of those desiring a cable of greater resisting powers, we furnish a cable made up with two braided coverings over the rubber insulation, the last braid being treated with our "Diamond Crown" finish, making it oil and acid repellant. In some in-



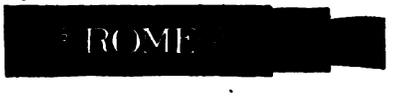
Rome Lighting and Starting Cables

stances, it is desirable to have two lighting cables under one cover. Where a neater job and a better appearance is desired, we recommend our duplex lighting cable. Each conductor of this style is braided with different colored cotton yarn, thereby making it possible to connect terminals properly without confusion. Where lighting cables are to withstand extra hard usage and also for appearance's sake, some people prefer to use armored cables. These cables are composed of flexible copper



Rome Armored Cables

conductors, insulated with two layers of varnished cambric tape, applied in opposite directions, covered with a cotton braid, impregnated with an oil and waterproof finish and then covered with a strip of electro-galvanized steel. Owing to the heavy amperage used in starting a car, it is necessary that a wire of rather heavy carrying capacity be used in carrying the current from the battery to the starting motor. This style of cable is also used in connecting one terminal of the battery to the ground. Owing to the size of the wire



Rome Lighting and Starting Cable

and the advisability of having this wire as flexible as possible, the copper conductor is made up of a number of fine, soft-drawn tinned copper wires in order to obtain a maximum amount of flexibility. See display adv. page 1247. —Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Tubular Woven Fabric Co., Main & Carver St., Pawtucket, R. I.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

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WIRE, AUTOMOBILE, MISCELLANEOUS.—Automobile wire for use on the miscellaneous low-voltage circuits, such as the horn, spotlight, rear traffic signals, bells on electric vehicles, etc., does not require the same insulation as the starting and ignition circuits. Rubber-covered stranded conductor is generally used for this purpose. A braid is commonly applied and often two wires are twisted together into a pair.

Manufacturer:

ROME WIRE CO., DIAMOND BRANCH, Buffalo, N. Y. Rome "Spotlight" or horn wire. This wire consists of a flexible copper strand, cotton wrapped,



Rome Spotlight Wire

rubber-insulated, braided with a black glazed cotton and finished with an oilproof varnish and is used extensively in connecting spotlights, horns or other accessories in which the current used is of low voltage. The principal size used for this purpose is No. 18 B. & S. Gage, although other sizes are made up as requirements demand. See display adv. page 1247.—Adv.

WIRE, AUTOMOBILE, STARTING.—Wire used in the starting circuits of gasoline automobiles is quite heavy and is made of several strands. For this reason it is often called starting cable. The necessity for the large cross-sectional area is that a large current, often in excess of 50 amperes, is carried, with a potential usually of only 6 or 12 volts. Without a large conductor the voltage drop and heating would be excessive. Where the starting wires are used around the battery they are usually rubbed-covered without any braid, because they are then not affected by the acid spray.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.

AMERICAN STEEL & WIRE CO. Sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. This company has given the closest attention to and has perfected a very complete line of wires used in electric lighting, starting and ignition systems for automobiles. Send for our descriptive bulletin.—Adv.

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."

Bourn Rubber Co., 58 Warren St., Providence, R. I.

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)

INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite," "Peerless." For description see classification Wire Automobile, Lighting and adv. pages 1235-1239.—Adv.

Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.

Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.

Marion Insulated Wire & Rubber Co., Marion Ind. "Eagle Brand."

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Otter Mfg. Co., Inc., 243-45 W. 17th St., New York, N. Y. "Individual Container."

Packard Electric Co., Warren, Ohio. "Packard," "Packard Junior."

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

Roebling's Sons Co., John A., Trenton, N. J.

ROME WIRE CO., Rome N. Y. (See display adv. page 1247.)

ROME WIRE CO., DIAMOND BRANCH, Buffalo, N. Y. For description see classification Wire, Automobile, Lighting.—Adv.

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I.

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, BLASTING.—Blasting or leading wire is used to lead from the supply main to the charge in blasting to furnish the energy for explosion of the charge. It consists of insulated wire of small diameter, similar to annunciator or telephone wires, with or without rubber insulation, and in single or twisted-pair types.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of wire used in blasting.—Adv.

Atlas Powder Co., 140 N. Broad St., Philadelphia, Pa.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

New England Electrical Works, Lisbon, N. H.

New York Blasting Supply Co., 11 Broadway, New York, N. Y. "New York."

Okonite Co., The, Canal St., Passaic, N. J.

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE BONDS.—See Bonds, cable, electrolysis preventive. Bonds, rail.

WIRE-BRAIDING AND TAPING MACHINES.—Machines carrying a number of rotating spools of threads which are caused to revolve, usually in alternately opposite directions, around an uncovered or partly insulated wire drawn through the machine, thus weaving on it a braided insulation or outer protective covering. Taping machines are machines carrying one or more reels of tape which are caused to rotate around an uncovered wire drawn through the machine, thus covering it with one or more overlapping layers of fabric or paper tape. Both these classes of machines are often motor-driven.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."

New England Wire Machinery Co., Water Front St., New Haven, Conn.

Textile Machine Works, Reading, Pa.

Wardwell Braiding Machine Co., Central Falls, R. I. "Wardwellian."

WIRE, BRASS.—Brass wire is seldom used as an electrical conductor, but is generally furnished in hard-drawn grades as tempered spring brass. In this form it is used in various coiled springs, such as hinge springs and contact-making springs.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.

American Copper Products Corp., 200 Broadway, New York, N. Y.

Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."

Bay State Insulated Wire & Cable Co., Hyde Park, Mass.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Chase Metal Works, 236 Grand St., Waterbury, Conn.

Dallas Brass & Copper Co., 820 Orleans St., Chicago, Ill.

Driver-Harris Co., Harrison, N. J.

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

Halstead Wire Co., Inc., 132 Front St., Rome, N. Y.

Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."

Manhattan Brass Co., 332 E. 28th St., New York, N. Y.

McAvity & Sons, Ltd., T., King St., St. John, N. B., Can.

Plume & Atwood Mfg. Co., 470 Bank St., Waterbury, Conn.

Roebling's Sons Co., John A., Trenton N. J.

SCOVILL MFG. CO., 99 Mill St., Waterbury, Conn. (See display adv. page 1327.)

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

WIRE, BREWERY CORD.—See Cord, flexible, brewery.

WIRE, BRONZE.—Bronze is an alloy of copper and tin, with the addition of zinc or other metals in some cases. One of the bronzes largely used as an electrical conductor in the form of wire is phosphor bronze, which see. The conductivity of bronze is less than that of copper, but it is much stronger and is used as binding wire, antenna wire, etc., in places where reliability is required. Silicon bronze, an alloy of copper, silicon, sodium and in some cases tin and zinc, is also used in the form of wire. Its resistivity is from 2.2 to 2.5 times that of copper, but it is from 35 to 70% stronger. Bronze wires are also coming into favor as trolley wires in places of hard usage.

Manufacturer:

American Copper Products Corp., 200 Broadway, New York, N. Y.

WIRE, CANVASITE CORD.—See Cord, flexible.

WIRE, CAR, AND CABLE.—Car wire and cable is used in wiring electric railway cars and steam railroad cars that are lighted by axle-driven generators, head-end sets or storage batteries. It is usually stranded conductor, especially in sizes from No. 0 to No. 10 A. W. G. Single conductors are used for sizes up to No. 16 A. W. G. Each conductor is covered with a coating of 30% pure rubber compound and with one or two cotton braids which are saturated. This wire is used for the lighting circuits of individual cars and for master control circuits. When trailers are used on electric motor cars and when the head-end system is used for steam-train lighting a cable is required to connect the cars together. This is composed of the same kind of conductors with an outer rubber coating and two layers of saturated braid. Another form, known as car jumper cable, is used for connecting the control circuits of adjacent multiple-unit cars. This is a flexible cable composed of from 5 to 30 stranded rubber-covered conductors covered with a braid. These conductors are cabled with dry jute fillers and covered with a rubber tape and then a coating of 30% rubber compound and two saturated braids.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.

AMERICAN, STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture the well known "Americore" line of car cables for light and power circuits, and for electric cars and motor-lead cables. —Adv.

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin." "Neptune." "Triton." (See display adv. page 1252.)

Bay State Insulated Wire & Cable Co., Hyde Park, Mass.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. "Habirlite." (See display adv. pages 1244-1245.)

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" car wire is made in 7-wire strand type, single, double and triple weatherproof braid. The strand is covered be-

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fore insulating with a wrap of cotton. Sizes run from No. 8 to No. 1 B. & S. The 49-wire strand "Paranite" car wire can also be supplied in either single, double or triple braid weather-proof finish. See display advertising on 1235-1239.—Adv.

Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Philadelphia Insulated Wire Co., 200 N 3rd St., Philadelphia, Pa.

ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.

Roebling's Sons Co., John A., Trenton, N. J.

ROME WIRE CO., Rome, N. Y. (See display adv. pages 1247.)

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg. Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE CHIEF, TELEPHONE.—A person has charge of the maintenance of outwires and cables and often of the ruments.

WIRE CLIPS.—See Clips, wire rope.

WIRE CONNECTORS.—See Connectors, Connectors, emergency; Connectors, tension, separable; Connectors, solder-Connectors, spring clip.

WIRE, COPPER, BARE, TRANSMIS-ON LINE, ETC.—On lines where the age is too high to permit work being on them by ordinary means the ex-e of insulation is not warranted and mitted except where required by ances. Solid copper wire is usually drawn as used for overhead lines. tranded form both annealed and hard-n conductors are used. The strength rd-drawn wire is from 55,000 to 65,000 per square inch, that of annealed being from 35,000 to 45,000 lbs. per e inch. Hard-drawn is preferable ansmission and for long spans, but led wire has advantages for distribu-lines. Hard drawn copper wire is sed extensively in the smaller sizes lephone lines. Also see Wire, trolley.

ufacturers:

y Metal Wire Co., 154 Nassau St., w York, N. Y.

ERICAN BRASS CO., THE, Waterry, Conn. Bare copper wire put up wanted, in coils or on reels. Soft l hard-drawn for insulating; medium d drawn for power transmission es; hard drawn for telephone and lley lines. Flat copper wire for nature and field coils. Fine copper e for all electrical purposes. (For ation of mills and factories, see nabetical listing under firm name.)—

ican Copper Products Corp., 200 adway, New York, N. Y.

ican Electrical Works, Phillipsdale, I. "Emelectric."

RICAN INSULATED WIRE & BLE CO., 954 W. 21st St., Chicago, "American Brand." (See display page 1250.)

RICAN STEEL & WIRE CO., sales es in principal cities. See display page 1240 for list of offices and trations and descriptions of our ucts. We manufacture a complete of trolley wire, also bare wires and es to meet any specification.—Adv.

ONDA COPPER MINING CO., ng Mills Department, Sales Office, Conway Bldg., Chicago, Ill. The any's mill at Great Falls, Montana, e only plant of its kind located of the Mississippi river. The ad-ges of this location for shipments iddle-western and western points ite apparent. Every step from the g of the ore to the shipping of the ed wire is conducted under Ana-supervision and direction. All for telephone, telegraph, power mission and all industrial uses are from Anaconda electrolytic cop-he average metallic impurity con-f which is less than 1/100 of 1%. splay advertisement on page 1246.

N MFG. CO., 2300 S. Western Chicago, Ill.

ort Brass Co., Bridgeport, Conn. o-Electric."

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Chase Metal Works, 236 Grand St., Waterbury, Conn.

CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (See display adv. page 1249.)

Copper Clad Steel Co., Rankin, Pa. "Copperweld."

DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.

Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.

Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."

ILLINOIS WIRE & CABLE CO., Sycamore, Ill. "Illinois." (See display adv. page 1250.)

Josyln Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.

Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."

National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y.

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

PHILLIPS WIRE CO., Pawtucket, R. I. "Phillips."

Roebling's Sons Co., John A., Trenton, N. J.

ROME WIRE CO., Rome, N. Y., manufactures a complete line of round, flat, square, bare and tinned, soft and hard drawn copper wire, performing every manufacturing operation from the wire bar to the finished article. The diamond dies through which the wire is drawn are manufactured in the company's own plant and are accurate as to gauge. Special methods of annealing the wire insure uniform softness. Rome wire standard specifications require that round copper wire must be uniformly cylindrical, smooth, free from splinters, cracks or laminations and clean; that the tinned wire must be uniformly tin coated, clean and free from lumps, spots, kinks, scraped surface or corrosion. The soft bare and tinned round copper wire shall be thoroughly annealed after the last drawing operation, and must be thoroughly soft throughout. Conductivity of copper used shall not be less than 98 per cent, and the conductivity of the tinned wire shall not be less than 96 per cent, 100 per cent conductivity being based on copper having a resistance of 0.1530 ohms per meter gram at 20 deg. C. For the purpose of calculating weights, cross sections, etc., the specific gravity of copper shall be taken as 8.89 at 20 deg. C. Tensile strength and elongation standards are strict, ranging from 40,000 lbs. ultimate tensile strength, and 17 per cent minimum elongation in 10 ins., for the 0.003 to 0.007 in. soft annealed bare and tinned round copper wire, up to 36,000 lbs. ultimate tensile strength and 35% minimum elongation for all wire over 0.460 ins. in diameter. For bare wire the average variation in diameter does not exceed 1 per cent above or below the nominal gauge on all sizes heavier than .0100 in. nor more than .0001 ins. for the smaller sizes. Tinned wire diameter does not exceed 3 per cent above nor 1 per cent below the nominal gauge on all sizes heavier than .0100 ins. nor vary more than .0003 ins. above or .0001 ins. below for the smaller sizes. The quality and thickness of the tin coating on tinned wire is subjected to a standard test with hydrochloric acid, and a high standard of tinning is required in all sizes. Rome wire is furnished in continuous lengths, such joints as necessary being so made that the wire at that point is identical in softness and dimensions with the rest of the wire and guaranteed to have 95 per cent of its strength. Certain standards for coiling, reeling and spooling bare and tinned copper wire are followed but wire will be wound on order to special specifications if desired.



Rome Bare Copper Wire



Rome Bare Copper Wire

Hard drawn bare and tinned copper wire can be furnished in all sizes, standards ranging from 0.040 ins. in diameter up to 0.460 ins. Rome wire standard specifications require that the 0.040 ins. wire shall have a minimum ultimate tensile strengh of 67,000 lbs. per sq. in. and a minimum elongation in 10 ins. of 0.7 per cent. The 0.460 in. wire shall have a minimum ultimate tensile strength of 49,000 lbs. per sq. in. and a minimum elongation in 10 ins. of 3.75 per cent. For other Rome Wire products see display advertisement on page 1247.—Adv.

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, COPPERCLAD, STEEL.—The strength of steel being greater than that of copper, copperclad steel wire has been developed for use where economy of first cost is a factor and the load is relatively small. The copper coating increases the conductivity and protects the steel from corrosion. This wire has also been used for lightning protective grounded wire above transmission lines with good effect.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

Copper Clad Steel Co., Rankin, Pa. "Copperweld."

Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."

HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)

INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelpha, Pa.

SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."

Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard." "C. C. C."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE CUTTERS.—See Cutters, wire.

WIRE, DECK.—See Cord, flexible, deck or marine.

WIRE-DRAWING DIES.—Devices for reducing the diameter of wires, consisting of blocks of hardened alloy steel for the larger sizes and diamonds for the smaller sizes, each perforated with a hole of successively smaller diameter until the last die, which has the exact diameter of the finished wire. The dies have bell-shaped entrance and exit edges. The wire is drawn through the dies and wound on a drum and is reduced to the final size in several stages.

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Manufacturers:

Eby Mfg. Co., H. H., 13th & Wallace Sts., Philadelphia, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Midwest Mfg. Co., 117 N. Wells St., Chicago, Ill.
New England Wire Machinery Co., Water Front St., New Haven, Conn.
VIANNEY WIRE DIE WORKS, 1 Union Sq., New York, N. Y. Diamond dies for drawing all kinds of metals, made from selected diamonds, the weights of which are guaranteed and stamped on the mountings. All sizes can be supplied from the New York plant, which also keeps in repair wornout diamond dies. Drilling plants are located at Trevoux and Vezeronce, in France.—Adv.



Vianney Diamond Die

WIRE DRAWING MACHINES AND BENCHES.—Machines consisting of a line or series of drawing dies of successively smaller diameters and rotating mandrels between each pair of dies. The mandrels are connected to a common driving mechanism through gearing. A large coil of copper "rod" is placed at one end and drawn through the dies, becoming smaller in diameter as it passes through each die. It is wrapped around each mandrel two or three times to give a uniform and steady tension as it passes each die. The gearing of the mandrels is such that those handling the smaller diameter wire will wind up more than the first mandrel which winds the wire as it leaves the first die. This gives a steady tension and also makes up for the increased length of the wire as it progresses through the machine. In some machines, the mandrels run in water or in a cooling and lubricating compound. The dies are also cooled, as the friction in the dies heats them up as well as the wire. Since the mandrels and dies are mounted on a large raised horizontal platform resembling a bench, these machines are commonly called wire-drawing benches.

Manufacturers:

Langelier Mfg. Co., Arlington, Cranston, R. I.
Standard Machinery Co., Auburn, R. I. (P. O. address, Elmwood Station, Providence, R. I.)
Vaughn Machinery Co., The, Cuyahoga Falls, Ohio.

WIRE, ELEVATOR.—See Cable, elevator trolley, lighting and signaling.

WIRE, ENAMELED, MISCELLANEOUS.—Copper conductors provided with a hard elastic insulating covering of enamel applied in thin successive coats and baked on at a high temperature. The coating is not affected by moisture, ordinary solvents or moderately high degrees of heat. Enameled wire is used largely for winding magnet coils, induction coils, etc., where a saving of space is realized because of the thinner insulation. The coils can be worked at higher temperatures and need not be so thoroughly protected against moisture. Enameled wire is also coming into extensive use in other lines, such as for telephone cables, where it not only permits a smaller cable but effects a saving in the cost of manufacture, because of the large increase in the price of silk floss, which was formerly used. Other application of it are for field and armature coils, especially on small motors, ignition coils, high-resistance receivers for radio telephony and telegraph, small transformer windings, etc.

Manufacturers:

ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. "Acme." (See display adv. page 1248.)
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of enameled magnet wire. Send for special bulletin.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. pages 1251.)
MARING WIRE CO., Clay & 8th Sts., Muskegon, Mich. "Maring Process."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. (See display adv. page 1247.)
Toledo Enameled Wire Products Co., The, 1345-1349 Miami St., Toledo, Ohio. "Toledoenamel."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

WIRE, FISH.—See Tapes or wires, steel fish.

WIRE, FIXTURE.—Copper conductors of No. 18 or 16 A. W. G. generally provided with 1/64 in. or 1/32 in. rubber insulation and an outer impregnated braid of silk or cotton. Fixture wire is made with either single or stranded conductors. Asbestos, applied and impregnated with a binding cement, is sometimes used in place of the rubber. Fixture wire is used for the internal wiring of lighting fixtures, brackets, chandeliers, etc., especially where it must be drawn into arms or stems of small diameter, hence the need for a small wire. Where the fixtures are subjetced to temperatures exceeding 120° F., asbestos-insulated or other heat-resisting fixture wire is required.

Manufacturers:

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a full line of "Americore" fixture wires.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin." "Neptune." "Triton." (See display adv. page 1252.)
Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite." "Belden."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata." "Paraxel." "Bishop Standard." "Bishop Snecial." "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. "Deltabeston." See Wire, asbestos covered. Adv.
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. Under its trade name "Paranite," this company makes fixture wire solid conductor, single braid, in sizes from No. 14 to 6, B. & S., solid conductor, double braid in sizes from No. 14 to No. 4 B. & S., solid duplex conductor, double braid, for conduit work, in sizes from No. 14 to No. 6 B. & S. All of the above are made in stranded conductors of the same nominal size as the solid. See display advertisement on pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Morse, Frank W., 289 Congress St., Boston, Mass.
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. (See display adv. pages 1302-1304.)
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome rubber covered fixture wire is manufactured in strict accordance with the National Electric Code Standard, using such material and employing manufacturing methods approved by the Underwriters Laboratories. The No. 18 stranded fixture wire has an insulating wall 1/64 in. thick. All Rome fixture wires are made of either solid or stranded tinned copper conductors, insulated with vulcanized rubber, covered with a single braid of cotton, saturated with black weatherproof compound and smoothly polished. Both light and heavy insulation can be furnished, that having 1/64 in. insulation being approved by the Underwriters' Laboratories for arms of fixtures not exceeding 24 ins. in length and to supply not more than 16 c.p. or its equivalent. The heavily insulated fixture wire is made in accordance with the Underwriters' Laboratories code rules and may be used for other purposes than electric light fixtures. Rome fixture wire may be identified by the one yellow and one green thread woven together in braid the entire length of the coil. It is manufactured in No. 18 gage with insulation of either 1/64 in. or 1/32 in. thick, No. 16 gage with 1/32 in. insulation and No. 14 gage with 1/16 in. insulation. For other Rome Wire products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simcore."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., New York, N. Y. "Paracore" fixture wires are rubber insulated for 300 volts. Adv.
Wolf & Davis, 71-73 Spring St., New York, N. Y.

WIRE, FLAMEPROOF, OR STATION CABLE.—Copper conductors having two or more braids of cotton impregnated with a flame-resisting compound for use in dry places on switchboards or where subject to moderate heat normally and the possibility of an occasional short-circuit in neighboring conductors. If ordinary inflammable insulation were used, there would be danger of a quick spread of fire from one conductor to another. Also see Cable, switchboard; Wire, asbestos-covered.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of fireproof cable, high voltage cables for interior service, protected by heavy braids and thoroughly flameproof to give exceptionally good protection.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" twisted flame proof or jumper wire is made in sizes 22, 20 and 19 B. & S. Conductors are soft drawn tinned copper rubber insulated, braided and then saturated with flameproof compound.

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For other "Paranite" products, see display advertising on pages 1235-1239.—Adv.
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen Sts., Chicago, Ill. (See display adv. page 1327.)
National India Rubber Co., Bristol, R. I.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, FLEXIBLE CORD.—See Cord, flexible (10 types.)

WIRE FUSE.—See Fuse, wire and strip.

WIRE GAGES.—See Gages, wire; Gages, wire-measuring.

WIRE-GALVANIZING MACHINES.—Apparatus for passing iron or steel wire in a continuous process through a bath of molten zinc or an electroplating bath to provide a galvanized protective coat-

Manufacturers:

Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."
U. S. Electro Galvanizing Co., 32-34 Stockton St., Brooklyn, N. Y.

WIRE, GERMAN SILVER.—A high-resistance wire, now generally called "nickel-silver" and described under Wire, resistance.

WIRE GRIP.—Trade name for wood moulding made by the Mitchell Moulding Co., 15th St. & Circle Ave., Forest Park, Ill.

WIRE GRIPS.—See Grips, wire.

WIRE, GUY.—See Strand, galvanized steel.

WIRE, HEATER OR STOVE.—A wire used for wiring electric stoves and ranges in boiler rooms, drying ovens and other places of excessive heat and low moisture. It is made in sizes larger than No. 6 A. W. G. and is insulated with vitrified asbestos with a protective covering of braided cotton. Also see Cord, electric, portable heater; Wire, asbestos-covered.

Manufacturers:

American Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN ELECTRICAL HEATER CO., Woodward, Burroughs & Cass Sts., Detroit, Mich.
American Insulating Machinery Co., Carhill & Huntingdon Sts., Philadelphia, Pa. "American."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of heater or stove wire.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Bird Electric Co., Inc., 9 Church St., New York, N. Y.
Canadian General Electric Co., Ltd., 212 King Sts., W., Toronto, Ont., Can.
D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. See "Asbeston." See Wire, asbestos-covered. Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gilbert Heating & Lighting Co., 220 Gold St., Brooklyn, N. Y. "Gold."
HAZARD MANUFACTURING CO., Wilkes-Barre, Pa. (See display adv. pages 1244-1245.)
INDEPENDENT LAMP & WIRE CO., 1790 Broadway, New York, N. Y. See display adv. page 1251.)
Klein, Frank W., 289 Congress St., Boston, Mass.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Textile Machine Works, Reading, Pa.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, IGNITION.—See Wire, automobile ignition.

WIRE-INSULATION WINDING MACHINES.—These are the machines in which the cotton or silk insulation is wound onto wire. The wire is drawn through the machines, passing through a number of guiding blocks. A revolving head is used to carry the insulating yarn, which is applied in a group of strands. The lay of the insulation is determined by the relative speeds of the revolving heads and of the wire passing through. After the wire passes through one head it has one serving or layer of insulation on it. It then goes through another head, which usually revolves in the opposite direction so that the superposed servings are of opposite direction. This helps to prevent unwrapping of the insulation. The wire may pass through another head and have a third serving applied also, after which it is coiled on large spools or reels for impregnation or other treatment, if desired.

Manufacturer:

American Insulating Machinery Co., Philadelphia, Pa.

WIRE, IRON CORE, FOR INDUCTION COILS, ETC.—Iron wire in bundles is used almost entirely for the core of induction coils or spark coils, and when wound into a ring, as the core for telephone repeating coils. A very high-grade of pure soft iron is required for this purpose, as the magnetic properties depend upon the chemical properties, heat treatment and mechanical treatment. Impurities in the iron decrease its permeability and increase the iron losses. Norway or Swedish iron has been generally acknowledged as the best grade of wrought iron and is used largely for this purpose. Some domestic iron, doubly refined and specially annealed in covered boxes and allowed to cool very slowly is also used with good results.

Manufacturers:

American Rolling Mill Co., The, Middletown, Ohio. "Armco."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Roebling's Sons Co., John A., Trenton, N. J.
Seneca Wire Mfg. Co., Fostoria, Ohio. "Seneca."

WIRE, IRON LINE, TELEGRAPH AND TELEPHONE.—Iron line wire is used on some sections of telephone and telegraph lines, especially where initial line construction economy is desired and long spans are required. To a limited extent it has been used for rural light and power lines. The type generally used is known as "Extra Best Best" (E. B. B.) iron wire. It has a much lower conductivity than copper and larger sizes must be used if line loss is to be kept down. Copper is becoming more common now, and for very long lines is used almost exclusively.

Iron wire in the other grades, "Best Best" and steel are also used in some places. Best Best is used by telephone companies and steel is used for short distances where exceptionally long spans are unavoidable and where conductivity must be sacrificed for strength. Steel and iron wire are usually measured by the Birmingham wire gage. Nearly all iron wire is carefully galvanized to prevent corrosion and a small amount is covered with a rubber coating and a weather-proof braid. Also see Wire, copper, bare, transmission line, etc.

Manufacturers:

American Electrical Works, Phillipsdale, R. I.
American Rolling Mill Co., The, Middletown, Ohio. "Armco."
AMERICAN INSULATED WIRE & CABLE CO., Chicago, Ill. "American Brand" BB and EBB steel and iron telegraph and telephone wire is guaranteed to meet the required laboratory tests. It is made with both double and triple braids in sizes No. 18 to No. 4 BWG, with the same care that our standard weatherproof copper wire is made. See page 1250.—Adv.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of iron line wire for telephone and telegraph purposes.—Adv.
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Gulf States Steel Co., Brown-Marx Bldg., Birmingham, Ala.
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Indiana Steel & Wire Co., Muncie, Ind.
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.

WIRE, LEAD COVERED.—See Cable, lead-covered, miscellaneous; Cable, lead-covered, power types; Cable, telegraph and telephone, aerial and underground.

WIRE, LEADING OR CONNECTING.—See Wire, blasting.

WIRE, MAGNET, ASBESTOS-COVERED.—Wire for winding electromagnet or solenoid coils that are subject to considerable heating is sometimes asbestos-covered. This covering can withstand much higher temperatures than cotton, silk or enamel. It is therefore used for the magnet coils of arc lamps, lifting magnets, field magnets of furnace-regulating and other heat-exposed motors, and for similar windings subjected to high temperatures.

Manufacturer:

D & W FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. See Wire, asbestos covered.—Adv.

WIRE, MAGNET, COTTON OR SILK-COVERED.—Copper wire in sizes from Nos. 16 to 40 A. W. G. wound with either one or two layers of silk or cotton thread. Used on solenoid or electromagnet coils and for windings where high temperature, moisture and the action of destructive fluids or fumes are not present. Single cotton-covered wire is often designated S. C. C.; double, D. C. C. Likewise for silk, S. S. C. and D. S. C.

Manufacturers:

ACME WIRE CO., THE, main office and plant, New Haven, Conn. Branch offices at New York, Chicago and Cleveland. Manufacturers of Magnet Wire in all the standard insulations, comprising enamel, cotton and silk, and also combination of enamel and cotton ("Cottonite") and of enamel and silk ("Silkenite"). Also specialists in winding all types of coils in quantities to engineer's specifications. See advertisement on page 1248.—Adv.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
American Enameled Magnet Wire Co., Muskegon, Mich. "American."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of magnet wire, cotton or silk covered, round, rectangular or square; also paper-covered and asbestos-covered.—Adv.
Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. Manufacturer of enameled, silk and cotton-covered magnet wires; rubber-covered wires and cables; telephones and wireless cords and cordage; coils and coil windings; braided and stranded copper cables, and pigtails, terminals and connectors.—Adv.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (cotton). (See display adv. page 1249.)
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display advertisement on page 1250.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

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Gottschalk Mfg. Co., John W., Philadelphia Pa. "Wizard."
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
MARING WIRE CO., Clay & 8th Sts., Muskegon, Mich. "Maring Process."
Massachusetts Electric Mfg. Co., 11 Margin St., West Lynn, Mass. "Massachusetts."
National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y.
New England Electrical Works, Lisbon, N. H.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
Reliable Machine Co., The, 1188 Main St., Bridgeport, Conn.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Rome Electrical Co., Rome, N. Y.
ROME WIRE CO., Rome, N. Y. Rome silk and cotton magnet wire, round, flat and square is guaranteed accurate as to gage and uniform thickness of insulation, conforming to the most approved standards. It can be furnished with single, double or triple coverings of silk or cotton. Magnet wire can be furnished to meet any special requirements if desired, but Rome Wire standard specifications cover types and sizes suitable for all ordinary purposes. The insulation of single, double or triple cotton covered wire consists of one, two or three layers of unbleached cotton yarn. Each wrapping of yarn is firmly applied and is continuous and free from "skips." The completed wrappings form a smooth, continuous and uniform insulation at all points on the wire. In double and triple covered wire the wrappings are wound right and left hand alternately. All wire is furnished in continuous lengths, free from joints, necessary joints being so made that the bare wire at that point is identical in softness and dimensions with the rest of the wire and has at least 95% of its strength. The method of spooling and coiling is illustrated,



Rome Magnet Wire

each spool or reel containing only one piece of wire. The bare wire used in Rome silk and cotton magnet wire conforms to the general rigid specifications of Rome bare copper wire (see that classification). The cotton covered wire is regularly made in all sizes from 4/0 Brown & Sharpe gage to 40 gage. The illustration below shows one of the types of large size magnet wire covering machines. Silk covered magnet wire is manufactured in fifteen



Magnet Wire Covering Machine

colors, either single or double covering under the same general specifications as applying to cotton covered wire, and in sizes 15 to 40 Brown & Sharpe gage. Cotton covered copper ribbon is manufactured from standard Rome bare copper wire, soft, flat or square, round edge, with single, double and triple cotton yarn coverings. The insulation is so applied as to give the least possible hardening effect to the ribbon, which is thoroughly annealed after the last rolling operation. The bending test for Rome cotton covered copper ribbon is identical with the test for Rome copper ribbon (see that classification) for identical sizes, and the general specifications are the same. Double cotton covered square magnet wire and rectangular ribbon is manufactured in practically all sizes and shapes up to .270 by .500 ins. For other Rome Wire products see display advertisement on page 1247.—Adv.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Toledo Enameled Wire Products Co., The, 1345-1349 Miami St., Toledo, Ohio. "Toledonamel."
Wolf & Davis, 71-73 Spring St., New York, N. Y.

WIRE, MAGNET, ENAMELED.—Copper wire having a very thin covering of enamel possessing high insulating and moisture-proof qualities. Made in sizes varying from No. 8 to No. 40 A. W. G., and used chiefly on solenoid or electromagnet coils where cotton or silk coverings would be quickly destroyed, as where water, alkalies, weak acids, alcohol, etc., are present. The enamel is applied to the wire by drawing it several times through a bath of liquid enamel, the latter being baked hard and dry each time. This covering remains flexible and should not crack when the wire is bent around a mandrel three or four times the wire diameter. In some cases enameled magnet wire is further covered with cotton or silk as additional protection to the enamel. Also see Wire, enameled, miscellaneous.

Manufacturers:

ACME WIRE CO., THE, Dixwell Ave., New Haven, Conn. "Enamelite." (See display adv. page 1248.)
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of enameled magnet wire.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenamel."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
DOWNEY CO., GILBERT H., 7 S. 17th St., Philadelphia, Pa.
DUDLO MFG. CO., Wall St., Fort Wayne, Ind. (See display adv. page 1250.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1233.)
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
KELLOGG SWITCHBOARD & SUPPLY CO., Adams & Aberdeen St., Chicago, Ill. (See display adv. page 1327.)
MARING WIRE CO., Muskegon, Mich. Manufacturers of "Maring Process" enameled, cotton and silk-covered magnet wire. In the manufacture of "Maring Process" enameled copper magnet wire, the Maring Wire Co. has departed from the conventional forms of manufacture, producing physical, chemical and electrical properties in its enamel insulation, obtained by successive coating and baking of high-grade insulating varnish under a process that is basically correct and proven so by many years of experiment and practical operation, with the following characteristics. Physical: The enamel is applied to the conductor in an adhesive, uniform, glossy smooth mass, rendering it tough, pliable, able to withstand rough usage. It will not crack, scale or peel off, being flexible to the breaking point of the wire. Chemical: Chemically inert to ordinary reagents; impervious to moisture; indestructible by any temperatures to which it may be subjected in commercial service. Electrical: Possesses a dielectric strength of 600 volts per mil of thickness. When the enamel wire is desired to be cotton or silk-covered, all the foregoing specifications with respect to enameled wire itself apply, and in addition the wire is efficiently covered with layers of a good quality of unbleached cotton yarn or silk, wrapped firmly, closely, evenly and continuously, free from knots and skips.—Adv.
Massachusetts Electric Mfg. Co., 11 Margin St., West Lynn, Mass. "Massachusetts."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electric Works, Ltd., Eugene F., Montreal, Que., Can.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome enameled copper wire is hard, glossy, elastic, tough, moisture proof, free of impurities, capable of withstanding high temperature without deterioration and more moderate temperatures for long periods without dielectric change.



Rome Enameled Magnet Wire

It is insoluble in water, alcohol, oil and most solvents, weak acids and alkalies. Having a dielectric strength of 600 volts per mil insulation it is superior in a large degree in insulating value to silk or cotton of equal thickness. Rome enameled wire is also furnished covered with silk or cotton. The bare wire used is manufactured under the strict Rome Wire specifications for soft bare and tinned round copper wire (see that classification). The wire is coated with an insulating film of enamel of uniform thickness free from lumps and foreign material. The insulating film is guaranteed to pass a severe test for dielectric strength. Enameled wire is wound on reels and spools, as illustrated and can be furnished in practically any size desired from .0031 in. to .1018 in., Brown & Sharpe gage from 12 to 40. Enameled cotton magnet wire consists of standard Rome enameled wire with one, two or three layers of high grade unbleached cotton yarn. Enameled silk magnet wire consists of standard Rome enameled wire with either one or two layers of good quality silk yarn (white unless otherwise specified). Each wrapping of yarn is firmly applied, continuous and free from skips and the several wrappings form a smooth, continuous and uniform insulation at all points on the wire. Double and triple covered wire are wound right and left hand alternately. Enameled cotton covered magnet wire is regularly furnished in any size from No. 12 to 40 Brown & Sharpe gage. Enameled silk covered magnet wire is regularly furnished in any size from No. 15 to 40 Brown & Sharpe gage. Reeling and spooling the same as for enameled wire. For other Rome Wire Company products see display advertisement on page 1247.—Adv.
Toledo Enameled Wire Products Co., The, 1345-1349 Miami St., Toledo, Ohio. "Toledonamel."

WIRE MEASURING REELS OR OUTFITS.—These outfits usually comprise a wire winder, or reel with crank and handle, for winding up the wire as it is being measured, and a meter consisting of a pair of self-adjusting rollers of known circumference geared to a dial or revolution counter. The wire is drawn through the meter by the winder and the meter shows either the revolutions or the length directly in feet. In some forms the reel is omitted.

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Manufacturers:

merican Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."
finneapolis Electric & Construction Co., 112 S. 7th St., Minneapolis, Minn.
Waldman, J. J., 64-66 Murray St., New York, N. Y.

VIRE, MINING MACHINE.—See Cable, ning machine; Cable, mining locomotive.

VIRE, MISCELLANEOUS AND SPE-AL.—This classification is for special ns of wire and for wire used for misaneous purposes, that is not listed elsere under Wire, Cable or Cord. Some the special forms are wire used for n-frequency purposes. One of these is wn as Litzendraht wire; it is used for ting radio coils. There are various er special forms and kinds of wire havproperties that adapt them to some icular electrical problem and which are made as a standardized product.

anufacturers:

anford Electric Co., Inc., 9 Church St., New York, N. Y. (sealing). "Vitroseal."
ommercial Research Co., The, 18 E. 41st St., New York, N. Y. "Eldred."
uyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio. (Wire formed to special shapes.)
agle-Picher Lead Co., 208 S. LaSalle St., Chicago, Ill.
ectrical Alloy Co., The, Morristown, N. J.
rrington & Co., 28-30 Grand St., Mount Vernon, N. Y.
ABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (locomotive headlight). "Haberlite." (See display adv. pages 1244-1245.)
zard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa. (locomotive headlight).
DIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. See display advertising on pages 1235-1239.—Adv.
w England Electrical Works, Lisbon, N. H.
ebling's Sons Co., John A., Trenton, N. J.

RE, MOTION-PICTURE.—A stranded uctor varying in size from No. 14 to 0 A. W. G., and insulated with a layer sbestos fiber over which an asbestos ing is woven. The outer cover is imated with a moistureproof compound. used for wiring motion-picture ma-s, projectors, rheostats, and similar nces requiring heat-resisting conrs. It is often called motion-picture or cable.

ufacturers:

oy Metal Wire Co., 154 Nassau St., ew York, N. Y.
erican Electrical Works, Phillipsdale, I. "Emelectric."
LDEN MFG. CO., 2300 S. Western ve., Chicago, Ill.
iop Gutta-Percha Co., 420-430 E. 25th .., New York, N. Y. "Balata," "Parcel," "Bishop Standard," "Bishop pecial," "Hytest."
ada Wire & Cable Co., Ltd., 2410 ndas St., West, Toronto, Ont., Can. Canada."
adian General Electric Co., Ltd., 212 ng St., W., Toronto, Ont., Can.
CAGO INSULATED WIRE & MFG. ., Sycamore, Ill. (See display adv. ge 1249.)
W FUSE WORKS OF GENERAL LECTRIC CO., Providence, R. I. eltabeston." See Wire, asbestos covd.—Adv.
oit Insulated Wire Co., 4561-4641 esson Ave., Detroit, Mich. "Detroit."
ERAL ELECTRIC CO., Schenectady, Y. (See adv. pages 1203-1223.)
EPENDENT LAMP & WIRE CO., 7 Broadway, New York, N. Y. (See play adv. page 1251.)
ite Co., The, Canal St., Passaic, J. "Okonite."
delphia Insulated Wire Co., 200 N. St., Philadelphia, Pa.
KBESTOS PRODUCTS CORP., P. O. wer 1102, New Haven, Conn.
ling's Sons Co., John A., Trenton, J.
E WIRE CO., Rome, N. Y. (See dis-y adv. page 1247.)
'LEX WIRE & CABLE CO., 201 ronshire St., Boston, Mass. "Simc."
lard Underground Cable Co., Westhouse Bldg., Pittsburgh, Pa. "Stand-."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, NICKEL.—Nickel wire has a resistance approximately six times that of copper. Nickel is a metal easily worked and it withstands continuous high temperatures. Nickel wire may therefore be used as anchor wires in tungsten lamps, as supports for heating elements and other apparatus having rather high temperatures. Nickel wire is made in sizes from No. 16 to 40 A. W. G., and may be insulated with either single or double servings of cotton or silk.

Manufacturer:

Electrical Alloy Co., The, Morristown, N. J.

WIRE OR CABLE, FEEDER.—Copper conductors of solid or stranded type provided usually with weatherproof and sometimes rubber insulation. They are used for running feeder circuits for street-railway lines, for power-transmission lines, lighting mains, etc. Feeder cables are frequently of such size that they are often designated by their circular mil. area, rather than gage number. Outside cables are invariably weatherproof and not rubber-covered.

Manufacturers:

American Copper Products Corp., 200 Broadway, New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of feeder or cable wire for incandescent lighting, street railway feeders, power transmission, electric light, telephone or telegraph service.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I. "I. X. L."
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, PACKINGHOUSE.—See Cord, flexible, packinghouse.

WIRE, PHOSPHOR BRONZE.—An alloy of copper, tin and phosphorus, and occasionally zinc and lead, which is made into wire having a conductivity about 35% of that of copper wire of the same size. Its principal advantage is its high tensile strength, which is over 100,000 lbs. per sq. in. It is used largely for armature banding wire, radio telegraph and telephone antennas and for reinforcing strands in cables, etc.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Copper Products Corp., 200 Broadway, New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
Barnes Co., The Wallace, Bristol, Conn. "Barnes-Made."
Bridgeport Brass Co., Bridgeport, Conn.
Driver-Harris Co., Harrison, N. J.
Electrical Alloy Co., The, Morristown, N. J.
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
New England Electric Works, Lisbon, N. H.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y., is prepared to manufacture many kinds of bronze wires to meet specifications calling for high tensile strength and high conductivity. The company has special facilities for casting mixtures and has benefited from extensive experimental work. The Special Rome Bronze wire is recommended for telephone, telegraph and trolley wire purposes where a very high conductivity is required, coupled with a tensile strength in excess of that of copper. Where a conductivity of 35% to 40% with a high tensile strength and very tough wire is required, The Rome Hyten wire is recommended. For other Rome Wire products see display advertisement on page 1247.—Adv.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

WIRE, PLATINUM. — See Platinum sheet, wire, gauze, etc.

WIRE POLISHING MACHINES.—Machines for burnishing or polishing the outer surface of the insulation on weatherproof, slow-burning or other similarly insulated wires. They are used with a special wax polishing compound that is applied evenly, and the polishing gives a hard smooth finish to the wire.

Manufacturers:

General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
New England Butt Co., 403 Pearl St., Providence, R. I.

WIRE, RAILWAY SIGNAL.—This wire is made to conform with very exacting specifications of the Railway Signal Association, giving a high-grade product that is standardized. This is very important as upon the reliability of the signals depends the safety of millions of passengers. The wire is specially rubber-coated, having a coating known as R.S.A. compound which is thicker than that usually employed on rubber-covered wire. One cotton braid, weatherproofed, is placed over the rubber. It is usually made in sizes from No. 0 to No. 18 A.W.G. Signal wire is also made up into cables for aerial and underground work and also as submarine cables. The voltage rating on all of these is 660 volts or less.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y.
Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. "Amerite" wires and cables meet the rigid specifications of the Railway Signal Association. They are insulated with 30% Para rubber or higher grade, as may be required by the leading railways of the country.—Adv.
Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata," "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
Copper Clad Steel Co., Rankin, Pa. "Copperweld."
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Okonite Co., The, Canal St., Passaic, N. J.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

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Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE REELS.—See Reels, leading wire (for blasting); Reels, payout and takeup.

WIRE, RESISTANCE, MANGANIN, NICHROME, NICKEL-SILVER, ETC.—Conductors having a much higher specific resistance than copper or aluminum and ordinarily used in the construction of resistors and heaters. Resistance wires are usually alloys containing various proportions and combinations of copper, aluminum, nickel, chromium, zinc, manganese and steel. Nickel-silver, formerly called German silver, is more extensively used than any other resistance material. It is an alloy of copper, nickel and zinc, and is usually listed in terms of the nickel content as 18 per cent or 30 per cent alloy; 18 per cent alloy has about 18 times the resistivity of copper and 30 per cent alloy about 28 times the copper resistivity. A copper-manganese alloy having a very low or negligible temperature coefficient is known as manganin. It contains a small amount of either nickel or aluminum and is usually composed of copper, manganese or ferromanganese and nickel. Copper-nickel alloys are also used extensively for resistors. An alloy of copper and nickel found in nature is known as Monel metal in its purified form. Nickel-steel alloy has a resistivity nearly 50 times that of copper, but is not as resistant to oxidation or other corrosion as some other alloys. Nickel-chromium alloys are much superior in this respect and also have a higher specific resistivity and consequently are used for resistance wires where very high resistivity is desired, such as heating elements. One much used alloy of these metals is known as Nichrome.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.
AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture "Tico" resistance wire for use where a high specific and uniform resistance is required.—Adv.
Baker & Co., Inc., 54 Austin St., Newark, N. J. (Manganin.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenamel."
Bishop & Co., Platinum Works, J., Malvern, Pa.
Branford Electric Co., Inc., 9 Church St., New York, N. Y. "Feronic," "Cupronic."
Driver-Harris Co., Harrison, N. J. "Advance," "Climax," "Nichrome," "Therlo," "Kromore," "Nichrome II."
Electrical Alloy Co., The, Morristown, N. J. "Calido," "Rayo," "Comet," "Ideal," "Lucero," "Phenix."
Gold Car Heating & Lighting Co., 220 36th St., Brooklyn, N. Y. "Gold."
Halstead Wire Co., Inc., 132 Front St., Rome, N. Y.
Hoskins Mfg. Co., Lawton & Buchanan Sts., Detroit, Mich. "Chromel."
Metal Products Co., Inc., 549 W. Washington St., Chicago, Ill. "Electric," "Eureka," "Excelsior," "Acme," "Superior," "Peerless," "Premier."
New England Electrical Works, Lisbon, N. H.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

WIRE ROPE LUBRICATING CO.—40 Clinton St., Newark, N. J. Manufacturer of lubricating and preservative compounds for wire rope. President, treasurer and general manager, R. W. Tobin.

WIRE, RUBBER-COVERED. — Wire conductors, either solid or stranded, varying in size from No. 14 A. W. G. to 1,000,000 circular mils or over, and insulated by a wall of vulcanized rubber compound completely covering the wire. Over the compound is placed at least a single cotton braid and on conductors larger than No. 8 A.W.G. two braids or a tape and a braid are used. Lead coverings are also used in place of the braid or braids in some cases. Before the rubber is applied the conductors are tinned to prevent injurious action of the sulphur present in the rubber compound. Many different grades of rubber compound are used, the rubber content varying from 15 to 40 per cent. This is determined by a series of chemical tests made at the Underwriters' Laboratories on all samples of N.E.C. wire. Five tests are made to limit the use of excessive amounts of materials known to be injurious to rubber compounds and which do not give desirable insulating properties. The total of the five extractions or determinations must not exceed 80 per cent by weight of the rubber compound. The thickness of the wall of rubber is specified by the National Electrical Code, and samples must not vary more than 5 per cent below on small sizes and 10 per cent on the larger sizes. This thickness varies with the working voltage and size, and ranges from 3 to 18/64ths of an inch. The rubber must also meet certain requirements as to elasticity and per cent of elongation before breaking. Rubber-covered wire is very extensively used for interior wiring of buildings where only ordinary temperatures are encountered. When covered with an outer protective covering other than the braids mentioned, it usually receives another name, such as lead-covered wire or cable, or a name indicating a specific use. Some wires that have a rubber covering only are also given special names, such as battery-charging cable.

Manufacturers:

A-A Wire Co., Inc., 50 E. 42nd St., New York, N. Y. "A-A New Code," "A-A Red," "A-A 30%."
Acorn Insulated Wire Co., 77 Richards St., Brooklyn, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of rubber-covered wire for all purposes.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. on page 1252.)
Bay State Insulated Wire & Cable Co., Hyde Park, Mass.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill. "Beldenite." "Calumet," "Belden-30," "Belden-20."
Bishop Gutta-Percha Co., 420-430 E. 25th St., New York, N. Y. "Balata." "Paraxel," "Bishop Standard," "Bishop Special," "Hytest."
Boston Insulated Wire & Cable Co., Boston, Mass. "B.I.W."
Bourn Rubber Co., 58 Warren St., Providence, R. I.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I. "I.X.L."
Crescent Insulated Wire & Cable Co., Olden & Taylor Sts., Trenton, N. J. "Imperial."
Detroit Insulated Wire Co., Wesson Ave. & Albert St., Detroit, Mich. "Detroit."
Gottschalk Mfg. Co., John W., Philadelphia, Pa.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. "Ecco," "Red Core," "Black Core." (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite." (See display adv. pages 1235-1237.)
Kerite Insulated Wire & Cable Co., 50 Church St., New York, N. Y.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
National India Rubber Co., Bristol, R. I. "Paracore."
NATIONAL METAL MOLDING CO., Fulton Bldg., Pittsburgh, Pa. "Liberty" rubber-covered wire and cable is made in sizes from No. 14 to 1,000,000 circular mils. It is National Electrical Code standard. Like all "National" products, it is carefully manufactured of the best materials and under expert supervision. See display adv. pages 1302-4.—Adv.
New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Raven."
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Page Steel & Wire Co., 30 Church St., New York., N. Y.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.
PHILLIPS WIRE CO., Pawtucket, R. I. Maker of "Parac" black core code insulation.—Adv.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome rubber covered wires, cables and cords are manufactured in strict accordance with the National Electric Code standard, and each coil of Rome rubber covered house wire is approved for use by the National Board of Fire Underwriters. The No. 14 Brown & Sharpe



Rome Rubber Covered Wire

gage solid conductor, single braid Rome rubber covered wire is here illustrated. Also the No. 14 stranded conductor, single braid. In addition to the manu-



Rome Rubber Covered Wire

facture of National Electric Code Standard house wires special Rome wires and cables for electrical and automobile requirements are manufactured, all using the high grade bare copper wire conforming to the strict general specifications for Rome bare copper wire, (see that classification). The No. 10 duplex stranded conductor is next illustrated, showing the triple braid insulation. The 500 circular mils stranded conductor, rubber covered and double braid insulation is shown below.



Rome Rubber Covered Wire

Rome rubber covered wire is manufactured in all sizes from No. 16 Brown & Sharpe gage up to 4/0 gage in the solid conductor type, and in the stranded type conductor using seven strands for the smaller sizes up to 61 strands for the heaviest cables of 1,000,000 circular mils capacity. For other Rome Wire Company products see display advertisement on page 1247.—Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simcore." "Caoutchouc."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Sterling," "Tip-Top," "Standard."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I.
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. Rubber insulated wires and cables, solid, stranded or flexible stranded copper conductors for 600 volts or over. "Paracore" wires and cables are made in accordance with N. E. Code standards. Adv.

WIRE SCRAPERS.—See Scrapers, wire.

WIRE, SILVER.—Silver wire is drawn from silver bars and is used to a limited extent in places where very high conductivity and absence from corrosion due to moisture are desired. It is sometimes drawn into fine wire and used on coils for instruments, etc. An important use is for making silver contacts or contact points. A rather large wire is usually drawn and used for this latter purpose.

Manufacturers:

Canadian Seamless Wire Co., Ltd., 198 Clinton St., Toronto, Ont., Can.
Handy & Harman, 59 Cedar St., New York, N. Y.

WIRE SKINNERS.—See Skinners, wire.

WIRE SLEEVES.—See Sleeves, trolley wire splicing; sleeves, wire splicing, miscellaneous.

WIRE, SLOW-BURNING.—A wire the insulation of which is especially adapted for interior use in hot, dry places where

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linary insulation would not endure. bber and weatherproof insulation are obtionable in such places because they are ammable. Usually the insulation con- :s of three braids each saturated with ompound having fire-resisting and insuing properties. The surface of the wire finished smooth and hard. This wire well adapted for use on the rear of tchboards, for open wiring in mill-conuction buildings, for risers in elevators other shafts, etc.

anufacturers:

MERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
merican Copper Products Corp., 200 Broadway, N. Y.
merican Electrical Works, Phillipsdale, R. I. "Emelectric."
MERICAN INSULATED WIRE & CABLE CO., Chicago, Ill. "American Brand" slow burning (white) wire is saturated with our superior fireproof compound distinguished by one red and one green thread and is made in solid and stranded conductors with three braids. The solid sizes 18 to 4/0 and stranded sizes 10 to 2,000,000 CM inclusive. See page 1250.—Adv.
MERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture the "Reliance" slow-burning wires and cables in which an insulation is used that will not carry flame; especially useful in hot, dry places where ordinary insulations would perish and where wires are brought together, as on the back of a large switchboard or in a wire tower. This wire is made in strict accordance with the requirements of the National Board of Fire Underwriters in all respects.—Adv.
sonia Electrical Co., The, Ansonia, Conn. "Shield Brand."
nada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. Canada."
adian General Electric Co., Ltd., 212 ing St., W., Toronto, Ont., Can.
CAGO INSULATED WIRE & MFG. ., Sycamore, Ill. (See display adv. ge 1249.)
LYER INSULATED WIRE CO., 249 Main St., Pawtucket, R. I. "I. L."
oit Insulated Wire Co., 4561-4647 esson Ave., Detroit, Mich. "Deit."
ERAL ELECTRIC CO., Schenecdy, N. Y. (See adv. pages 1203-23.)
NOIS WIRE & CABLE CO., Sycare, Ill. "Illinois." (See display adv. ge 1250.)
n Mfg. & Supply Co., 133 W. Washton St., Chicago, Ill.
onal India Rubber Co., Bristol, R. I.
ing Electrical Works, De Kalb, Ill.
lite Co., The, Canal St., Passaic, J.
delphia Insulated Wire Co., 200 N. St., Philadelphia, Pa.
LIPS WIRE CO., Pawtucket, R. I. illips."
KBESTOS PRODUCTS CORP., P. O. wer 1102, New Haven, Conn.
ling's Sons Co., John A., Trenton, J.
lard Underground Cable Co., Westhouse Bldg., Pittsburgh, Pa. "Stand-"
ED STATES RUBBER CO., 1790 adway, New York, N. Y. "U. S."

SLOW-BURNING WEATHER.—A wire that does not burn as as ordinary weatherproofed wire s not soften as easily under heat. ly applicable to interior wiring and f rather high temperatures. It will id more moisture than what is low-burning wire. The insulation y consists of two braids, the inner ng saturated with weatherproofing id, and the outer one, which com- t least six-tenths of the total wall. ated with fireproof compound and hard.

acturers:

ICAN BRASS CO., 414 Meadow Waterbury, Conu.
an Copper Products Corp., 200 dway, New York, N. Y.
an Electrical Works, Phillipsdale, "Emelectric."
ICAN INSULATED WIRE & LE CO., Chicago, Ill. This wire was formerly called "Fire & Weatherproof" wire. The two inner braids are thoroughly saturated with our superior "American Brand" fireproof compound, the outer braid with a black weatherproof compound, and finished hard and smooth but pliable. Is made in solid and stranded conductors with three braids. Solid sizes—18 to 4/0, stranded —10 to 2,000,000 CM. inclusive. See page 1250.—Adv.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture special weatherproof slowburning wires having a combined insulation of black weatherproof and white slowburning coverings.—Adv.
Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Canadian General Electric Co., Ltd., 212 King St., W., Toronto, Ont., Can.
CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (See display adv. page 1249.)
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
ILLINOIS WIRE & CABLE CO., Sycamore, Ill. "Illinois." (See display adv. page 1250.)
Joslyn Mfg. & Supply Co., 133 W. Washington St., Chicago, Ill.
Nehring Electrical Works, De Kalb, Ill.
Okonite Co., The, Canal St., Passaic, N. J.
Philadelphia Insulated Wire Co., 200 N. 3rd St. Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, SPRING.—Wire used in making springs varies considerably in its composition. High-grade steel wire known as music or piano wire is used more than any other spring wire. Small test pieces of best grade music wire between 0.04 and 0.05 in. in diameter, give tensile strengths of from 342,000 to 388,000 lbs. per square inch. Brass wire, nickel-steel, phosphor-bronze and other similar alloy wires are also used for making springs. If the springs are to conduct current to an instrument or other apparatus they are usually made of bronze or brass.

Manufacturers:

Cary Spring Works, 240-242 W. 29th St., New York, N. Y.
Cuyahoga Spring Co., The, 10252 Berea Rd., Cleveland, Ohio.
Page Steel & Wire Co., 30 Church St., New York, N. Y.
Roebling's Sons, Co., John A., Trenton, N. J.
Root Co., The C. J., Bristol, Conn.

WIRE, STAGE.—See Cord, flexible, stage or theater.

WIRE, STEEL-TAPED.—See Cable, armored, also Cord, flexible, armored.

WIRE-STRAIGHTENING MACHINES.—Machines consisting of a number of grooved guides or rollers mounted in different planes between which wire to be straightened is drawn. Another type of machine has a curved tube, supported in a lathe and constantly rotated, through which the wire is drawn.

Manufacturer:

Shuster Co., F. P., New Haven, Conn.

WIRE STRAND.—See Strand, galvanized steel.

WIRE, STRANDED.—A group of small wires used as a single wire. This is very similar to a single-conductor cable, but only refers to the smaller sizes as a rule. If a stranded wire is substantially insulated to withstand wear it is called a cord.

WIRE-STRANDING MACHINES.—Machines consisting of a number of wire-reel carriers which are caused to revolve around a common axis and lay a number of strands or individual wires on a central strand or core in a continuous process. Also see Cabling machines.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."
New England Wire Machinery Co., Water Front St., New Haven, Conn.

WIRE, SWITCHBOARD.—Wire composed of tinned extra flexible strands of high-conductivity copper, insulated with a rubber coating and one or two closely woven cotton braids saturated in weatherproof or fireproof compound. It is made to meet special and very exacting voltage requirements, and is used for wiring on the rear of a switchboard, or for connecting to machine brushes, etc., or wherever very flexible wire is required. Also see Cable, switchboard.

Manufacturers:

American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture the well known "Americore" rubber-covered switchboard cables. National Electrical Code standard.—Adv.
ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin" "Neptune." "Triton." (See display adv. page 1252.)
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
D. & W. FUSE WORKS OF GENERAL ELECTRIC CO., Providence, R. I. "Deltabeston." See Wire, asbestos covered.—Adv.
GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)
Gottschalk Mfg. Co., John W., Philadelphia, Pa.
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDEPENDENT LAMP & WIRE CO., 1737 Broadway, New York, N. Y. (See display adv. page 1251.)
Okonite Co., The, Canal St., Passaic, N. J. "Okonite."
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
ROCKBESTOS PRODUCTS CORP., P. O. Drawer 1102, New Haven, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Rünzel-Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago, Ill.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."

WIRE TAGS.—See Tags, cable, circuit, trolley and wire.

WIRE, TELEPHONE, BRIDLE OR JUMPER.—A name sometimes applied to insulated wires connecting open wire lines at a junction or turning pole.

WIRE, TELEPHONE CORD.—See Cords, flexible, telephone switchboard and receiver.

WIRE, TELEPHONE DROP.—Drop wire or drop line is rubber-covered iron or copper wire, used to connect from the nearest pole usually at the rear of a lot to the subscriber's house, a single span. Much of the drop wire now used is made up as twisted pair.

Manufacturers:

Acorn Insulated Wire Co., 77 Richards St., Brooklyn, N. Y.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of telephone drop wire.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Copper Clad Steel Co., Rankin, Pa. "Copperweld."

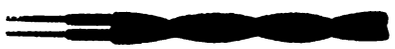
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Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Electric Cable Co., The, Yonkers, N. Y. "Ecco."
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" iron telephone drop wire is rubber insulated, braided and twisted and saturated with a weatherproof compound. Regularly supplied in twisted pairs; plain pairs supplied if desired, sizes 16, 14 and 12 B. & S., 18, 16 and 14 B. W. G. For other "Paranite" products, see display advertising on pages 1235-1239.—Adv.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Page Steel & Wire Co., 30 Church St., New York, N. Y.
PARAGON ELECTRIC CO., Old Colony Building, Chicago, Ill. "Ironite" rubber insulated telephone wire is a special conductor of purest metal and highest conductivity. Special insulation not less than 15% pure Para rubber. Covered with extra heavy tough



"Ironite" Telephone Wire

braid. Has greaf toughness of insulation, great tensile strength, great flexibility, high conductivity; all the qualities essential for the very best insulated telephone wire.—Adv.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
ROME WIRE CO., Rome, N. Y. Rome Wire rubber-covered telephone wires conform to the strict general specifications of the other Rome rubber covered wire products. These wires are furnished either single, double or with three conductors, for interior, outside and switchboard requirements to meet standard needs. The outside wires have a close woven cotton braid well



Rome Telephone Drop Wire

saturated and finished with a weatherproof compound. It is 14 gage with a heavy rubber insulation, the diameter over rubber being $\frac{1}{4}$ ins. Bridle wire is furnished in 16 and 18 gage. Interior wire in No. 19 gage, any desired color, and pothead wire in 18, 19, 20 and 22 gage. For other Rome Wire products see display advertisement on page 1247. —Adv.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y., "Safety."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

WIRE, TELEPHONE INSIDE.—Interior telephone substation wire is small copper wire, rubber-covered, protected by a braided coating and twisted in pairs. Magnet and relay wire is much used also. It is copper, enameled, but silk insulation is sometimes used. Most of the interior office wiring is in the form of cables. See Cables, telephone and telegraph, interior.

When writing to manufacturers please mention the
E M F ELECTRICAL YEAR BOOK

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of wire used in interior telephone work.—Adv.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Boston Insulated Wire & Cable Co., Boston, Mass. "B. I. W."
Canada Wire & Cable Co., Ltd, 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
Detroit Insulated Wire Co., 4561-4647 Wesson Ave., Detroit, Mich. "Detroit."
Electric Cable Co., The, Yonkers, N. Y. "Ecco."
HABIRSHAW ELECTRIC CABLE CO., Point St. Yonkers, N. Y. (See display adv. pages 1244-1245.)
Hazard Mfg. Co., 81 Ross St., Wilkes-Barre, Pa.
INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind. "Paranite" twisted pair "inside" or "substation" wire is carried in stock in single conductor, twisted pair and triples. For additional information on "Paranite" products see pages 1235-1239.—Adv.
Lowell Insulated Wire Co., 171 Lincoln St., Lowell, Mass.
Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."
Morse, Frank W., 289 Congress St., Boston, Mass.
New York Insulated Wire Co., 114 Liberty St., New York, N. Y. "Raven."
Page Steel & Wire Co., 30 Church St., New York, N. Y.
Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y. "Safety."
Seneca Wire & Mfg. Co., Fostoria, Ohio. "Seneca."
SIMPLEX WIRE & CABLE CO., 201 Devonshire St., Boston, Mass. "Simplex."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."
Western Electric Co., Inc., 195 Broadway, New York, N. Y.

WIRE, TELEPHONE LINE.—Telephone line wire is generally hard-drawn copper wire for open wire lines. Some iron is used for short runs and rural lines. Where greater strength is needed than that of copper, as in special places of exceptionally long span, etc., copperclad steel wire is sometimes used. For manufacturers of telephone line wire, see Wire, copper, bare, transmission line, etc.; Wire, copperclad steel; Wire, iron line, telegraph and telephone.

WIRE, TICKET.—A circuit over which toll telephone operators pass calls to each other.

WIRE-TINNING MACHINES.—Machines used for passing bare copper wires in a continuous operation through a cleansing fluid, a bath of molten tin and a felt wiper, to protect the wire from deterioration due to oxidation or corrosive action, especially when it is to be rubber-covered, and to facilitate soldering in telephone construction, switchboard work, etc.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y.
New England Wire Machinery Co., Water Front St., New Haven, Conn.

WIRE, TRANSMISSION GROUND.—This is a form of ground wire that is strung over a high-tension transmission line, usually on insulators mounted on top of the pole or tower. It is grounded at frequent intervals and serves as a protection against lightning and related disturbances. It is a solid wire, usually of steel or copperclad steel. If of steel, it is always heavily galvanized. Strand or messenger wire is also used for this purpose. For this see Strand, galvanized steel.

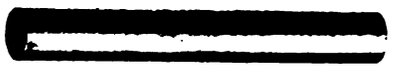
Manufacturers:

AMERICAN STEEL & WIRE CO., 208 S. La Salle St., Chicago, Ill.
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Colonial Copper Clad."

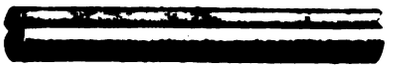
WIRE, TROLLEY.—Conductor wire usually carried overhead from which electrically operated cars are energized. The common trolley wire consists of hard-drawn copper, although special bronze alloys and steel conductors are being used under certain special conditions. Ordinary trolley wire sizes are 0, 00, 000 and 0000 A. W. G. and the round wire section is the oldest and most generally used. Owing to the irregular underrun with the round wire due to the lips of the ear or clamp encircling the wire, sparking and wear results, and to overcome this difficulty wire has been drawn of a figure-8 section. The ear or clamp engages the upper lobe of the figure-8 section, leaving a smooth underrun for the trolley wheel. Although such wire gives a smooth underrun its unequal section has caused difficulty in erecting, the wire tending to kink during installation. To overcome this latter objection, grooved wire has been drawn. The grooved wire is a perfect circle with a groove along each side slightly above the center line. The supporting clamp or ear engages in these grooves. Such wire is almost as easily handled as the round wire and gives the advantages of a smooth underrun. This wire has been standardized in section by the wire manufacturers, the American Electric Railway Engineering Association and others so that there is no difficulty in procuring fittings which will properly fit wire drawn to American standard grooved section.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn.
American Copper Products Corp., 200 Broadway, New York, N. Y.
American Electrical Works, Phillipsdale, R. I. "Emelectric."
AMERICAN INSULATED WIRE & CABLE CO., 954 W. 21st St., Chicago, Ill. "American Brand." (See display adv. page 1250.)
AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of trolley wire to meet any specifications.—Adv.
ANACONDA COPPER MINING CO., Rolling Mills Department, Sales Office, 547 Conway Bldg., Chicago, Ill. Round grooved and figure 8 trolley wire furnished to meet any desired specification.



Round



Grooved

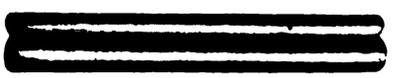
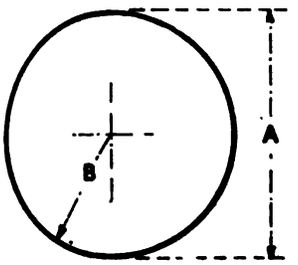


Figure 8

Anaconda trolley wire is more durable because of fewer brazes per mile. See display advertisement on page 1246.—Adv.
Bridgeport Brass Co., Bridgeport, Conn. "Phono-Electric."
Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."
CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (See display adv. page 1249.)
Copper Clad Steel Co., Rankin, Pa. "Copperweld."
Hazard Mfg. Co., 81 E. Ross St., Wilkes-Barre, Pa.
Page Steel & Wire Co., 30 Church St., New York, N. Y.
PHILLIPS WIRE CO., Pawtucket, R. I. "Phillips." Round, grooved and figure 8 trolley wire.—Adv.
Roebling's Sons Co., John A., Trenton, N. J.

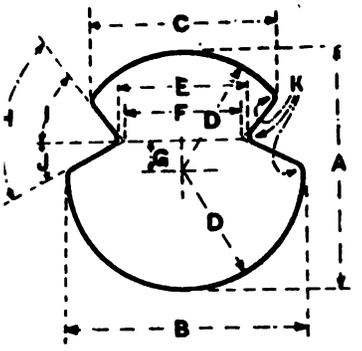
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)ME WIRE CO., Rome, N. Y. "Rome Wire" hard drawn trolley wire, is of high conductivity, uniform, strong and durable, and free from scale, flaws, splints and other defects. It is drawn n three shapes, the round a cross sec-



Round

on of which is illustrated above, the rooved, a cross section of which is



Grooved

istrated next, and the figure eight, a ss section of which is illustrated ow. It is furnished in four sizes in

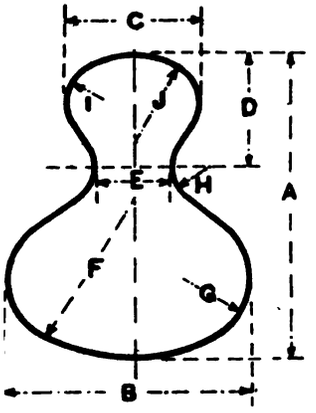


Figure 8

hree types, 1/0, 2/0, 3/0 and 4/0 'n & Sharpe gage. The two small- zes are shipped in reels of one mile Reels of the two larger sizes .in one-half mile each. Rome bare r trolley wire is guaranteed clean, from roughness, cracks and lam- ons. Conductivity of the copper not be less than 98%, 100% con- vity being based on copper hav- resistance of 0.1530 ohms per gram at 20 deg. C. For the pur- of calculating weights, cross sec- etc., the specific gravity of cop- taken as 8.89 at 20 deg. C. The e strength of the grooved and of gure eight wire is required to be f that required for round wire of ame sectional area which for the ire is 51,000 lbs. per sq. in.; and longation shall be the same as required for round wire of the sectional area, which for the 3/0 s 3.20% (minimum elongation in). Round wire is guaranteed not y more than 1% above or below the nominal gage and shall be uniformly cylindrical. Grooved wire shall not vary more than 4% in average weight per unit length. Figure eight wire shall not vary more than 4% in average weight per unit length. Necessary brazes in hard drawn trolley wire are made in accordance with best commercial practice and tests upon a section of wire containing a braze must show at least 95% of the tensile strength of the unbrazed wire to pass the Rome Wire standard specifications. For other Rome Wire Company products see display advertisement on page 1247. —Adv.

Standard Underground Cable Co., Westinghouse Bldg. Pittsburgh, Pa. "Standard."

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE TUNGSTEN.—See Tungsten, wire.

WIRE, TWIN.—Two small insulated conductors laid parallel, having a common covering.

WIRE-TWISTING MACHINES.—Apparatus designed with wire-reel holders arranged to rotate about a common axis to twist individual conductors together in a continuous process, thus forming twisted pairs, etc., for telephone wires, lamp cords, and many other types of flexible cords.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

New England Wire Machinery Co., Water Front St., New Haven, Conn.

WIRE, WEATHERPROOF.—A copper conductor, either solid or stranded, covered by three fibrous braids each saturated with a heavy moistureproof compound, usually containing waxes. This wire is for use outdoors where moisture is sure to be present and where fireproof qualities are not necessary, and is therefore used extensively for lighting and power distribution mains and feeders. It is made in all sizes from No. 20 A. W. G. to the largest feeder cables. In distribution circuits in cities and towns it is customary to use insulated wire of the weatherproof variety. This insulation, taken in conjunction with other insulating features, adds to the safety of overhead line work, where more than one circuit is carried on the same poles.

Manufacturers:

AMERICAN BRASS CO., 414 Meadow St., Waterbury, Conn. "KK."

American Copper Products Corp., 200 Broadway, New York, N. Y.

American Electrical Works, Phillipsdale, R. I. "Emelectric."

AMERICAN INSULATED WIRE & CABLE CO., Chicago, Ill. "American Brand" weatherproof wire is manufactured by a process which preserves the insulation and yet it is pliable under all conditions. The braid next to the wire is saturated with a compound which prevents same from running. The second braid has a compound saturation of high melting point. The outside braid is saturated with a wax compound which prevents peeling, cracking or sticking, and always keeps a smooth, highly polished surface. "American Brand" weatherproof wire is made in solid sizes from No. 18 to 4/0. The stranded conductor is made in sizes No. 10 to 2,000,000 CM inclusive. It is made in the same sizes in double braid. See page 1250.—Adv.

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of weatherproof wire. Send for catalog.—Adv.

Ansonia Electrical Co., The, Ansonia, Conn. "Shield Brand."

BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.

Canada Wire & Cable Co., Ltd., 2410 Dundas St., West, Toronto, Ont., Can. "Canada."

CHICAGO INSULATED WIRE & MFG. CO., Sycamore, Ill. (See display adv. page 1249.)

COLLYER INSULATED WIRE CO., 249 N. Main St., Pawtucket, R. I. "I X. L."

Copper Clad Steel Co., Rankin, Pa. "Copperweld."

GENERAL ELECTRIC CO., Schenectady, N. Y. (See adv. pages 1203-1223.)

ILLINOIS WIRE & CABLE CO., Sycamore, Ill. "Illinois." (See display adv. page 1250.)

Kelly Electric Wire Co., Grand Haven, Mich.

Marion Insulated Wire & Rubber Co., Marion, Ind. "Eagle Brand."

Monarch Electric & Wire Co., 624 W. Adams St., Chicago, Ill. "Monarch."

National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y.

National India Rubber Co., Bristol, R. I. "National."

Nehring Electrical Works, De Kalb, Ill.

Okonite Co., The, Canal St., Passaic, N. J. "Okonite."

Peerless Insulated Wire & Cable Co., 90 West St., New York, N. Y. "Fibre Clad."

Philadelphia Insulated Wire Co., 200 N. 3rd St., Philadelphia, Pa.

Phillips Electrical Works, Ltd., Eugene F., Montreal, Que., Can.

PHILLIPS WIRE CO., Pawtucket, R. I. Makers of "O. K." brand cotton yarns used exclusively with high-grade compounds.—Adv.

Roebling's Sons Co., John A., Trenton, N. J.

ROME WIRE CO., Rome N. Y. A weatherproof braid is used on various types of Rome Wire lamp cords to make them moisture and damp proof, using the same solid or stranded conductors and insulation as in the standard Rome Wire fixture and lamp cords. The 18 gage reinforced portable cord



Rome Portable Cord

illustrated shows the first wrapping of fine Sea Island cotton around each stranded conductor, the individual insulation of seamless rubber and outer braid of cotton, then the seamless rubber insulation around both conductors and finally the black weatherproof braid. All Rome Wire is manufactured from copper having 98% conductivity and high grade materials are used throughout. For other Rome Wire products see display advertisement on page 1247.—Adv.

UNITED STATES RUBBER CO., 1790 Broadway, New York, N. Y. "U. S."

WIRE, WELDING.—A thin wire usually made of commercially pure iron with small percentages of other metals added, according to the character of the metal to be welded, and used as the electrode or as an auxiliary in the arc-welding process. Welding wire sometimes also contains a refractory flux, usually applied as an outside coating to the iron wire. The iron or steel electrode is melted by the arc and fills the space between the pieces to be welded. Due to the fusing action of the arc it actually becomes a part of the metal on either side of the gap it fills. The success of a weld is determined largely by the composition of the welding wire and the flux. Welding wire is used only in light welding; for heavier work the pieces are called welding rods. When carbon electrodes are used the welding wire or rod serves chiefly as a melt rod that is fused to fill crevices in the joint being welded.

Manufacturers:

Alloy Metal Wire Co., 154 Nassau St., New York, N. Y.

Alloy Steel Products Corp., 123 Liberty St., New York, N. Y.

American Rolling Mill Co., The, Middletown, Ohio. "Armco."

AMERICAN STEEL & WIRE CO., sales offices in principal cities. See display adv. page 1240 for list of offices and illustrations and descriptions of our products. We manufacture a complete line of wire used in the art of welding. —Adv.

ATLANTIC INSULATED WIRE & CABLE CO., 52 Vanderbilt Ave., New York, N. Y. "Dolphin," "Neptune," "Triton." (See display adv. page 1252.)

Carbic Mfg. Co., Duluth, Minn. "Carbic."

Central Steel & Wire Co., 119-127 N. Peoria St., Chicago, Ill. "Lektrox Swedox."

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Electrical Alloy Co., The, Morristown, N. J.
Electro-Weld Co., 70 Munroe St., Lynn, Mass.
Gibb Instrument Co., 348 E. Palmer Ave., Detroit, Mich.
HABIRSHAW ELECTRIC CABLE CO., Point St., Yonkers, N. Y. (See display adv. pages 1244-1245.)
Indianapolis Switch & Frog Co., Springfield, Ohio.
Noble & Co., F. H., 59th & Wallace Sts., Chicago, Ill.
Page Steel & Wire Co., 30 Church St., New York, N. Y.
Quasi-Arc Weldtrode Co., Inc., Atlantic Ave. & Warwick St., Brooklyn, N. Y.
Rail Welding & Bonding Co., 2400 Woodland Ave., Cleveland, Ohio.
Roebling's Sons Co., John A., Trenton, N. J.
Siemund Wenzel Electric Welding Co., 30 Church St., New York, N. Y. "Siemund."
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa. "Standard."
Tubular Woven Fabric Co., Main & Carver Sts., Pawtucket, R. I.

WIRE-WRAPPING MACHINES.—Machines for wrapping coils of wire with overlapping layers of paper tape to protect the coils during shipment or storage. The machine consists of a split circular shuttle on which a spool or quantity of tape is carried. The shuttle is opened and the coil to be taped inserted. The shuttle is then rotated about the coil and for each rotation lays one layer of paper tape.

Manufacturers:

American Insulating Machinery Co., Fairhill & Huntingdon Sts., Philadelphia, Pa. "American."
Miller, Charles E., Anderson, Ind. "Miller-Anderson."
New England Wire Machinery Co., Water Front St., New Haven, Conn.
Textile Machine Works, Reading, Pa.

WIREDUCT.—Trade name for nonmetallic tubing for electric wires made by the American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.

WIRELESS.—A widely used contraction of wireless telegraphy or wireless telephony.

WIRELESS.—Trade name for electric pipe locator and cable tester manufactured by the Electric Specialty Mfg. Co., Cedar Rapids, Iowa.

WIRELESS MFG. CO.—619 4th St., N. W. Canton, Ohio. Manufacturer of radio equipment. Henry L. Ley, owner.

WIRELESS SPECIALTY APPARATUS CO.—C & Fargo Sts., Boston, Mass. Manufacturer of radio apparatus. Business established 1907. President and general manager, George S. Davis; vice-president, William Newsome; secretary, John L. Warren; treasurer, Edward C. Porter; sales manager, Walter J. Henry.

WIRELESS TELEGRAPHY.—A name first used for the system of communication by means of signals radiated through space as electromagnetic waves. It was called this to emphasize the uniqueness of the development, because no line wires were required. The term radio telegraphy is now used in its stead and is preferred by most writers and radio associations. See Radio communication, development and status of.

WIRELESS TELEPHONY.—A name given to the systems of transmitting speech over distance by means of the radiation of electromagnetic waves and without the use of any line wires. Its name was to emphasize the novelty and importance of the latter fact. The term radio telephony is now preferred. See Radio communication, development and status of.

WIRELETS.—Trade name for conduit bodies and covers manufactured by the Steel City Electric Co., 1221 Columbus Ave., Pittsburgh, Pa.

WIREMOLD.—Trade name for raceways or metal moldings for surface wiring made by the American Wiremold Co., 81-83 Woodbine St., Hartford, Conn.

WIRING ASSEMBLIES, AUTOMOTIVE.—Automobile manufacturers frequently do not have facilities for making the wire or cord used in the starting, lighting and ignition systems. Some wire manufacturers who furnish this material cut the wire to length, solder on terminal lugs, form it completely, and braid on a complete covering, thus giving all the necessary wiring on the car in one assembly or cable ready to be installed. This is also done for airplanes, motorboats and other automotive equipment. The insulation requirements are frequently special, although standard wire is also supplied. (Also see Wire, automobile, ignition; also lightng and starting.)

Manufacturers:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
BELDEN MFG. CO., 2300 S. Western Ave., Chicago, Ill.
Grossman Auto Parts Co., White Plains, N. Y. "Gapco."

WIRING OF DWELLINGS.—This term embraces what is commonly called "house wiring" or "residence wiring." The word dwelling is broader, since it includes from the humblest to the most pretentious residence and all the wide variety of apartment buildings now found in large cities, ranging from the simple "two-flat" to the sumptuous apartment hotels. Using the word dwelling in this broad sense as any relatively permanent place of abode, it is evident that dwellings constitute the largest class of buildings in the country. Consequently, the wiring of dwellings is of very high importance to the electrical industry, not only to electrical wiring contractors, but to central-station companies, manufacturers, jobbers and others interested in seeing the greatest possible development for electric service and electrical appliances.

Definite figures emphasize the importance of this matter. There are now in the United States about 20,482,000 dwellings, of which total approximately 14,190,000 are not yet wired for electric service. Considering the youth of the electrical industry, the 30.7% of all dwellings wired represents a big achievement, but a far greater one yet awaits, for near 70% of the total represents the potential field in this line. Of these 14,190,000 unwired dwellings, about 4,993,500 are within cities, villages and districts covered by central-station lines; that is, over one-third of this total should be immediately available for wiring—the service is at hand, and it remains only to convince the householder that the wiring of his dwelling is every day becoming more and more of a necessity for the welfare of his family.

There are about 6,362,500 farms in the United States, and on these there are in use about 350,000 electric light and power plants (commonly called farm lighting plants). Allowing for the farms that have central station service, there are about 6,000,000 farm dwellings (or 94% of all farm dwellings) that have not yet experienced the value of being wired and equipped for electricity. Of the remaining eight million odd unwired dwellings, nearly five million have been referred to above as within the reach of central-station lines, and the other three million are chiefly in suburban districts, small villages and hamlets to which electric service would be extended if a considerable percentage of their houses were made ready for service by being wired.

These figures are sufficiently striking to warrant further consideration of the entire subject of wiring of dwellings.

Development. The first use of electricity in the home was for operating electric bells somewhat over forty years ago. The wiring for bells is very simple, since but small wires suffice and a few cells of primary battery and simple push buttons with bells or buzzers are used. Such bells were commonly installed in connection with speaking tubes, and this was the beginning of the business of many electrical contractors.

Electric lighting came into use in residences a little less than forty years ago, being employed first in larger and more pretentious residences. Its progress in this field was slow for many years, one of the reasons being that there was little knowledge of just what was required in the way of suitable equipment for lighting circuits. The first contractors, being practically merely bell hangers, did not understand the higher requirements that lighting circuits called for. And, therefore, many of the early circuits were installed with inadequate wire and without proper precautions to prevent short-circuits and other troubles. The material available in the way of wire, sockets, switches and insulators was also inferior, and consequently both these conditions resulted in not infrequent fires due to crossed wires, incorrect fusing and similar causes, which prevented the more rapid spread of electric lighting in residence service.

As a result of this condition, fire insurance underwriters took up the regulation of electrical installations involvng 110 volts or above. The final form of these regulations was the National Electrical Code, whose first edition appeared in 1897. After a few years this code become recognized as a reliable guide in making electric lighting installations much more safe, and from this point on considerable progress resulted, electric lamps replacing gas and oil in considerable numbers. The advance was steady, but still rather slow until about twelve years ago, when the advent of the tungsten lamp brought about an entirely different state of affairs.

When this type of lamp was developed so as to be fairly rugged, its superior efficiency made it a decided competitor to all other types of interior illuminants. Central-station companies began the practice of replacing carbon lamps with tungstens, and the development of residence lighting from then on made rapid progress. New possibilities in the way of lighting were also developed with the introduction of these lamps, and special efforts were made both by lighting companies and by many contractors to stimulate wiring of residences. Practically all new houses from that date on have been wired during construction, and a very large number of wiring campaigns have been conducted to make it possible to wire finished houses under favorable conditions.

Although the improvement in electric lighting gave a decided stimulus to electric service in the home, there was at the same time a group of very important developments in other branches of electric service which further enhanced its value in the household. Of these improvements, the first and most important was the extensive use of electrically heated appliances, of which the first and most widely used was the electric flatiron, this being followed by the electric toaster, coffee percolator, chafing dish, tea urn and kettle, disk stove, heating pad, curling iron, etc. Following the use of these smaller devices, there was further application in successive years of many larger devices, such as electric radiators or room heaters, water heaters of various types, fireless cookers, electric ovens and complete electric ranges on which all household cooking and baking can be done.

There were also introduced in the home an extensive line of motor-driven appliances, among which were electric fans, washing machines, vacuum cleaners, hair driers, vibrators, dishwashers, ironing machines, electric sewing machines and motors for various kitchen and general utility purposes. During the World War the scarcity of servants, and especilly of laundresses, caused a great increase in the use of electric washing machines, also vacuum cleaners.

At the present time electric service in the home is for all these various utilities, and the old saying of having one's house "wired for electric light" is entirely obsolete and has come to be replaced by the phrase "wired for electric service." This last is far more comprehensive and representative of present day conditions. Gradually the householder has come to recognize that, instead of making household electric appliances incidental to the lighting, they are of equal importance thereto. Consequently an important change has been brought about in the general layout of the house-wiring system in that equal provision is properly made for the appliances and for the lighting.

Systems of Wiring. The wiring of bells, annunciators and other such low-voltage signaling systems has always been with small wires run concealed behind partitions, if installed during construction, or run along picture moldings in the corners of rooms, etc., if installed after the building is occupied. Such signaling systems operate in most cases on a few cells of dry battery or other primary battery and very seldom exceed over 20 volts, even in the case of large apartment buildings. In many cases, where alternating current is supplied, bell-ringing transformers are now used in place of batteries. In this case the primary of the transformer is connected directly to the 110 to 115-volt circuits in the house, and the low-voltage side of the transformer is connected directly to the bells, buzzers or other signaling circuits. Such bell-ringing transformers have become popular, as they eliminate all battery troubles and minimize the possibility of having the bells out of order, which in nine cases out of ten is due to batteries run down.

For lighting circuits it was early recognized that exposed or open wiring would not be suitable, because of its poor appearance and lack of protection. Since such circuits carry 110 volts as a standard voltage, they have to be insulated much more perfectly than the bell circuits referred to above. One of the first methods of insulating and protecting them was by means of

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what was called wood molding, and a great eal of this was installed by being run in iany cases like picture molding and also nstalled alongside of door and window rames and other places, in all cases being xposed on the surface of the walls and eilings. Such molding has grooves in its ase, which provide raceways for the indi- idual circuit wires; on top of this base is aced a capping, which protects the wires. uch wood molding is not especially attrac- ve, however, and it also is not a com- etely satisfactory protection. For this rea- n other methods of protecting wiring iere introduced and at the same time pro- bition against the use of wood molding is enacted in a number of large cities in iich special precautions are necessary to sure the highest possible protection of cuits on account of variable occupancy buildings, especially apartments and ten- ents.

For running circuits in partitions, one of e first methods used was what was called knob-and-tube system. This has been d very extensively, especially in smaller ns, but is applicable only for buildings course of construction. It makes use of celain knobs fastened to the joists or er wood partition supports and also em- s porcelain tubes to serve as bushings the wires where they are run through ts or other wood work. If carefully in- led and not disturbed, such a system is irly satisfactory one. However, in large s, as above referred to, the likelihood lterations in partitions to suit the needs various tenants, as well as the higher dards of safety required, has resulted is system not being approved. Conse- itly, in the larger cities, the use of a pletely protected wiring system is usu- required.

r complete protection of the wiring, ous types of conduit systems have been loped. The first of these employed l tubing of very light construction, slightly heavier than ordinary speak- ube. This being found to be mechan- weak, the requirements for rigid llic conduit have been gradually in- ed, and this material is now made of less steel tubing and forms the st type of protection for wiring sys-

When installed in ceilings or wall ions or other concealed places, con- must be put in during the construc- of the building, and with it must be led numerous conduit fittings, such nduit outlet boxes, switch boxes, cut- abinets, etc.

permit the equivalent of a rigid con- system to be installed in a building y finished, two types of flexible con- ere developed. One of these is made se fabric and is known under various , such as nonmetallic flexible con- flexible fabric tubing, loom and nu- s special trade names. This also re- special terminal fittings in the way es or outlet plates and connectors to the tubing remaining in place. Such tubing is installed in many cases as plete system and in others it is used protection of the wires at the out- the knob-and-tube ssytem.

her type of flexible conduit developed known as flexible steel, which is f helical interlinked layers of cor- l spring steel that form a continuous y or duct which is quite flexible and cially suitable for wiring finished It can be readily drawn into ceiling for wall partitions.

evelopment from this type of flex- el conduit was what has become to d steel-armored cable, which con- the flexible steel conduit, with cir- es already drawn in and perma- nstalled so as to eliminate the need rately drawing the wires in the after the latter has first been in- Such armored cable is quite exten- ed in the wiring of finished dwell- makes a very satisfactory installa-

ellings of all kinds the tendency is install the rigid or flexible steel flexible nonmetallic fabric tubing ed cable, and these materials are d as giving the highest type of on. In smaller communities and districts, where inspection re- ts are not so rigid, and in fact e wiring is not likely to be dis- e use of the knob-and-tube sys- permissible and permits saving pense. provided the wiring can lled while the house is being the wiring is for a farm house rom a 32-volt farm lighting plant. vier wiring is needed than for 110 ause heavier currents are required on the lower voltage to get the same power.

Outlets. In wiring of new dwellings, provision was made in early days for lighting outlets only. This was natural because lighting was the only service of standard voltage until within the last ten or twelve years, when various types of appliances came into use. On the part of architects and also of many contractors there has not been sufficient recognition of the need for special outlets for these miscellaneous appliances. Moreover, the number of outlets installed for lighting service in the home is entirely inadequate. It is quite common to find bed rooms, kitchens, bath rooms and other smaller rooms with only a single outlet. Unless that outlet is placed so that a lamp which may be placed in its socket will thoroughly illuminate the room, it is entirely out of the question to get satisfactory lighting, and the possibility of using appliances at the same time that light is required is seriously handicapped. During the last few years central-station organizations and the more progressive electrical manufacturers and contractors have recognized the desirability of having more complete wiring done in the residences. Numerous campaigns have been conducted with the special object in view of providing more outlets for the attachment of appliances of all kinds.

Aside from the disadvantage of having, say, only one socket outlet in a room which would ordinarily mean removal of the lamp in order to connect in an attachment plug for some appliance, there is the more important one that most sockets, if of the key or pull-chain type, have a limited current capacity which is slightly over 2 amperes, or 250 watts. If a device taking a heavy current, such as 600-watt flatiron, is connected to the socket, the latter is likely to be overheated and have its contact mechanism damaged if this is used for switching the current on and off. Since special sockets designed and rated for 660 watts are not yet in extensive use in the home, it is desirable to provide special outlets of 660-watt rating for the use of the heavier appliances at least.

The use of these additional outlets, such as wall or baseboard receptacles or floor receptacles, makes it very much more convenient to connect any appliance than it is to connect it to a high-hung lighting socket. Furthermore, it eliminates the need for disturbing the lamp so that it is possible to use the light and also use the appliance at the same time. Wall receptacles are almost invariably rated at 660 watts and are therefore especially suited for the various heating and motor-driven appliances that may take as much power. Moreover, they make it very convenient to connect floor lamps and table lamps, electric fans and a great variety of other devices and this convenience stimulates the use of these appliances.

Lack of sufficient outlets in the home, as usually found, has resulted in the use of large numbers of current taps, special duplex sockets and various devices of this type to permit connecting more than one appliance or a lamp and an appliance to what was originally a single socket. While this is far better than no connection at all, it is not the complete solution of the problem. In fact, inasmuch as it results in many cords hanging from fixtures and being run promiscuously along the walls, this is neither an attractive nor completely safe method of connecting these appliances. The use of sufficient wall receptacles has come to be recognized as the most satisfactory method of meeting all requirements, both of convenient connection of appliances of all kinds and of permitting flexibility in the lighting by means of portable table or floor lamps that can be readily moved about from place to place. The installation of additional outlets does not cost nearly as much as is commonly believed, especially if these are placed at the time the building is being wired.

To make it possible to install house wiring without a heavy financial burden to the householder various methods have been developed within the past dozen years. One of the most favored ones is the installment method of payments. This permits the owner or tenant, whoever is responsible for having the wiring done, to pay for it in equal monthly installments spread over a period of from six to twenty-four months. Some contractors have conducted business on this basis and financed the matter themselves. As a rule, the capital required to carry such outstanding accounts is rather heavy and beyond the power of the ordinary contractor. In some cases banks have advanced the money for the purpose, but the most satisfactory method and the one most used has been the financing of the wiring by the central-station companies, they making an agreement with the contractor to pay him the entire cost on completion of the wiring and carrying the account for the prescribed time in the form of monthly payments added to the electric service bill. This method has been found especially suitable for bringing about the wiring of completed buildings and, if it had not developed, the progress in this field would have been very much less than it has been.

During the recent World War financial conditions did not permit making as liberal terms, but it is believed that gradual improvement in this line will permit the partial-payment system to be extended and the wiring of finished houses to be greatly accelerated. The wiring of new buildings is undertaken almoss invariably on the same basis as the contracts for other installation work, such as plumbing, heating, painting and decorating, etc.

WIRT CO.—5221 Greene St., Philadelphia, Pa. Manufacturer of electric heating pads, regulating lamp sockets and portable lamps, resistance units and other electrical specialties. President, Charles Wirt; vice-president, C. H. Chandler; secretary, William J. Conlen; treasurer and general manager, P. H. Stuckley; sales manager, J. C. Kaelber. Sales representatives, Hatheway & Knott, 117 West St., New York, N. Y.; Doherty & Hafner Co., 618 W. Jackson Blvd., Chicago, Ill.; Benjamin Electric Mfg. Co., 580 Howard St., San Francisco, Cal.

WISCONA.—Trade name for internal combustion engine manufactured by the Termaat-Monahan Mfg Co., Oshkosh, Wis.

WISCONSIN.—Trade name for gas and gasoline engines and farm lighting plants manufactured by the Lauson-Lawton Co., De Pere, Wis.

WISCONSIN.—Trade name for gas engines manufactured by the Wisconsin Motor Mfg. Co., 44th Ave. & Burnham St. Milwaukee, Wis.

WISCONSIN ELECTRIC CO.—16th St & Junction Ave., Racine, Wis. Manufacturer of motors, electric cloth cutting machines, driers, grinders, buffers, etc. Business established 1913. President and general manager, L. H. Hamilton; vice-president, C. H. Beach; secretary and treasurer, A. Hugunin; sales managers, L. B. Augstine and J. E. Davis.

WISCONSIN ELECTRICAL & MFG. CO.—Milwaukee, Wis. Manufacturer of panelboards, switchboards, etc.

WISCONSIN ELECTRICAL ASSOCIATION.—President, William C. Lounsbury; secretary-treasurer, J. P. Pulliam, 140 1st National Bank Bldg., Milwaukee, Wis

WISCONSIN MOTOR MFG. CO.—44th Ave. & Burnham St., Milwaukee, Wis. Manufacturer of gas engines. Sales manager, C. L. Cole.

WISCONSIN STATE ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.—Officers 1921-22: President, B. L. Burdick, Milwaukee, Wis.; vice president, W. F. Meter; secretary and treasurer, John L. Acker, Sheboygan, Wis.; acting secretary H. M. Northrup, Milwaukee, Wis.

WISCONSIN STATE TELEPHONE ASSOCIATION.—President, Walter J. Gallon, Antigo, Wis.; secretary, J. A. Pratt, Menomonee Falls, Wis.

WISE-MC CLUNG MFG. CO., THE.—New Philadelphia, Ohio. Manufacturer of electric vacuum cleaners. Business established 1917. President and general manager, W. J. Wise; vice-presidents, A. Q. Beyer and E. E. Gulbrandson; secretary and treasurer, W. E. McClung

WISS & SONS CO., J.—33 Littleton Ave., Newark, N. J. Manufacturer of electrician's scissors.

WITHERBEE STORAGE BATTERY CO., INC.—New York, N. Y. Manufacturer of storage batteries. Business established 1903. President and general manager, Charles Meder; vice-presidents, F. C. Colwell, N. Wise; secretary, N. Wise; treasurer, Charles Staudt; sales manager, F. C. Colwell. Main office, 643-655 W. 43rd St., New York. N. Y. Factories, New York, N. Y.; North Bergen, N. J. Branch office, 7th Ave at 56th St., New York, N. Y.

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WIZARD.—Trade name for bells and buzzers manufactured by the Ansonia Electrical Co., Ansonia, Conn.

WIZARD.—Trade name for electric milk and cream pasteurizers and motor-driven milk coolers manufactured by the Creamery Package Mfg. Co., 61-7 W. Kinzie St., Chicago, Ill.

WIZARD.—Trade name for magnet wire manufactured by the John W. Gottschalk Mfg. Co., Lehigh Ave. & Mascher St., Philadelphia, Pa.

WIZARD.—Trade name for ignition magneto generators manufactured by the Hercules Mfg. Co., 2122 Northwestern Ave., Indianapolis, Ind.

W-N-B.—Trade name for ladders manufactured by the Brown Safety Ladder Mfg. Co. (Sales department Swanstrom Sales Co., 825 Manhattan Bldg., Chicago, Ill.)

W. N. MFG. CO., THE.—180 Main St., Manchester, Conn. Manufacturer of small water motors and water-driven generators. Business established 1909. President, Fred H. Norton; secretary, E. J. Norton.

WOCHER & SON CO., THE MAX.—23-29 W. 6th St., Cincinnati, Ohio. Manufacturer of lighting fixtures, X-ray and high-frequency apparatus, sterilizers and other hospital equipment. Business established 1837. President and treasurer, Max Schmidt; vice-president, O. A. Hoeller; secretary, Theodore O. Bumeller.

WODACK ELECTRIC TOOL CORP.—23-27 S. Jefferson St., Chicago, Ill. Manufacturer of motors and portable electric tools. Business established 1916. President, treasurer and general manager, Oscar P. Wodack; vice-president, A. K. Wodack; secretary, Albert T. Lochner. Sales representative, Anker Engineering Co., Widener Bldg., Philadelphia, Pa.

WOHL & CO., INC., M. J.—Payntar Ave. & Hancock St., Long Island City, N. Y. Manufacturer of photographic arc lamps.

WOHLITE.—Trade name for photographic arc lamps manufactured by M. J. Wohl & Co., Inc., Payntar Ave. & Hancock St., Long Island City, N. Y.

WOHLWILL PROCESS.—An electrolytic process for refining impure gold. The impure material is cast into anodes and used in an electrolyte of aurochloric acid ($HAuCl_4$) containing free hydrochloric acid (HCl). Pure gold is deposited in coherent form on the cathodes, while silver and the platinum metals are converted into their chlorides and recovered. The temperature is maintained at about 70° C. Some gold must be dissolved chemically and added to the bath to keep up its concentration.

WOLF, FRED W.—802 Diversey Parkway, Chicago, Ill. Manufacturer of electric refrigerators.

WOLF & DAVIS.—71-73 Spring St., New York, N. Y. Manufacturers of adjustable lighting fixtures, insulated wire, silk trimmings for electric fixtures, etc. Business established 1902.

WOLF ELECTRICAL PROMOTING CO., THE.—Cincinnati, Ohio. Manufacturer of electric cloth cutting machines. Business established 1893. President, J. Bloch; vice-president, H. R. Bloch; secretary and treasurer, Felix Elsbach; general manager, H. A. Meyer. Main office and factory, 810 Main St., Cincinnati, Ohio. Branch office, 852 Broadway, New York, N. Y.

WOLFRAM.—Trade name for incandescent lamp filaments manufactured by the Richard Pick Mfg. Co., 224 N. Wells St., Chicago, Ill.

WOLKE LEAD BATTERIES CO.—918-923 E. Main St., Louisville, Ky. Manufacturer of lead type storage batteries. Business established 1918. President and general manager, A. F. Wolke; vice-president, Don Warren; secretary and treasurer, Fred Kromar; sales manager, J. L. Moran.

WOLVERINE.—Trade name for leather belting manufactured by the Detroit Oak Belting Co., Detroit, Mich.

WOLVERINE MOTOR WORKS.—Bridgeport, Conn. Manufacturer of gasoline engines, contact points, etc.

WOLVERINE TUBE CO.—1411 Central Ave., Detroit, Mich. Manufacturer of brass and copper tubing. Business established 1916. President, C. C. Limbocker; vice-president, G. R. Anthony; secretary and treasurer, H. J. Hooks.

WOMAN'S FRIEND—Trade name for electric washing machines manufactured by the Bluffton Mfg. Co., Bluffton, Ohio.

WONDER.—Trade name for pipe and conduit benders manufactured by the American Pipe Bending Machine Co., 39 Pearl St., Boston, Mass.

WONDER.—Trade name for gasoline engines manufactured by the Construction Machinery Co., Waterloo, Iowa.

WONDER.—Trade name for electric washing machines manufactured by the Victor Mfg. Co., Leavenworth, Kans.

WONDER SPOOL CO.—13 Wormwood St., Boston, Mass. Manufacturer of fiber spools for cord and wire.

WONDER WORKER.—Trade name for fire extinguishers and soldering paste manufactured by the Hall-Thompson Co., Hartford, Conn.

WONDERLITE.—Trade name for luminous compounds manufactured by the Cold Light Mfg. Co., 18th & Blake Sts., Denver, Colo.

WONDERLIGHT.—Trade name for lighting fixtures manufactured by Samuel Frost, 41-43 W. 14th St., New York, N. Y.

WON-DOR.—Trade name for flush receptacle manufactured by the Bryant Electric Co., Bridgeport, Conn.

WOOD & CO., R. D.—Wood Bldg., Philadelphia, Pa. Manufacturers of steam pumps, hydraulic presses, etc. Proprietor, Walter Wood.

WOOD AS AN INSULATOR.—Wood, if thoroughly dried and impregnated with an insulating or moisture proofing compound, makes a fairly good insulator. Hard woods, such as maple, cherry and hickory, are used rather extensively and when used in transformers are usually impregnated with transformer oil, but for use in air (as in trolley strain insulators) with paraffin or varnish, although oxidized linseed oil is sometimes used. Well dried wood will stand about 4 kv. per mm. continuously without heating or burning. It is important that wood be carefully dried before impregnation as moisture contained in the cells makes wood a poor insulator and stimulates decay.

WOOD ELECTRIC CO., C. D.—441 Broadway, New York, N. Y. Manufacturer of sockets, automobile lamps, flashlights and other electrical specialties. Business established 1913. President, C. D. Wood; vice-president, J. B. Creighton; secretary and treasurer, Lester Haft.

WOOD MOLDING.—This material was the first type of enclosure used for wires in the interior of buildings. It has since come to be called wood raceway. See Raceways or molding, wood, for surface wiring.

WOOD PRESERVATION.—Wood is a very stable compound at ordinary temperatures unless attacked by living organisms. It will remain unchanged for centuries either in air or under water. Bacteria and fungi are the chief enemies of wood and they thrive best with warmth and abundance of moisture and air. Contact with the ground is very favorable to fungus growth and causes rapid decay at these points. Not all woods are affected to the same degree, sapwood being more vulnerable than heartwood, while wood cut in the late fall or winter is more durable than that cut in the late spring or summer. The seasoning also has an effect on its resistance to decay.

There are two general methods of protecting wood from destruction by living organisms: (a) by controlling the conditions necessary for the life of the organism and thus inhibiting its growth; (b) by the injection of a material which will kill or poison the organism itself or any enzymes through which it may accomplish its work. The first method is not practical for wood used for ordinary commercial purposes. For the second method, any material may be used that is poisonous enough to kill the organism, but to do this it must be soluble in the body fluids of the organism or in water. All preservatives must therefore be soluble in water to the extent of rendering the water toxic.

Several preservatives have been used, the most common and most effective of which is creosote oil. Other common preservatives are zinc chloride and sodium fluoride. The difference between the oil preservatives and inorganic salt preservatives is in their method of retaining the reserve supply of toxic material. Creosote oil may be considered as consisting of two compounds, one sufficiently soluble to render the water toxic, the other insoluble, but which retains the other compound of the oil and feeds it as it is needed. Zinc chloride has no reserve supply, all the material being soluble in the amount of moisture ordinarily present in air-dried wood. Sodium fluoride may have a reserve in the form of solid crystals due to the use of saturated solution.

Preservative treatment of poles, crossarms, ties, etc., has been attracting much attention for some time among large users of wood, as the timber supply is constantly decreasing and the price rising. Consequently several methods of treating wood have been tried. The first or simplest of these is the brush method. This is generally used with creosote and consists of two applications of hot creosote (at 220° F.) about 24 hours apart. It is a cheap method and increases the life of the wood from 2 to 3 years on the average. In the open tank method, which is mostly used for poles, the dry pole butts are placed in tanks containing the hot preservative for several hours. The penetration is about three times as great as with the brush treatment. It is estimated by some that the increase in life is 20 to 25 years; others give varying amounts from 8 years up. The third method is the pressure treatment. The poles or other articles to be treated are placed in a long steel cylinder, which is filled with steam under pressure for several hours. The steam and as much air as possible are then exhausted to give a vacuum. At the end of the vacuum period the preservative is admitted under pressure, which incures a deep penetration and a long life. No definite data are available on the increase in life, but many poles treated in this manner are still in service after 60 years. Also see Creosoting plants for poles, crossarms, ties, etc.

WOOD PRESERVING EQUIPMENT, MISCELLANEOUS.—Wood preserving equipment is quite varied because of the several processes that are used. It consists essentially of large tanks in which the poles, ties or other material to be treated are placed, after having been thoroughly dried either in a kiln or by air drying. The pressure process requires a large iron cylinder into which the ties, paving blocks, etc., can be placed and steam admitted under pressure. This also requires pumps to control the preservative or exhaust the steam and air from the cylinder. There is also miscellaneous equipment for mechanically separating the pores to allow the compound to penetrate. The preservatives most commonly used are creosote and zinc chloride. Also see Creosoting plants for crossarms, poles and ties, and Wood preservation.

WOOD SHOVEL & TOOL CO., THE.—Piqua, Ohio. Manufacturer of shovels, spades, scoops and drainage tools. President, H. K. Wood; vice-president and treasurer, William W. Wood; secretary, C. C. Proctor; manager of sales, C. M. Avery.

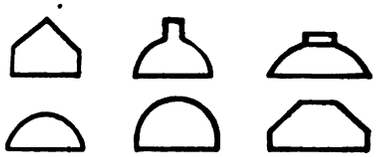
WOOD SPECIALTIES, TURNINGS, ETC., FOR ELECTRICAL PURPOSES.—These are products made of wood for use in the electrical industry. Large numbers of wooden parts are used in nearly all branches of the industry. Among them are many turned articles, including push-button bases, handles and knobs for electrical apparatus, handles for screw drivers and tools of various kinds, switch, rheostat and controller handles, etc. There are also a large number of other articles, such as wood cabinets, boxes, chests, etc. For the latter see Boxes, battery; Boxes, spark coil; Boxes, telephone ringer or bell; Boxes, telephone, wall set; Boxes, tool, portable; Boxes, wood, for instruments, meters, etc.; Boxes, wood molding or raceway; Chests, electricians' tool; Cabinets, battery; Cabinets, miscellaneous. Also see Bases and pedestals, or standards, floor lamp, reed or wood; Bases and stands, table lamp, reed or wood.

Manufacturers:

Bonnett & Co., Nicholas, 619 W. Adams St., Chicago, Ill.
Estes & Sons, E. B., 362-364 5th Ave., New York, N. Y.
Novelty Turning Co., 34 Main St., Norway, Me.
Ottawa Car Mfg. Co., Ltd., Ottawa, Ont., Can.
Peterson Co., F. W., 18 Greene St., New York, N. Y.
Piqua Handle & Mfg. Co., The, Piqua, Ohio.
Rowe Mfg. Co., Henry, Newaygo, Mich.

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Schutz Bros., Inc., 152 Chambers St., New York, N. Y.
Standard Electric Machinery Co., Baltimore, Md. "Standard-Baltimore."
Stephenson Mfg. Co., South Bend, Ind.
Stiles & Co., H. A., 97 Oliver St., Boston, Mass. "Hasco."
WHITE ELECTRICAL SUPPLY CO., T. C., St. Louis, Mo. Manufactures a very high grade line of hard maple wedges to fit any of the standard forms of armature slots in use; also



"White" Hard Maple Wedges

makes a specialty of furnishing hard maple wedges for special forms. Prompt delivery is guaranteed and prices immediately furnished upon receipt of blue print or sample model.—Adv.

VOODFIBRE.—Trade name for lighting ures and electric portable lamps manutured by the Falkenbach Mfg. Co., Inc., E. 54th St., New York, N. Y.

/OODIN & LITTLE.—33-41 Fremont St., ı Francisco, Cal. Manufacturers of gase engines.

/OODISON CO., THE E. J.—Detroit, h. Manufacturers of fire brick. Presit, Edward J. Woodison; vice-president, rles H. Woodison; secretary, John C.)dison; treasurer, Charles D. Yahne. n office, Detroit, Mich. Branch offices, ton, Mass.; Buffalo, N. Y.; Cleveland,); Philadelphia, Pa.; Milwaukee, Wis.; :tle, Wash.; St. Loius, Mo.; Toronto, , Can.; Montreal, Que., Can.; Windsor, , Can.

OODLEY SLATE CO.—Bangor, Pa. ufacturer of electrical slate and elec-lly illuminated bulletin boards. Busi- established 1879. President and gen- manager, Thomas Bolger; secretary, . Bolger; treasurer, Oliver Labor. Exve distributor, the Structural Slate Pen Argyl, Pa.

)ODMAN MFG. & SUPPLY CO., R.—udbury St., Boston, Mass. Manufac- of fare registers for electric railways,

)ODMAN'S.—Trade name for insulat-arnish manufactured by the Dielec-Mfg. Co., St. Louis, Mo.

)ODROW MFG. CO.—Newton, Iowa. facturer of electric washing machines. ess established 1916. President, O. B. row; vice-presidents, D. H. Hendricks F. Woodrow; secretary and man- M. H. Woodrow; sales manager, es M. Brown. Sales representatives, e Mfg. Co., St. Paul, Minn.; Ameri-lectric Co., St. Joseph, Mo.; Capital ic Co., Salt Lake City, Utah; W. E. & Co., Seattle, Wash.; California ow Washer Co., Los Angeles, Cal.; H. Orr. Winnipeg, Man., Can.

)D'S.—Trade name for high-fre- apparatus manufactured by the S. Betz Co., Hoffman St., Hammond,

)DS MACHINE CO., S. A.—Boston, Manufacturer of motors and port-tools. Business established 1854. ent, H. C. Dodge; vice-president and er, C. W. H. Blood; secretary and manager, R. Lowe, Jr. Main office, rell St., Boston, Mass. Branch office arehouse, 520 1st Ave., S., Seattle, District offices, 1019 Maison Blanche, rleans, La.; 332 Railway Exchange Chicago, Ill.; 296 Broadway, New N. Y. Sales representatives, Eby ery Co., San Francisco and Los , Cal.; Baker & Gustaveson, Nora.; W. J. Glor, Cleveland, Ohio.

DTURNING PRODUCTS CO., INC. y, Mass. Manufacturer of wood)llers, coil bobbins, cord and wire nd other wood specialties. Business ıed 1915. President, H. P. Gould; sident and general manager, George ay; treasurer, H. C. Davis.

)WARD GOVERNOR CO.—240 Mill cford, Ill. Manufacturer of hydrauıe governors. Business established resident, H. M. Woodward; secreasurer and general manager, E. E. rd; sales manager, R. J. Kelley. Sales representative, William J. Dawson, 70 Bowery St., Cohoes, N. Y.

WOODWARD IRON CO.—Woodward, Ala. Manufacturer of steel for springs, etc.

WOODWIN.—Trade name for automobile and miniature lamps, flashlights, sockets and other electrical specialties manufactured by the C. D. Wood Electric Co., 441 Broadway, New York, N. Y.

WORCESTER.—Trade name for electric drill grinders and drafting tables manufactured by the Washburn Shops, Worcester, Mass.

WORCESTER BRUSH AND SCRAPER CO.—26 Southbridge St., Worcester, Mass. Manufacturer of boiler tube cleaners. President and treasurer, Edward F. Fletcher; vice-president and secretary, Raymond B. Fletcher.

WORCESTER ELECTRIC & MFG. CO.—Worcester, Mass. Manufacturer of cable lugs, terminals and other electrical specialties.

WORCESTER PRESSED STEEL CO.—Worcester, Mass. Manufacturer of wrenches, sheet metal stampings, etc. President and treasurer, J. W. Higgings; secretary, A. P. Higgins; sales manager, H. P. Harris.

WORCESTER STAMPED METAL CO.—Worcester, Mass. Manufacturer of sheet metal stampings. President, Harry R. Sinclair; secretary, Harold O. McCauley; treasurer and general manager, Frank E. Billings.

WORK.—Work is defined as the product of a force by the distance through which it acts. The unit of work will depend upon or vary with the units of force and distance used. When the dyne and centimeter are used, the unit of work is the erg. When the pound and foot are the units, the foot-pound is the unit of work. The unit of electrical work is the joule, which is equal to one watt-second.

WORKRITE.—Trade name for surface push buttons manufactured by the S. H. Couch Co., Inc., Norfolk Downs, Quincy, Mass.

WORKRITE.—Trade name for push buttons manufactured by Frank W. Morse, 289 Congress St., Boston, Mass.

WORKRITE.—Trade name for hydrometers and outfits manufactured by the Workrite Mfg. Co., 5606 Euclid Ave., Cleveland, Ohio.

WORKRITE MFG. CO—Cleveland, Ohio. Manufacturer of automotive equipment. President and general manager, V. H. Meyer; vice-president, G. H. Angell; secretary, H. G. Schowe; treasurer, F. Demuth. Main office, 5608 Euclid Ave., Cleveland, Ohio. Branch office, 2204 Michigan Ave., Chicago, Ill.

WORLD.—Trade name for electroplating generators manufactured by the Boissier Electric Co., Long Island, N. Y.

WORLD.—Trade name for valves, steam and vacuum gages, etc., manufactured by T. McAvity & Sons, Ltd., King St., St. John, N. B., Can.

WORLD.—Trade name for lighting fixtures manufactured by the World Lighting Appliance Co., 136 Bowery, New York, N. Y.

WORLD LIGHTING APPLIANCE CO.—136 Bowery, New York, N. Y. Manufacturer of lighting fixtures.

WORLD'S BEST.—Trade name for electric heating appliances manufactured by the Security Electric Mfg. Co., 1463 W. Ohio St., Chicago, Ill.

WORLEY JEWEL CO., JOHN.—Lane St., Waltham, Mass. Manufacturer of jewel bearings for instruments. Business established 1900. President, John Worley; general manager, J. L. Worley.

WORSHAM.—Trade name for electrically driven sand riddles manufactured by the Marosa Mfg. Co., Marosa, Ill.

WORTHINGTON.—Trade name for water-tube boilers manufactured by James Beggs & Co., 36 Warren St., New York, N. Y.

WORTHINGTON PUMP & MACHINERY CORP.—New York, N. Y. Manufacturer of electric and steam pumps, motor-driven air compressors, oil engines, water wheels, etc. President, C. P. Coleman; vice-presidents, J. S. Saque, F. H. Jones, L. P. Feustman; secretary, C. N. Barney; treasurer, W. H. Baumes. Main office, 115 Broadway, N. Y. Factories, Harrison, N. J.; E. Cambridge, Mass.; Hazleton, Pa.; Holyoke, Mass.; Cincinnati, Ohio; Buffalo, N. Y.; Cudahy, Wis. Branch offices: Atlanta, Ga.; Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Denver, Colo.; Detroit, Mich.; El Paso, Tex.; Houston, Tex.; Kansas City, Mo.; Los Angeles, Cal.; New Orleans, La.; Omaha, Nebr.; Philadelphia, Pa.; Pittsburgh, Pa.; St. Paul, Minn.; St. Louis, Mo.; Salt Lake City, Utah; San Francisco, Cal.; Seattle, Wash.; Tulsa, Okla.; Washington, D. C.

WOTTON.—Trade name for battery-charging equipment manufactured by the Electric Products Co., Cleveland, Ohio.

WOVENITE.—Trade name for flexible cord manufactured by the Flexible Woven Cable Co., 170 Purchase St., Boston, Mass.

W. R.—Trade name for CO_2 recorders manufactured by the Chadburn Ship Telegraph Co. of America, Inc., Troy, N. Y.

WRAPPERS, INCANDESCENT LAMP. See Cartons, incandescent lamp.

WRAPPING AND SEALING MACHINES, ELECTRICAL.—Appliances operated by an electric motor and used to fold (automatically) paper and pasteboard wrappings about bread, biscuits, cakes, candies and similar products placed in the machine and then to seal the package. The machines vary in detail according to the articles to be wrapped. They are especially suited for food products, because of their sanitary operation; they are of advantage also because of their speed, and, therefore, large capacity and labor economy, likewise because they make a neater package thar can ordinarily be done by hand.

Manufacturer:

Package Machinery Co., Medford St. & Bernie Ave., Springfield, Mass.

WRENCHES, AUTOMOBILE.—Automobile wrenches are adjustable wrenches used on electric vehicles and trucks and other automobiles. A very common form is a single-end wrench with a steel handle and parallel steel jaws. The jaws are set at a slight angle with the handle of the wrench. Double-end wrenches of this type are also used.

Manufacturers:

Barcalo Mfg. Co., Buffalo, N. Y.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bonney Vise & Tool Works, Inc., Allentown, Pa. "Vixen," "Baby Vixen."
C. N. B. Wrench Co., Garwood, N. J.
Coes Wrench Co., 1 Coes Sq., Worcester, Mass.
Crescent Mfg. Co., The, 129 Reade St., New York, N. Y. "Crescent."
Crescent Tool Co., Jamestown, N. Y. "Crescent."
Edelmann & Co., E., 2638-56 N. Crawford Ave., Chicago, Ill. "Han-D," "Sextet-Rench."
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Fairmount Tool & Forging Co., The, 10611 Quincy Ave., Cleveland, Ohio. "Fairmount."
Goodell-Pratt Co., Greenfield, Mass.
Graham Roller Bearing Corp., Coudersport, Pa.
Havard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Kilborn & Bishop Co., The, Chapel & Lloyd Sts., New Haven, Conn. "Saxon."
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio. "Lamson."
Mayhew Steel Products, Inc., 291 Broadway, New York, N. Y. "Mayhew."
Mossberg Co., Frank, Lamb St., Attleboro, Mass.
NEVERSLIP WORKS, THE, Hamilton & Neilson Sts., New Brunswick, N. J.
Niefhoff & Co., Inc., Paul G., 232-242 E. Ohio St., Chicago, Ill. "Elite," "Standard."
Otter Mfg. Co., Inc., 243-45 W. 17th St., New York, N. Y. "Individual Container."
Robinson Co., M. W., 296 Broadway, New York, N. Y. "Carel," "Robinson."
Shuster Engineering Corp., Erie Ave. & Allen St., Philadelphia, Pa. "Seco."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
Starrett Co., The L. S., Athol, Mass.
Takamine Commercial Corp, 120 Broadway, New York, N. Y.
UNIVERSAL MFG. CO., 2633 Randolph St., Lincoln, Neb. "Universal."
Vichek Tool Co., The, 3000 E. 87th St., Cleveland, Ohio.
Walden-Worcester, Inc., Worcester, Mass.
Walworth Mfg. Co., Boston, Mass.

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Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."
Worcester Pressed Steel Co., Worcester, Mass.

WRENCHES, COMBINATION.—Combination wrenches are adjustable wrenches with hardened steel duplex jaws for gripping nuts, bolts or lag screws on one side and pipes or conduits on the other side. They are constructed so as to combine a monkey and a pipe wrench.

Manufacturers:

Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bonney Vise & Tool Works, Inc., Allentown, Pa.
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Mossberg Co., Frank, Lamb St., Attleboro, Mass.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Village Blacksmith Folks, The, Watertown, Wis.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."

WRENCHES, LAG SCREW.—These are steel wrenches of heavy construction with a square opening at one end large enough to fit over a lag-screw heal, which usually is square. The handle is usually bent up so that, if the screw is being placed in the floor or in a beam, there is room enough to grasp the wrench tightly and turn it without scraping the floor or injuring the hands.

Manufacturers:

Bonney Vise & Tool Works, Inc., Allentown, Pa. "Hercules."
KLEIN & SONS, MATHIAS, 3200 Belmont Ave., Chicago, Ill. We manufacture a select bar steel wrench to fit machine bolts, nuts or lag screws from ⅜ in. to ⅝ in. Small hole at end of handle for ¼ in. machine bolts or lag screws. An indispensable wrench for cross-arm work. See illustration of this and other Klein products on page 1259, and write for our complete catalog of construction tools.—Adv.
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Lowell Wrench Co., 54 Commtercial St., Worcester, Mass.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

WRENCHES, LINEMEN'S.—Linemen's wrenches are special forms of lag-screw wrenches or combination lag-screw wrenches which may be used either on lag screws or ordinary nuts of the same size. There are also other forms of wrenches, such as terminal wrenches, that are rather flat wrenches having openings at either end for nuts of various sizes.

Manufacturers:

Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
SMITH & HEMENWAY CO., INC., Irvington, N. J. "Red Devil."
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Verona Tool Works, Oliver Bldg., Pittsburgh, Pa.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Williams & Co., J. H., 79 Vulcan St., Buffalo, N. Y.

WRENCHES, MACHINISTS' OR MONKEY.—Machinists' wrenches are adjustable wrenches having a solid handle usually, and a head or jaw at right angles to the handle and forged from the same piece of steel. The movable jaw is below this head and moves on a screw which is supported by a small lug on the handle. The screw is turned by a thumb nut or knurled head and as it turns in one direction it pulls the threaded adjustable head down towards the handle and when turning in the opposite direction forces it up towards the stationary head. These wrenches may be had in sizes that will open up to about 4 ins. They are very commonly called "monkey" wrenches.

Manufacturers:

Athol Machine Co., Athol, Mass. "Athol."
Au-to Compressor Co., The, 233 Mulberry St., Wilmington, Ohio. "Oro."
Barcalo Mfg Co., Buffalo, N. Y.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bonney Vise & Tool Works, Inc., Allentown, Pa
Coes Wrench Co., 1 Coes Sq., Worcester, Mass. "Knife-Handle," "Steel Handle," "Key Model."
Crescent Tool Co., Jamestown, N. Y. "Crescent."
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Helwig Mfg. Co., St. Paul, Minn. "Helwig."
Lamson & Sessions Co., The, 2188 Scranton Rd., Cleveland, Ohio. "Lamson."
Larco Wrench & Mfg. Corp., 7800 Woodlawn Ave., Chicago, Ill. "Larco."
Mossberg Co., Frank, Lamb St., Attleboro, Mass.
NEVERSLIP WORKS, THE, Hamilton & Nellson Sts., New Brunswick, N. J. "Boss."
Peck, Stow & Wilcox Co., The, Southington, Conn. "Pexto," "Solbar," "Stronghold," "Samson."
Shuster Engineering Corp., Erie Ave. & Allen St., Philadelphia, Pa. "Seco."
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Trimont Mfg. Co., 55-71 Amory St., Roxbury, Boston, Mass.
Vichek Tool Co., The, 3000 E. 87th St., Cleveland, Ohio.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond." "Whitaker."
Whitman & Barnes Mfg. Co., Akron, Ohio. "W & B."
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y. "Always Ready," "Bull Dog." "Peerless," "Falcon."

WRENCHES, PIPE.—Pipe wrenches, as their name implies, are used for gripping pipe or conduit and are widely used by pipe fitters and electricians. They are made adjustable and have two serrated or knurled jaws set at a slight angle, so that they will slip on a pipe when turned in one direction, but will grip it securely when turned in the other. The upper head or one farthest from the handle is usually the movable one in a pipe wrench. There are many patented forms of pipe wrenches. For very large pipes the chain wrench is frequently used; this uses a chain passing around the pipe, one end being fastened to the jaw of the wrench and the other jaw being engaged in one of the links of the chain.

Manufacturers:

Bonney Vise & Tool Works, Inc., Allentown, Pa.
Erie Tool Works, The, 11th & French Sts., Erie, Pa.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass. "Wells," "G. T. D."
Larco Wrench & Mfg. Corp., 7800 Woodlawn Ave., Chicago, Ill. "Larco."
Peck, Stow & Wilcox Co., The Southington, Conn. "Pexto."
Trimont Mfg. Co., 55-71 Amory St., Roxbury, Mass. "Trimo."
Walworth Mfg. Co., Boston, Mass.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y. "Vulcan," "Agrippa," "Falcon."

WRENCHES, RATCHET.—Ratchet wrenches are small steel wrenches with heads arranged to fit over various sized nuts. They are used on nuts in inaccessible places where only a short turn of the handle may be made and the head will remain in that position while the handle may be turned back.

Manufacturers:

C. M. B. Wrench Co., Garwood, N. J.
Goodell-Pratt Co., Greenfield, Mass.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass. "Multo," Multiplex."
Mossberg Co., Frank, Lamb St., Attleboro, Mass.
Shuster Engineering Corp., Erie Ave. & Allen St., Philadelphia, Pa "Seco."
Starrett Co., The L. S., Athol, Mass.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Walden-Worcester, Inc., Worcester, Mass.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

WRENCHES, SPANNER.—Spanner wrenches are special forms of wrenches used in handling large pipes, or especially in screwing a collar or cap onto a large pipe or joint. In electrical construction they are often used for screwing the collar onto a cable-splicing joint. One form of this wrench consists of a handle, with a curved head, just the diameter of the cap and with a pin or lug at the end of the curved portion, which fits into a hole in the collar. These wrenches can be used on only one size of collar or cap.

Manufacturers:

Bonney Vise & Tool Works, Inc., Allentown, Pa.
Fairmount Tool & Forging Co., The, 10611 Quincy Ave., Cleveland, Ohio. "Fairmount."
Harvard Electric Co., 525 W. Van Buren St., Chicago, Ill.
Mossberg Co., Frank, Lamb St., Attleboro, Mass.
Takamine Commercial Corp., 120 Broadway, New York, N. Y.
Western Tool & Mfg. Co., Springfield, Ohio. "Champion."
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."
Williams & Co., J. H., 187 Vulcan St., Buffalo, N. Y.
Worcester Pressed Steel Co., Worcester, Mass.

WRENCHES, TRACK.—Track wrenches are the tools used for tightening the various bolts, screw spikes, etc., used in connection with track construction. There are a large variety of adjustable wrenches on the market, but as each individual company usually employs only a few kinds of bolts or spikes which constitute its standard fastenings, it is quite customary to use a very simple form of spanner wrench, viz., a bar with jaws on one end of it of the proper size to fit the standard nut or spike.

Manufacturers:

HUBBARD & CO., 6301 Butler St., Pittsburgh, Pa. "Hubbard."
Lakeside Forge Co., East Lake Rd., Erie, Pa. "Lakeside."
Verona Tool Works, Oliver Bldg., Pittsburgh, Pa.
Warwood Tool Co., Wheeling, W. Va.
Whitaker Mfg. Co., 409 S. Green St., Chicago, Ill. "Triple Diamond," "Whitaker."

WRIGHT.—Trade name for demand meters manufactured by the General Electric Co., Schenectady, N. Y.

WRIGHT.—Trade name for spark plugs manufactured by the New York Mica & Mfg. Co., Auburn, N. Y.

WRIGHT-AUSTIN CO.—Detroit, Mich. Manufacturer of steam traps, separators and other boiler-room instruments. President, F. F. Wormer; vice-president, C. C. Wormer; secretary, L. S. Moore, Jr., treasurer, C. C. Wormer, Jr.; general manager, C. B. Walter. Main office, Detroit, Mich. Branch offices, New York, N. Y.; 190 N. State St., Chicago, Ill.; Boston, Mass.

WRIGHT CO., M. S.—164 Fremont St., Worcester, Mass. Manufacturer of electric vacuum cleaners. H. R. King, sales manager. Sales representative, Pneuvac Co., Worcester, Mass.

WRIGHT MACHINE CO., THE.—321-408 E. 2nd St., Owensboro, Ky. Manufacturer of internal combustion engines. Business established 1880. President, D. C. Stimson; vice-president, W. S. Hatfield; secretary, Jesse Gabbert; treasurer and general manager, Sidney A. Wright.

WRIGHT TRAFFIC SIGNAL CO.—Cincinnati, Ohio. Manufacturer of traffic directing signals.

WRIGLEY CO., THOMAS.—504 Sherman St., Chicago, Ill. Manufacturer of conduit and pipe benders and toggle bolts. President and treasurer, Thomas Wrigley; vice-president, E. M. Wrigley; secretary and general manager, E. H. Ahlander.

WRINGERS FOR ELECTRIC WASHING MACHINES.—These are similar to the ordinary hand wringers in having two rubber-covered rollers, but are operated by a shaft and bevel gear driven by an electric motor under the tub. Electrically operated wringers are usually equipped with a safety device for releasing the pressure between the rollers; they

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an be reversed, and in many cases are lso arranged to swing in almost any angle round a vertical shaft, as from the wash- ng tub to the clothes basket or station- ry tub.

Manufacturers:

GILLESPIE EDEN CORP., 7 Dey St., New York, N. Y. (See display adv. on page 1296.)
HORTON MFG. CO., Fort Wayne, Ind.
Machen Electric Mfg. Co., 4639-43 E. Thompson St., Bridesburg, Philadelphia, Pa.
Sunny Line Appliances, Inc., 4058 Beaufait Ave., Detroit, Mich.
Swinehart Tire & Rubber Co., 21 W. North St., Akron, Ohio. "Swinehart." (Rubber rollers only.)

WRINKLET.—Trade name for wiring vices manufactured by the Bryant Elec- c Co., Bridgeport, Conn.

WROUGHT IRON & ART GLASS FIX- IRE CO.—195 Canal St., New York, N. Y. Manufacturer of lighting fixtures and portable lamps. Business established 1900. President, M. D. Zuckerman.

W-S-M.—Trade name for electric coal mining, coke drawing, rubber working, furnace charging machines, cranes and hoists manufactured by the Wellman-Seaver-Morgan Co., 7000 Central Ave., Cleveland, Ohio.

WUNSCHE CELL.—An electrolytic cell for the production of bromine from bromide solutions. See Bromine.

WURDACK ELECTRIC MFG. CO., WILLIAM.—21 S. 11th St., St. Louis, Mo. Manufacturer of switches, switchboards, panelboards, switch boxes, etc. Business established 1895. President, William Wurdack; vice-president, G. R. Smith; secretary, William Wurdack, Jr., treasurer, H. M. Maag.

WURLITZER MFG. CO., THE RUDOLPH.—North Tonawanda, N. Y. Manufacturer of electrically operated pianos, orchestras and electric actions for pipe organs.

WYATT.—Trade name for chains manufactured by the Clinton E. Hobbs Co., 30-35 Pearl St., Boston, Mass.

WYLE & BROS., INC., J. J.—18-20 E. 27th St., New York, N. Y. Manufacturer of cut crystal lighting fixtures. Business established 1907. President, J. J. Wyle; secretary, treasurer and general manager, Milton Wyle.

WYNK-A-LYTE.—Trade name for flashing socket plug manufactured by the Betts & Betts Corp., 511 W. 42nd St., New York, N. Y.

WYOGA.—Trade name for steam piston packing made by the Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio.

WYOMING.—Trade name for steam traps and separators manufactured by W. H. Nicholson & Co., 125 Oregon St., Wilkes-Barre, Pa.

X

—The symbol for reactance in elec- il equations and formulas; it is ex- sed in ohms. The form x is used in y mathematical equations as an un- vn quantity, and as an ordinate.

NDER, J. G.—824 Court St., Read- Pa. Manufacturer of battery ter- l cleaners.

ELADUCT.—Trade name for flexible ior conduit manufactured by the Na- l Conduit Co., Ltd., Dufferin & Queen Toronto, Ont., Can.

UCT.—Trade name for rigid steel ilt manufactured by the American lar Loom Co., 90 West St., New N. Y.

L.—Trade name for polishing wheels factured by the Eastern Felt Co., hester, Mass.

—Trade name for storage batteries factured by the Ex-Cel Battery s, Inc., 1502 S. Wabash Ave., Chi- Ill.

.—Trade name for spark plugs, r and fiber washers, felt cushions, s, etc., manufactured by the Excel- eather Washer Mfg. Co., Inc., Rock- ll.

..—Trade name for conduit benders actured by the Henderson Electric mpere, N. J.

-Trade name for lava insulators actured by the Tennessee Burner o., Chattanooga, Tenn.

T.—Trade name for wire, copper, bronze sheets, tubing, etc. manu- d by the Illinois Smelting & Re- Co., 410 N. Peoria St., Chicago,

T.—Trade name for electric pump ctured by the Rumsey Pump Co., eneca Falls, N. Y.

Y.—Trade name for lighting fix- eflectors and other lighting special- nufactured by the National X-Ray r Co., 235 W. Jackson Blvd., Chi- l.

Y APPARATUS (COMPLETE S).—Complete outfits for the pro- of X-rays consist of many differ- ts and are made in several sizes various designs, depending on the rpose in view. In former years its were often of the induction- e, having an interrupter and in- coil to obtain a high voltage, as anywhere from 25,000 to 200,000 en used on the tubes. The ma- ow used are of two principal ne interrupterless type and the fying tube type.

terrupterless type machine con- a small stepup transformer rais- primary voltage to limts of 60,- 00,000 volts (root-mean-square). nsformer is fed either directly 60-cycle, 110, 220 or 440-volt nes, through a controller which consists of either a variable-voltage transformer, or a rheostat, or both, for varying the primary voltage to give the desired secondary voltage that determines the ability of the X-rays to penetrate materials, or in the case of d-c. supply lines, suitable primary voltages are obtained by means of small inverted synchronous converters of capacities up to 10 kw., which supply alternating current to the transformer, the primary control being inserted between the converter and the high-tension transformer. These small high-tension transformers are of capacities up to 10 kw. normal heat-rating basis, with an allowable momentary load of 300%. The high-tension alternating current is led to a large mechanical rectifier or synchronous commutating rectifier of sufficient dimensions to rectify this secondary voltage, the mechanical rectifier being driven in the case of a-c. supply by a small synchronous motor, with ratings up to 3/8 hp.; and in the case of the d-c. supply the rectifier is connected directly to the shaft of the synchronous converter. This delivers a unidirectional current at very high potential to the tube.

The self-rectifying tube type of apparatus consists of the foregoing with the exception of the high-tension rectifier, since it is used with a Coolidge tube that rectifies its own current. See X-ray tubes.

The larger complete equipments are used chiefly in special X-ray laboratories that make examinations and radiographs (X-ray photographs) of any part of the body, or of inanimate objects of various kinds as in special inspection or research service. Where the work is so varied, the equipment is necessarily very complete and includes means for producing both soft and hard rays for light or deep penetrations. A varied assortment of tubes may be required, also several methods of mounting them so as to project the rays effectively upon the body part or other object under investigation.

Manufacturers:

Acme Apparatus Co., 27 Windsor St., Cambridge, Mass. "Acme."
Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
Branston Co., Charles A., 41-45 Ellicott Sts., Buffalo, N. Y.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass. "Clinical," "Clinette," "Surex."
Edwards X-Ray Corp., 111 N. New Jersey St., Indianapolis, Ind.
Empire Electric Co., Inc., 2227 S. San Pedro St., Los Angeles, Cal. "Rose."
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y. "International Auto-Xray."
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky. "Keleket Quality."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Rodgers Electric Laboratories Co., The, 2015 E. 65th St., Cleveland, Ohio.
Roentgen Appliance Co., 693 Mission St., San Francisco, Cal. "Rieber."
Standard X-Ray Co., 1932-42 N. Burling St., Chicago, Ill.
Thompson-Plaster X-Ray Co., Leesburg, Va.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Vulcan Electric Co., 239 So. Los Angeles St., Los Angeles, Cal. "Vulcan."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Waugh."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 300 5th St., Racine, Wis.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.
X-Ray Foot-O-Scope Corp., Inc., 100 Boylston St., Boston, Mass. "Foot-O-Scope."

X-RAY CONTROLLER CABINETS OR PANELS.—These cabinets and panels are used to give the control of the secondary voltage that regulates the electron discharge in the tube. The power and control equipment is often mounted in the cabinets and, as it is quite special equipment, has not been standardized to any great extent. Voltage-regulating transformers are one of the most important parts of the control equipment. These have step arrangements to vary the utilization voltage as desired. The equipment is all mounted on the panels or in the cabinet as a protection, to afford a place where all of the control may be collected and removed from the danger of burn or shock to the operator.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Edwards X-Ray Corp., 111-113 N. New Jersey St., Indianapolis, Ind.
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."

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Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
NATIONAL ELECTRIC CONTROLLER CO., 154 Whiting St., Chicago, Ill. (See display adv. page 1286.)
Rodgers Electric Laboratories Co., The, 2015 E. 65th St., Cleveland, Ohio.
Standard X-Ray Co., 1932-42 N. Burling St., Chicago, Ill.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Waugh."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.

X-RAY DENTAL CHAIRS.—These are chairs which are arranged with special head rests, or with reclining positions and head rests, for the purpose of facilitating the holding of the head in some particular position for the making of X-ray dental films, or for making examinations. The chairs often have supporting arms for the X-ray tubes to be mounted thereon. They are finished in white enamel or other finishes to correspond with the interior of dentists' offices or of special dental X-ray laboratories.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
Reid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Ritter Dental Mfg. Co., Inc., 404 West Ave., Rochester, N. Y. "Ritter."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Garretson."

X-RAY FLUOROSCOPES.—Fluoroscopes are used with X-ray apparatus for the purpose of making the images visible to the eye. This permits examination of conditions without the necessity of making a photograph. Such direct examination is often desirable, especially where no permanent record is needed. The fluoroscopes consist of a fluorescent screen which is used in the path of the invisible X-ray beam to make its effects visible. When the rays strike certain substances, such as a barium platino-cyanide screen, light rays which are visible to the eye are given off. This gives the image or shadows produced by the X-rays on the fluorescent screen.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
Balch Roentgenoscopic Screen Co., Salem, Mass.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Columbia X-Ray & Electric Corp., Austin Pl. & E. 144th St., New York, N. Y. "Columbia."
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Patterson Screen Co., The, 625 Main St., Towanda, Pa.
Roentgen Appliance Co., 693 Mission St., San Francisco, Cal. "Rieber."
Thompson-Plaster X-Ray Co., Leesburg, Va.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Solace."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

X-RAY FOOT-O-SCOPE CO., INC.—100 Boylston St., Boston, Mass. Manufacturer of X-ray apparatus.

X-RAY FURNITURE, MISCELLANEOUS.—This furniture includes the special casings or cabinet work in which the various parts of the X-ray equipment are mounted, and which may be used to store the tubes, plates, screens, etc. These cabinets and equipments are made in several styles, some designed for stationary service in an office, others mounted on small wheels or trucks so that they may be moved from place to place as in a military field hospital. The furniture is often made special to harmonize in finish and style with that in a physician's office. In addition to these cabinets there are special tables, chairs, etc., that are used in making the examinations. These are also included under X-ray furniture. Also see X-ray dental chairs.

Manufacturers:

CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass. ("Clinix" table.)
Edwards X-ray Corp., 111-113 N. New Jersey St., Indianapolis, Ind.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.

X-RAY INTERRUPTERS.—Interrupters are sometimes used with induction coils to produce high-frequency currents. The current in the primary of the induction coil is interrupted for the purpose of inducing a current in the secondary coil, which current is used to excite the X-ray tube. For powerful discharges in short exposures, electrolytic interrupters are preferred. For most therapeutic and X-ray work, however, the mechanical vibrating interrupter, the rotary break and the mercury-jet interrupters are more common. Interrupters and induction coils are not used as widely now as formerly. Also see Interrupters, induction coil.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Thompson-Plaster X-Ray Co., Leesburg, Va.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Solace," "Waugh."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.
Wocher & Son Co., The Max, 23-29 W. 6th St., Cincinnati, Ohio.

X-RAY SWITCHES.—The switches used on X-ray apparatus serve as the controlling and operating switches for the tube. They carry only a small current and are not required to have a large current capacity. They are nearly always installed in the primary circuit of the transformer and operate in conjunction with a rheostat or other regulating means to vary the secondary voltage. The switches need to be insulated for 110, 220 or 440 volts, depending on the voltage applied to the primary.

In some equipments time or clock-controlled switches are used. These are employed chiefly when deep penetrations are desired and it is necessary to limit the application so as to prevent X-ray burns on the patient. In other cases, time switches are used to insure obtaining exactly uniform time of exposure where a series of photographs is to be taken for comparison under as nearly equivalent conditions as possible. The time switches are set to give the desired time of exposure and cut off the primary current at that time.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Edwards X-Ray Corp., 111-113 N. New Jersey St., Indianapolis, Ind.
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Liebel-Flarsheim Co., The, 410-418 Home St., Cincinnati, Ohio.
Standard X-Ray Co., 1932-42 N. Burling St., Chicago, Ill.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.

X-RAY TUBES.—X-Ray tubes are of two general types, gas tubes and incandescent cathode tubes. The gas tube is a glass bulb having mainly two electrodes, one of which is called the target and the other the cathode. This glass bulb contains a very small amount of gas at a very low pressure. Voltages of from 25,000 to 200,000 have been used across the terminals of these tubes, but in general the majority of work is done between 40,000 and 100,000 volts, and the most common value is 60,000 volts (r.m.s.).

When these voltages are applied to the terminals of the tube, the gas in the tube becomes conducting by being ionized and allows current, from a few milliamperes at the highest voltage to several hundred at the lowest, to pass through the tube. The electrical or electron discharge in the tube, or the cathode stream, as it is called in X-ray work, upon striking the target produces X-rays, the ability of which to penetrate materials increases with the voltage across the tube.

The incandescent cathode, or electron tube, as it is sometimes called (in this country it is known as the Coolidge tube), is similar in construction and operation to the gas tube, but has as much of the gas removed from the bulb as possible, so that the residual gas produces no conductivity.

The removal of this gas eliminates the necessity of keeping the gas at a constant pressure, which is necessary for constant conductivity in the gas tube. The conductivity in the incandescent cathode tube is produced by the fact that incandescent materials throw off electrically conducting particles, known as electrons, which supply the conductivity for this tube.

Coolidge tubes are made in two general types: The universal type, which is designed for operation on unidirectional currents, and the radiator type, which is designed for operation on either unidirectional currents or alternating currents. In the latter case the tube rectifies its own current.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich.
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Easter Electric Co., The, 827 14th St., Denver, Colo.
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
Green & Bauer, Inc., 234 Pearl St., Hartford, Conn. "Clover Leaf," "Rex."
International X-Ray Corp., 326 Broadway, New York, N. Y.
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky.
Kesselring X-Ray Tube Co., 652 W. Lake St., Chicago, Ill.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Mica Insulator Co., 68 Church St., New York, N. Y.
Mica Insulator Co., Victoriaville, Que., Can.
Vacuum Glass Co., Lynn, Mass.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Vulcan Electric Co., 239 S. Los Angeles St., Los Angeles, Cal. "Vulcan."
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

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Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Pa.

X-RAY UNITS OR SETS, DENTAL.—These are complete units or sets used by dentists in making direct examinations and photographs by means of X-rays. They are specially constructed for this purpose to give rays of low penetration, the higher rays are not necessary. The low-penetration (soft) rays are produced by 25 to 30 kilovolts, and are largely absorbed by the glass wall of the tube and the soft tissues of the body. The units or sets are generally similar to the complete outfits described above, but are smaller and more simple.

Manufacturers:

Adams X-Ray Co., Maple & Rivard Sts., Detroit, Mich. "Adams."
CAMPBELL ELECTRIC CO., 17 Stewart St., Lynn, Mass.
Edwards X-Ray Corp., 111 N. New Jersey St., Indianapolis, Ind.
Empire Electric Co., Inc., 2227 S. San Pedro St., Los Angeles, Cal. "Rose."
Engeln Electric Co., The, 4601 Euclid Ave., Cleveland, Ohio.
Fischer & Co., Inc., H. G., 2341 Wabansia Ave., Chicago, Ill.
International X-Ray Corp., 326 Broadway, New York, N. Y. "International Auto-X-ray."
Kelley-Koett Mfg. Co., Inc., The, Covington, Ky. "Keleket Quality."
Klitzen Radio Mfg. Co., Inc., Flett Ave., Racine, Wis.
Kny-Scheerer Corp. of America, 56-58 W. 23rd St., New York, N. Y. "Kayess."
Kriebel-Florsheim So., The, 410-418 Home St., Cincinnati, Ohio.
Kid Instrument Co., Inc., J. E., 408 N. 12th St., Philadelphia, Pa.
Ledgers Electric Laboratories Co., The, 2015 E. 65th St., Cleveland, Ohio.
Lentgen Appliance Co., 693 Mission St., San Francisco, Cal. "Rieber."
Standard X-Ray Co., 1932-42 N. Burling St., Chicago, Ill.
Thompson-Plaster X-Ray Co., Leesburg, Va.
Victor X-Ray Corp., 236 S. Robey St., Chicago, Ill.
Vulcan Electric Co., 239 S. Los Angeles St., Los Angeles, Cal. "Vulcan."
White & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y. "Waugh."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.
WESTERN COIL & ELECTRICAL CO., 900 5th St., Racine, Wis.

RAYS.—X-rays or Roentgen rays discovered by Conrad Roentgen in They are produced when the cathode rays in a vacuum tube is focused on target of platinum or tungsten. They resemble ordinary light in that they travel with the same velocity, but the wave length, which depends on the conditions in the tube, is much less about 1/1000 part of the wave length of violet light. When X-rays are passed through a gas it becomes ionized, that is, the molecules become separated into positively and negatively charged ions which serve as carriers of electricity and the gas becomes conducting.

One of the principal noticeable differences between light rays and X-rays is that the latter have the property of passing through a different class of materials from the former. For instance, visible light rays pass readily through lead glass (cut glass stock), whereas this material is opaque to X-rays. On the other hand, aluminum is, of course, opaque to light rays, but X-rays pass through it very readily. Again, we have materials which are opaque to both classes of rays; for example, lead passes no visible light rays and practically no X-rays. Further, we have materials which are translucent to both classes of rays; as an example, soda glass allows both light rays and X-rays to pass through very readily.

X-rays are themselves invisible, but when they fall upon certain substances, such as calcium tungstate or platinocyanides of barium and potassium, they cause them to give off visible radiation or light rays, known as fluorescence.

X-rays also excite chemical activity in materials through which they pass, such as glass and photographic emulsions. Glass may change its color under the action of X-rays; photographic plates or films show exposure under their action. By means of barium platino-cyanide screens and photographic plates or films, images or in reality shadows are produced by X-rays. All images produced by X-rays are caused by the fact that the materials through which X-rays pass are of varying degrees of opaqueness to X-rays by reason of their nonuniform structure, or by differences of thickness. For instance, a shadow produced by the bones in the hand by means of X-rays is possible because the bones are more opaque to the X-rays than the flesh, as well as the fact that the bones vary in thickness.

We may make an X-ray shadow of a coin which is made of uniform material but has minute differences in thickness. In this way we get an image of both faces of the coin on the photographic plate by means of X-rays. Skillfully made X-ray plates are wonderfully rich in detail, showing the minutest scratch on a bone or piece of metal, or even the engraving on paper currency, a split in a piece of wood, a blow hole in a casting; even stress on the surface of a metal may be indicated, and many other similar applications which space does not permit to recite.

Applications. In the past, X-rays have been applied mainly in the practice of medical diagnosis and treatment of diseased tissue. Among the things for which X-rays are used as a diagnostic medium are fractured bones, diseased bones and teeth, location of bullets, shell splinters, etc., ulcers of the stomach and of the abdominal region, appendicitis, tuberculosis and numerous others. Among the diseases successfully treated by X-rays we may mention principally cancerous tissue and the like, as well as skin diseases and the removal of skin blemishes.

The general commercial application of X-rays is just beginning and its application to the inspection of materials opens up a wide field. The detection of blow holes in castings, splits in wooden devices, such as airplane propellers, detection of thin spots or foreign bodies in electrical insulation and similar applications make the rays a wonderful agent for the purpose. The destruction of bacteria in foods and tobacco has been carried on very successfully, and some of the better grades of cigars have had the bacteria in them destroyed in this way.

Dangers. X-ray apparatus is dangerous from two standpoints: First, from the liability of shock from high-voltage conductors, and secondly, from the tissue-destruction action of X-rays. Great precaution should be taken around X-ray apparatus to avoid coming into the proximity of the conductors which operate the tube, as they are ordinary 60-cycle, 40,000 to 100,000-volt circuits and are not the harmless induction coils of the past. They must be treated strictly as power circuits, though, of course, there is some limitation to the energy available on account of the small size of the apparatus connected.

X-ray apparatus is today equipped with adequate protection against X-ray burns or skin destruction by X-rays, and it is only with great exposures that X-ray burns become a possibility; probably five times the exposure given in ordinary X-ray work. Great care should be taken by operators of X-ray apparatus, however, and such apparatus should not be handled until complete instructions on its electrical features and the full technique of manipulation of the X-ray tubes have been thoroughly mastered.

XTRALITE.—Trade name for lighting fixtures manufactured by J. C. Hobrecht Co., 1012 6th St., Sacramento, Cal.

XX.—Trade name for power transmission and other chains manufactured by the United States Chain & Forging Co., Union Arcade, Pittsburgh, Pa.

XXX.—Trade name for bells and buzzers manufactured by Stanley & Patterson, 34 Hubert St., New York, N. Y.

Y

The letter Y is the chemical symbol the element ytterbium. In electrical ons it is used as the symbol for admittance, expressed in mhos. It is also s an unknown and as an ordinate in natical formulas.

Trade name for oil engines manufactured by Fairbanks, Morse & Co., 900 ash Ave., Chicago, Ill.

NNECTION.—See Star or Y-con-

ER'S.—Trade name for soldering anufactured by the Alexander R. Co., Hudson, N. Y.

E.—Trade name for electric hoists, and tractors manufactured by the Towne Mfg. Co., Stamford, Conn.

E & TOWNE MFG. CO., THE.—d, Conn. Manufacturer of electric trucks and tractors. President, C. Allen; vice-presidents, Schuyler Joseph A. Horne; treasurer, Wil-Case; secretary, J. H. Towne; genanager, Edward C. Waldvogel. fice and factory, Stamford, Conn. offices, 9 E. 40th St., New York, 29 E. Lake St., Chicago, Ill.; St. es, Ont., Can.

EE.—Trade name for hand set es manufactured by the S. H. Couch Co., Inc., Arlington & Squantum Sts., Norfolk Downs, Quincy, Mass.

YANKEE.—Trade name for refillable fuses manufactured by the Metropolitan Electric Mfg. Co., East Ave. & 14th St., Long Island City, N. Y.

YANKEE.—Trade name for screw drivers, drills, vises, etc., manufactured by the North Bros. Mfg. Co., Lehigh Ave. & American St., Philadelphia, Pa.

YARD LIGHTING UNITS.—See Lighting units, yard, dock, playground, etc.

YARN, COTTON INSULATING.—Cotton yarn for use in winding on wires and cables for insulating purposes is prepared by twisting together long fibers of cotton. These are generally twisted into loose threads and several such threads grouped together and wound on a bobbin or spool. It is prepared in various colors for use in making coded wires or for giving a distinctive coloring. Several grades of yarn are also available.

Manufacturer:

Multiple Winding Co., 77 Summer St., Boston, Mass.

YARN, JUTE.—See Jute rope, twine and yarn.

YARNALL-WARING CO.—Philadelphia, Pa. Manufacturer of valves, feed water meters and other power plant specialties. President, D. G. Waring; vice-president, D. R. Yarnall. Main office, Mermaid Ave., Chestnut Hill, Philadelphia, Pa. Branch offices, 90 West St., New York, N. Y.; 58 W. Washington St., Chicago, Ill.; Candler Annex, Atlanta, Ga.; 550 Rockefeller Bldg., Cleveland, Ohio; Detroit, Mich.; Fulton Bldg., Pittsburgh, Pa. Sales representative, G. B. Allen & Co., Deere Bldg., Dallas, Tex.

YARNS, ASBESTOS. — See Asbestos tape, tubing, twine, yarn, etc.

YARWAY.—Trade name for valves, feed water meters and other power plant specialties made by the Yarnall-Waring Co., Mermaid Ave., Chestnut Hill, Philadelphia, Pa.

YATES CO., WILLIAM G.—Cleveland, Ohio. Manufacturer of electric ironing machines. Business established 1921. President, William G. Yates.

YATES MACHINE CO., P. B.—Beloit, Wis. Manufacturer of motor-driven woodworking machinery. President and general manager, P. B. Yates; secretary and sales manager, L. M. Randall; treasurer, L. D. Forbes. Main office and factory,

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Beloit, Wis. Branch offices, Chicago, Ill.; Philadelphia, Pa.; Buffalo, N. Y.; Boston, Mass.; Birmingham, Ala.; New Orleans, La.; Minneapolis, Minn.; Spokane, Wash.; Seattle, Wash.; San Francisco, Cal.; Memphis, Tenn.; Richmond, Va.; Spartanburg, S. C.; Hamilton, Ont., Can.

YEAGER & CO., INC., H. W.—154 N. 11th St., Philadelphia, Pa. Manufacturer of motor drive equipment for pianos. Business established 1919. President, S. Arthur Love; secretary, S. Arthur Love, Jr.; treasurer, Donald M. Love; general manager, M. Alexander Laverty. Sales representative, Globe Co., Philadelphia, Pa.

YELL-O-GUARD.—Trade name for automobile locks made by the Bradsto Appliances, Inc., 65 Main St., Buffalo, N. Y.

YEOMANS BROS. CO.—1433 Dayton St., Chicago, Ill. Manufacturer of electric pumping machinery. President, Edward Yeomans; secretary and treasurer, Charles Yeomans; general manager, Elmer J. Codner; sales manager, Paul D. Townsend. Sales representatives, Burford Hall & Smith, Third National Bank Bldg., Atlanta, Ga.; Gassman & Cunningham, Brown-Marx Bldg., Birmingham, Ala.; Power Equipment Co., 131 State St., Boston, Mass.; C. H. Cobb, Daly Bank Bldg., Butte, Mont.; J. R. Purser, Commercial Bank Bldg., Charlotte, N. Car.; O. J. Ollonier, Provident Bank Bldg., Cincinnati, Ohio; Cleveland Pump & Supply Co., Cleveland, Ohio; John H. Van Zandt, 1612 Southwestern Life Insurance Bldg., Dallas, Tex.; D. C. Murphy, 210 Security Bldg., Davenport, Iowa; Charles M. Kelso Co., Reiboid Bldg., Dayton, Ohio; Power Plant Supply Co., Penobscot Bldg., Detroit, Mich.; George W. Herlin, 619 Noble St., El Paso, Tex.; Weinshank & Fenstermaker, Hume-Mansur Bldg., Indianapolis, Ind.; McCulley-Widener & Wright, 303 E. 10th St., Kansas City, Mo.; F. C. Millard Co., Marsh-Strong Bldg., Los Angeles, Cal.; Charles W. Miller, 209 Grand Ave., Milwaukee, Wis.; Healy-Ruff Co., Plymouth Bldg., Minneapolis, Minn.; Darling Bros., Ltd., Montreal, Que., Can., Toronto, Ont., Can., Winnipeg, Man., Can.; Brian & Powers, Canal Bank Bldg., New Orleans, La.; E. A. Julie, 51 E. 42nd St., New York, N. Y.; McCulley-Widener & Wright, W. O. W. Bldg., Omaha, Neb.; Charles C. Enderle, 621 Commercial Trust Bldg., Philadelphia, Pa.; Carl D. Bushnell, Park Bldg., Pittsburgh, Pa.; Gordon & Finkbeiner, 224 Pine St., Portland, Ore.; J. F. Brightman, Mercantile Bldg., Rochester, N. Y.; Hawley-Richardson-Williams Co., Dooly Bldg., Salt Lake City, Utah; California Hydraulic Engineering & Supply Co., 70 Fremont St., San Francisco, Cal.; A. H. Cox & Co., 307 First Ave., S., Seattle, Wash.; Charles M. Kelso Co., National Bank Bldg., Utica, N. Y.; Frank Darling & Co., 1142 Homer St., Vancouver, B. C., Can.

YOERGER ELECTRIC SIGN CO., P. F.—62½ E. Long St., Columbus, Ohio. Manufacturer of electric signs. Business established 1897. P. F. Yoerger, sole owner.

YOKE.—That part of a bipolar or multipolar field structure of an electromagnet or of an electrical machine which connects and supports the pole cores and at the same time provides a magnetic path for the field flux.

YOKE, BRUSH.—The brush yoke of an electrical machine is the rocker arm, ring, quadrant or other adjustable support for maintaining the brush studs or holders in their proper relative positions and by means of which the entire brush gear can be shifted through a small angle.

YOKES, STRAIN.—Strain yokes are heavy metal yokes for use with strain and suspension insulators of the link type. They are made in pairs, the upper part to hook onto an eye bolt or to be bolted to the crossarm. The yokes are made either single or double-arm. Double-arm yokes support a string of insulators from each side or arm of the yoke, while single-arm yokes support one string only. The other (lower) part of the yoke is secured to the bottom of the string of insulators. This yoke is then secured to the conductor. These yokes are capable of withstanding heavy strains.

Manufacturer:

Thomas & Sons Co., The R., East Liverpool, Ohio. "Thomas."

YONKERS.—Trade name for cable hanger manufactured by the Cameron Appliance Co., 48 Waters Ave., Everett, Mass.

YORK ELECTRIC & MACHINE CO.—30 N. Penn St., York, Pa. Manufacturer of incandescent lamp making machinery and electric vacuum pumps. President and general manager, John E. Graybill; vice-president, F. W. Gartman; secretary and treasurer, H. G. Wiest.

YORK MFG. CO.—York, Pa. Manufacturer of motor-driven ice making and refrigerating machines. Business established 1874. President, W. L. Glatfelter; vice-president and general manager, Thomas Shipley; secretary and treasurer, B. H. Loucks; sales manager, A. B. Strickler. Sales representatives, Shipley Construction & Supply Co., 42nd St. & 2nd Ave., Brooklyn, N. Y.; Bay State Construction & Supply Co., 88 Broad St., Boston, Mass.; Central Construction & Supply Co., 2222 Arch St., Philadelphia, Pa.; Greenwood Construction & Supply Co., 47-49 Terminal Way, Pittsburgh, Pa.; York-Ohio Ice Machine Co., 1106-08 Woodland Ave., Cleveland, Ohio; Southern Construction & Supply Co., 116-18 Central Ave., Atlanta, Ga.; Westerlin & Campbell Co., 1113 Cornelia St., Chicago, Ill.; York-Allan Ice Machine Co., 1213 Jackson St., Omaha, Nebr.; Pilsbry-Becker Engineering & Supply Co., 117-19 S. 11th St., St. Louis, Mo.; York Mid-West Ice Machine Co., 2121 Market St., Denver, Colo.; York Engineering & Supply Co., 2201 Texas Ave., Houston, Tex.; York-California Construction Co., 832-38 Folsom St., San Francisco, Cal.; 306 Boyd St., Los Angeles, Cal.; York Construction & Supply Co., 508 Terry Ave., N., Seattle, Wash.; Canadian Ice Machine Co., Toronto, Ont., Can. Branch office, Monadnock Block, Chicago, Ill.

YOST ELECTRIC MFG. CO.—1805 Hawthorne St., Toledo, Ohio. Manufacturer of sockets. President, treasurer and general manager, Frank H. Chapman; vice-president, Howard V. Chapman; secretary and sales manager, Frederick W. Chapman. Sales representatives, Belknap Hardware Co., Louisville, Ky.; Smith-Perry Electric Co., Dallas, Tex.; William P. Johnson, Minneapolis, Minn.; American Brass & Copper Co., New York, N. Y.; Peerless Light Co., Chicago, Ill.; Incandescent Supply Co., Pittsburgh, Pa.; Great Lakes Electric Co., Detroit, Mich.

YOUGH.—Trade name for electric and steam pumps manufactured by Boyts, Porter & Co., Connellsville, Pa.

YOUNG BROS. CO.—Detroit, Mich. Manufacturer of electric japanning, enameling, drying and core ovens. Business established 1896. President, C. A. Young; vice-president, C. H. Lisch; secretary and treasurer, G. A. Young; sales manager, R. B. Reed. Main office, 6500 Mack Ave., Detroit, Mich. Branch offices, 22 W. Monroe St., Chicago, Ill.; 708 Engineers Bldg., Cleveland, Ohio. Sales representatives, Industrial Specialties, Inc., 52 Vanderbilt Ave., New York, N. Y.; Milton Mill, 217 International Life Bldg., St. Louis, Mo.

YOUNG CO., A. B.—Fair Haven, Vt. Manufacturer of electrical slate.

YOUNG CO., WILLIAM B.—1733 N. 6th St., Philadelphia, Pa. Manufacturer of portable electric lamps, lamp shades and bases. Business established (about) 1906 as Young & Russell. President, C. C. Humphreys; secretary and treasurer, William B. Young. Sales representatives, E. W. Hammond, 10 W. 23rd St., New York, N. Y.; Himmelstern Bros., 718 Mission St., San Francisco, Cal.; E. M. Meder, 17 N. Wabash Ave., Chicago, Ill.

YOUNG, INC., LORIN W.—214 E. 40th St., New York, N. Y. Manufacturer of electric lighting fixtures and portable lamps.

YOUNG MFG. CO., R. W.—Chicago, Ill. Manufacturer of electric turntable tractors. Main office, 111 W. Monroe St., Chicago, Ill. Branch office, 2038 Grand Central Terminal, New York, N. Y.

YOUNGSTOWN SHEET & TUBE CO.—Youngstown, Ohio. Manufacturer of conduit and cables. Business established 1900. President, James A. Campbell; vice-presidents, H. G. Dallon, C. S. Robinson, W. E. Manning, Richard Garlick; secretary, W. E. Meub; treasurer, Richard Garlick; general manager, W. C. Reilly; sales manager, W. E. Manning. Main office and factory, Stambaugh Bldg., Youngstown, Ohio. Branch offices, 120 Franklin St., Boston, Mass.; 30 Church St., New York, N. Y.; Healey Bldg., Atlanta, Ga.; Oliver Bldg., Pittsburgh, Pa.; Leader-News Bldg., Cleveland, Ohio; Dime Savings Bank Bldg., Detroit, Mich.; McCormick Bldg., Chicago, Ill.; 1139 Olive St., St. Louis, Mo.; 1st National Bank Bldg., Denver, Colo.; Dallas Co., State Bank Bldg., Dallas, Tex.; 604 Mission St., San Francisco, Cal.; Central Bldg., Seattle, Wash.

YPSILANTI REED FURNITURE CO.—Ionia, Mich. Manufacturer of portable lamps and reed lamp bases. Business established 1902. President, M. M. Reed; vice-president, F. A. Chapman; secretary, treasurer and general manager, Fred W. Green; sales manager, C. C. Lindsley. Main office, Ionia, Mich. Factories, Ionia, Portland, Lyons, Lowell, Saranac, Mich. Branch office, 1722 Arcade Pl., Chicago, Ill.

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Z

Z.—The symbol for impedance, expressed ohms.

Z.—Trade name for kerosene, gas and soline engines manufactured by Fair-nks, Morse & Co., 900 S. Wabash Ave., icago, Ill.

ZAPON.—Trade name for metal lac-ers and enamels manufactured by the lluloid Zapon Co., 200 5th Ave., New rk, N. Y.

ZAPON LEATHER CLOTH .CO.—200 Ave., New York, N. Y. Manufacturer leather cloth for car curtains, etc.

ZAUBITZ, AUGUST.—95-97 Cliff St., w York, N. Y. Manufacturer of elec-indicating pyrometers.

B.—Trade name for remote control tch manufactured by the Electric Con-ler & Mfg. Co., 2700 E. 79th St., Cleve-d, Ohio.

ENA.—Trade name for packings for ons, valves, etc., manufactured by dolph Brandt, 70 Cortlandt St., New k, N. Y.

ENITH.—Trade name for belting man-tured by the Jewell Belting Co., Hart-, Conn.

ERNICKOW, O.—15 Park Row, New c, N. Y. Manufacturer of indicating recording instruments.

EUS.—Trade name for electric welders ufactured by the Gibb Instrument Co., E. Palmer Ave., Detroit, Mich.

NC.—A bluish white metal. Symbol at. wt. 65.4; sp. gr. 6.9; m. p. 433° C.; 930° C. Its important ores include sulphide, carbonate, silicate and oxide. chief producing countries are the ed States, Germany and Belgium. The ucing capacity of the latter two has very much curtailed, so that out of rld's production of 566,000 long tons in the United States produced 410,000. e the war the United States' output about 300,000 tons out of a total of 000 for the annual world output. nercial slab zinc is sometimes called ter," but this name is disappearing. principal uses are in making galvan-iron (sheet iron coated with zinc to nt rusting) and as a constituent of and other alloys.

metal is usually recovered from the heating in a closed retort (preceded asting off sulphur or carbon dioxide cessary) with coal as a reducing so that the oxide is reduced to and the latter is distilled off as and collected in a condenser placed end of the retort. The retort fur-are usually gas-fired, but electric ng is also carried on in a few places power is cheap. Considerable zinc y high purity is now produced by ctrolytic method. The oxidized ore hed with dilute sulphuric acid and sulting zinc sulphate solution elec-d with insoluble anodes. A part of ntained zinc is thus plated out on thodes and sulphuric acid is regen-in the electrolyte, which is used for leaching. Certain impurities are dissolved from the ore, as cop-l iron, must be precipitated before ctrolysis for zinc is begun, other-ese would deposit with the zinc.

ANODES.—These are large bars es of pure zinc used as anodes in ytic and electrogalvanizing process-ey are usually cast in large sizes, suspended in the tank from lugs, op of the anode. These are anodes soluble type and are eaten away or osed when the cells or processes action, the zinc being deposited on terial being plated or electrogal-

facturers:

tt-O'Connell Co., 3600 S. Morgan Chicago, Ill.
Mfg. Co., The, Water St., Plym-, Mass.
l Platers' Supply Co., Inc., 489-Broome St., New York, N. Y. "G. ."
rford Brass & Copper Co., U. T., afayette St., New York, N. Y. Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
New Jersey Zinc Co., The, 160 Front St., New York, N. Y.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y .
Tallman Brass & Metal, Ltd., Wilson St., Hamilton, Ont., Can.
U. S. Electro Galvanizing Co., 32-34 Stockton St., Brooklyn, N. Y.
Vulcan Electric Co., 239 S. Los Angeles St., Los Angeles, Cal. "Vulcan."
Wappler Electric Co., Inc., 162 Harris Ave., Long Island City, N. Y.

ZINC CHLORIDE.—Symbol $ZnCl_2$; this is one of the common zinc salts and it is used for electrical purposes in some types of primary batteries. The Leolanché type cell and especially its modification, the dry battery, use some zinc chloride in the electrolyte. Zinc chloride is also used as a wood preservative in some treatments of poles, crossarms, pins, etc.

Manufacturers:

Grasselli Chemical Co., The, Cleveland, Ohio.
Harshaw, Fuller & Goodwin Co., Philadelphia, Pa.
Mallinckrodt Chemical Works, St. Louis, Mo.
Merrimac Chemical Co., 148 State St., Boston, Mass.
New Jersey Zinc Co., The, 160 Front St., New York, N. Y.
Roessler & Hasslacher Chemical Co., 100 William St., New York, N. Y.
Sandoval Zinc Co., 410 N. Peoria St., Chicago, Ill.
United American Metals Corp., Brooklyn, N. Y.
United Zinc Smelting Corp., Moundsville, W. Va.

ZINC, ELECTROLYTIC. — Electrolytic zinc is now being produced in a very pure state and in large quantities. In the process of production the oxidized ore is leached with diluted sulphuric acid, giving zinc sulphate. The zinc sulphate solution is purified to remove copper, iron, etc., and it is then electrolyzed by using insoluble anodes, part of the zinc being plated out on the cathodes. The electrolyte is largely regenerated into sulphuric acid and may be used over again.

Manufacturers:

American Smelters Securities Co., 201 1st St., San Francisco, Cal.
Anaconda Copper Mining Co., 42 Broadway, New York, N. Y. "Anaconda Electric."
Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, B. C., Can. "Trail."
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
McINTOSH BATTERY & OPTICAL CO., 223-233 N. California Ave., Chicago, Ill.
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.

ZINC PLATES, RODS, SHEET, ETC.—Zinc plates, rods and sheet are rolled from zinc ingots for use in the electrical industry. The plates and rods are used for making battery zincs and electrodes of various kinds. Sheet zinc is widely used for making the cans or containers for dry batteries. It is also used in other places in electrical equipment, where its corrosion-resisting properties are of advantage, such as for metal cylinders of washing machines. Zinc ingots are used in brass and other alloy foundries of electrical manufacturing plants in mixing the ingredients of brass, certain bronzes, etc.

Manufacturers:

Apollo Metal Works, LaSalle, Ill. "Apollo-Nickelzinc."
Edes Mfg. Co., The, Water St., Plymouth, Mass.
General Platers' Supply Co., Inc., 489-493 Broome St., New York, N. Y. "G. P. S."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Matthiessen & Hegeler Co., LaSalle, Ill.
New Jersey Zinc Co., 160 Front St., New York, N. Y. "Horse Head."
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
Sandoval Zinc Co., 410 N. Peoria St., Chicago, Ill.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y.
Stimpson Co., Edwin B., 70 Franklin Ave., Brooklyn, N. Y.

ZINC SLABS.—Zinc slabs are manufactured by refiners of zinc ore. They are merely large slabs of pure zinc furnished for use in making brass or for the manufacture of electrodes for galvanizing processes and other electrolytic processes. They are also used for rolling into sheet zinc and for various other manufacturing purposes.

Manufacturers:

Mineral Point Zinc Co., 140 S. Dearborn St., Chicago, Ill.
Union Smelting & Refining Co., Inc., Pulitzer Bldg., New York, N. Y.
United Smelting & Aluminum Co., 183 Commerce St., New Haven, Conn.
U. S. Reduction Co., East Chicago, Ind.

ZINCS, BATTERY.—Battery zincs are cast in forms suited for use in primary batteries of various kinds. Some of these more common forms are the crowfoot, cylinder, round, pencil or rod, star, plate, etc. There are also several other special forms for the less common types of primary batteries.

Manufacturers:

Beattie Zinc Works, Reading, Mass.
Bryant Mfg. Co., 323 W. Jackson Blvd., Chicago, Ill.
Bryant Zinc Co., 600 Orleans St., Chicago, Ill.
Canadian National Carbon Co., Ltd., Hillcrest Park, Toronto, Ont., Can.
Edes Mfg. Co., The, Water St., Plymouth, Mass.
Grasselli Chemical Co., The, Cleveland, Ohio. "Franklin."
Hungerford Brass & Copper Co., U. T., 80 Lafayette St., New York, N. Y. "Star Brand."
Illinois Smelting & Refining Co., 410 N. Peoria St., Chicago, Ill. "XLNT."
Manhattan Electrical Supply Co., Inc., 17 Park Pl., New York, N. Y.
Matthiessen & Hegeler Co., LaSalle, Ill. "LeClanche."
New Jersey Zinc Co., 160 Front St., New York, N. Y. "Horse Head."
Pacific Metal Works, 153-159 1st St., San Francisco, Cal.
SMITH & McCRORKEN, INC., 407 E. 18th St., New York, N. Y. All sizes and gages of zinc for flashlights can be furnished in sheet or ribbon form, and company is equipped to cut material to any special size required. Zinc cups furnished in any size and gage specified. Solder supplied in any composition required.—Adv.
Waite & Bartlett Mfg. Co., 53 Jackson Ave., Long Island City, N. Y.

ZINKOTE.—Trade name for rigid metallic conduit manufactured by the Mark Mfg. Co., 111 W. Washington St., Chicago, Ill.

ZINSSER & CO., WILLIAM.—New York, N. Y. Manufacturers of insulating varnish, shellacs and sealing waxes. President, William H. Zinsser; treasurer, Rudolph Zinsser. Main office, 195 William St., New York, N. Y. Factories, New York, N. Y., and Chicago, Ill. Branch office, 319 N. Western Ave., Chicago, Ill.

ZN.—The form Zn is the chemical symbol for the metallic element zinc.

ZOKUL ELECTRIC LAMP DIVISION, NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.—Cleveland, Ohio. Manufacturer of carbon lamps. H. C. Gordon, general manager.

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The Story of Electrical Development
Begins in the Laboratory

The early scientists worked independently, and their discoveries often found no immediate outlet in practical utility. But today discoveries are put to work. With the establishment of the industrial research laboratory, scientific investigation is directed toward results of industrial usefulness. The needs of industry are known or anticipated, and any new scientific principles are readily applied. Thus industry and science have joined hands.

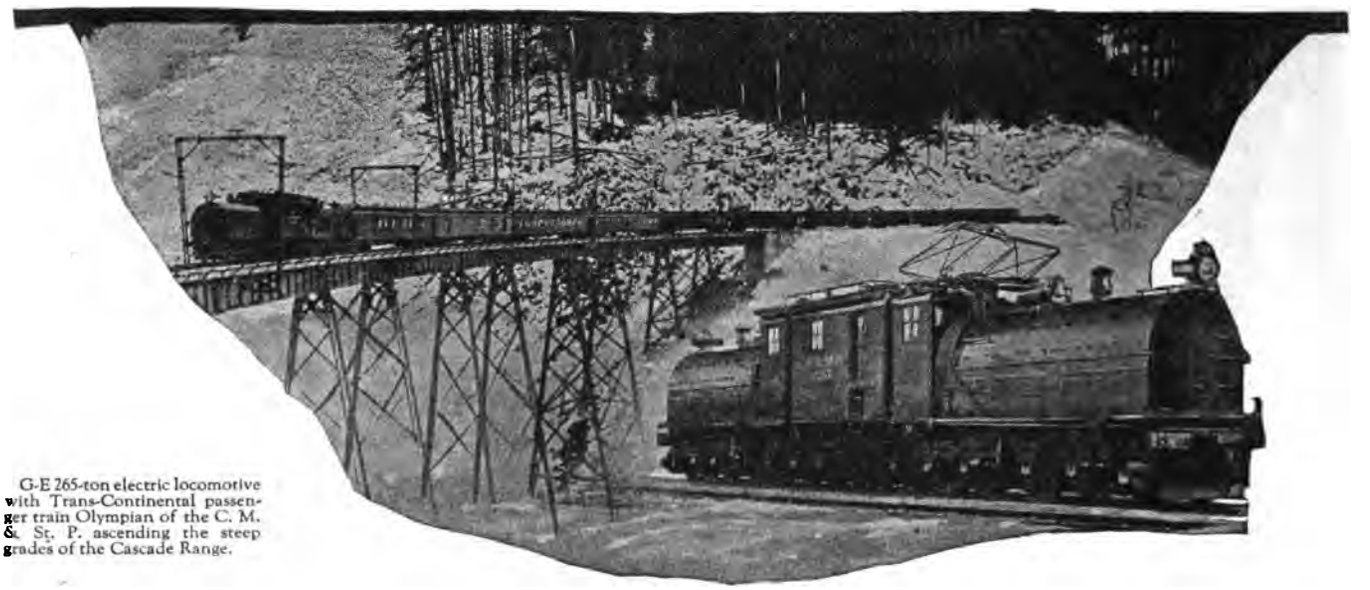
The research laboratory of the General Electric Company is dedicated to the electrical industry, with facilities almost coextensive with the scope of the industry itself. Here was developed the process of making tungsten ductile after it had resisted for 130 years all efforts of man to change its natural state. Wrought tungsten came into universal use for incandescent lamp filaments; it became an element in a new rectifier for charging batteries; and this same research, combined with extensive study of extremely high vacua, resulted in important improvements in apparatus for X-ray work and wireless telegraphy and telephony.

This is only one of representative achievements which have given impetus to electrical development. Every phase of the electrical industry has been advanced by research, for back of it all is the scientist working to get greater usefulness from electricity in light, heat, and power.

95-380

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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Greater availability of electric power has meant more electric transportation, with its economy, speed, safety, and reliability



G-E 265-ton electric locomotive with Trans-Continental passenger train Olympian of the C. M. & St. P. ascending the steep grades of the Cascade Range.



G-E electric railway motors and control have stimulated the adoption of one-man Safety Cars.



Reliable distribution, motive power, and control equipment make the subway trains dependable.

Electricity Helps to Haul the World

Electricity has added new possibilities to all forms of transportation and become an almost universal motive power.

Electric railway transportation in cities has completely replaced the horse-drawn car within the memory of this generation and become a recognized public necessity. It has moved homes from a congested area to the clean, healthful atmosphere of the suburbs. It has transformed undesirable smoky terminals into flourishing business districts.

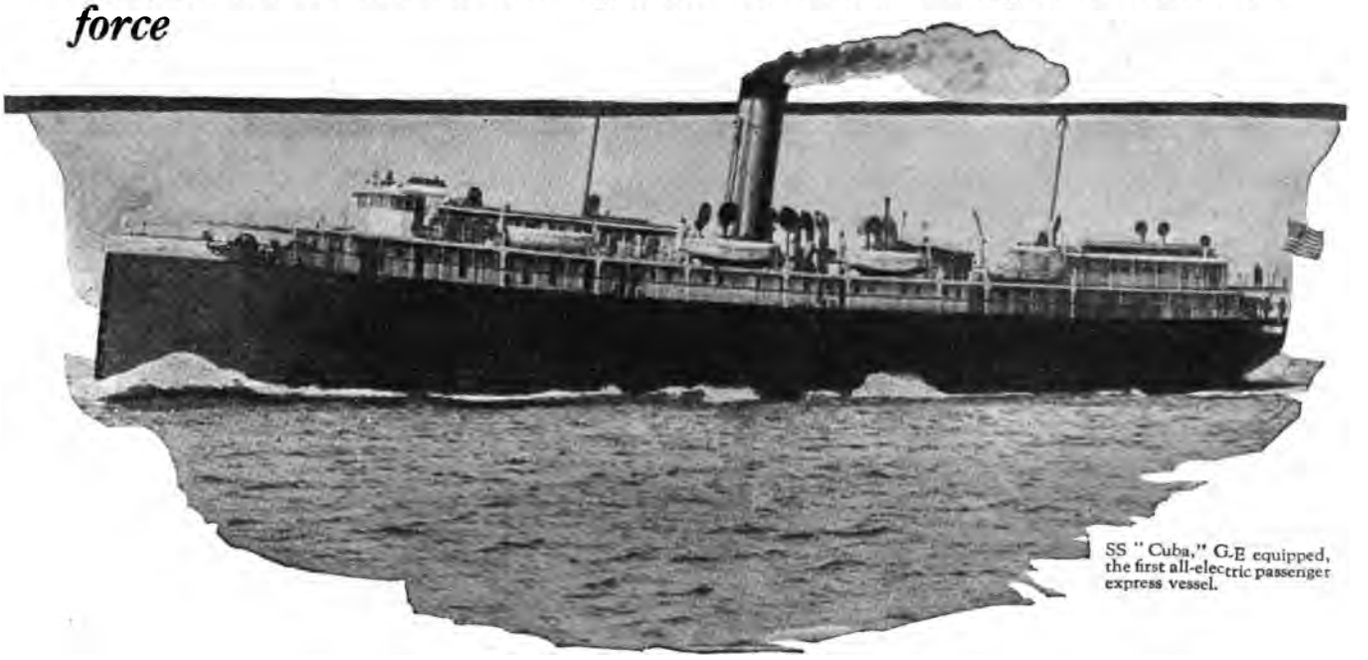
Electrification of main lines has not only increased the comfort and dispatch of passenger travel, but where steam once puffed its way over mountain ranges the electric locomotive pulls heavier loads at greater speeds and adds economy by utilization of water power.

The General Electric Company has contributed to every phase of this development producing electrical equipment to generate and distribute the necessary power; increasing operating economies by making such equipment automatic; and applying that power to make it serve all traffic requirements.

25-133

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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Marine transportation, formerly limited by brawn and sail, is now rated in horsepower with electricity a dominant force



SS "Cuba," G-E equipped, the first all-electric passenger express vessel.

Making Great Ships into Cruising Cities

With the same aptitude it has shown on land, electricity has plunged into the solution of marine transportation problems.

The success of G-E electric propulsion machinery on the U. S. Collier "Jupiter," now the "Langley," paved the way for its application on the U. S. S. "New Mexico" when electric drive for large vessels became a fact. Electric propulsion has since proved successful for passenger vessels, cargo boats, fire boats and fishing trawlers and will be installed on new navy vessels requiring 180,000 h. p. each.

The generators in the electric ship supply power not only to propel it, but to steer it and light it, to hoist and lower its life boats and anchors, and to load and unload the cargo. Moreover, electricity is the servant in the galley and laundry, and it otherwise provides the comforts of home for the men on board.

So that the ship coming into port today is keeping pace with the best the world has in transportation machinery on land. The General Electric Company, besides building pioneer propulsion machinery, has studied for more than 30 years the electrical needs on shipboard and developed equipment for generating and utilizing electric power for auxiliaries of every sort.



Two G-E steam engine-driven generating sets supplying power for auxiliaries aboard a merchant vessel.

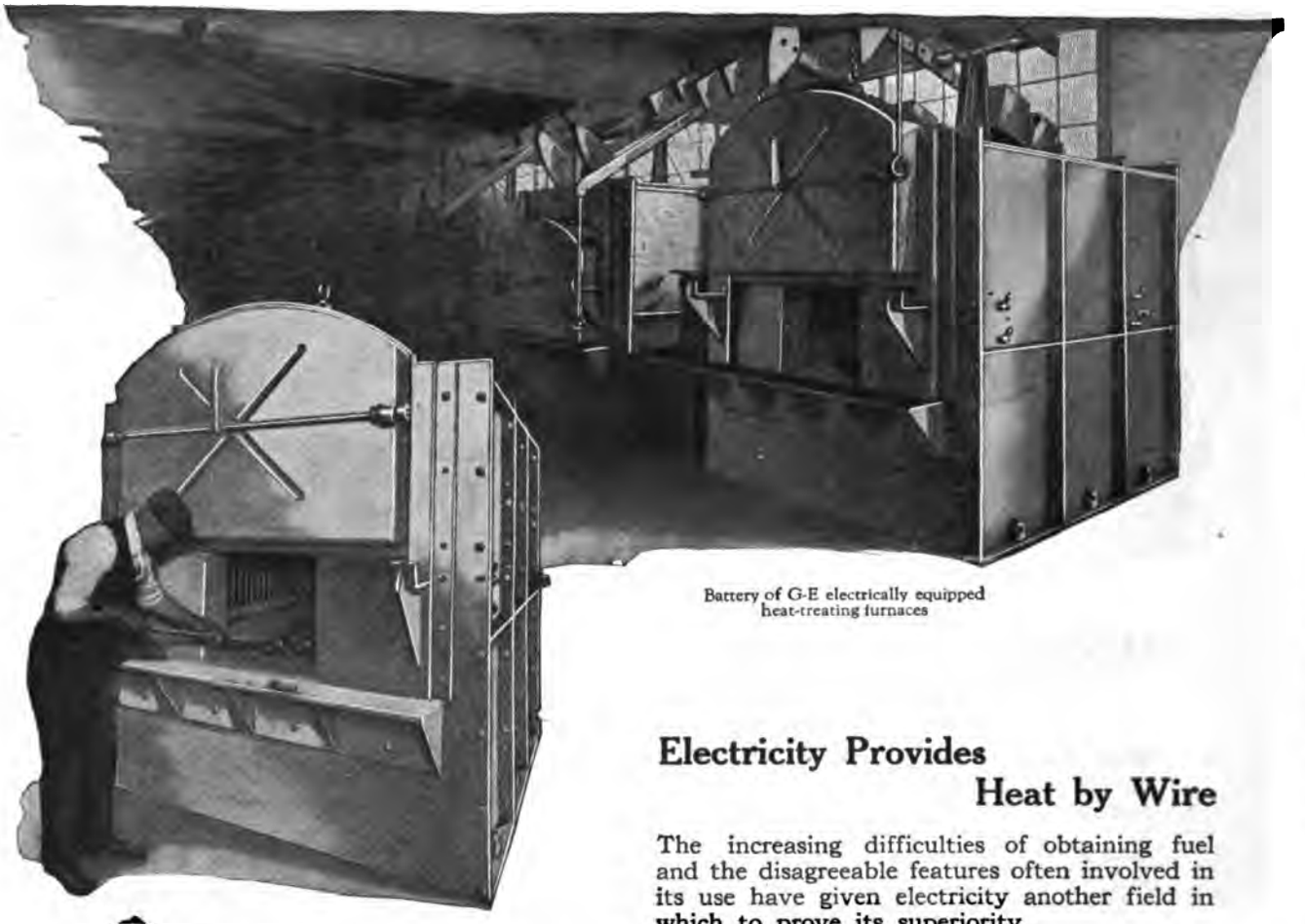


Efficient electric motor-driven cargo winches replace wasteful steam-driven ones.

26-28

General Electric Company
General Office Schenectady, N.Y
Sales Offices in all large cities
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Electric heat, applicable not only to the little household appliance, has given industries, too, better ways of doing the old job



Battery of G-E electrically equipped heat-treating furnaces



The G-E automatic arc welder is a new machine tool for building up surfaces.



An electric soldering iron has many uses in manufacturing and repair work.

Electricity Provides Heat by Wire

The increasing difficulties of obtaining fuel and the disagreeable features often involved in its use have given electricity another field in which to prove its superiority.

An electric current, after being transmitted to wherever it is desired, may become instantly available as heat, which is easily controlled, and can be concentrated to the highest degree. Modern industry is calling upon it to melt and alloy metals, to weld and cut, to bake enamels and varnishes, to heat rivets and to temper tools —to perform speedily and efficiently the many tasks that require heat.

Meanwhile electric heating appliances have simplified housekeeping. Where power is plentiful from water sources, the economical heating of homes by electricity has also proved practical.

The General Electric Company has stimulated the adoption of electric heat by developing a variety of electric heating apparatus, both complete and for application to existing equipment. With further achievements electric heat as a universal benefit will rank with electric light and power.

39-64

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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If electricity had found no other service than that of turning night into day it could be counted a great benefactor



Illumination with G-E ornamental Novalux units.

Night Comes On— but Light Remains

The glow of the first incandescent lamp, about a generation ago, was prophetic of better days.

Now incandescent lamps as well as luminous arcs drive the darkness from city and village streets. The floodlight illumines buildings, festivals, and playgrounds, and makes a 24-hour day for such work as outdoor construction, and handling material at terminals. The electric headlight blazes a path for trains and trolley cars, while the searchlight cuts through the fog and darkness for ships at sea.

To the home, electric lamps have brought a better light at less cost. For the merchant, they add to the comfort and attractiveness of his store, and advertise his wares to the passers-by. Industries, too, have found better light a good investment, paying dividends in products of higher quality and in more contented workers.

The General Electric Company has pioneered in the development of good illumination. Ever since through research it made tungsten practical for lamp filaments, the initiative of its illuminating engineers has been devoted to putting the proper light in the proper place.



Night view of U. S. capitol, flood-lighted.

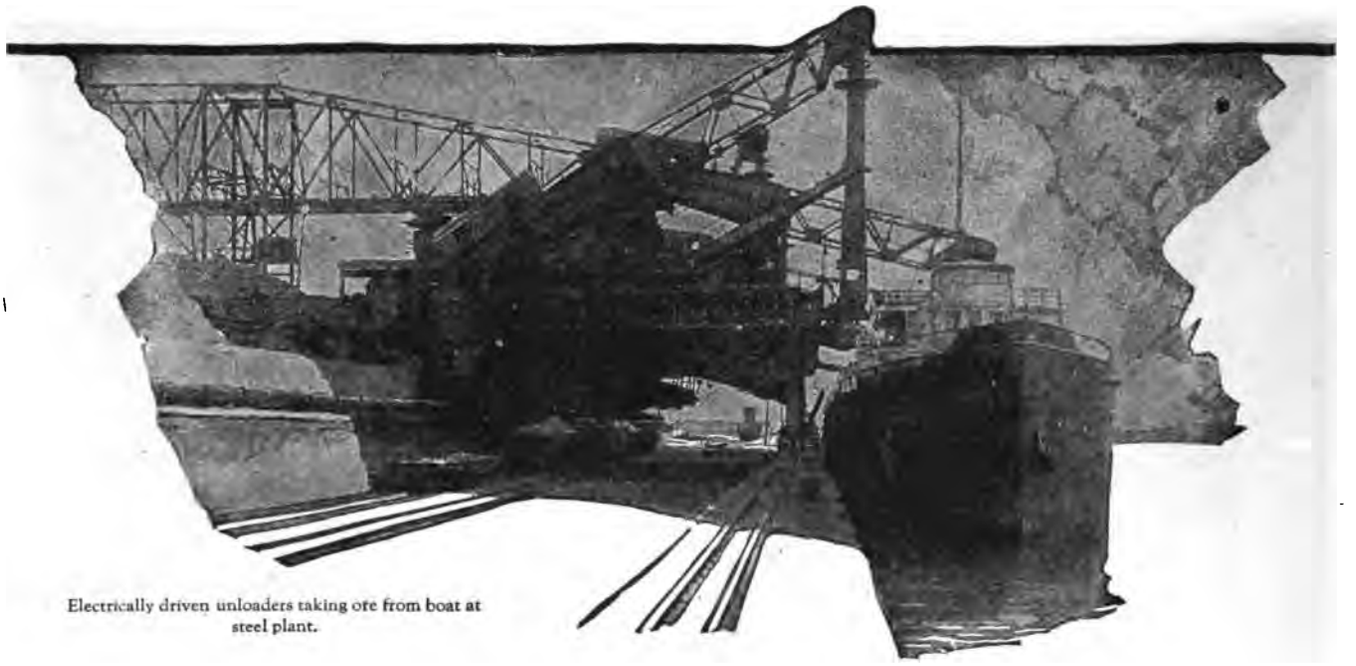


Powerful G-E electric headlights help to make travel safe.

35C-63

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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The advantages of electrically driven machinery for mechanical handling wherever materials must be moved have been fully demonstrated



Electrically driven unloaders taking ore from boat at steel plant.



Train pulled by electric tractor equipped with G-E automotive motor.



G-E electric industrial locomotive hauling 50 tons of copper plates.



Portable motor driven elevator piling up sugar—a ton a minute.

Making One Do the Work of Many

Less than fifty years ago, ore and coal were unloaded from boats with wheelbarrows. Today when a big ship docks a giant power quickly gets under way to clear the hold—electricity applied to material handling machines.

A modern unloader handles ore with a 15-ton bucket. Package cargo is deposited on the dock by an electric hoist and distributed to the warehouses by traveling cranes, conveyors, electric trucks, or little electric trackless trains.

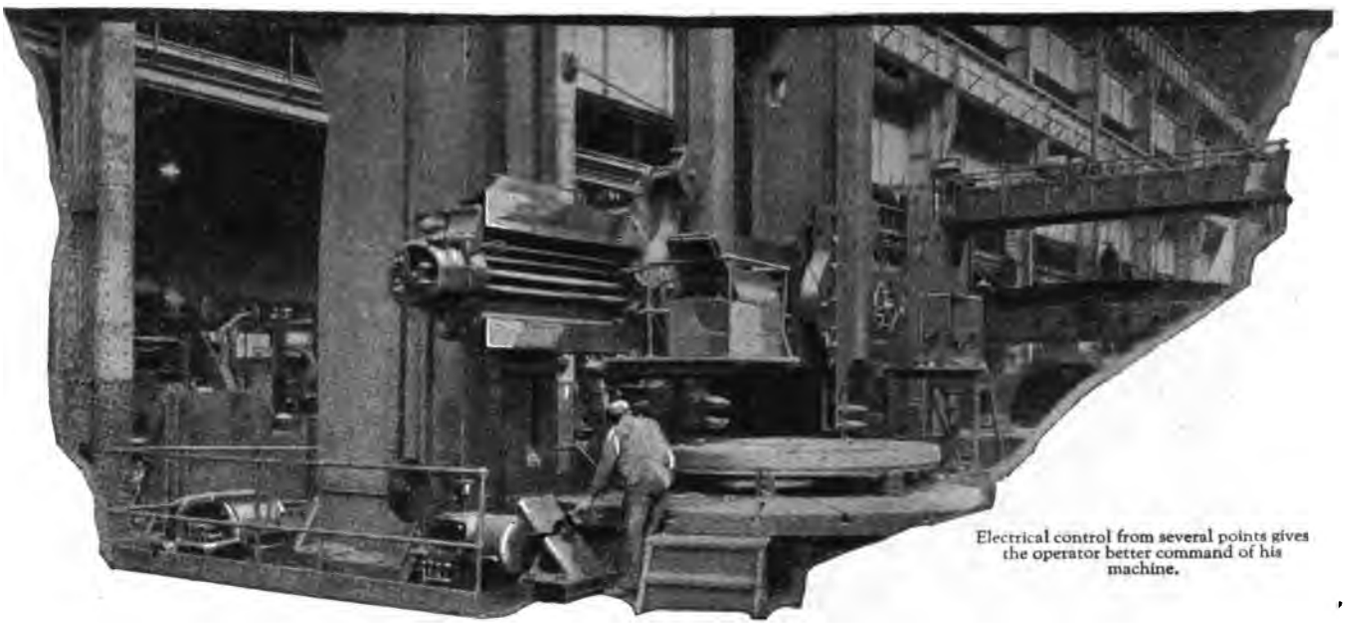
The great adaptability of electric power to handling material has been proved by its successful application alike to the simplest package conveyor and to car unloaders that handle 100 tons at a time. Automatic control has simplified and speeded up the operation of the most massive machinery, eliminating every second of wasted time.

The General Electric Company, by perfecting electrical equipment in co-operation with the machinery manufacturer, has extended the possibilities of mechanical handling. In thus helping industries confronted with such tasks, it performs the broader service of making it easier to have the world's goods laid down at the consumer's door.

43B-569

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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Electrical control of most operations powered by electricity has proved to be more dependable than control by even the most skilled and careful hands



Electrical control from several points gives the operator better command of his machine.

A Mere Touch Directs Electricity

Control equipment plays a part as important as the motor itself in the industrial success of electricity. The ease and accuracy of operating machine tools, even the big machines such as shown here, can be credited largely to the flexible, positive control of electric drive.

Down in the mine the hoist operator can "jog" his machine a fraction of an inch or "race" it at full speed. The trolley car is equipped to "speed up" at a maximum rate, and the electric locomotive can hold back its train on the mountain-side electrically. Almost all motor-driven appliances start at the push of a button, run at speeds to suit the work, and stop with the opening of a switch, all by virtue of important apparatus—the control.

Modern engineering has made electricity function as the controlling force in its application until "Do it automatically" has become a slogan, whether it be in the control of an electrified pump, furnace, or sugar mill.

The General Electric Company has gone even further, applying these principles to the generation and distribution of power. Complete G-E automatic station control equipment is now operating in more than 100 stations which start up and shut down without human attendance.



Electric locomotive cab where the train is controlled electrically.



G-E electric non-ferrous metal melting furnace and automatic control.



Interior of hydroelectric station with G-E automatic control equipment.

43B-632

General Electric Company

eral Office ... Sales Offices in ...

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In the mining of coal, a basic industry without which many other industries could not exist, electricity is rapidly becoming a very important factor



The electric locomotive has won a lasting place in coal mines for gathering and haulage.



G-E motor directly connected to hoist in main shaft.



Electric motor driving mine pump—keeping the workings dry.



G-E heavy-duty, well-protected motor, driving shaker screen and picking table.

The "Black Diamond" Miner's Best Helper

An adequate supply of coal means heat for homes, electric power from steam, and the basis for many necessary chemical by-products. Electricity's service to man, through its service to this industry, is already without measure.

Down in the mine an electric spark ignites the blasting charge that opens up the vein; electric mining machines help to cut and load the coal; electrically driven pumps keep out flood water; electric fans remove the dangerous gases and supply fresh air to the miner, who works by the light of electricity.

The mine mule has been replaced by electric locomotives that gather the loaded cars into a train and haul them up difficult grades or speed along open stretches, dependent only upon the presence of power. Elsewhere, electric motors help to crush the coal and hoist it up the shaft.

Nearly 30 years ago the General Electric Company began the study of mine electrification, and some of its earliest equipment is still in service. Today finds it qualified to specify and furnish complete electrical equipment for mines, yielding either coal or metal, much of it specially designed for the severe work underground.

43B-830

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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The chemical industries, supplying almost innumerable commodities, reached their present high state of development largely by extensive application of electric power



G-E synchronous motors driving 20 air compressors—the largest such application in the world.

The Stimulating Force in Great Industries

Every individual is dependent for his daily needs upon the great family of chemical industries, which, out of minerals from the earth and elements of the air produce literally hundreds of the commodities of life.

In these industries today electricity is everywhere—speeding up an operation or making a better product. Successful application, often with automatic control, has been made to a vast number of dissimilar operations. It has called for the specialized engineering facilities of the General Electric Company cooperating in the design and equipping of the largest plants, which seem to have grown up over night.

The immense developments in modern applied chemistry are in large part due to the success of electrical energy as applied to chemical processes—developments which would not have been possible without corresponding developments electrically.

And yet this progress has only begun. Many chemical processes are being worked out which will assume large-scale manufacturing proportions in a few years. In this further expansion the electrical engineer will undoubtedly be called upon to cooperate with the chemist as he has done in the past.



Electrically driven pumps for the transference of liquids in process.



An electric furnace is clean, accurate, and economical, and maintains high temperatures.

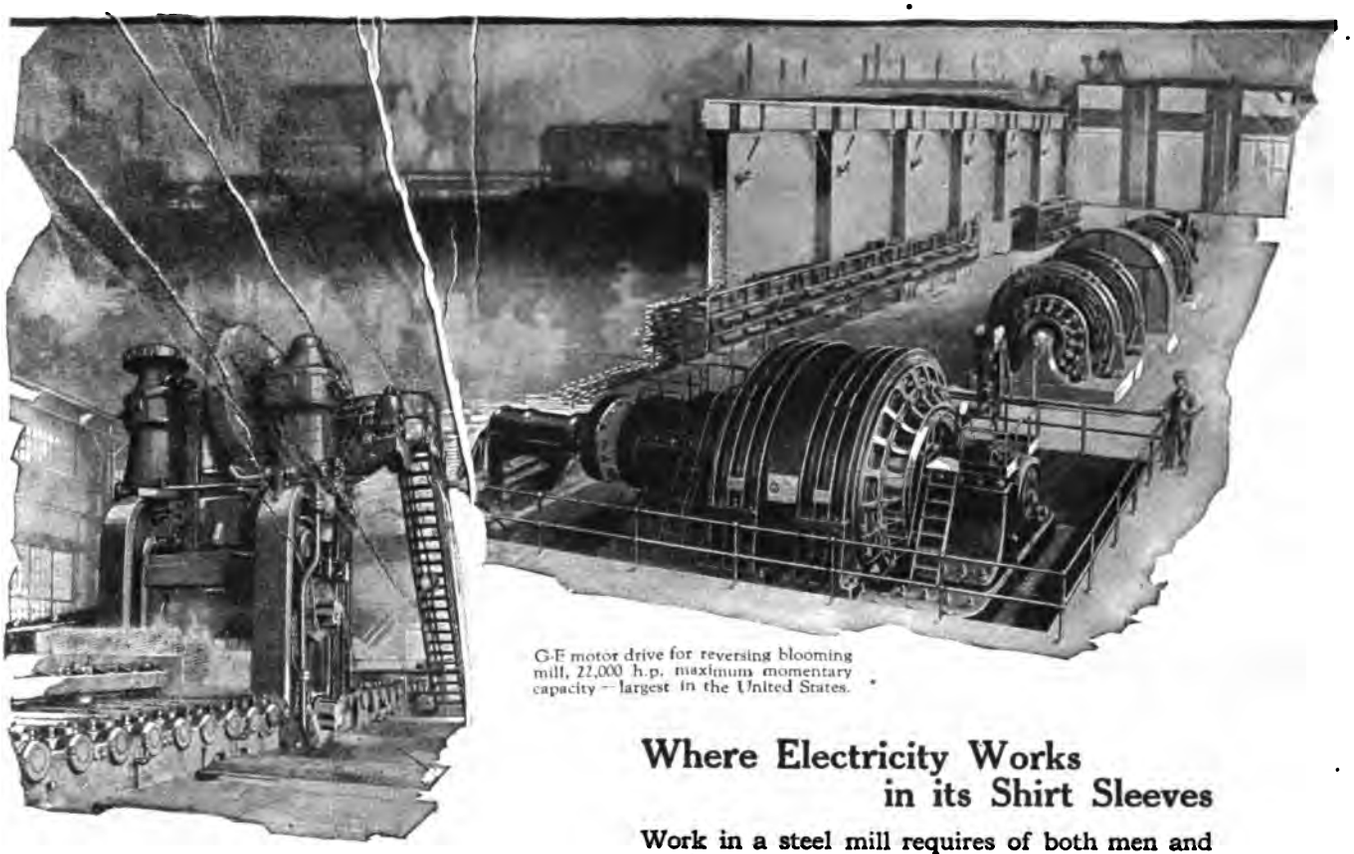


G-E motor driving mixing machines under severe atmospheric conditions.

47B-571

General Electric Company
General Office
Sales Offices in
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Great adaptability of electric motors and ease of their control, even in thousands-of-horsepower sizes, have made them indispensable for heavy jobs in the steel mill



G-E motor drive for reversing blooming mill, 22,000 h.p. maximum momentary capacity—largest in the United States.

Where Electricity Works in its Shirt Sleeves

Work in a steel mill requires of both men and machines the very best that is in them, and the electrically driven machine has qualified for the hardest jobs of all.

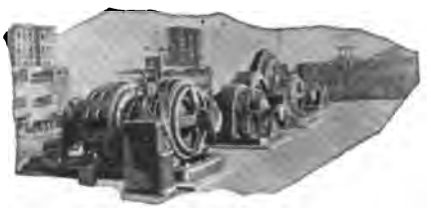
In the making of steel the power requirements are many, and single units must be large. In one modern plant nearly a quarter of a million horsepower is utilized through electric motors alone. Their advantages over steam and hydraulic power have been demonstrated in operation under various conditions.

G-E main roll motors were among the first in the field and present G-E installations are among the largest in the world. For these drives the General Electric Company has developed the Scherbius system of control to a point where it is possible to regulate the induction motor above as well as below its synchronous speed, affording many operating advantages, while decreasing the size of auxiliaries and increasing the overall efficiency.

In other parts of the modern plant G-E motors and control shoulder the heavy burdens just as faithfully—unloading ore and coal, operating coke ovens and steel furnaces, and driving plate mills and auxiliaries.



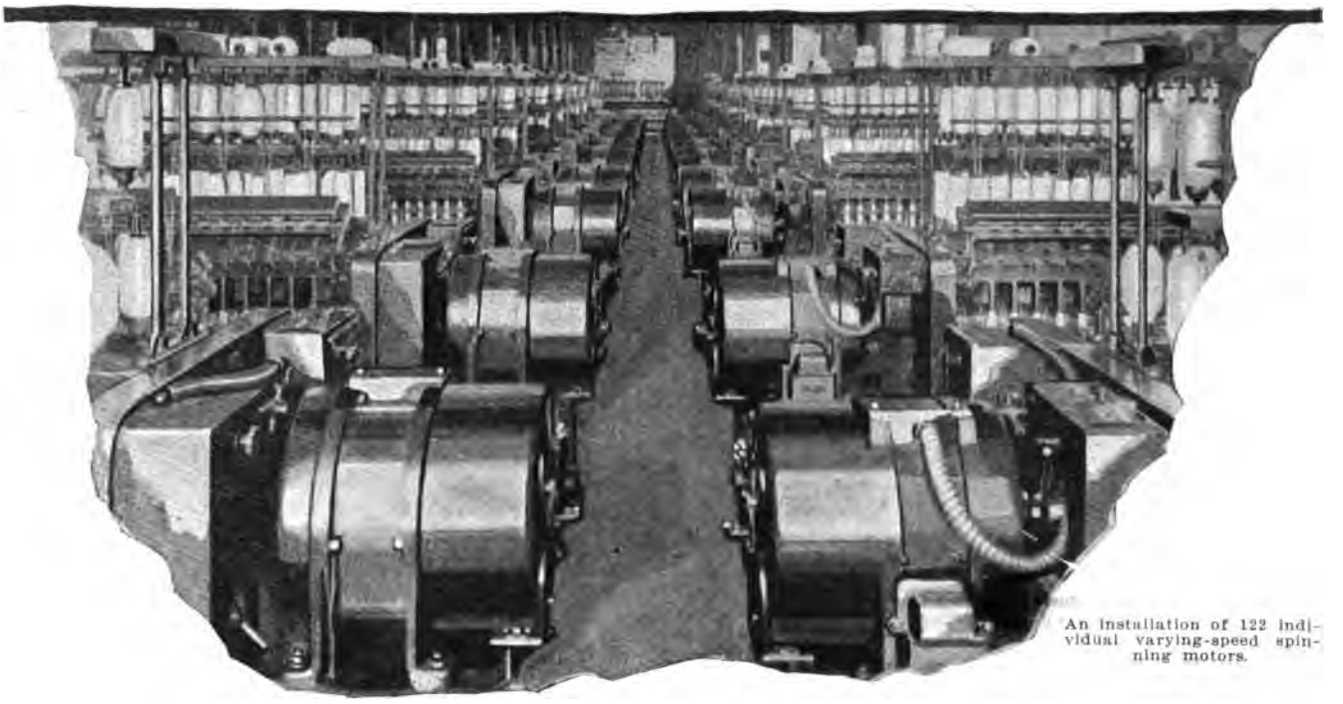
G-E mill type motors driving side guards and manipulators.



Speed regulating sets for roughing and finishing mill motors.

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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The modern textile mill has found electrification essential to making a superior product and assigns an electric motor to each machine



An installation of 122 individual varying-speed spinning motors.

Where Delicate Work Requires Intelligent Power

Among the machines prominent in modern industry, and for which electric drive has especial advantages, is the loom. On it are produced an enormous variety of fabrics for utility, comfort and ornament, ranging from the heaviest ducks and carpets through woolen and worsted goods to the finest silks and laces.

After successfully supplanting the steam engine for ginning and bleaching processes, electric power has continued to advance step by step until today the machinery in a modern textile mill is nearly all run on the individual motor principle

Paralleling the development of electric drive have come improvements in lighting facilities, giving each department, whether it be combing, carding, warping, or weaving, the illumination best suited for the particular work.

Throughout the textile industry G-E motors and control, developed especially for mill machinery, have increased production. In close cooperation with mill owners, the General Electric Company has met each new problem, advising as to the utilization of water power wherever available, and supplying complete electrical equipment.



Vertical Picker Motor direct connected to Creighton Opener.



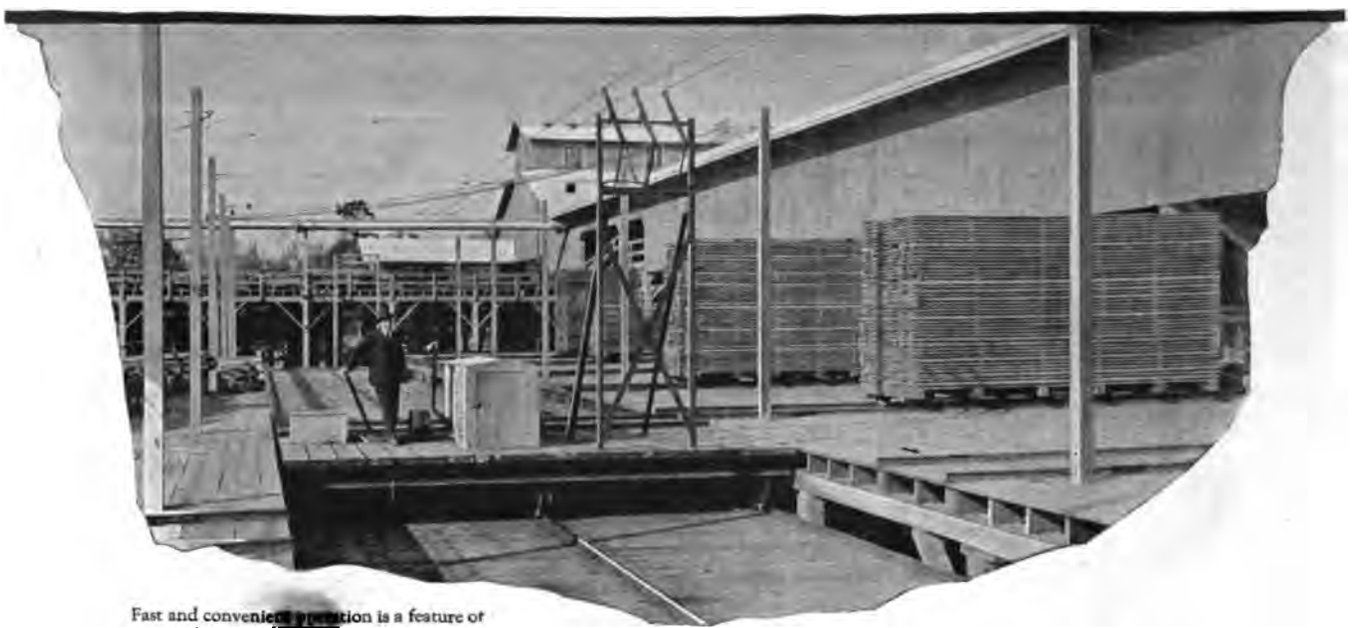
Brush-Shifting, Variable-Speed, 3-phase Motors driving cloth printing machine.



Individual motor drive of spoolers.

General Electric Company
General Office
Sales Offices in
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As it invaded nearly all other fields of endeavor, electricity has gone into the forest to help get out the world's timber and shape it for man's use



Fast and convenient operation is a feature of the motor driven transfer car.



G-E electric generating equipment in lumber plant supplying power for the electrified operations.



Electric yarder and loader for gathering the logs in the woods.



Typical G-E motor installation in a lumber mill.

More Lumber from Electrified Mills

In the old days the lumberman's only help was animal power or the force of running water on a wheel. Later came the steam engine, but increased demand for lumber called for still cheaper, safer, and more rapid methods. Electric power answered that call.

In the woods today logs are gathered by the electric yarder and loader which drags the tree trunks across the cutting area to the railroad and loads them on the cars. An electric locomotive draws the log train down to the stream or all the way to the mill pond, where electric winches pull the logs up on the dock to be carried into the mill on an electrically-driven endless chain.

In the saw mill electric drive has demonstrated its supremacy in every department, adding efficiency in driving the log hoists, head saws, transfers, conveyors, edgers, slashers, and resaws, and in handling and stacking the finished products.

The General Electric Company has stimulated this development by its ability to supply and coordinate all the equipment necessary for a complete electrical system, thus solving the power problems of the lumber plant.

43B-573

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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With electricity's aid, the farmer has begun to realize greater results with less effort and to enjoy conveniences formerly limited to city life



The Farmer's best "help," the electric motor at the silo.

Into the Country— Helping to Produce

The progressive farmer finds more uses for electricity than simply to start and light his car. He sees in other industries the significance of electrification and uses this power to the utmost, either generated with his own gas engine or obtained from the nearest electric line which supplies his neighborhood, perhaps runs past his door.

Thus electricity is reaching out to help the farmer. Through electric motors it toils from morning till night, in many ways taking the place of a hired hand. In the farm home electricity is the "maid" doing the cleaning, washing, and sewing, and, when the day is done, the electric lamp gives the evening a new pleasure.

The broadest use of electricity on the farm is dependent on the availability of central station power, which can be furnished at little cost, besides possessing many other advantages.

The extent of rural power service is already another tribute to the work of the General Electric Company. In producing electrical equipmen to generate, transmit and control electricity, as well as that to make it toil for the farmer, this company has helped to enlarge the field of the central station.



The water needed by every farm is best pumped *electrically.*



Corn shelling, grinding, pumping—whatever the farm task—the electric motor has no rival!

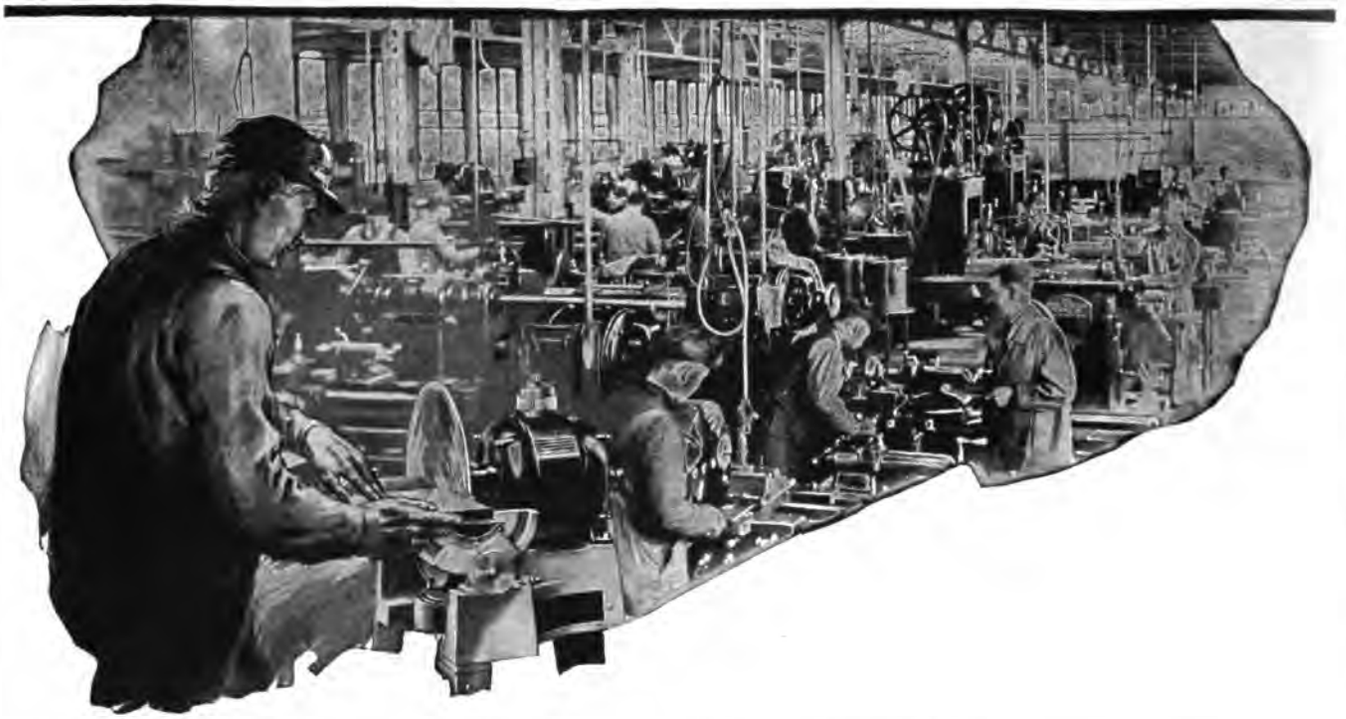


The dairy *must* be *clean*, hence the electric motor *must* be the chosen "drive."

45-107

General Electric
General Office Company Sales Offices in
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Doing many little things well has helped to place machines driven by the smallest electric motors in the class of big achievements





Portable electric hammer and cutter — handy for metal construction work.



Offices with motorized machines are more efficient.



Freezing ice cream can be done electrically, just as washing, ironing and cleaning.

G-E Motors Help Do the Little Jobs

While men harnessed waterfalls, made electricity drive ships, electrified industries and learned to talk across the ocean, they have developed motors for utilizing electric power in extremely small units.

G-E fractional horsepower motors have won a permanent place in the life of the land by economizing time and conserving energy. They drive a host of machines in the factory, office, and store, and in the home they remove the drudgery of other days.

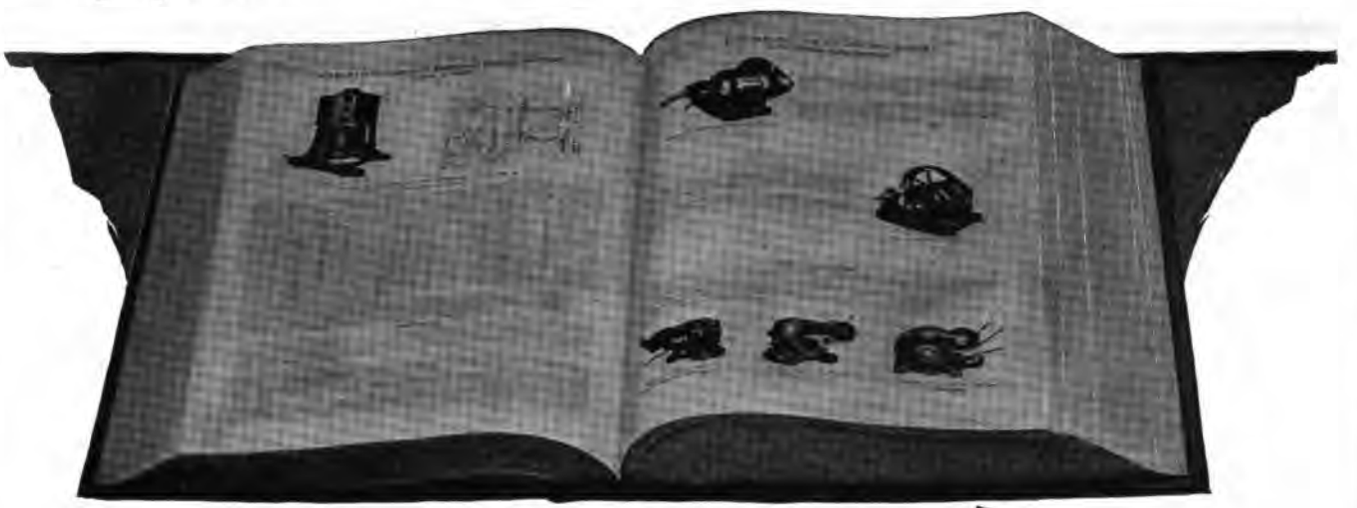
The knowledge and research necessary to design and build less-than-one-horsepower motors, and build thousands every day, is comparable with that required to build big steel mill motors or an electric locomotive. The skill in manufacture is even more exacting because of the minute parts and the quantities produced.

Manufacturers who build G-E motors into their machines secure the benefits of experience gained in building a half million motors a year, and applying them to machines for practically every purpose.

55B-44

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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Technical literature, illustrated and easy to read, is often of material aid to buyers and users of electrical equipment



G-E General Catalog of 1300 pages—printed annually and distributed to purchasers of G-E equipment



Special bulletins and booklets about G-E products and their applications are available upon request

G-E Publications Help to Select and Maintain

In the interest of proper selection of G-E equipment and supplies a vast line of G-E publications has been evolved, designed to give adequate information to the user both before and after purchase. **Foremost among these is the General Catalog which combines in one volume descriptions and data, and, in some cases, identification for ordering practically all G-E products. It is supplemented by special bulletins and booklets, giving more detailed information—available upon request from G-E Sales Offices.**

Information for the Operator

To aid in the proper assembly of equipment and to insure its correct operation, special information accompanies shipment. This includes instruction books, instruction cards, drawings, and connection diagrams, and additional copies are gladly furnished upon request.



Complete instructions help to familiarize the operator with new equipment

Renewal Parts—Easy to Order

Special renewal parts catalogs, covering industrial equipment, and G-E supply parts bulletins enable the user to select at a glance exactly what he needs each time he orders. Then G-E warehouses fill the orders quickly.



G-E Renewal Parts catalogs make it easy to order parts accurately and quickly

See page 1223 for list of G-E Sales Offices.

95-443

General Electric Company
General Office Schenectady, N.Y.
Sales Offices in all large cities
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The utility of a manufacturing organization is measured not alone by its ability to produce but also by service to the user of its product



Works at Schenectady, N. Y. Ground area, 340 acres. Floor space, 5,800,000 square feet.



The first new cane sugar mill electrified —electrical equipment furnished by the General Electric Company



Every city has its G-E motor-dealer —who knows motors, their application and their control



Electrical dealers everywhere sell G-E package goods—with the orange and blue label

How G-E Products Are Made Available

Contact with users of G-E apparatus is maintained through a network of sales offices embracing the whole country, being directed from the General Office at Schenectady, N. Y., through 65 branch offices comprising 8 districts, each with its district office in a principal city. G-E distributing jobbers are located in all large cities at home and in foreign lands. Warehouses, conveniently placed, insure prompt delivery of orders from sales office or jobber.

Distribution Through Dealers

G-E motor dealers located in every city and large town are headquarters for standard motors and motor repair service. Merchandise products—small electrical devices, usually packaged—are distributed through the jobber to electrical supply stores everywhere.

Engineering Service

G-E engineers with specialized knowledge are prepared to advise in the proper selection of G-E equipment for every purpose.

Co-operation with Manufacturers

Manufacturers of machinery receive cordial co-operation from the General Electric Company in developing the electrical features of their products. Machinery users may readily obtain G-E products incorporated in electrically driven machinery by specifying "G-E" when the equipment is purchased.

General Electric Company

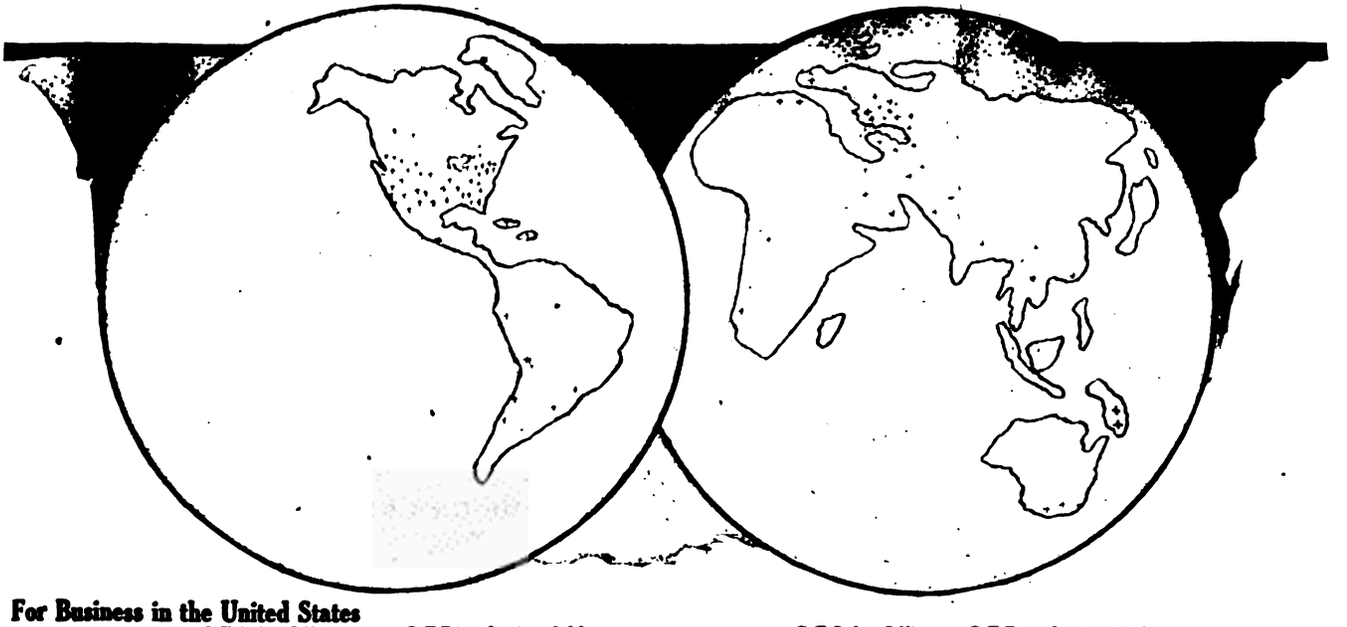
General Office Schenectady, N.Y.

Sales Offices in all large cities

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Where to Get G-E Service—

Quick service is best obtained from the nearest G-E sales office, distributing jobber, or foreign representative



For Business in the United States

G-E Sales Office	G-E Distributing Jobber
Alabama, Birmingham	Matthews Elec. Supply Co.
Arkansas, Little Rock	
California, Los Angeles†	Pacific States Electric Co.
California, Oakland†	Pacific States Electric Co.
California, San Francisco§†	Pacific States Electric Co.
Colorado, Denver†	The Hendrie & Bolthoff Mfg. & Sup. Co.
Connecticut, Hartford	
Connecticut, New Haven	
Connecticut, Waterbury‡	New England Eng. Co.
District of Columbia, Washington	National Elec'l Supply Co.
Florida, Jacksonville	Florida Elec. Supply Co.
Florida, Tampa‡	Florida Elec. Supply Co.
Georgia, Atlanta§†	Carter Electric Company
Georgia, Savannah‡	Carter Electric Company
Illinois, Chicago§†	Central Electric Company Commonwealth Edison Co.
Indiana, Fort Wayne	
Indiana, Indianapolis	Indianapolis Elec. Supply Co.
Indiana, South Bend‡	South Bend Electric Co.
Indiana, Terre Haute	
Iowa, Des Moines	Mid-West Electric Co.
Kentucky, Louisville	Belknap Hardware & Manufacturing Co., Inc.
Louisiana, New Orleans	Gulf States Electric Co., Inc.
Maryland, Baltimore	Southern Electric Co.
Massachusetts, Boston†	Pettingell-Andrews Co.
Massachusetts, Springfield	
Massachusetts, Worcester	
Michigan, Detroit	Frank C. Teal Company
Michigan, Grand Rapids	
Michigan, Jackson	
Minnesota, Duluth	Northwestern Electric Equipment Company
Minnesota, Minneapolis†	Peerless Electrical Co.
Minnesota, St. Paul‡	Northwestern Elec. Equip. Co.
Missouri, Joplin†	
Missouri, Kansas City†	The B-R Electric Co.
Missouri, St. Louis§†	Wesco Supply Company
Montana, Butte†	Butte Electric Supply Co.
Nebraska, Omaha	Mid-West Electric Co.
New Jersey, Newark	Tri-City Electric Co., Inc.
New Jersey, Trenton	
New York, Albany‡	Havens Electric Co., Inc.
New York, Buffalo	Robertson-Cataract Elec. Co...
New York, Elmira	
New York City§†	E. B. Latham & Company Royal Eastern Elec'l Sup. Co. (Also Borough of Brooklyn and Jamaica, L. I.) Sibley-Pitman Elec. Corp.
New York, Niagara Falls	
New York, Rochester	Wheeler-Green Elec'l Sup. Co
New York, Schenectady	
New York, Syracuse	Mohawk Elec'l Sup. Co.
North Carolina, Charlotte	Elec. Supply & Equipment Co.
Ohio, Cincinnati†	The F. D. Lawrence Elec. Co.
Ohio, Cleveland	Republic Electric Co.
Ohio, Columbus	The Erner & Hopkins Co.
Ohio, Dayton	The Wm. Hall Electric Co.
Ohio, Toledo	W. G. Nagel Electric Co.
Ohio, Youngstown	
Oklahoma, Oklahoma City†	Southwest G-E Co.
Oregon, Portland†	Pacific States Electric Co.
Pennsylvania, Erie	
Pennsylvania, Philadelphia§†	Philadelphia Electric Company Supply Department
Pennsylvania, Pittsburgh†	Union Electric Company
Rhode Island, Providence	
South Carolina, Columbia‡	Ferry-Mann Elec. Co., Inc.
Tennessee, Chattanooga	James Supply Company
Tennessee, Knoxville	
Tennessee, Memphis	Electric Supply Company
Tennessee, Nashville	
Texas, Dallas†	Southwest G-E Co.
Texas, El Paso†	Southwest G-E Co.
Texas, Houston†	Southwest G-E Co.
Utah, Salt Lake City†	Capital Electric Company
Virginia, Richmond	Southern Electric Company
Washington, Seattle†	Pacific States Electric Co.
Washington, Spokane	Pacific States Electric Co.
Washington, Tacoma	
West Virginia, Bluefield	
West Virginia, Charleston	
Wisconsin, Milwaukee	

For Hawaiian business address Catton, Neill & Company, Ltd., Honolulu.

‡No G-E Office †Warehouse. §Service Shop.

Distributor for the General Electric Company Outside of the United States

INTERNATIONAL GENERAL ELECTRIC COMPANY, INC.

120 Broadway, New York, N. Y. Schenectady, N. Y.

Foreign Offices and Representatives

Argentina: General Electric, S. A., Buenos Aires.
Australia: Australian General Electric Co., Ltd., Sydney and Melbourne.
Belgium and Colonies: Societe d'Electricite et de Mecanique Procedes Thomson-Houston & Carels Societe Anonyme, Brussels.
Bolivia: International Machinery Co., La Paz and Oruro.
Brazil: General Electric, S. A., Rio de Janeiro and Sao Paulo.
Canada: Canadian General Electric Co., Ltd., Toronto.
Chile: International Machinery Company, Santiago, Antofagasta and Valparaiso.
China: Andersen, Meyer & Company, Ltd., Shanghai; International General Electric Co, Inc.,(General representatives of the Far East, excluding China and Japan) Shanghai.
Colombia: Wesselhoeft & Poor, Medellin, Barranquilla and Bogota.
Cuba: General Electric Company of Cuba, Havana.
Dutch East Indies: International General Electric Co., Inc., Soerabaia, Java.
Ecuador: Carlos Cordoves, Guayaquil and Quito.
Egypt: British Thomson-Houston Co., Ltd., Cairo.
France and Colonies: Compagnie Francaise Thomson-Houston, Paris.
Great Britain and Ireland: British Thomson-Houston Co., Ltd., Rugby; International General Electric Co., Inc., London.
Greece and Colonies: Compagnie Francaise Thomson-Houston, Paris, France.
India: British Thomson-Houston Co., Ltd., Calcutta and Bombay; International General Electric Company, Inc., Calcutta.
Italy and Colonies: Franco Tosi Societa Anonima, Milan.
Japan: Shibaura Engineering Works, Tokyo; Tokyo Electric Co., Ltd., Kawasaki.
Mexico: Mexican General Electric Co., City of Mexico and Guadalajara.
New Zealand: National Electrical & Engineering Co., Ltd., Auckland, Dunedin, Christchurch, and Wellington.
Paraguay: General Electric, S. A., Buenos Aires, Argentina.
Peru: W. R. Grace & Co., Lima.
Philippine Islands: Pacific Commercial Company, Manila.
Porto Rico: International General Electric Co., Inc., San Juan.
Portugal and Colonies: Sociedad Iberica de Construcciones Electricas, Madrid, Spain
Russia: Wseobshtchaia Electricheskaia Kompania, Petrograd and Vladivostok.
South Africa: South African General Electric Co., Ltd., Johannesburg and Cape Town.
Spain and Colonies: Sociedad Iberica de Construcciones Electricas, Madrid, Spain.
Uruguay: General Electric, S. A., Montevideo.
Venezuela: Wesselhoeft & Poor, Caracas.

95-458

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

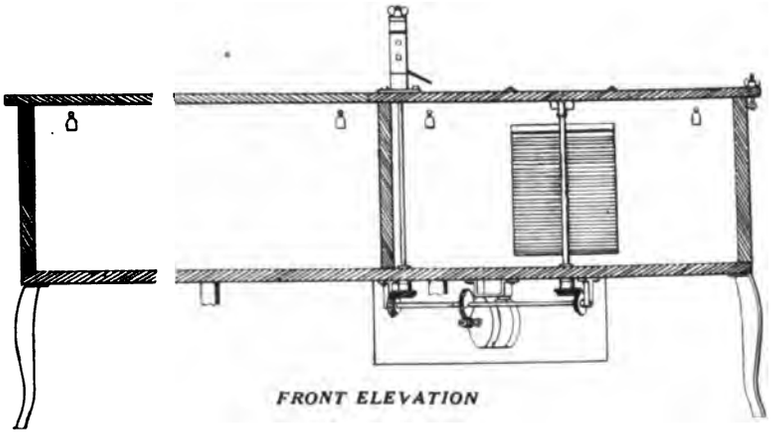
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The Latest Development in Clothes Washers

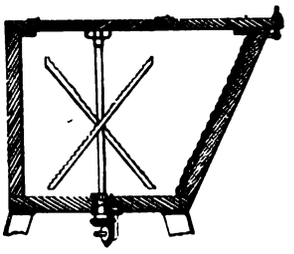
"SANITARY"

Electric Washing Machine

Jobbers and Dealers—here's a live proposition — A practical Clothes Washing Machine that is contained in a Laundry Tub. No fancy case, or complicated construction to make it costly but a simple, substantial, inexpensive mechanism which can be quickly inserted in the tub. An easily-sold, low-priced machine that washes clothes clean. We furnish the machine complete with the tubs, or can supply the mechanism separately for installation where homes are equipped with standard Laundry Tubs.



FRONT ELEVATION



SIDE ELEVATION

Features—

Two agitator blades of Corrugated Metal 45° angle, lifts clothes. No sharp edge—can't tear clothes.

Driving shaft of agitator operated by speed reduction gear.

Agitator makes 60 complete revolutions a minute—forcing water through meshes of clothes.

Water Seal Bushing—Tub can't leak even when filled with water.

One-fifth H. P. Motor Direct connected to driving shaft by worm gear. No belts to break or get out of order.

All driving mechanism completely enclosed in metal housing.

Features—

Absolutely safe—No parts to catch clothes of operator.

Inside front surface of tub corrugated.

Wringer operated by direct contact with gears from motor.

Sectional cover permits inserting clothes while motor is running.

No back-breaking carrying of water to and from machine.

Two types of machine—Complete with washing and rinsing tubs—or separate mechanism for homes where standard tubs are installed.

Also see description under Classification "Washing Machines, Clothes, Electric, Household, Special Type."

Write or wire for liberal discounts and complete information about the franchise in your territory.

Dexter-Reynolds Mfg. Co., Inc.

128 North Wells Street

Chicago, Illinois

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CUTLER-HAMMER

Principal Products

Automatic Motor Control Equipment.
Auto-Transformer Starter.
Battery Charging Equipment.
Brakes (Electrically-Operated).
Crane Cab Heaters.
Crane and Hoist Controllers.
Dean Valve Control (Motor-Operated).
Elevator Controllers.
Farm Lighting Plant Switches.
Fire Pump Starters.
Float Switches.
Generator Field Rheostats.
Industrial Heating Appliances for all Purposes.
Lamp Sockets (660 Watts capacity).
Lifting Magnets.
Machine Tool Controllers.
Magnetic Clutches.
Magnetic Clutch-Brakes.
Magnetic Gear Shift for Gasoline Motor Cars.
Magnetic Separators.
Mine Duty Starters.
Motor Protective Devices.
Motor Speed Regulators.
Motor Starters.
Moulded Products.
Phase Failure and Phase Reversal Protective Device.
Pressure Controller Speed Regulators.
Pressure Regulators.
Printing Press Controllers.
Pump and Compressor Starters and Controllers.
Push Switches and Wiring Devices.
Remote Control for Valves.
Resistance Units.
Safety Limit Stop for Cranes.
Seventy-Fifty Switch.
Soldering Irons (Electric).
Space Heaters (Electric).
Steel Mill Control Apparatus.
Switches (Float-Operated).
Switches (Remote Control).
Theatre Dimmers.
Thomas Meters for Measuring Gas in Quantities.
Thomas Recording Gas Calorimeter.

Offices and Agents

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Pittsburgh.....Farmers Bank Bldg.
Philadelphia.....Commonwealth Bldg.
Cincinnati.....Dixie Terminal Bldg.
Chicago.....323 No. Michigan Ave.
Cleveland.....Guardian Bldg.
Boston.....Columbian Life Bldg.
Detroit.....Kresge Bldg.
St. Louis.....Railway Exchange Bldg.

■ ■ ■

Selling Agents

H. B. Squires Co., San Francisco, 583 Howard St.
Los Angeles: 308 East Third St.
Seattle: 552 First Ave., So.

General Machinery Co., Birmingham, Brown Marx Bldg.

H. L. Vaughan, Denver: 536 U. S. Nat'l Bank Bldg.

L. Brandenburger, Salt Lake City, 59 W. Broadway.

The Northern Electric Co., Ltd., Montreal, Canada.

Igranic Electric Co., Ltd., Bedford and London. England.

■ ■ ■

More detailed information on the various types of C-H Products will be found in the sections of this book, arranged in alphabetical order.

For more complete information concerning any of these, write to the office or agent nearest you.

C-H

THE CUTLER-HAMMER MFG. CO.

WORKS: MILWAUKEE AND NEW YORK

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CUTLER-HAMMER



C-H Bulletin 2111 Used in Connection With Combination Fan and Pump Motors. These Outfits Supply Air and Oil to Oil Burning Boilers.



C-H Automatic Starter and Enclosed Pressure Regulator (to Right of Starter) Which Automatically Keeps Pressure on Hydraulic Elevator Between Desired Limits.



C-H Auto Transformer Starter for Bulletin 9141, Used in Connection With Squirrel Cage Motor Driving a Group of Punch Presses.



C-H Automatic Control Board Installed in the Philadelphia City Hall for Controlling Motors Driving Pumps Which Supply the Water Pressure for the Hydraulic Elevators.

Motor Controllers

What These Two Words Cover

Motor Controllers as made by The Cutler-Hammer Mfg. Co., first meant the small starting boxes or rheostats used when the first commercial applications of electric motors were made in the last century.

With the development of motors and the desire to apply electric motor drives to machines, fans, pumps, elevators, printing presses, cranes and hoists, conveyors and other material handling equipment means for getting the motors started properly—methods of safeguarding machinery and men—the ability of regulating the speed, gradual stopping, reversing, etc., were sought after.

It has been the privilege of Cutler-Hammer engineers to work with motor and machinery builders and develop control apparatus and systems to help make motor drive successful and to widen the field of the electric motor.

In many industries special lines were required, as in the steel plant, rubber mill, machine shop, newspaper and printing plant. Many types of C-H Automatic

The Cutler-Hammer Mfg. Co.

Works: Milwaukee and New York

C-H

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CUTLER-HAMMER

Starters and Control Systems looked upon at first as special, have been standardized in many forms for use with both direct current and alternating current motors.

A Saving to the User

In fact, for about three decades information, data on tests and applications, and ideas on the control of electric motors have been accumulated in our files to the extent that information on practically any problem can now be quickly checked up. C-H lines have been so developed that while the arrangement of standard apparatus may have to be altered sometimes, the expense of special controllers is practically eliminated.

In many plants today, however, big savings in operation, greater safety, insurance against damage, and the release of workmen can be made possible by a study of the motor-driven machinery and application of C-H Automatic Control used in connection with various Limit Stops, Reversing Switches, Float or Pressure Switches and Push Button Stations.

Engineers in any of the Cutler-Hammer District Offices are available at all times for consultation purposes. A request sent to the office nearest you will bring a man to you and entails no obligations.

The Cutler-Hammer Mfg Co.

Works: Milwaukee and New York

C-H



Two Automatic Controllers, One 25 HP and One 15 HP Used on Motors Driving Friction Calenders on Cloth Finishing Material.



C-H Master Controllers and One of the Four Automatic Control Panels Used on a Mason-Hoover Ore Bridge. The View is Part of the Interior of the Operator's Cage.



Automatically Operated Open Hearth Floor Type Charger Showing Two of the C-H Control Panels Used on this Equipment in the Plant of the Sharon Steel Hoop Company, Lowellville, Ohio.



C-H Magnetic Controllers for Three Cold Rolling Mills Connected in Tandem.

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CUTLER-HAMMER



C-H Circular Type Lifting Magnet.

Magnet and Clutch Department Products

Lifting Magnets

Wherever steel and iron are handled either in the raw material form, or as finished castings, structural pieces, plates, rails, or as scrap, Cutler-Hammer Lifting Magnets, because of their higher continuous lifting capacities, have been put to work.

The most common type is the circular magnet made in standard sizes of 24, 36, 43, 52 and 60-inch diameter. For special plates, pipe, etc., rectangular magnets often used in pairs are finding a constantly increasing field.

Magnetic Clutches

The C-H Magnetic Clutch may be engaged and disengaged by means of a push button control station. They have been the means of increasing the application of synchronous motors, by allowing them to be started without load, the Clutch later connecting the motor to the shaft. The increased power factor resulting from the use of these motors makes available power otherwise lost. Used in combination with a magnetic brake they have become standard safety equipment on rubber mill drives, instant stopping of the rolls being possible in case of accident.



C-H Magnetic Clutch Used With Synchronous Motor.



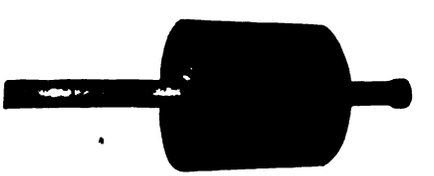
C-H Type M Electrically-Operated Brake.

Electrically Operated Brakes

Brakes, Electrically Operated, are made for use on both direct current and alternating current circuits, known as C-H Type M and Type RS respectively. These are particularly used with such motor-driven equipment as elevators, hoists, conveyors, etc. Disc type brakes, used to a great extent on battleships and cruisers, and solenoid operated hand brakes are also made. The latter are used in connection with Magnetic Clutches.

Magnetic Separator Pulleys

These are employed to take out stray iron or steel pieces from material which is to be crushed and thus prevent costly damage to crushing and pulverizing machines. They are used in 36 industries, as the cement plant, powdered fuel plants, linoleum factories, glass plants, mines, gypsum mills, fertilizer plants, wood pulp mills, etc., etc.



C-H Magnetic Separator Pulley.

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CUTLER-HAMMER



C-H Pendent Switch.



C-H Surface Snap Switch.





C-H Attachment Plug.



C-H Duplex Receptacle.

Switch and Specialty Department Products

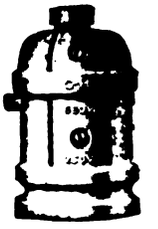
The well-known Pendent Switches, Automobile Lighting Switches, Attachment Plugs, Receptacles, Sockets, Snap Switches that carry the C-H monogram and the still better known C-H Seventy-Fifty Switch are the chief products of this growing department.

The 70-50 Switch has probably become the most popular device on the market because of the convenience provided in the use of electric toasters, irons, table stoves, and portable motor-driven appliances.

These switches and specialties are carried by Electrical Jobbers and Dealers in all parts of the country.



C-H Brass Shell Pendent Switch



C-H Porcelain Push Button Socket.



C-H 70-50 Switch Shown Used With Toaster







amples of Moulded Products Department

C-H MOULDED PRODUCTS

Thermoplax ***Pyroplax***

Thermoplax is a heat-resisting material which may be moulded into various forms and shapes such as are used in the manufacture of many electrical devices, radiator caps, knobs and handles, etc.

Pyroplax is a fire-resisting material used where higher temperatures are encountered, or where the effects of weather or water must be withstood.

Savings can be made through the use of C-H Moulded Material because holes, depressions, metal inserts may be moulded in place, thus saving later work. Also any form of letter, trade mark, or figure is easily formed during the moulding process.

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CUTLER-HAMMER

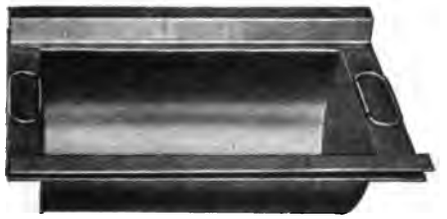
Industrial Heating Equipment



C-H Electric Space Heater.



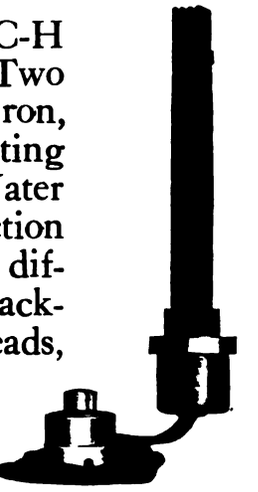
C-H Electric Soldering Iron.



C-H Electric Chocolate Warmer.

The best known of the standard C-H Appliances are the Space Heater (Two Feet of Electrical Heat), Soldering Iron, Chocolate Warmer, Metal Melting Pots, and Immersion Type Water Heaters. Various kinds of conduction heaters are made for application to different types of machinery, such as package sealing machines, embossing heads, ironing machines, washing machines and others.

The C-H Industrial Electric Heating Department is ready to give attention to problems of this nature.



C-H Tank Type Water Heater.

Battery Charging Equipment



C-H Panel of Six Battery Charging Rheostats of the Constant Current Type.

This apparatus is built in several types for the charging of industrial trucks, street vehicles, and battery locomotives. C-H Charging Equipment is designed on the unit idea so that rheostats for a few or many trucks can be assembled depending on requirements. Addition may be readily made and therefore future extension to fleets of trucks does not mean a complete rearrangement of charging equipment.

High grade design and construction are adhered to because of the importance of properly charging batteries and maintaining their usefulness.

Publication 830 will be sent on request.



C-H Panel of Four Battery Charging Units of the Modified Constant Potential Type.

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BENJAMIN REFLECTORS *and* FIXTURES

SOCKETS ARE NATIONAL ELECTRICAL CODE STANDARD



Shallow Bowl Reflector Socket

Benjamin Reflector Sockets and Reflector Units cover every industrial lighting requirement both from the standpoints of utility and scientific design. They are easy to install and the maintenance cost under most conditions is comparatively low.



Dissembled View Showing Parts of Socket and Supporting Fitting with Stem Added



Deep Bowl Reflector Socket

The reflectors are porcelain enameled by the best process, under which the enamel and steel are fused together, making practically one piece of material with the strength of steel and the hard, everlasting surface of flint or granite.

The sockets are two-piece, easy-to-wire type and the supporting fitting is strong, durable and easily put in place.



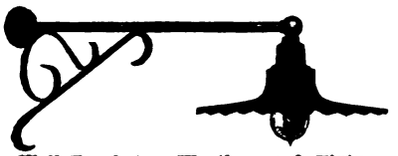
Elliptical Angle Reflector for Signboard Lighting



Dome Reflector Unit



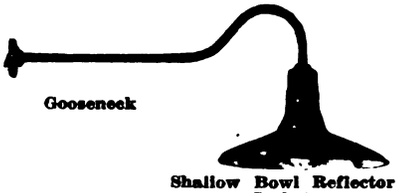
Deep Bowl Reflector Unit



Wall Bracket — Weatherproof Fixture Radial Reflector



Cluster Fixture



Shallow Bowl Reflector Socket



Store Lighting Unit



Show-case Lighting Fixtures



Ceiling Unit with Shade Holder



Vaporproof Fixture with Reflector



Vaporproof Fixture with Guard

MADE ONLY BY

BENJAMIN ELECTRIC MFG. CO.

Factories: Chicago and Desplaines, Ill.

Sales and Distribution Offices:

NEW YORK

Benjamin Electric Mfg. Co. of Canada, Ltd.
Montreal—Toronto—Winnipeg

CHICAGO

BENJAMIN
Makers of Things More Useful

SAN FRANCISCO

The Benjamin Electric, Ltd., London, England

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Benjamin-Starrett Panel Boards and Cabinets

NATIONAL ELECTRICAL CODE STANDARD

Standardized Panels



Standardized Panel Front View



View Showing Partial Assembly of a Standardized Panel



Standardized Panel Rear View

Standardized panels are constructed from standard panel units which are made under modern factory methods, i. e., with efficient machinery and on a production basis. The finished article has all the neatness, accuracy of measurement and finished appearance characteristic of the machine made product.

Panels with cabinets are assembled at the factory immediately upon receipt of orders so that delays formerly incident to filling orders for panel equipment have been done away with.

Standardization is the principle underlying the design and construction of the entire range of Benjamin-Starrett Panel Boards. It means that panel boards and cabinets are now capable of being ordered and shipped as ordinary staple electrical merchandise.

In securing this standardization of panel boards and cabinets nothing of an electrical or mechanical advantage that might be secured through the most rigid specifications is sacrificed.



Open Front



Dead Front

The dead front types deserve special consideration. They are unusually simple and neat in design and easy to install and operate.

Many advantages, due to regularity of design, precision in manufacture and accuracy in assembly are gained. Benjamin-Starrett Panel Boards are factory made and assembled from start to finish, resulting in less delay in shipping, better appearance, lighter weight, easier handling and lower labor cost in installation.

Stock Panels



The line of Stock Panel Boards was developed as a result of a well recognized need and considerable demand for panel equipment that might be obtained from stock without delay. These panels with cabinets are carried in stock by jobbers.

Standardized Panels in Cabinets

Residence Panels



The dead front residence type was designed to meet a growing demand for a positively safe residence panel for the protection of those, who, having little or no knowledge of electrical equipment, fear to change a fuse or throw a switch.

Panel Cut Outs



Benjamin-Starrett Panel Cut-outs take the place of porcelain blocks and vastly improve the job, at the same time reducing installation costs.

Write for Catalog of Benjamin-Starrett Panel Boards

MADE ONLY BY

BENJAMIN ELECTRIC MFG. CO.

Factories: Chicago and Desplaines, Ill.

Sales and Distribution Offices:

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Benjamin Electric Mfg. Co.
of Canada, Ltd.
Montreal—Toronto—Winnipeg

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London, England

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BENJAMIN ELECTRICAL SPECIALTIES AND WIRING DEVICES

NATIONAL ELECTRICAL CODE STANDARD



Adjustable Plug Socket



Two-way Plug with Pull Chain



Adjustable Stand Lamp Cluster



Wireless Clusters



Socket Extension



Swivel Attachment Plug



Current Tap Socket



Mogul Socket with Shadeholder



Twin Socket



"Benco" Socket Pull Chain Type



"Benco" Socket Showing Method of Attaching Shadeholder



Stand Lamp Cluster



Angle Cap Socket with Pull Chain and Shadeholder Attached



Porcelain Key Socket



Copper Cap Porcelain Socket



Sign Receptacle



Outlet Box Cover with Shadeholder Thread



Separable Plug with Convertible Cap



Wall Receptacle



Hand Portable Lamp



Receptacle with Box Cover

Write for Complete Catalog

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BENJAMIN MARINE LIGHTING *and* SIGNALLING APPARATUS

NATIONAL ELECTRICAL CODE STANDARD



Keyless Two Pole Receptacle in Water Tight Junction Box and Two Pole Attaching Plug



Two Lever Key Receptacles in Water Tight Junction Box with Water Tight Swivel Attaching Plug



Lever Key Receptacle in Water Tight Junction Box and Water Tight Swivel Attaching Plug



Water Tight Angle Bulkhead or Wall Fixture



Lever Key Water Tight Hand Portable with Guard and Hook



Junction Box Type Water Tight Deck or Bulkhead Fixture.



Separable Two Pole Water Tight Connector



Water Tight Drop Fixture with Plunger Key



Water Tight Marine Howler



Water Tight Buzzer



Water Tight Bell with Water Tight Push Button



Locking Type Water Tight Push Button

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IF IT'S **PARANITE** IT'S RIGHT

Paranite Rubber Covered Wires and Cables More than Code Requires

For Underground, Aerial, Submarine and Inside Use



The Home of PARANITE, Jonesboro, Ind.

Telephone, Telegraph and Fire Alarm Cables
Lamp-Cords, Portable Cords and Ignition Cables

Indiana Rubber and Insulated Wire Co.

Factory and General Offices

JONESBORO, IND.

Chicago Offices: 210 S. Desplaines St.
New York Offices: 63 Vesey St.

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Paranite Rubber Covered Wires and Cables, More Than Code Requires

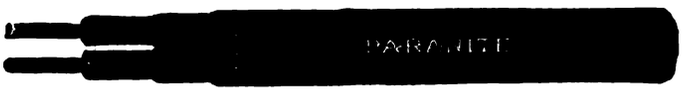
For Underground, Aerial, Submarine and Inside Use



SOLID CONDUCTOR. SINGLE BRAID



SOLID CONDUCTOR. DOUBLE BRAID



DUPLEX SOLID. FOR CONDUIT WORK. DOUBLE BRAID



FIXTURE WIRE. SOLID



STRANDED CONDUCTOR. SINGLE BRAID



STRANDED CONDUCTOR. DOUBLE BRAID



DUPLEX STRANDED. FOR CONDUIT WORK. DOUBLE BRAID



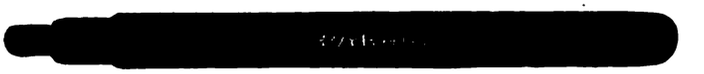
FIXTURE WIRE. STRANDED



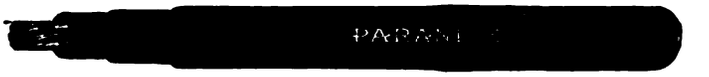
FLEXIBLE CABLES. CIRCULAR MIL. SIZES



CIRCULAR MIL. SIZES. DOUBLE BRAID



FLEXIBLE SWITCHBOARD CABLE. SINGLE BRAID

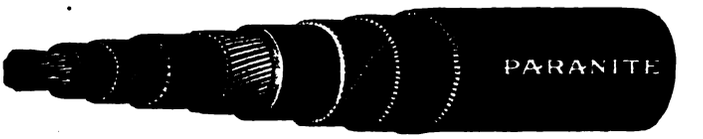


FLEXIBLE SWITCHBOARD CABLE. DOUBLE BRAID



MINING MACHINE CABLE. DUPLEX

The strands are flexible, each conductor is finished with a weather-proof braid, the two conductors are then laid side by side and covered with two or three braids of hard cotton, which is then saturated with a weatherproof compound.



CONSTRUCTION "B"

This is the same as "A" without the outside belt of rubber.



TRIPLE BRAID

Telephone, Telegraph and Fire Alarm Cables
Lamp Cords, Portable Cords and Ignition Cables

Indiana Rubber and Insulated Wire Co.

Factory and General Offices, JONESBORO, IND.

Chicago Offices: 210 S. Desplaines St.
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IF IT'S PARANITE IT'S RIGHT

Paranite Rubber Covered Wires and Cables. More than Code Requires For Underground, Aerial, Submarine and Inside Use



ELEVATOR LIGHTING CABLE
With 2 Steel Supporting Strands—(Type "P.WP.")



CONCENTRIC MINING MACHINE CABLE
CONSTRUCTION "A"

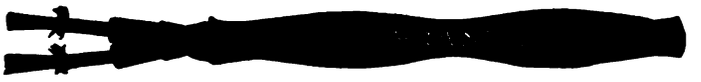
The center is flexible strand, insulated with rubber 1/64 inch thicker than code standard. This is finished with a tape and a braid. Over this are placed fine wires, equal in area to the center conductor. A belt of rubber code thickness is then applied and the whole cable finished with a tape and a double braid, saturated with a weatherproof compound.



GATHERING LOCOMOTIVE CABLE
Tape and Braid



GATHERING LOCOMOTIVE CABLE
Taped with Special Seine Braid



Style A



Style C



Style D
HEATER CORD



NEW CODE FLEXIBLE CONDUCTORS
Brewery Cord. (Type "C.B.")

Made up of two flexible conductors, seamless rubber insulated, braided, twisted together and saturated with weatherproof compound.



CANVASITE CORD (Type "C.C.")

Made up of two flexible conductors, seamless rubber insulated, braided, twisted together and finished with a weatherproof braid over all.



PACKINGHOUSE CORD (Type "PK.WP.")

Made up of two flexible conductors, seamless rubber insulated, braided, twisted together with jute and finished with two weatherproof braids.



DECK CABLE

Made up of two flexible conductors, seamless rubber insulated, braided, twisted together with jute filler and covered with a seamless belt of rubber and a weatherproof braid.



THEATER OR STAGE CABLE (Type "T")

Made up of two flexible conductors, rubber insulated, braided and twisted together with jute and finished with two weatherproof braids.



BORDER LIGHT CABLES (Type "B")

Are exactly the same as theater or stage cable but consist of more than two conductors.



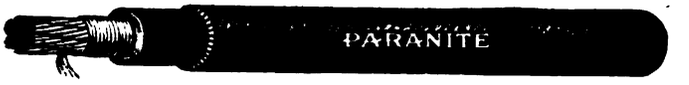
ELEVATOR CONTROL CABLES
With Steel Supporting Strands—(Type "E")

Made up from 4 to 12 conductors No. 16 flexible rubber insulated, twisted together and covered with 3 outside braids.



CAR WIRE. 7-WIRE STRAND

The strand is covered before insulating with a wrap of cotton. The rubber is National code thickness. The finish is either SINGLE, DOUBLE or TRIPLE BRAID weatherproof.



CAR WIRE. 49-WIRE STRAND

The strand is covered before insulating with a wrap of cotton. The rubber is National code thickness. The finish is either SINGLE, DOUBLE or TRIPLE BRAID weatherproof.

Telephone, Telegraph and Fire Alarm Cables, Lamp Cords, Portable Cords and Ignition Cables

Indiana Rubber and Insulated Wire Co.

Factory and General Offices, JONESBORO, IND.

Chicago Offices: 210 S. Desplaines St. **New York Offices: 63 Vesey St.**

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IF IT'S **PARANITE** IT'S RIGHT

Paranite Rubber Covered Wires and Cables More Than Code Requires

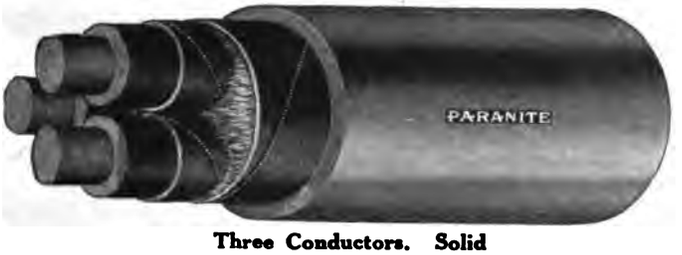
For Underground, Aerial, Submarine and Inside Use



LEAD ENCASED WIRES
Single Conductor. Solid



Duplex Conductors. Solid



Three Conductors. Solid



Three Conductors. Stranded



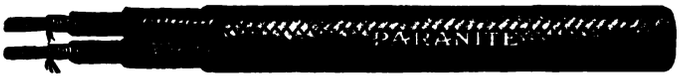
LEAD ENCASED CABLES
Duplex Conductors. Stranded



LEAD ENCASED CABLES
Single Conductor. Stranded



NEW CODE LAMP CORD (Type "C")
Glazed Cotton Twisted



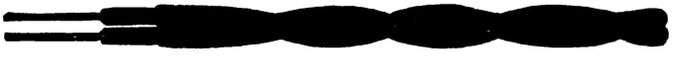
PARALLEL NEW CODE LAMP CORD (Type "P. O.")
Glazed Cotton Covered



REINFORCED PORTABLE CORD (Type "P" 5)
Made up of two conductors flexible new code lamp cord twisted, covered with a belt of rubber and then covered with a glazed cotton braid.



SPECIAL REINFORCED PORTABLE CORD (Type "P. S.")
Made up of two flexible conductors, cotton wound, insulated with 1/64 in. new code seamless rubber, braided with cotton, twisted and then covered with a light rubber belt, over which is placed a cotton braid.



Twisted Pair "Inside" or "Sub-Station" Wire
Conductors are soft drawn Tinned Copper insulated, braided and twisted. Stock colors are Oak Tan and Olive Green, carried in stock in single conductor twisted pair and triplex.



Plain (No Braid) Pot Head Wires
Conductors are soft drawn Tinned Copper rubber insulated, Plain, (No braid); one conductor black rubber, one conductor red rubber.



Twisted Pair "Bridal Wire"
Conductors are soft drawn Tinned Copper rubber insulated, braided and twisted, saturated with a weatherproof compound, wax finish, one conductor having a raised tracer to distinguish it from the other.



Twisted Pair Flame Proof or Jumper Wire
Conductors are soft drawn Tinned Copper rubber insulated, braided and twisted, one conductor white cotton, one conductor red cotton and then saturated with Flame Proof Compound.

Telephone, Telegraph and Fire Alarm Cables
Lamp Cords, Portable Cords and Ignition Cables

Indiana Rubber and Insulated Wire Co.

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IF IT'S **PARANITE** IT'S RIGHT

Paranite Rubber Covered Wire and Cables More Than Code Requires

For Underground, Aerial, Submarine and Inside Use



ELECTRIC VEHICLE CABLE
30% Plain Rubber, no Braid



PEERLESS AUTO CABLE
Peerless Primary Cable

Peerless cables are made up with BARE Copper Wires, insulated with Rubber and covered with ONE BROWN BRAID with YELLOW TRACER, finished with Enamel Varnish baked on.



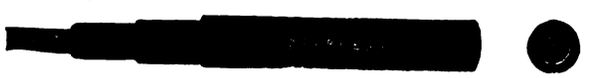
PEERLESS AUTO CABLE
Peerless Multiple Conductor Cable



PEERLESS PLAIN ITALIAN CABLE



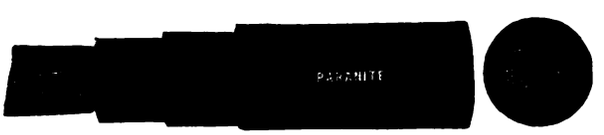
PLAIN ITALIAN CABLE (Varnished)



PEERLESS HIGH TENSION MAGNETO CABLE



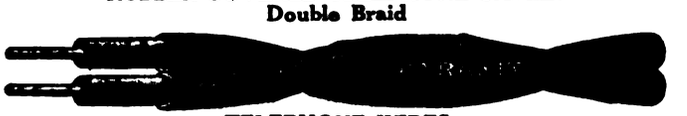
PEERLESS STARTING CABLE
Double Braid



STARTING CABLE



RUBBER COVERED TELEPHONE CABLES
Double Braid



TELEPHONE WIRES
Twisted Pair Hard Drawn Outside Distributing Wire

Conductors are hard drawn Tinned Copper rubber insulated, braided and twisted, saturated with black weatherproof compound, wax finish, one conductor having a raised tracer to distinguish it from the other.



IRON TELEPHONE DROP WIRE

Conductors are Iron Telephone Wire rubber insulated, braided and twisted, saturated with a weatherproof compound, wax finish, one conductor with a raised tracer to distinguish it from the other.



PRIMARY CABLE

Tinned copper wires are used insulated with New Code Rubber, covered with TWO BROWN BRAIDS with RED TRACER, and finished with several coats of Enamel Varnish baked on.



HIGH TENSION MAGNETO CABLE



MULTIPLE CONDUCTOR PRIMARY AND LIGHTING CABLE



LEAD ENCASED TELEPHONE CABLES

Telephone, Telegraph and Fire Alarm Cables
Lamp Cords, Portable Cords and Ignition Cables

Indiana Rubber and Insulated Wire Co.

Factory and General Offices, JONESBORO, IND.

Chicago Offices: 210 S. Desplaines St.
New York Offices: 63 Vesey St.

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American Steel & Wire Co.

Principal Sales Offices

CHICAGO, 208 So. La Salle Street
NEW YORK, 30 Church Street
WORCESTER, 24 Grove Street
BOSTON, 120 Franklin Street
CLEVELAND, Western Reserve Building
PITTSBURGH, Frick Building
BALTIMORE, 32 So. Charles Street
BUFFALO, 337 Washington Street
CINCINNATI, Union Trust Building
DETROIT, Foot of First Street
PHILADELPHIA, Widener Building
ST. LOUIS, Liberty Central Trust Company Building
WILKES-BARRE, PA., Miners Bank Building
MONTREAL, Bank of Ottawa Building
BIRMINGHAM, ALA., Brown-Marx Building
ST. PAUL-MINNEAPOLIS, Pioneer Building, St. Paul
KANSAS CITY, 417 Grand Avenue
OKLAHOMA CITY, First National Bank Building
DENVER, COLO., First National Bank Building
SALT LAKE CITY, UTAH, Walker Bank Building
UNITED STATES STEEL PRODUCTS CO.,
Export Representatives, New York, 30 Church Street
Pacific Coast Dept., San Francisco, Rialto Building
Portland, Ore., Sixth and Alder Streets
Seattle, Wash., 4th Avenue So. & Conn. Street
Los Angeles, Calif., Jackson & Cent. Avenue
New Orleans, La., Maison Blanche Annex Building

Bare Copper and Copper Trolley Wire

Trolley wire of hard drawn copper is made in three shapes as shown; round, grooved and figure 8. Is of high conductivity, strong and durable. Sizes from 1/0 to 4/0 B & S gauge.



Round Trolley Wire. Sizes Range from 4/0 to 1/0 B & S Gauge.



Figure 8 Trolley Wire. Sizes Range from 4/0 to 2/0 B & S Gauge.



Grooved—"American Standard" Trolley Wire. Sizes Range from 4/0 to 2/0 B & S Gauge.

Reliance Weatherproof and Slow Burning Wire

Double and triple braid Reliance weatherproof wire designed to meet all requirements of conductors for outdoor service, having a moderate degree of insulation and less expensive than rubber insulated conductors. A superior grade of slow-burning wire is made for indoor purposes. Meets all requirements of National Board of Underwriters.



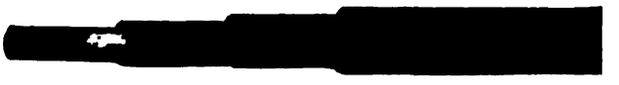
Solid Copper Conductor—Double or Triple Braid. Made in sizes from No. 18 to 4/0 B & S Gauge.



Standard Copper Conductor—Double or Triple Braid. Made in sizes from No. 8 to 4/0 B & S Gauge and from 250,000 to 2,000,000 Circular Mils.



Solid or Stranded Copper Conductor—Slow Burning Finish for Indoor service. Cables Having Any Number of Conductors Can be supplied.



Solid Iron Conductor—Double or Triple Braid Especially Adapted for Fire Alarm, Telephone, Telegraph and Burglar Alarm Construction Where Danger of Short-Circuits with Other Wires or Trees Exists.

Annunciator and Office Wire



Annunciator Wire. Used in Primary Battery Circuits for Call Bell or Annunciator Wiring. Made in sizes from No. 14 to No. 22 B & S Gauge. Insulated with Two Firm Winds of Cotton Applied in Opposite Directions and Saturated with Specially Prepared Paraffine Wax Compound. Supplied in 7 lb. Spools.



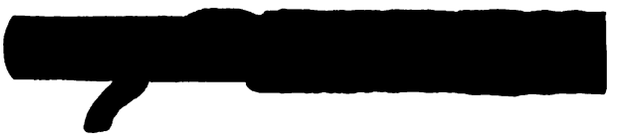
Office Wire, made in sizes Varying From No. 14 to No. 20 B & S Gauge. Insulated with One Wind and One Braid of Cotton. Saturated with Paraffine Wax Compound. Supplied in Coils of 20 lbs.



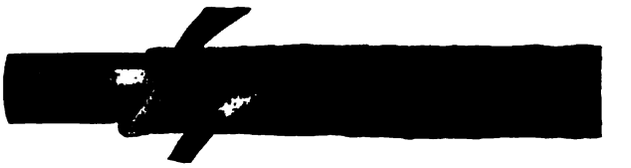
Damp-proof Office Wire Has Two Inside Cotton Winds Which are Thoroughly Impregnated with Black Weatherproof Compound.

Magnet Wire

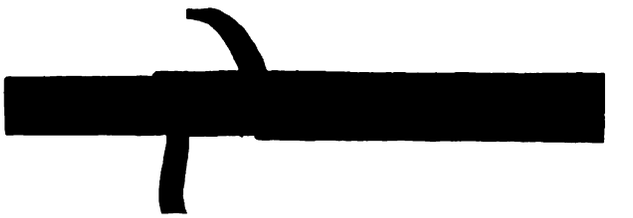
All copper wire drawn for magnet purposes is thoroughly annealed by processes which insure uniform and extreme softness, highest conductivity and ease of handling.



Round, Single Cotton Covered Magnet Wire. Made in Sizes Varying from No. 40 to 1/0 B & S Gauge.



Round, Double Cotton Covered Magnet Wire. Made in Sizes Varying from No. 40 to 1/0 B & S Gauge. Covers are Wound Spirally about the wire, Successive Layers Being Wound in Opposite Directions.



Rectangular and Square Double Cotton Covered Magnet Wire. Silk, Asbestos and Paper Coverings Can also Be Supplied on all Magnet Wire.

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American Steel & Wire Co.

Americore Rubber-Covered Wire

National Electrical Code Standard

Americore rubber has all the desirable qualities of a new code wire. It is a high grade compound, meeting all N. E. C. requirements and is recommended for all service conditions in which the working pressure is 7,000 volts or under.



Solid Tinned Copper Conductor—Single or Double Braid, for Voltage up to 600. Made in Sizes Varying from No. 18 to 4/0 B & S Gauge.



Stranded Tinned Copper Conductor—Single or Double Braid, for Voltages up to 600. Made in Sizes Varying from No. 14 to 4/0 B & S Gauge.



Flexible Tinned Copper Conductor—Single or Double Braid. For Switchboard, Brush-Holder and Similar Connections. Sizes Range from No. 14 to No. 1 B & S Gauge.



Light Insulation Fixture Wire, Single Braid. Made in Sizes Varying from No. 20 to No. 12 B & S Gauge.



Car Connector—Cotton or Paper Wrap over Conductor—Single Braid—Weatherproof. Made in Sizes from No. 14 to No. 2 B & S Gauge.



Twin—Solid or Stranded Conductors—Braid on Each Conductor —Braid Over All. Made in Sizes from No. 18 to 4/0 B & S Gauge.



Brewery Cord. Each Conductor Regular Lamp Cord Strand, Cotton Wound, Insulated With Code Thickness of Vulcanized Rubber, Covered with a Cotton Braid and Saturated With a Weatherproof Compound.



Two Lamp-Cord Conductors Twisted Into Pairs, Interstices of Which are Filled With Jute Laterals to Make the Whole Cylindrical and Then Braided Over With Two Heavy Cotton Braids and Weatherproofed.



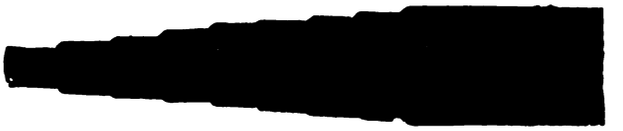
Canvasite Cord. Consists of Two Lamp-Cord Conductors Twisted Together and Covered With an Additional Weatherproof Braid.



Twin Mining Machine Cable Consisting of Two Flexible Strands of Tinned Annealed Copper of Highest Conductivity Each of Which is Insulated With Vulcanized Rubber and Protected with a Braid of Cotton Saturated With Weatherproof Compound. Two Finished Cables are Then Placed Side by Side and Covered With Two or Three Strong Cotton Braids Saturated in Weatherproof Compound or the Outer Covering may Consist of Tubular Weave Loom.



Theater or Stage Cable. In Sizes No. 10 to No. 16 Lamp-Cord Strand is Used. In Sizes No. 8 to No. 1 Bare Conductors Consist of Concentric Strands of Tinned Copper Wires.

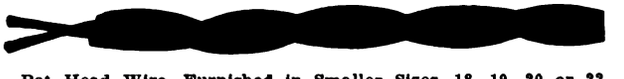


Concentric Mining Machine Cable. Over the Inner-Conductor is Stranded the Outer-Conductor Consisting of a Number of Tinned Annealed Copper Wires Equal in Area to the Central-Conductor. Made in Sizes Ranging from No. 8 to No. 4 B & S Gauge.

Rubber Covered Telephone Wire



Inside or Sub-Station Wire. Conductors, No. 19 B & S Gauge are of Soft Drawn Tinned Copper Insulated to a Diameter of 3/32 in. Over Rubber, Covered with a Single Hard Glazed Cotton Braid.



Pot Head Wire, Furnished in Smaller Sizes, 18, 19, 20 or 22 B & S Gauge—Either Single Conductor or Twisted Pair.



No. 14 B & S Twisted Pair Outside Distributing Wire. Conductors are Treated with a Weatherproof Compound Wax Finish.

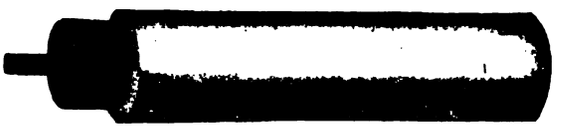
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American Steel & Wire Co.

Special Power and Lighting Cables



Solid or Stranded Tinned Copper Conductors Rubber Insulated, Taped and Lead Encased.



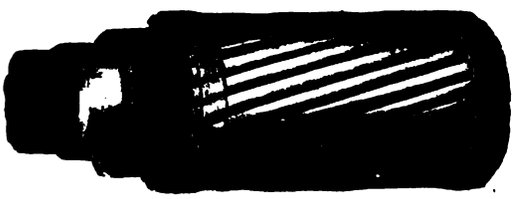
Single Conductor Paper or Cambric Insulation Lead Sheath. Made in sizes Ranging from 250,000 Circular Mils to 2,000,000 Circular Mils.



No. 6 B & S Gauge Solid Three Conductor, Paper or Cambric Insulated, Lead Encased Cable.



Two Conductor Submarine Cable, Lead Encased Jute Sewed and Armored.



Multiple Conductor Rubber, Lead and Armored Signal Cable.

Park and Suburban Constructions

Rubber, Lead and Armored with Flat Steel Tapes Asphalted Jute on Outside.



Single Conductor made as follows: Stranded Copper Conductor, Insulation, Tape, Lead, Jute, First Steel Tape, Second Steel Tape With Jute Over all.

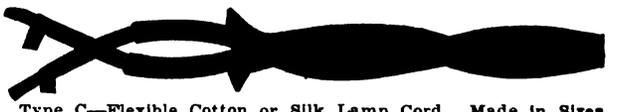


Twin Conductors made as Follows: Solid Copper Conductors Both Covered With Insulation, Taped Separately, Covered With Lead Over all, then Jute, First Steel Tape, Second Steel Tape and Jute Over all.

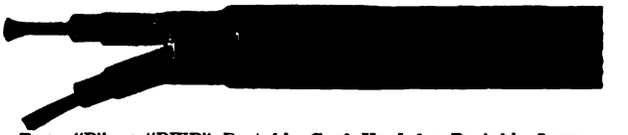


Three Conductor made as Follows: Each Conductor Solid Copper, Conductor Insulated, Taped; Three such Conductors Twisted together, Jute Filled to Make Round and Covered Over all With Tape, Lead, Jute, First Steel Tape, Second Steel Tape and Jute Over all.

Lamp and Portable Cords



Type C—Flexible Cotton or Silk Lamp Cord. Made in Sizes Ranging from No. 22 to No. 10 B & S Gauge.



Type "P" or "PWP" Portable Cord Used for Portable Lamps, Small Portable Motors, etc. Strong Endurable Outer Braid. Made in Sizes Ranging from No. 20 to No. 12 B & S Gauge.



Type "PD" Lamp Cord.

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American Steel & Wire Co.

Automobile Ignition, Lighting and Starting Cables

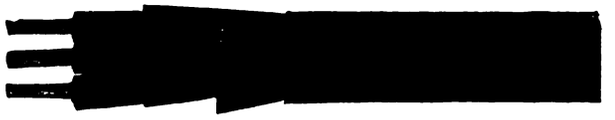
We are prepared to manufacture automobile wires and cables for both primary and secondary circuits to customers' specifications or samples. Automobile wire and cable is designed not only to withstand the severe electrical stresses met with in automobile service, but also the unusual physical conditions that are encountered, such as heat, oil, etc.



Style RR Plain Rubber Ignition Cable



Style RS1W Braided Lighting Cable.



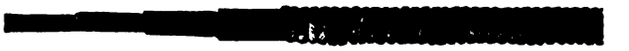
Style RS3W—Three Conductor Braided Lighting Cable.



Style B-5—Rubber Cambric and Braided Lighting Cable.



Style RB—Braided Ignition Cable.



Style GA—Cambric Armored Lighting Cable.



Style GA2W—Two Conductor Cambric Armored Lighting Cable.



Style C S—Cambric and Braided Starter Cable.

Rail Bonds



We manufacture several distinct types of rail bonds, there being many forms and sizes of each. Crown Rail Bonds. U. S., Crown Triplex, Twin Terminal, Soldered, Solid Wire Bonds, Flame Weld Bonds, Concealed Bonds and various other forms to meet any requirement.

W. & M. Telephone and Telegraph Wire



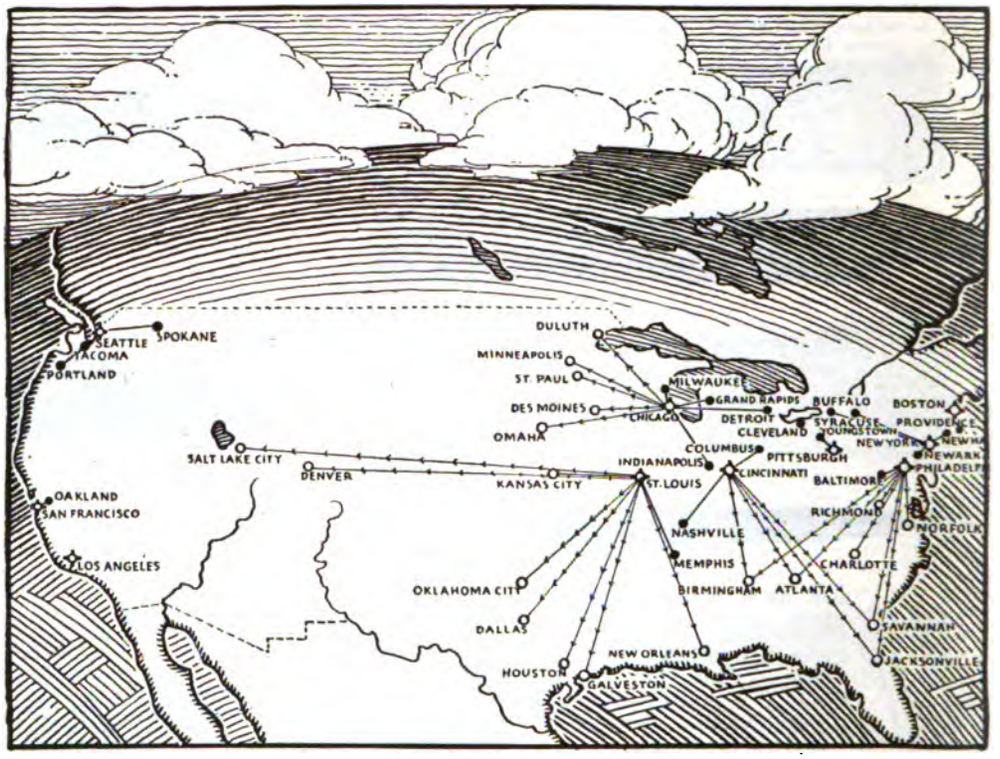
There are three standards of extra galvanized telephone and telegraph wire in general commercial use: "Extra Best Best" (E. B. B.) "Best Best" (B. B.) and "Steel." They are uniform in quality, pure, tough and pliable. E. B. B. standard stands highest in conductivity of any telegraph wire with a weight per mile ohm of from 4,700 to 5,000 lbs. Used largely by telegraph companies and in railway telegraph service. B. B. grade is used very largely by telephone companies.

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Habirshaw Insulated Wire-Plus

THE accompanying map shows how the nation-wide distribution of the Western Electric Company places complete wholesale stocks of Habirshaw wires and cables at the disposal of the trade, throughout the entire United States.

Western Electric materials, apparatus and appliances are all as standard as Habirshaw and are as readily accessible.



HABIRSHAW

"Proven by

For more than thirty years—practically from the beginning of the electrical industry—Habirshaw Insulated Wire has been accepted as a standard of quality all over the World.

HABIRSHAW success began and continues in the making of good wire. Upon the sound foundation of a "quality first" policy, an engineering and manufacturing organization was built which could assure *progress* in quality and a direct answer to every wire need of the electrical industry.

NATIONAL advertising and merchandising, not by destructive competitive sales tactics, but through sincere co-operation with architects, electrical engineers, contractors and dealers, and central station organizations everywhere, cultivated a broad and stable market.

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Western Electric Company's Service



THIS map is a graphic representation of the national marketing of Habirshaw insulated wire, through the branches and sub-branches of the Western Electric Company. Every important center in the United States is brought into touch with ample reserve stocks of Habirshaw wire by this wide-spread and efficient service of warehousing and distribution.

KEY TO MAP

- ☼ ○ ● Locations of Western Electric houses.
- ☼ Indicates houses carrying complete stocks of Habirshaw wire exclusively and in which a Habirshaw sales service representative is located.
- ● Represents houses carrying complete stocks of Habirshaw wire.
- ○ Signifies houses through which Habirshaw products can be obtained.
- —— Black line ties in sub-branch with its branch house—where Habirshaw representative is located. All these houses carry Habirshaw wire exclusively.
- →→→ Broken line ties in houses not carrying stock to Habirshaw, stock houses supplying their requirements of wire and cable.

The Western Electric Company sells to dealers, contractors, and central stations everywhere, electric material of standard quality.

Habirshaw wire may be secured on request in any Western Electric house, but is carried in stock in the following Branch Houses:

BOSTON Providence	CINCINNATI Nashville	PITTSBURGH Youngstown	CHICAGO Indianapolis Milwaukee Grand Rapids Detroit Columbus
NEW YORK Newark New Haven Syracuse Buffalo	CLEVELAND		
PHILADELPHIA Baltimore	SEATTLE Portland Tacoma Spokane	ST. LOUIS Memphis	
	LOS ANGELES	SAN FRANCISCO Oakland	

HABIRSHAW advertising will be constantly expanded to keep in touch with the ever-broadening Habirshaw markets.

Page space in the greatest national publications will be continued—and the long-established Habirshaw policy of co-operation with the electrical industry will be adhered to.

Insulated Wire & Cable

the test of time"

Habirshaw Wire Manufactured by *Habirshaw Electric Cable Co.* Incorporated Yonkers New York

Habirshaw Wire Distributed by *Western Electric Company* Incorporated Offices in All Principal Cities

Habirshaw Power Cables—Rubber · Varnished Cambric and Paper—Sector and Concentric

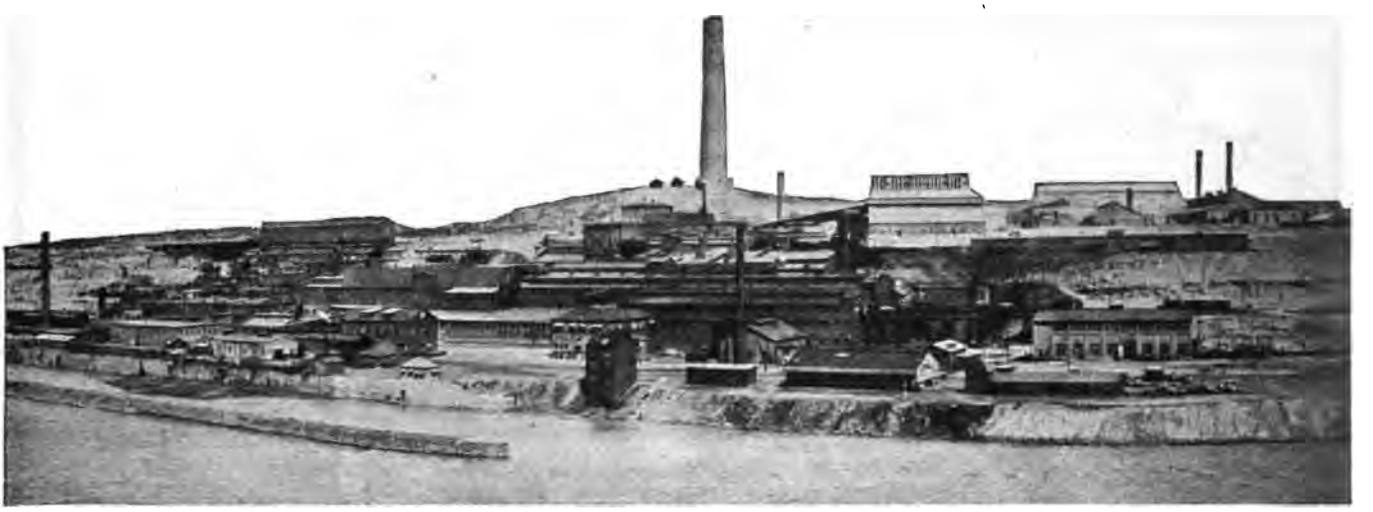
AND now that market is everywhere brought into touch with Habirshaw through the great organization of the Western Electric Company. The warehousing and distributing service of Western Electric Company is national in extent and renders an economical electrical equipment service unequalled in America today.

A HIGH-STANDARD product, such as Habirshaw wire, adds appreciably to the value of Western Electric Company's service—and, too, Western Electric Service is an invaluable supplement to the excellence of Habirshaw wire!

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ANACONDA

COPPER WIRE



"From Ore to Finished Product"

Anaconda Copper—mined at Butte, smelted at Anaconda, and Electrolytically refined at Great Falls, is rolled into rods and drawn into wire at the Great Falls mills.

Every step from the mining of the ore to the shipping of the finished wire is conducted under direct Anaconda supervision. Such facilities make it possible to offer users of copper wire a quality of service never before available.

The company's rod and wire mill is the only one of its kind located west of the Mississippi River. The advantages of this location can readily be appreciated for shipments to middle-western and western points.

Cooperating with the most up-to-date machinery obtainable, the company maintains a well equipped laboratory wherein the chemical, physical and electrical properties of all wires are carefully studied and developed.

Products.

Bare copper wires and cables for power transmission, telephone and telegraph lines, electric railway and all industrial uses.

Hot rolled copper rods.

All products are made from electrolytic copper the average conductivity of which is 100.75% Mathiessen's Standard, and are drawn to meet the specifications of the American Society of Testing Materials.

ANACONDA COPPER MINING COMPANY

ROLLING MILLS DEPARTMENT

General Offices—547 Conway Bldg., Chicago, Ill. **Mills—Great Falls, Mont.**

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ROME WIRE

[redacted]

The Symbol of Efficiency in Electrical Conductors



Specialists in Producing Wire For All Electrical Purposes

For over 20 years we have engaged in the exclusive manufacture of high grade electrical wires.

In that time we have extended the line, have designed and installed the most modern machinery obtainable; we have perfected our organization and improved our products to such an extent that they are today accepted as standard by wire users all over the world.

Every product of our plant is the work of experts. The materials are the best obtainable.

Jobber, dealer and user alike find Rome Wire products and Rome Service of the highest quality.

HOT ROLLED COPPER RODS
COPPER WIRE—Round, square and rectangular, plain and tinned.
TROLLEY WIRE
POWER CABLES
MAGNET WIRE—Enamel, Cotton, Silk Insulation, round, square and rectangular.
RUBBER INSULATED WIRES
HOUSE WIRES
FLEXIBLE CORDS
TELEPHONE WIRES
PACKING HOUSE, CANVASITE AND BREWERY CORDS
AUTOMOBILE CABLES
DECK CABLES
MINING MACHINE CABLES
WEATHERPROOF WIRE
LEAD COVERED CABLES
SPECIAL WIRES and CABLES

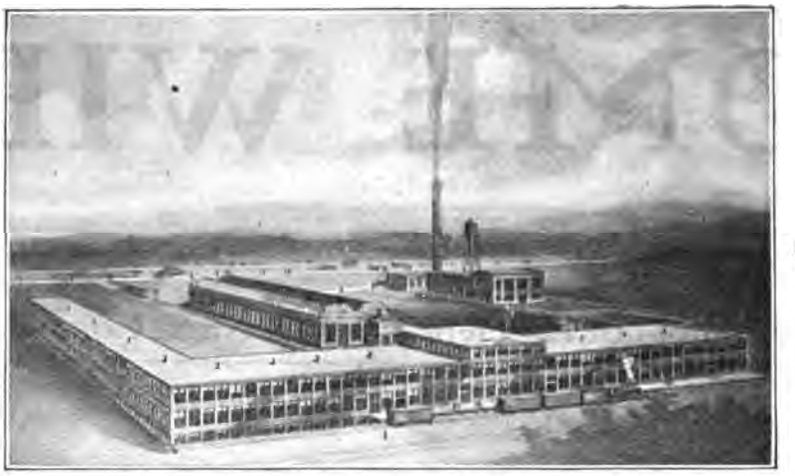
ALSO WIRES AND CABLES TO MEET REQUIREMENTS OF FOREIGN USERS

WRITE FOR CATALOG NO. 19E

ROME WIRE COMPANY

ROME — DIAMOND BRANCH, BUFFALO, N. Y. — NEW YORK

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Main Office and Plant, The Acme Wire Co., New Haven, Conn.

Acme Magnet Wire
and
Coil Windings

"Enamelite"—Plain enameled Magnet Wire
"Cottonite"—Cotton-covered "Enamelite"
"Silkenite"—Silk-covered "Enamelite"
Single and Double Cotton Magnet Wire
Single and Double Silk Magnet Wire

Remember—"It goes in the space"

The Acme Wire Co. offers a complete organization for the production of windings in large production quantities. Fifteen years of experience assure uniform high quality in the product and the exact fulfillment of your specification.

Field Coils — **Ignition Coils**
Meter Coils — **Transformer Coils**

New Illustrated Catalog sent on request

THE ACME WIRE CO. New Haven, Conn.
Cleveland New York Chicago

AcmeWire
"It goes in the space"

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Mark this page—

Refer to it when you need high grade electrical wires and cables :: :: ::









Bare Copper Wire and Cable

Weatherproof Wire

"1885" Weatherproof Wire is a high grade product which can be relied upon to give good service. It is put up on reels, or in coils, carefully wrapped, and shipped in cases of uniform weight.

Magnet Wires

The bare copper used in "1885" Magnet Wire is true to size, thoroughly annealed, and covered with long staple Sea Island Cotton. It is made in all sizes, both single and double covered.

Slow Burning Wire

Like all "1885" brands our Slow Burning Wire is made according to rigid specifications to insure maximum service. It is an excellent wire for hot and dry places where rubber insulation would quickly decompose.

Write for complete data and prices.

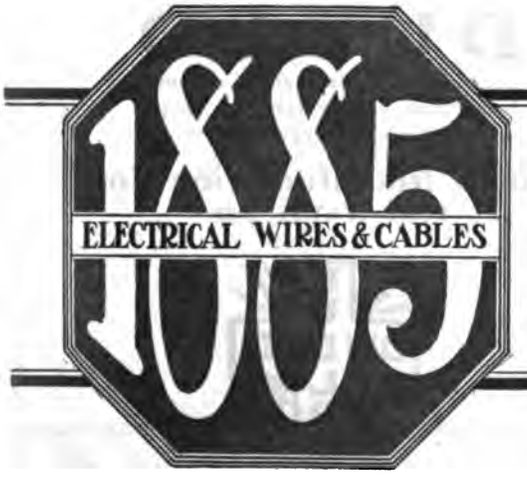
Other 1885 Products

"1885" Quality Products also include Bare and Weatherproof Copper and Iron Wires, Slow Burning Weatherproof Wire, Signal Wires, Annunciator and Office Wires, Magnet Wires, etc.

Each one is made in a modern plant, devoted exclusively to the manufacture of high grade bare and insulated Wires and Cables.

Chicago Insulated Wire and Manufacturing Co.

Sycamore, Illinois



Since 1885-Manufacturers of high grade bare and insulated wires and cables

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"AMERICAN BRAND"
WEATHERPROOF WIRE AND CABLES
HAVE NO EQUAL

"WIRE"
"AMERICAN BRAND"
Copper Wire and Cables

Superior Quality
for More Than 20 Years

We Manufacture

Weatherproof Wire and Cables.
Slow Burning Wire and Cables (all white).
Slow Burning Weatherproof Cables (black outside).
Weatherproof Iron Wire.
Single and Double Galvanized Guy Wire.

Bare Wire and Cables

Made to any specification and composition.

Order from your nearest jobber.
National Electrical Code Standard

Used by discriminating buyers throughout the United States, Mexico, South America and Europe.

American Insulated Wire & Cable Co.
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ILLINOIS WIRE & CABLE CO.
Sycamore, Ill.

Bare & Weatherproof
Wire and Cable

SYCAMORE

DUDLO

Magnet Wire
Magnet Wire Products

Quality Service and Quantity Production

The name

DUDLO

stands for highest grade magnet wire and coils. Used by large manufacturers everywhere.

Dudlo Manufacturing Co.
FORT WAYNE, IND.

DUDLO

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INDEPENDENT LAMP & WIRE CO.

INC.

OFFICES:
1737 BROADWAY
NEW YORK

FACTORIES:
WEEHAWKEN, N. J.
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MANUFACTURERS OF

Incandescent Electric Lamps of all types (Tungsol-Lamps).

Tungsten Contacts for ignition and other purposes.

Silver and Platinum Contacts.

Tungsten Plates, Sheets, Ribbons and Wires.

Molybdenum Sheets, Ribbons and Wires.

Tungsten and Molybdenum Products made to specifications.

"Copper-Clad" leading-in wire for vitreous vessels.

Asbestos Covered Insulated Wires (Salamander Wire).

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Wire Drawing Dies and Draw plates.

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Thermostatic Metal.

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INSULATED WIRES



Atlantic Wires are high in quality with great dielectric strength and resiliency.

Three widely known and extensively used Atlantic Wires are: DOLPHIN, code; TRITON, high grade, and NEPTUNE, 30% para.

ATLANTIC INSULATED WIRE & CABLE CO.

Sales Office: 52 Vanderbilt Ave., New York, N. Y. **Factory: Stamford, Conn.**

BALTIMORE
Electrical Sales Co.,
2 E. Redwood St.

BOSTON
A. D. Stein,
156 Purchase St.

CHICAGO
Geo. C. Richards & Co.,
557 W. Monroe St.

LOUISVILLE
T. C. Coleman & Son,
Starks Building

PITTSBURGH
W. A. McCombs & Co.,
Union Arcade Building

ST. PAUL
Rank & Goodell,
Merchants Bank Building

To Achieve Maximum Accuracy

In the compilation of the thousands of entries that appear in this volume every effort has been made to avoid errors. We have also gone to extreme limits to insure completeness, especially of trade information relating to products, manufacturers and trade names.

In order that the next edition will be even more complete, we will welcome suggestions for additional entries and especially information regarding corrections or revisions of the present text.

Manufacturers are particularly urged to keep us posted on new products, changes in personnel, etc.

E M F Electrical Year Book Published by Electrical Trade Publishing Co. 53 W. Jackson Boul., Chicago 116 Nassau St., New York

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First for Forty Years

For nearly half a century, Oshkosh Construction Tools have been the choice of buyers for public utility corporations and large contracting firms. More than half of the telegraph and telephone lines in the country have been built with their aid.

OSHKOSH
Construction Tools

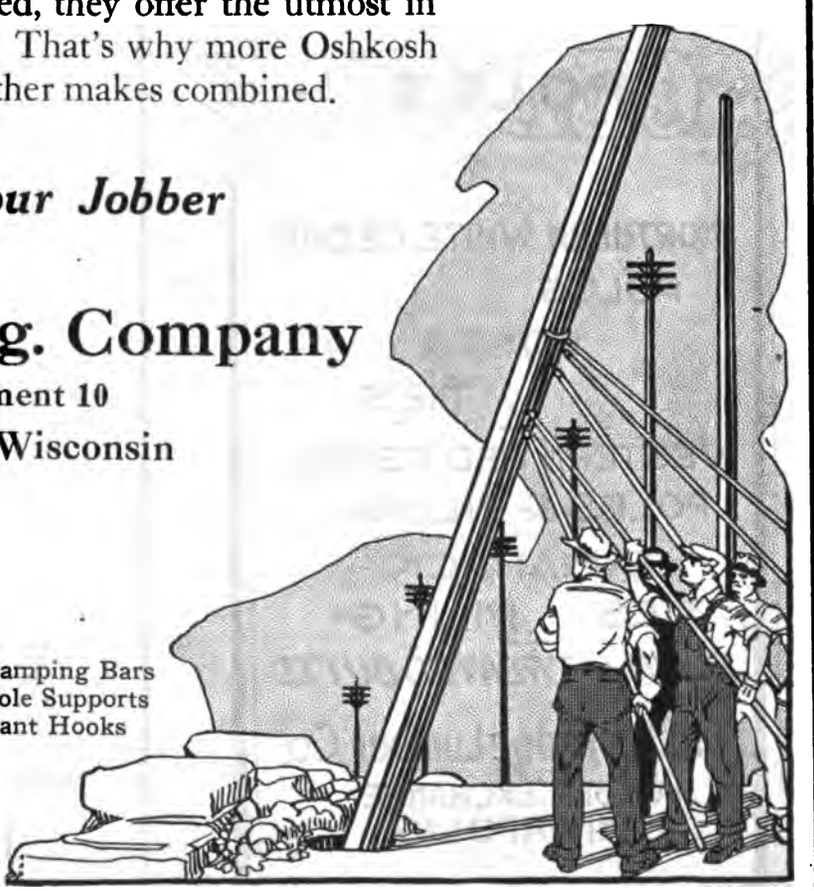
are also favored by workmen. Properly balanced, and no heavier than is necessary, these tools make the work easier and also increase speed and efficiency. Built of the finest steel and wood, thoroughly tested and triple inspected, they offer the utmost in long life and economy. That's why more Oshkosh Tools are sold than all other makes combined.

Ask Your Jobber

Oshkosh Mfg. Company

Department 10

Oshkosh, Wisconsin



Pike Poles
Spoons
Shovels

Climbers
Crowbars
Digging Bars
Reels

Tamping Bars
Pole Supports
Cant Hooks

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Electrical Sales Co.,
2 E. Redwood St.

BOSTON
A. D. Stein,
156 Purchase St.

CHICAGO
Geo. C. Richards & Co.,
557 W. Monroe St.

LOUISVILLE
T. C. Coleman & Son,
Starks Building

PITTSBURGH
W. A. McCombs & Co.,
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OSHKOSH
Construction Tools

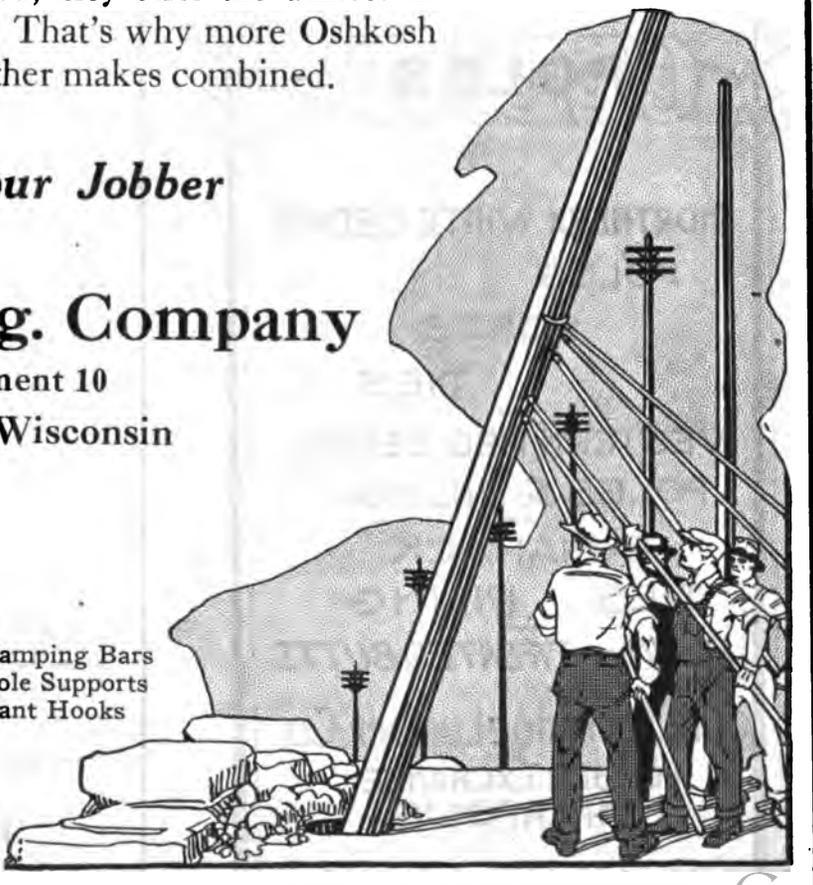
are also favored by workmen. Properly balanced, and no heavier than is necessary, these tools make the work easier and also increase speed and efficiency. Built of the finest steel and wood, thoroughly tested and triple inspected, they offer the utmost in long life and economy. That's why more Oshkosh Tools are sold than all other makes combined.

Ask Your Jobber

Oshkosh Mfg. Company

Department 10

Oshkosh, Wisconsin



Pike Poles	**Climbers**	**Tamping Bars**
Spoons	**Crowbars**	**Pole Supports**
Shovels	**Digging Bars**	**Cant Hooks**
	Reels	

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Northern White
and
Western Red
CEDAR POLES
Treated and Untreated

Wire or Write for Prices

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742 Peyton Building - - Spokane, Washington
Metropolitan National Bank Bldg., Minneapolis, Minn.
2844 Summit Street - - - Toledo, Ohio
220 Broadway - - - - New York, N. Y.

Main Office
Escanaba, Michigan
NATIONAL POLE COMPANY

CEDAR POLES

NORTHERN WHITE CEDAR
POLES
POSTS
TIES
WESTERN RED CEDAR
POLES & PILING
TAMARACK
TIES PILING
PLAIN or TREATED BUTTS

T. M. Partridge Lumber Co.
LUMBER EXCHANGE
MINNEAPOLIS



ARE you cutting into your poles to give your crossarms a bearing surface? When the HALLETT STEEL GAIN is used the only thing cut is the cost of maintenance.

Hallett Iron Works
Harvey, Illinois

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Western and Northern
CEDAR POLES
Butt-treated or Untreated

Our trademark on your poles assures absolute satisfaction because you get the benefit of our 30 years' experience in the production and marketing of cedar poles.

Our plant at Minnesota Transfer was the first commercial butt-treating plant in America, installed in 1907.

This illustration shows our latest unit for butt-treating poles.

Our poles possess all the vital requirements—Strength, Durability, Sightliness, Light Weight, Low Cost, Safety and Adaptability and are "GIANTS of TRANSMISSION".

It will pay you to let us know your requirements. Write, wire or phone for information.

THE VALENTINE-CLARK CO.

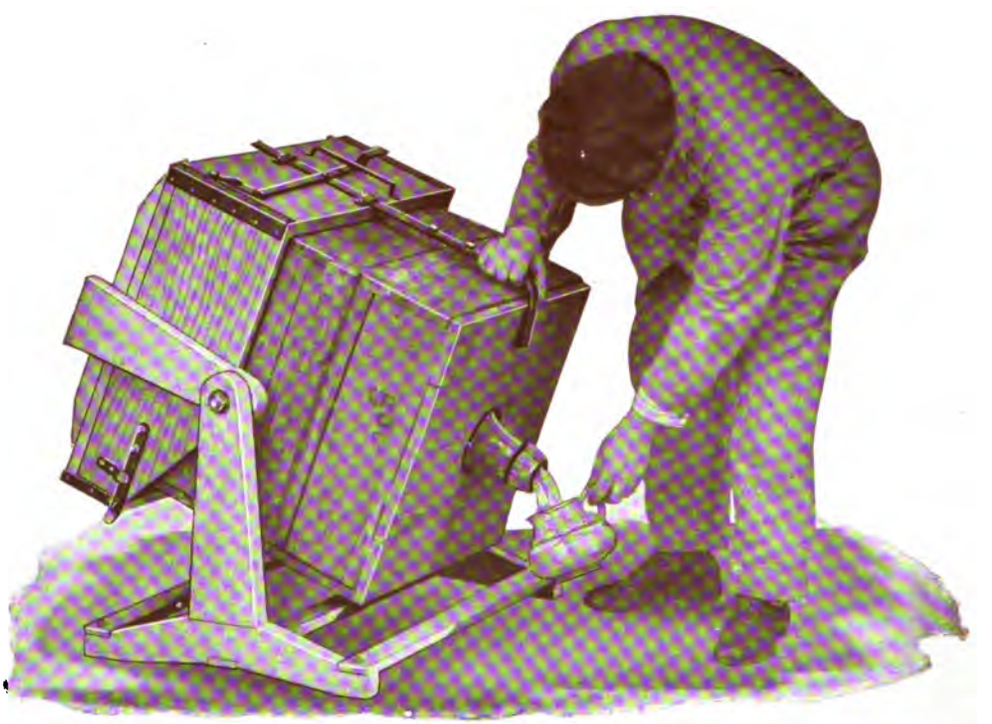
Spokane, Washington **Minneapolis, Minnesota**
Chicago, Illinois **Toledo, Ohio**

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For Pouring Acids

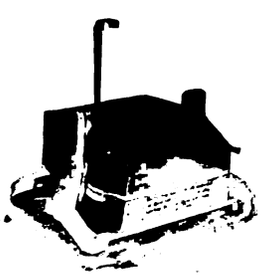
USE THE UNION CARBOY INCLINATOR



A SUPERIOR SAFETY APPLIANCE

THE UNION INCLINATOR is always ready for instant use—no attachments necessary. ¶It does not require valuable floor space over which to roll when pouring nor project into the runway when idle. ¶Can be operated in perfect safety by one man, and will return to upright position if accidentally released; locked while idle. ¶Holds any size carboy and medium size steel drums. ¶Recommended by compensation insurance companies.

5000 IN DAILY USE - ABSOLUTELY GUARANTEED



PAT. U. S. and CANADA

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Freight paid on order for two or more.
Weight 56 lbs. K. D.

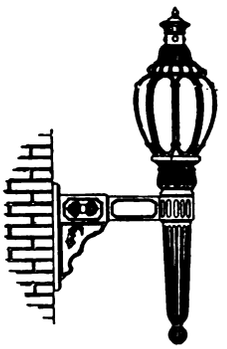


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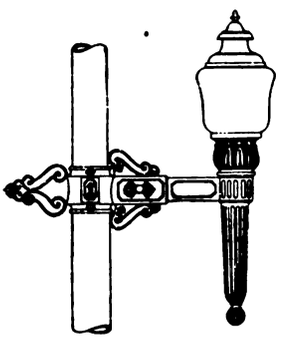
Horace M. McCord & Company, Inc.

1019 LUMBER EXCHANGE, MINNEAPOLIS, MINN.

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KING

LIGHTING STANDARDS

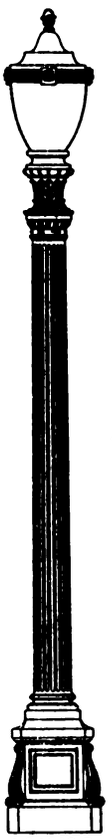
BRACKETS, NEWELS, TROLLEY EQUIPMENT

MONADNOCK BUILDING

CHICAGO, ILL.



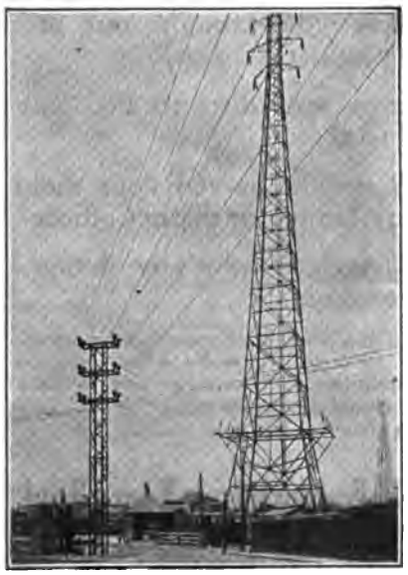
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The **TOWER DEPARTMENT** of

AMERICAN BRIDGE COMPANY



Transmission Towers,
Power Construction Company
Providence, R. I.

Manufacturers of

Transmission Towers

Wireless Towers

Poles and Other Structures

used in

Development of Electric Power

FRICK BUILDING, Pittsburgh, Pa.

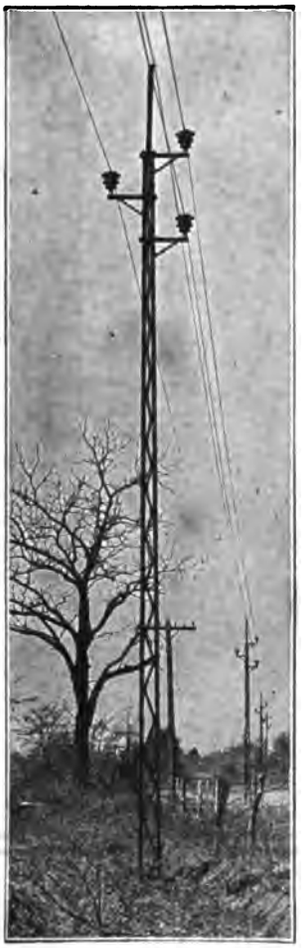
Sales Offices

PITTSBURGH, PA.	NEW YORK, N. Y.	CHICAGO, ILL.
Buffalo, N. Y.	Philadelphia, Pa.	St. Louis, Mo.
Cincinnati, Ohio	Boston, Mass.	Denver, Colo.
Atlanta, Ga.	Baltimore, Md.	Salt Lake City, Utah.
Cleveland, Ohio		Duluth, Minn.
Detroit, Mich.		Minneapolis, Minn

EXPORT REPRESENTATIVE—U. S. Steel Products Co., 30 Church Street, N. Y.
PACIFIC COAST REPRESENTATIVE—U. S. Steel Products Co., Pacific Coast Department, San Francisco, Portland, Ore., Seattle, Wash.

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Bates One-Piece Expanded Steel Poles



The combination of great utility and art with the lowest first cost, makes the Bates pole ideal for all Trolley, Telephone, Transmission Lines, Lighting Poles, Substation and similar construction.

SCIENTIFIC DESIGN—Gives these poles the maximum strength in proportion to their weight.

PERMANENT — One-Piece Construction of Bates Poles insures their permanency in all climates; there are no joints, bolts or welds; there are no hidden or inaccessible surfaces. It is the ONLY pole that can be completely painted and protected.

RELIABLE—The act of expanding these One-Piece Poles exposes any hidden defects which may be in the steel. This pole is therefore tested as it is made, insuring absolute reliability and uniformity of strength.

ECONOMY—The permanency and reliability of Bates Poles combined with their economical advantage has given them a world-wide popularity and distribution.

ARTISTIC—The graceful curve of the lacing in Bates Expanded Poles makes them extremely artistic and suitable for use upon the most exclusive residential or business streets.

Your construction is permanent when you use Bates One-Piece Steel Poles; their economy and tested strength gives unfailing service.

The transmission line of the Central Illinois Public Service Co., shown above, is a typical Bates installation. This line was built with steel expanded poles at a lower cost than a wood pole line. Lower maintenance and depreciation charges for Bates poles has materially increased the profits of this line.

The Trolley Installation of the New York, New Haven & Hartford Railway shown at the right emphasizes the great strength and adaptability of the Bates poles for this type of construction.



Our 128 page 1921 Steel Pole Treatise and Handbook sent upon request.

Bates Expanded Steel Truss Co.

208 South La Salle Street CHICAGO, ILL., U. S. A.

TOOLS

We will gladly give you the benefit of our extensive experience in the tool business when you are in need of tools.

We are prepared to meet ANY requirements for construction and maintenance tools.

We can supply the RIGHT tools at the RIGHT prices and make PROMPT shipment.

When You Need Tools Write HERBST.

25 years' practical Tool experience at your service.

PAUL W. HERBST CHICAGO

Distributor of High Grade Tools

Manufacturers:

Have you brought out any new products?

Have you discontinued any products?

Have you moved your main or any branch or district offices?

Have there been any changes in personnel?

It is important that your listings in the E M F Electrical Year Book be accurate and complete and we urge you to keep us informed of any changes. It will help if you place us on your mailing list.

E M F Electrical Year Book

PUBLISHED BY

Electrical Trade Publishing Co.,

53 W. Jackson Boulevard Chicago, Ill.

New York: 116 Nassau Street

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MATHIAS KLEIN & SONS

CHICAGO, ILLINOIS, U. S. A.

Manufacturers of

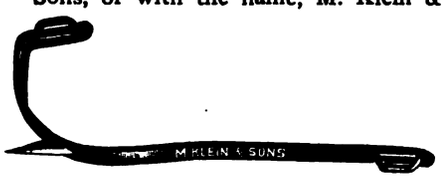
LINEMEN'S, ELECTRICIANS' and MECHANICS' TOOLS

Established 1857

Since the establishment of Mathias Klein & Sons in 1857, it has been the constant aim of this house to produce and offer to the trade tools of only the highest quality, and in pursuance of that resolve, they have steadfastly refused to make and market inferior goods.

The soundness of this policy is amply proven by the fact that today Klein tools are the universal standard all over the world among linemen, electricians, and electrical mechanics. All Klein products sell at long established prices and are backed by our rigid guarantee to replace defective goods.

We wish to caution purchasers that tools simply marked with the words "Klein pattern" or the word "Klein" alone, are not Mathias Klein products. Genuine Klein tools are stamped either with the full firm name, Mathias Klein & Sons, or with the name, M. Klein & Sons, or with our trademark.



Klein's Eastern Climber.



Klein's Haven's Steel Grip.



Klein Combination Steel Lag Screw Wrench.



"Staysalite" Linemen's Torch.



Klein's Belt and Safety Strap.



Klein's Favorite Tree Trimmer.



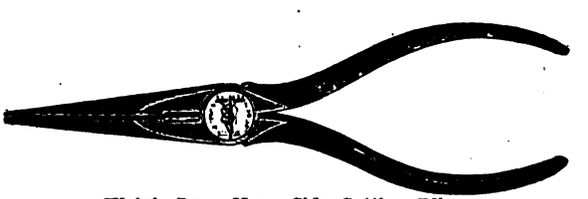
Klein's "Chicago" Grip.



Inspector's Harness Leather Tool Bag.



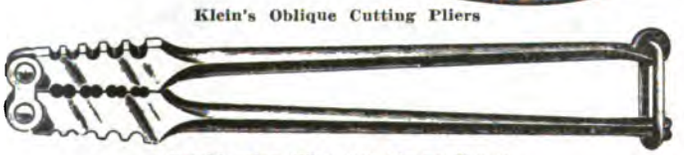
Klein's Oblique Cutting Pliers



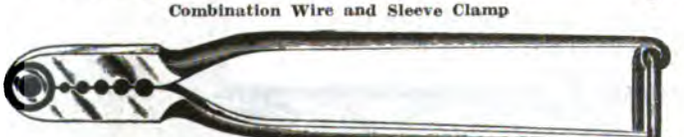
Klein's Long Nose, Side Cutting Plier



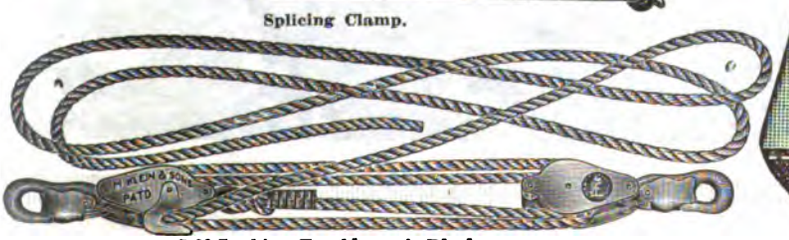
Klein's Linemen's Side-Cutting Plier.



Combination Wire and Sleeve Clamp



Splicing Clamp.



Self-Locking Troublemen's Blocks.



Linemen's Canvas Tool Bag, Leather Bottom.

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The "FRANKLIN" Line



of Bus Supports, Disconnecting Switches, Potheads, Relay Switches and other Generating Station Equipment, have all been designed to meet the most exacting operating conditions and have proven their unfailing reliability in service in the largest generating stations in the country. You can "Install the Franklin and forget it."













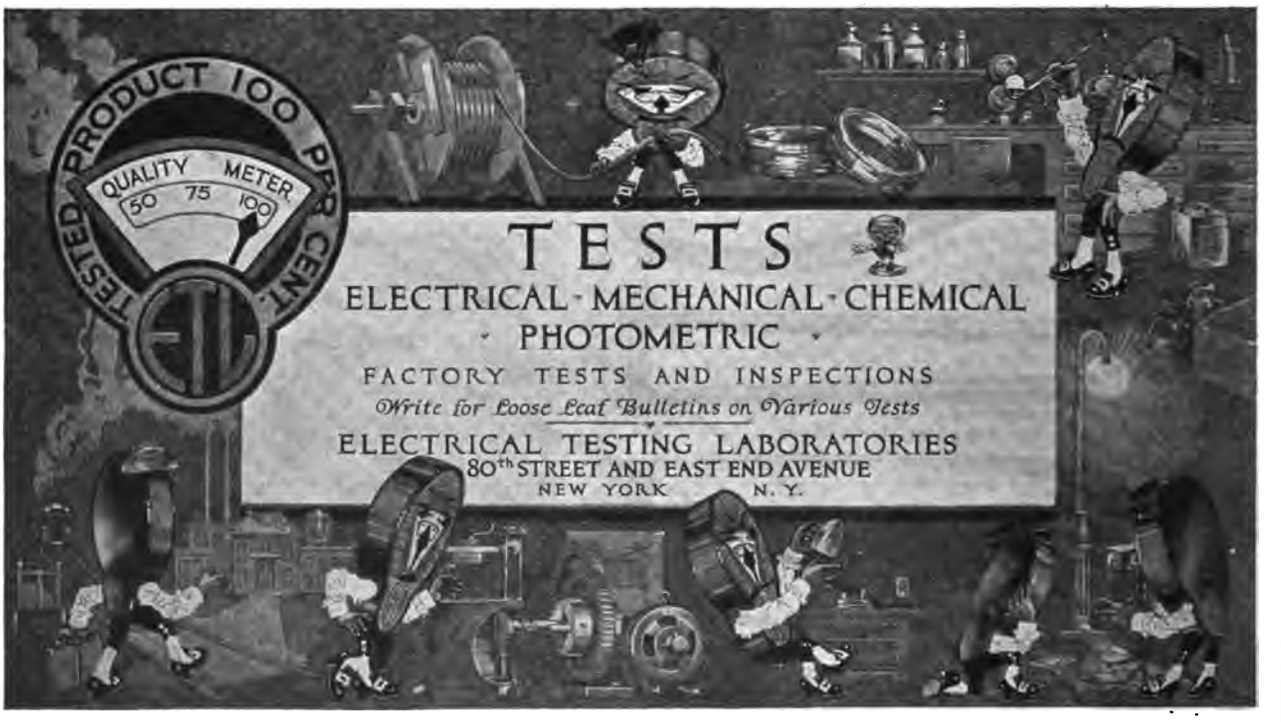
ELECTRICAL DEVELOPMENT & MACHINE COMPANY

Philadelphia

Sales Agents

Eastern States
Utility Products Corporation
30 Church Street
New York City

Central States
Midstates Engineering Company
Westminster Building
Chicago, Ill.



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"ELPECO" LINES

Ammeter Switches

Bus Bar Clamps

Bus Supports for Indoor and Outdoor Service

Cast Copper Fittings

Choke Coils for Indoor and Outdoor Service

Disconnecting Switches for Indoor and Outdoor Service

Insulator Pins

Outdoor Sub-stations

Pole Top Switches

Power Factor Switches

Remote Control Switches

Special Fittings

Switchboard Structural Devices and Fittings

Switchboards, A. C. and D. C.



All above covered by Bulletins issued or in process of compilation.



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FRANK ADAM ELECTRIC CO.

GENERAL OFFICE AND FACTORY
3650 Windsor Place
St. Louis, Mo.
Mail Address, 3649 Bell Avenue
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CINCINNATI, OHIO, 605 Mercantile Library Building
MINNEAPOLIS, MINN., 300 Builders Exchange Building
PITTSBURGH, PA., 7-9 West Canal Street, N. S.
NEW ORLEANS, LA., 534 Bienville Street
KANSAS CITY, MO., 404 Victor Building
DALLAS, TEXAS, 222 Interurban Building
CHICAGO, ILL., 208 Wells Street.

Products

"FA" METER CONTROL PANELS and CABINETS; SAFETY PANELS and CABINETS; FAN HANGER OUTLETS; FLOOR BOXES; MAJOR PRE-SELECTION SYSTEMS OF PILOT REMOTE CONTROL SWITCHBOARD for Theatre Lighting.

Knife Switches, Fuse Blocks, Switchboard Material, etc.

"FA" Meter Control Panel and Cabinet.

"FA" meter control panels are designed especially for use where tenants' space in buildings is liable to be increased or decreased. They are also rapidly becoming recognized as a necessity in many of the large production plants making diversified products, where it is essential to record the cost of manufacturing in the different departments.

PRINCIPLES OF CONSTRUCTION—The principles of construction consist of arranging meter bars parallel with each other in the same plane, and the consumption circuit bars crossing the meter bars from opposite sides of the panelboards.

These circuit bars on which the sliding "FA" busbar connecting devices are placed, are supported above the meter bars, which makes it possible to connect a circuit or a combination of circuits through any one of a number of meters, by simply changing the location of the "FA" busbar connecting devices to the desired meter bars.

CABINETS—Cabinets are made to meet practically any condition, such as, (1) enclosing under lock and key, the meter control panel, with separate compartments for the public light panel; (2) with gutters surrounding panels; (3) with wire space back of panel; (4) with separate compartments for meter control panel, public light panel and for enclosing meters.

SPECIFICATIONS—As shown on plans, a complete meter control panel and cabinet shall be installed, as described below:

The panelboards shall be of black marine finished slate, not less than ⅞ in. thick, and equipped on face of panel with the number of 30-ampere, 125-volt, double pole, single throw knife switches and Edison plug fuse connections, as specified in paragraph below. Panelboards to have necessary busbars, meter bars, meter fuse connections, subfeeders, etc., and all exposed copper parts to be satin finished, and wherever not used for contact must be lacquered.

Each panel to have a main knife switch and new code cartridge fuses, either 2- or 3-wire, depending on kind of service obtainable from lighting company.

Panels to have at least half as many meter bars and meter fuse connections as there are circuits.

Each panel to be furnished complete with black marine finished slate barriers, not less than ½ in. thick, and to be enclosed in a code thickness steel cabinet.

Cabinets to be of ample size to contain not only the panel in center, but also extended on both sides with sectional bushed covers so that a meter for each branch circuit can be mounted on face of cabinet front as shown by Fig. 1.



FIG. 2 "FA" METER CONTROL PANEL

Cabinets to have steel fronts not less than No. 10-gage steel, of flush or surface type (depending on installations) and to have doors over panel equipped with Yale lock and when door is over 40 in. high shall have vault handles with shoot bolts.

All fronts to be given at least 3 coats of paint, finished dead black.

Panels and cabinets as described above are to be of FRANK ADAM ELECTRIC CO., St. Louis, Mo., make, as shown and described on pages numbers 32, 33, 34 and 35 of their General Catalogue No. 24, 1919-1920.

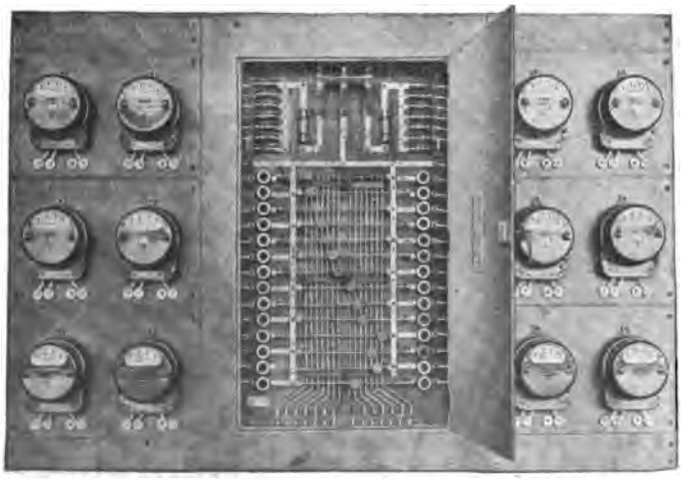


FIG. 1 "FA" METER CONTROL PANEL AND CABINET

Showing one compartment for meter control panel and separate compartments with sectional covers for mounting meters on face.

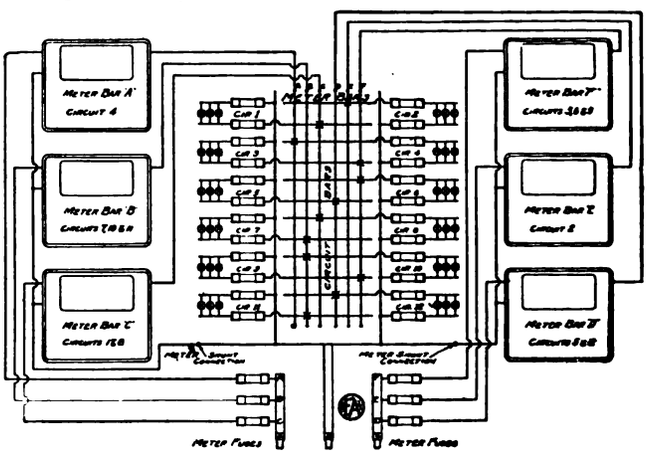


FIG. 3 DIAGRAM OF CONNECTIONS "FA" METER CONTROL PANEL AND CABINET

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"FA" Major Pilot Remote Control Switchboard.

This system owes its merit to the simple idea of using pilot control with magnetic switches for making and breaking the circuits.

In a small moving picture house or in the larger theaters and auditoriums, the major pre-selection system of theater lighting gives proportionately greater advantages. The stage electrician, while a scene is running, can "set-up" for a second and third scene, or for any desired combination of lights in advance. He can also make each change by means of single lever easily responding to a finger touch and he can make these "set-ups" without interfering with whatever control of individual circuits may be required as a matter of emergency or special purposes, such as "worklights" behind a drop during a dark change.

DESCRIPTION—The main elements of the major pre-selection systems of remote control of theater lighting are two:

(1) A pilot-control board (Fig. 4) usually located on the stage.

(2) A remote board (Fig. 7), usually located below the stage or elsewhere, preferably near the center of distribution.

Pilot Control Board—The pilot control board unit, as shown in Fig. 6, carries 2 normally open single pole double throw combination knife and brush contact switches, and plate with colored bullseye pilot lights.

Each handle has a neutral, a momentary contact, and a "set-up" or pre-selective position. The upper handle of each unit is the "on" switch and is connected to one side of the closing coil terminal of the remote switch (Fig. 5). The lower handle is the "off" switch and is connected to the opening coil of the remote switch.

The upper handle will only turn lights "on," while the lower handle will only turn them "off." In other words, the handle that turns them "on" will not put them out and vice versa.

Remote Control Board—The remote board (Fig. 7) is essentially an assembly of C-H remote switch units one of which is shown in Fig. 5.

OUTSTANDING FEATURES—The outstanding features of the major system are: pre-determination and pre-selection of "set-ups," simplicity, safety dead front, compactness, speed, elimination of heavy feeders from stage.

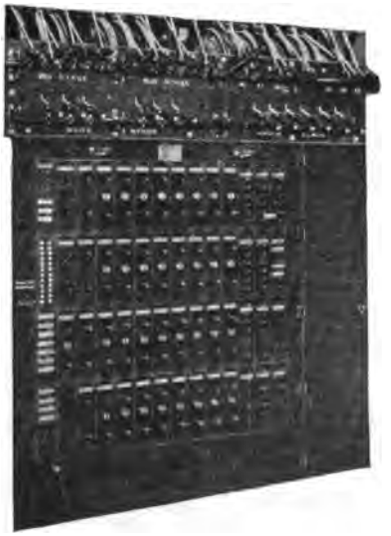


FIG. 4. MAJOR PILOT BOARD INSTALLED IN THE PEOPLES THEATER, CHICAGO, ILL.

This is the system that has been acclaimed by theater authorities as representing the highest development offered for producing the lighting effects and giving the service required by present-day theaters, in addition it represents the highest degree of safety as no live parts are exposed anywhere on face of board.

INSTALLATIONS—A list of theaters now being equipped with "FA" switchboards of the major system of control:

Majestic Theater, Bloomington, Ill.
Ft. Armstrong Theater, Rock Island, Ill.
Hull Theater, Peoria, Ill.
Kahl Theater, Davenport, Iowa.
Palace Theater, Cincinnati, Ohio.
Rialto Theater, Louisville, Ky.
New Colonial Theater, Allentown, Pa.
Strand Theater, Lansing, Mich.
Victory Theater, Evansville, Ind.
Gregory Theater, Hammond, Ind.
Blackstone Theater, South Bend, Ind.
Walker Theater, Minneapolis, Minn.
Harnon Theater, St. Paul, Minn.
Hanna Theater, Cleveland, Minn.
Tivoli Theater, Chattanooga, Tenn.
Columbia Theater, Baton Rouge, La.

Type PPSC Safety Panels and Cabinets.

BASE—7/8-in. slate, dead black finish.

BARRIERS—1/2-in. black oiled slate with "FA" adjustable corner supports.

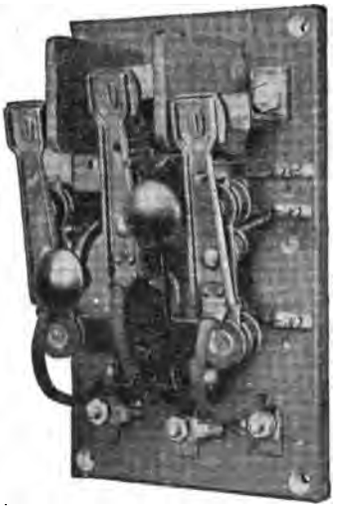


FIG. 5. C-H MAGNETIC REMOTE CONTROL SWITCH



FIG. 6. MAJOR PILOT SWITCH

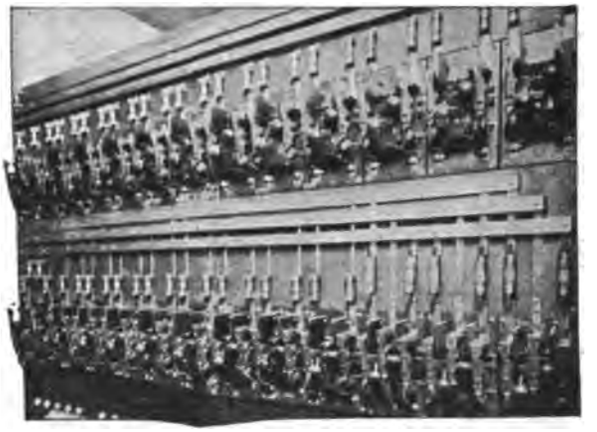


FIG. 7. CUTLER-HAMMER REMOTE CONTROL SWITCHES

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SAFETY COVER—Steel plate painted dead black.

CARD HOLDER—Metal, dead black; one for each switch.

GUTTER—3-in. space all around panel—separated from panel by the barriers.

CAPACITY OF MAINS—6-ampere per branch, 125-volt, 2-wire.

3-ampere per branch, 125-250-volt, 3 wire.

FUSE CONNECTIONS—For mains; new code cartridge fuse connections.

For branches: double pole Edison plug fuse connections.

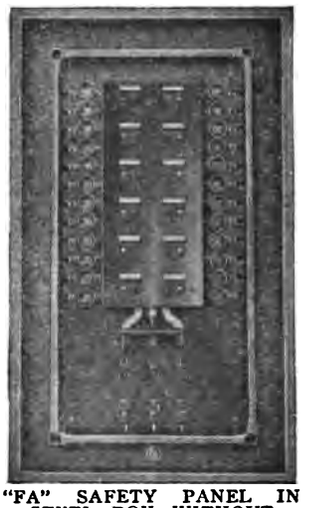
SWITCHES—Mains; standard knife switch.

Branches: 20-ampere, double pole push button switches.

BOXES—"FA" standard code gage steel.

FRONTS—"FA" all-steel front, dead black paint finish, equipped with "FA" combination spring catch Yale lock and where code requires they shall have shoot bolts, vault handles and Yale locks.

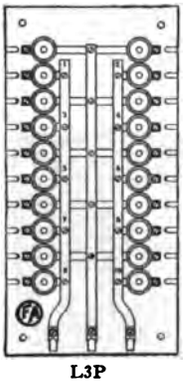
Door over fuse compartment equipped with Yale lock, door over switch compartment having catch only.



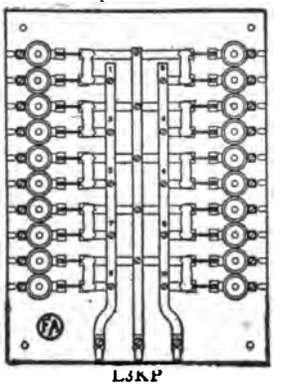
"FA" SAFETY PANEL IN STEEL BOX WITHOUT FRONT



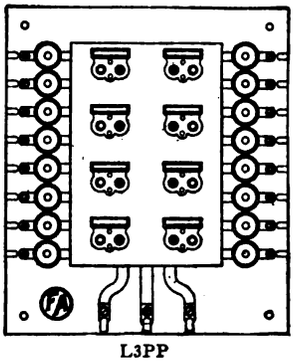
"FA" SAFETY PANEL IN STEEL BOX WITH FRONT



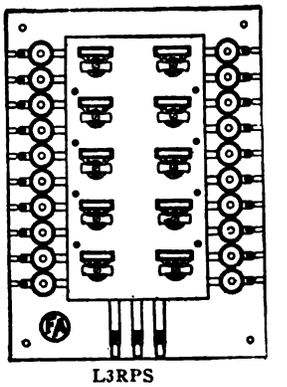
L3P



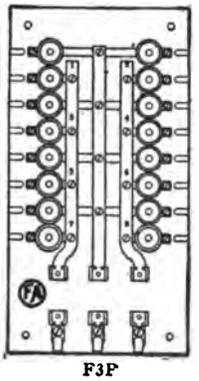
L3KP



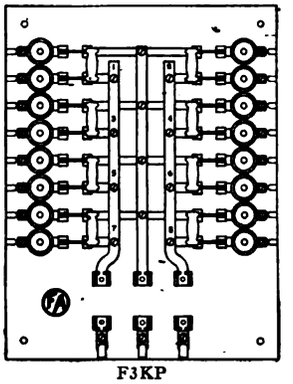
L3PP



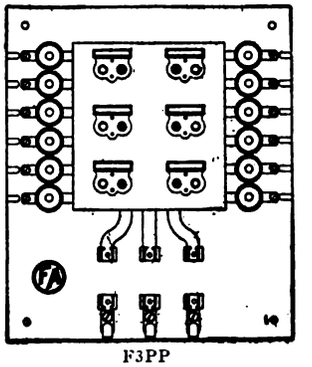
L3RPS



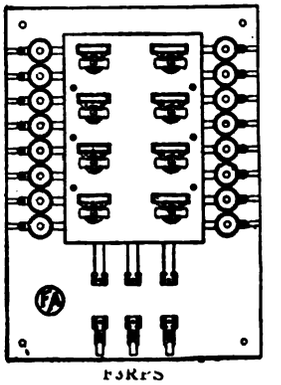
F3P



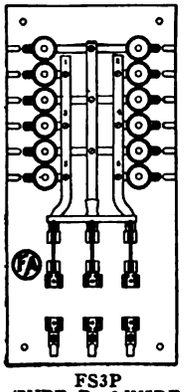
F3KP



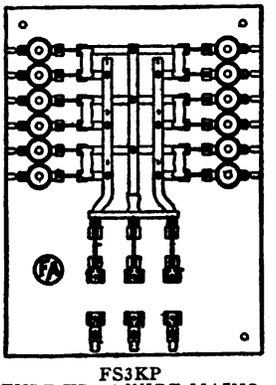
F3PP



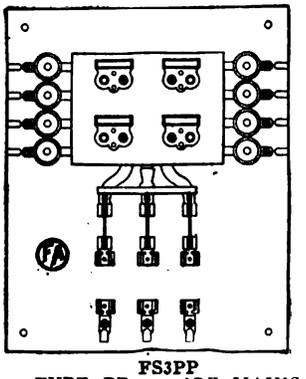
F3RPS



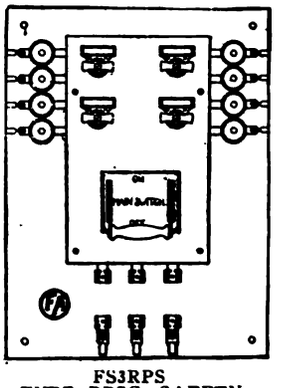
FS3P
TYPE P—3-WIRE MAINS
Branches—
D. P. N. C. plug fuse connection



FS3KP
TYPE KP—3-WIRE MAINS
Branches—30 amp. D. P. K. S. with N. C. plug fuse connection.



FS3PP
TYPE PP—3-WIRE MAINS
Branches—10 amp. D. P. push button switches with N. C. plug fuse connection.



FS3RPS
TYPE RPSC—SAFETY
Branches—30 amp. D. P. Krantz Snap Switch with N. C. plug fuse connection.

All the above types of panels are also made with 2-wire mains

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"FA" Floor Boxes (Catalogue No. FB 453).

Fully 80% of the post offices of the country (with electric service) being equipped with "FA" floor boxes is the best indorsement of the sterling qualities of this "all-in-one-floor-box," the reversible cover allowing the floor box to be converted instantly into active service without purchasing additional parts.



"FA" FLOOR BOX

Box, outside measure 4¾ in. square and 3¼ in. deep, having wall ¼ in. thick, will accommodate three ¾-in. or two 1-in. conduits in one side.

Adjustable top is readily adjustable for a variation of ¾ in.; also, made special for greater variation, and is made a permanent part of the box and floor construction by means of a fine cement mortar grouting.

The reversible cover, when removed, leaves a clear opening 3 in. to connect wires or install receptacle.

Standard flush receptacles can be installed by means of special steel hangers furnished with box.



REVERSIBLE COVER



FLANGED IRON RING



CAST IRON BOX



"FA" FLOOR BOX INSTALLED IN FINISHED WOOD FLOOR



"FA" FLOOR BOX INSTALLED IN CONCRETE FLOOR

"FA" Adjustable Hanger Outlet.

"FA" hanger outlets were designed and made especially for fan service—but readily lend themselves as a utility outlet for heaters and various electrical appliances.

They are adaptable to all classes of modern buildings where safety as well as efficiency is desired in fan service. They eliminate wall brackets, standards and all temporary installations that are dangerous and unsightly.

They are permanent, for they are built in at the same time as the rest of the service equipment.

DESCRIPTION—"FA" hanger outlets are a combination of a special code gage steel box 4 by 4 by 2¼ in., with substantial supports to which the inside adjustable plate is fastened with screws, and a finished cover of 3/32-in. brass, 5 in. square, with beveled edges, furnished with four brass screws 1¼ in. long to take up the variation in the thickness of plaster. The inside adjustable cover permits adjustment to plumb the finished cover as shown in illustrations. The finished cover has a standard flush receptacle in the center of the proper size for a standard interchangeable plug.

Attached to the center of the plate at the lower side is a ¼-in. steel machine threaded bolt, with nut and washer for attaching the fan.

FINISH—"FA" fan hanger outlets as listed are furnished with cover plates finished in brush brass or black, but can be had in any special finish, except gold, at an additional charge.



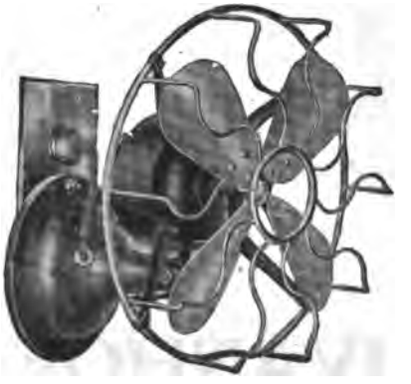
SHOWING BOX INSTALLED OUT OF PLUMB



SHOWING INNER PLATE ADJUSTED PLUMB



INSTALLED PLUMB



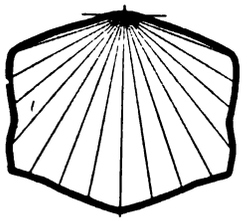
SHOWING FAN IN POSITION

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Ivanhoe Metal Reflectors



R L M STANDARD DOME REFLECTORS



Characteristic Distribution

For 75, 100, 150, 200, 300, 500, 750 and 1,000-watt Mazda Lamps

These reflectors are recommended as the highest standard of the distributing type. They are porcelain enameled, green outside and white inside. For uniform illumination they should be spaced not to exceed one and two-thirds times their height above the work.



R Type with Solid Top Containing Porcelain Socket



Standard B-Heel Type
For use with any of the Ivanhoe Holders shown on next page, or with any standard Form O Holder.



R Type Reflector with Pull-Chain Socket

R Type Reflectors with Solid Tops Containing Pull-Chain or Lock Sockets

With the exception of the difference in socket equipment, reflectors bearing these designations are the same as other reflectors.



R Type Reflector with Lock Socket

STANDARD BOWL REFLECTORS

For 25, 40, 50, 60, 75, 100, 150, 200, 300, 500, 750 and 1000-watt Mazda Lamps.

These bowl reflectors are porcelain enameled, green outside and white inside, and their bowl shape furnishes an effective shield against the glare of the lamp. They should be spaced not to exceed one and two-thirds times their height above the working-plane.





Characteristic Distribution



Standard B-Heel Type
For use with any of the Ivanhoe Holders shown on next page.



R Type with Solid Top Containing Porcelain Socket

PORCELAIN-ENAMELED ANGLE TYPE

For 25, 40, 50, 60, 75, 100, 150, 200, 300, 500, 750 and 1000-watt Mazda Lamps.

These angle reflectors should be used in industrial plants where overhead lighting is impractical, requiring the outlets to be placed along the wall. The weatherproof, easy-wiring R type is especially adapted to billboard lighting.





Characteristic Distribution



Standard B-Heel Type
For use with any of the Ivanhoe Holders shown on next page.



R Type with Solid Top Containing Porcelain Socket

IVANHOE-REGENT WORKS

of General Electric Company **CLEVELAND, OHIO**

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Ivanhoe Metal Reflectors

Ivanhoe Glass-Top Reflectors; Dome Type



Glass-Top Reflector
Dome Type with B Heel
For use with any of the Ivanhoe Holders for B-Heel Reflectors

For 75, 100, 150 and 200-watt Mazda C Lamps

These reflectors are made only in the standard Dome Type. The contour of the Glass-Top Reflectors conforms to that of the RLM Standard Dome Reflectors. Glass-Top Reflectors are porcelain-enameled, green outside and white inside. The metal part of the reflector is one compact piece, the form and the heel being connected by substantial legs rigidly welded.

A glass section of good quality opal glass of light density and excellent diffusing properties permits a portion of the light to be transmitted above the hanging height of the reflector.





Characteristic Distribution

Combination Outlet Box Cover and Receptacle

This Combination Outlet Box Cover and Medium Base Receptacle can be used with any standard deep outlet box of the dimensions indicated. It provides means for mounting reflectors



with 2¼-inch. B-heels flush against the ceiling. The bayonet slots permit the removal or attachment of the cover by simply loosening or tightening the holding screws.

Holders for B-Heel Reflectors

These holders offer a solid, workmanlike method of suspending B-heel reflectors. They are convenient to wire and install, as they can be put into place whenever convenient, independent of the reflectors.

For Medium-Base Lamps and Reflectors with 2¼-inch Fitters



No. 902

No. 902 is a steel holder finished in green paint. The top band of the holder attaches to the shade-holder groove of a porcelain or composition socket, and the bottom band fits around the B heel of the reflector.



No. 822

This is a porcelain socket holder, tapped at the top for a half-inch conduit. It attaches to the B heel by means of three clamps which are locked into place by a ring.

This holder can also be obtained with Pull-Chain or Lock Socket.



No. 824

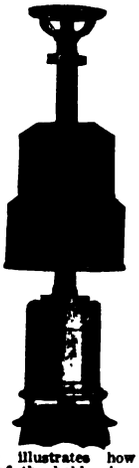
No. 824 is the same in design as No. 822, but provided with a green weatherproof porcelain-enameled canopy. The socket is wired by releasing the lock nut, and raising the canopy on the conduit or drop cord.

This holder can also be obtained with Pull-Chain or Lock Socket.



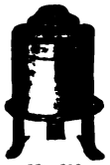
No. 884

This set-screw holder is tapped at the top for a half-inch conduit. It is finished in green porcelain-enamel, and contains a porcelain socket. Three set screws attach the holder to the B heel, and each screw is provided with a tension spring wire to prevent its being loosened by vibration.



This illustrates how the cover of the holder is raised on the pipe in order to wire the holder, and clamp it to the B-heel.

For Mogul-Base Lamps and Reflectors with 3¼-inch Fitters



No. 622

This is a porcelain socket holder, tapped at the top for a half-inch conduit. It attaches to the B-heel by means of three clamps, which are locked into place by a ring.



No. 705

This is a green porcelain-enameled set-screw holder containing a porcelain socket. It is tapped at the top for a half-inch conduit, and attaches to the B-heel by two lugs and a set screw. The screw is provided with a tension spring wire to prevent its being loosened by vibration.



No. 672

No. 672 is the same in design as No. 622, but provided with a green weatherproof porcelain-enameled canopy. The socket is wired by releasing the lock nut, and raising the canopy on the conduit.

Holders including sockets can be supplied with lamp-grip sockets if so desired

Ivanhoe Opal Lamp Caps

The Ivanhoe Opal Lamp Cap is made of Genco glass, which combines splendid diffusions with low absorption. This cap improves the illumination by hiding the filament and cutting down glare. It is designed particularly for use with reflectors, both glass and steel, which do not give sufficient eye protection.



Opal Lamp Cap Attached to Mazda C Lamp with Spring Wire Holder.

IVANHOE-REGENT WORKS

of General Electric Company **CLEVELAND, OHIO**

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Ivanhoe Commercial Lighting Units

The IVANHOE KELDON



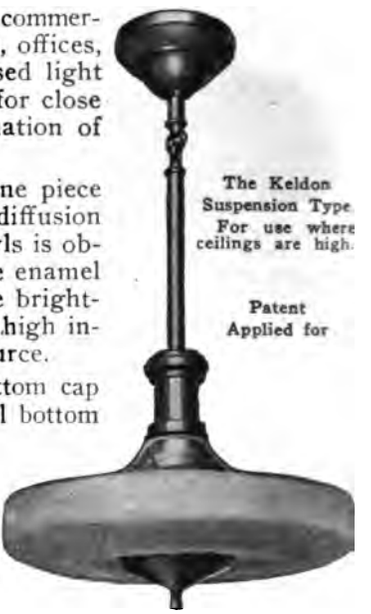
The Keldon Ceiling Type

For use with 9 or 10 foot ceilings where the use of semi-indirect lighting has formerly been impractical because of the lack of proper distribution of light on the ceiling.

The Keldon is a totally enclosed, *semi-indirect* commercial lighting unit. It is recommended for stores, offices, schools, hospitals and other places where diffused light of high intensity is needed at desks and tables for close work, or at counters and cases for the examination of goods displayed for sale.

The glass globe of the Keldon is blown in one piece and enameled on the sides and bottom. Light diffusion equal to that of the best heavy density glass bowls is obtained. The contour of the globe, density of the enamel and the position of the lamp, all help reduce the brightness of the unit and thus make possible light of high intensity, without uncomfortable glare from its source.

The Keldon can be supplied with the glass bottom cap shown on the ceiling type, or with the solid metal bottom cap shown on the suspension type.



The Keldon Suspension Type. For use where ceilings are high.

Patent Applied for

DISTINCTIVE FEATURES

The Keldon affords two great advantages in its use.

1st. Being totally enclosed, the Keldon does not suffer reduced efficiency through the accumulation of dust and dirt on the **lamp or inside the globe.** Dust that may collect on the exterior can be quickly removed from the smooth glass surface with a moist cloth.

2nd. The Keldon is unique in the enclosed glass unit line, in that the lamp can be removed or replaced without disturbing the globe itself. The lamp and socket are made quickly accessible by the removal of the bottom cap.

The IVANHOE ACE



The Ivanhoe ACE is an enclosing unit for commercial lighting to be used with MAZDA C lamps. It is made of one piece of crystal glass enameled with a special enamel which is fired on the upper surface and edge in a very dense coat to reflect the light downward, and on the outer surface of the bowl in a coat sufficiently dense to diffuse the light and prevent glare with very little light absorption.

SUITABLE FOR MANY LOCATIONS

The ACE is a very efficient unit for commercial lighting and is highly recommmended for serving lamps in stores, assembly halls, school rooms, offices, hotels, churches, banks, theatres, automobile display rooms and many other locations where a highly efficient unit of pleasing appearance for distributing light both above and below its mounting plane is required.

The IVANHOE TROJAN

The Ivanhoe TROJAN is an **enclosing** unit made in four sizes to serve MAZDA Lamps up to and including the 500-watt size. The TROJAN is made of one piece of light density Genco glass of high diffusing quality and low light absorption.



Having no exposed inside surfaces the TROJAN is practically dirt-proof and inside cleaning is seldom required. Outside cleaning is easily accomplished because of the continuous lines and smooth surface of the glass.

WHERE THE TROJAN CAN BE USED

The Ivanhoe TROJAN is especially suitable for commercial lighting. Distributing diffused light both above and below the mounting plane, it produces a pleasing luminous effect in all directions without sharp shadows or lines of contrast. The TROJAN is a most efficient unit for the illumination of stores, offices, assembly halls, hotels, cafeterias, churches, display rooms, school rooms, banks and other locations where an opal enclosing unit of pleasing lines is desired.

IVANHOE-REGENT WORKS
of General Electric Company CLEVELAND, OHIO

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Ivanhoe Glassware for Home Lighting



No. 5141—Old No. 1343—Crystal Glass with Rozelle Decoration, No. 337, Morning Glory Vine, Japanese Effect—Parchment Background.

The IVADINE

The Ivanhoe Ivadine supplies that combination of abundant light and soft color tints so desirable in dining room illumination, yet heretofore difficult to secure. When the Ivadine is lighted a cone of white light completely floods the table. The remainder of the room is toned with a soft, warm light which brings table, furnishings and decorations into pleasing harmony.

Lighted or unlighted, the Ivadine, with any of its decorations, is a beautiful ornament of distinctive lines and style.

Below are several illustrations showing characteristic shapes in which Ivanhoe glassware is made for the home. There are many color designs regularly applied to these shapes, only one of which is shown here. Send for Ivanhoe catalogues on Rozelle glassware, containing all designs made.



No. 5118½
Rozelle 291



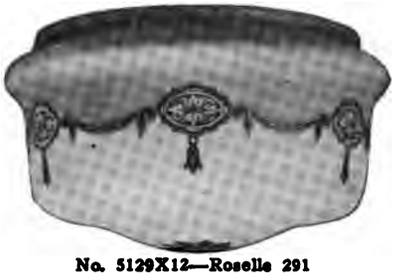
No. 538X17—Rozelle 291



No. 5133½
Rozelle 291



No. 5136—Rozelle 291



No. 5129X12—Rozelle 291



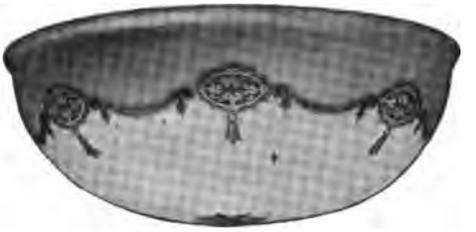
No. 5130—Rozelle 291



No. 5131—Rozelle 291



No. 5128—Rozelle 291



No. 53X12—Rozelle 291



No. 296½
Rozelle 291



No. 5135½
Rozelle 291



No. 5134½
Rozelle 291



No. 521½
Rozelle 291

IVANHOE-REGENT WORKS

of General Electric Company
CLEVELAND, OHIO

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Sell Lighting *by* "Fields"
And Cultivate Each Field!

Ever since its organization, the National Lamp Works has held firmly to the belief that the lamp business could best be promoted, not by attempting to stimulate the lighting field as a whole, but by subdividing the whole field into smaller specialized fields, and putting concentrated effort behind each field.

The success of this policy within the lighting field is indicated by the fact that more, rather than less specialization, has been the rule as time has gone on. The result has been that more and more concerns have been enabled to successfully build their businesses *around lighting!*

Today, more than ever in its history, we recommend to every central-station, jobber, contractor-dealer, or anyone who has to do with the sale of lighting, the concentrated cultivation of such clearly defined fields as home lighting, factory lighting, store lighting, sign lighting and many others that even though smaller in scope promise attractive profit. In short, to build business around lighting according to a logical, well-defined plan.

In this space it is possible merely to outline the three principal lighting fields.

1—Factory Lighting!

In the past, the man who sold lighting and the man who bought it were seriously handicapped by the fact that they were working on a guesswork basis. While the salesman might be convinced that the lighting was inadequate he had no figures on which to base his argument. Today, thanks to the Foot-Candle Meter, he can take the factory owner out into the shop and show him exactly how much lighting he is getting at this tool or that, on the bench, on the assembly floor, or wherever better light may be needed. He is further aided by the three booklets: "Illumination Design Data", "What an Industrial Lighting Salesman Should Know" and "The Great Discovery." Of these, "Illumination Design Data" deserves particular notice because it enables the lighting salesman to plan correct lighting with a minimum of effort. Practically all of the figuring is done in advance. The three booklets and the Foot-Candle Meter are the most effective tools that have ever been put in the hands of the lighting salesman.



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2—Home Lighting!



We fully realize that it doesn't help you to know that there are old houses in your neighborhood soon to be wired, that there are new houses just now reaching the wiring stage, that additions and alterations are constantly being made—unless you know also how to turn these facts into **sales.** We have prepared definite prospectuses that not only tell you what to do, but just how to do it. "Refixturing the Home" is one. "House Wiring Campaign" is another. And there is further valuable information in the booklet "To Help You Sell."

3—Store Lighting!



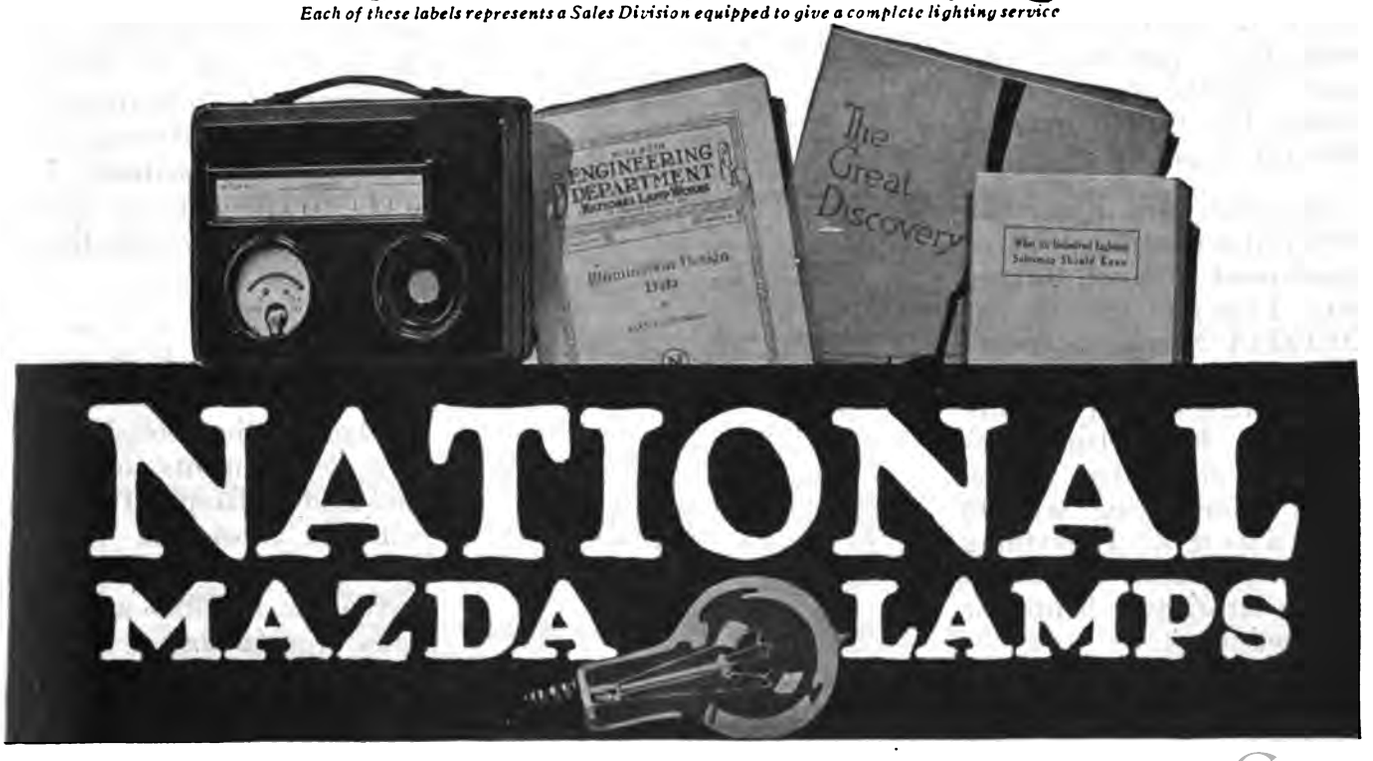
There is no town, large or small, without its quota of poorly lighted stores. These stores are easy to find—they are in fact self-announcing, but like any of the elements in any other lighting field they have to be cultivated. Somebody has to concentrate on store lighting and then wear out shoe leather making calls. Realizing the need for a definite plan of procedure, the National Lamp Works has worked out a complete campaign, which is furnished to dealers as a "Prospectus for Store Lighting Campaign." Another prospectus deals with window lighting alone, and another with sign lighting.

Your Sales Division Will Help You

Your Sales Division of National Lamp Works stands ready at all times to help you with window trims, store decoration and sales material for any campaign you have definitely in mind. All of the plans have been tried and found workable and profitable. There is no need for you to attempt to "go it alone" when this material is at hand all ready for you to use. Co-operate, *now,* with the Sales Division of the National Lamp Works that supplies your lamps. National Lamp Works of General Electric Co., 300 Nela Park, Cleveland, Ohio.



Each of these labels represents a Sales Division equipped to give a complete lighting service



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Coordinated Service

SERVICE has been defined as "Work done for the benefit of others," and it is for the benefit of our jobbers and dealers as well as for the general public that the coordinated service between our factories, home office, and sales offices has been established. It is by such coordination and cooperation among all these that the buyers of lamps can be more efficiently and satisfactorily supplied.

The list on the opposite page gives the addresses of our numerous sales offices, and the cities in which warehouse stocks of lamps are found. These offices have as their most particular function, the assisting of jobbers and dealers in their relations with their customers, and work with the warehouses to insure the earliest possible delivery of orders.

It is the work of our factories in ten cities, scattered from coast to coast, to keep our lamps up to the MAZDA Service Standard of quality while maintaining an adequate quantity of production. Every lamp goes through about ten inspections before being sent to our agents. Everything humanly possible is done to insure satisfactory lamps for our consumers.

For Your Information

Not Advertising But Engineering Facts

BULLETINS on lighting are constantly being printed for your information. They are not technical, yet they contain a gold mine of absolute fact. Every engineer who faces the solution of lighting problems will have these booklets sent to him if he requests that his name be placed on the mailing list.

These bulletins, prepared by practical engineers of wide experience, comprise a most comprehensive work on lighting. They are issued from time to time, and revised when necessary. Their contents will always be up to the minute, for they are the result of systematic investigation on the part of the authors, who have studied conditions as they exist, and who continue to keep in touch with all changes.

The mastery of the subjects covered is strengthened by additional features, such as sypnosis of the text of each bulletin, and the index numbers, which keep related subjects in logical order. Of particular note is the inclusion of a list of all important articles published in technical and trade journals during recent years, on the subjects covered by the bulletins. This series of publications is an achievement, and any of them is yours for asking.

Look These Titles Over:

Artificial Daylight For Merchandising.
Calculations of the Lighting Installation.
Commercial Photometry.
Edison Mazda Lamps—Theory and Characteristics.
Edison Mazda Lamp for Stereopticon Service.
Edison Miniature MAZDA Lamps, Standard vs. Special.
Effect of Color of Walls and Ceilings on Resultant Illumination.
Illumination and Production.
Incandescent Lamp—Its History.
Light and Safety.
Lighting of Schools.
Maintenance of the Lighting System.
Medical Lighting—Including Hospitals & Dental Offices.
110 vs. 220 Volt Circuit from the Standpoint of Lighting Service.
The Lighting of Armories and Gymnasiums.
The Lighting of Coal Mines.
The Lighting of Office Buildings and Drafting Rooms.
The Lighting for Outdoor Sports.
The Lighting of Piers and Warehouses.
The Lighting of Printing Plants.
The Lighting of Shoe Factories.
The Lighting of Show-Windows and Show-Cases.
The Lighting of Textile Mills.
The Manufacture of the Edison MAZDA Lamp.

The Home Office at Harrison is composed of many departments, all having the common watchword, "Service." They earnestly invite any requests whatsoever to be of assistance to jobbers, dealers or customers. It is the policy of our Sales Department to help every merchant associated with us to be a better *merchant,* not merely to be a better seller of lamps. With this idea in mind specialists and officials are constantly going out into the field to give jobbers and dealers the benefit of their accumulated knowledge of merchandising.

The Stock and Traffic Department keeps its finger on the pulses of demand and supply — consumption and production. It is always studying the requirements of every part of the country and regulating manufacture and distribution of lamp stocks to comply with those requirements.

The Commercial Egineering Department is constantly investigating the necessity for new developments in types and kinds of lamps. It forms with the Stock and Traffic Department a linking between the factories and the sales organization.

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In addition to the bulletin service of the Lighting Service Department this department investigates and recommends various lay-outs of lighting installation and every manner of improvement in the application of lamps and lighting units. It frequently sends out lecturers on applied illumination to show how good lighting may be efficiently and economically supplied.

The Department of Publicity by means of national advertising campaigns and use of display material, publications and the like, effects a tie-in between advertising that is nationally known and the direct appeal to local purchasers of lamps. The department is anxious to be of assistance to jobbers and dealers, either by sending them any of the stock publicity which is listed in the Edison Sales Builder or by giving them special service in the way of displays, advertisements, or campaigns prepared for their individual needs and conditions.

The Edison Sales Builder, which is the organ of the Edison Lamp Works, keeps all jobbers and dealers in touch with all our plans of advertising and merchandising, and will assist any jobber or dealer in building a profitable business in Edison MAZDA Lamps and other electrical merchandise.

If you are not selling MAZDA lamps, write our nearest office for further information on the advantages of this coordinated service

EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE, *HARRISON, N. J.

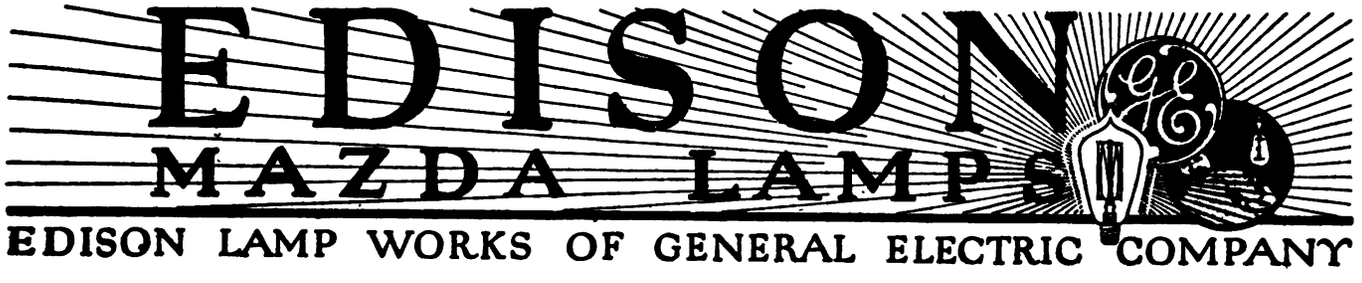
SALES OFFICES:

ATLANTA, GA., Citizens and Southern Bank Building.
BALTIMORE, MD., Lexington Street Building.
BIRMINGHAM, ALA., Brown-Marx Building.
*BOSTON, MASS., 84 State Street.
BUFFALO, N. Y., Electric Building.
BUTTE, MONT., Electric Building.
CHARLESTON, W. VA., Charleston National Bank Building.
CHARLOTTE, N. C., Commercial National Bank Building.
CHATTANOOGA, TENN., James Building.
*CHICAGO, ILL., Monadnock Building.
*CINCINNATI, OHIO, Provident Bank Building.
CLEVELAND, OHIO, Illuminating Building.
COLUMBUS, OHIO, The Hartman Building.
DAYTON, OHIO, Dayton Savings and Trust Building.
*DENVER, COLO., First National Bank Building.
DES MOINES, IOWA, Hippee Building.
DETROIT, MICH., Dime Savings Bank Building.
DULUTH, MINN., Fidelity Building.
ELMIRA, N. Y., Hulett Building.
ERIE, PA., Commerce Building.
FT. WAYNE, IND., 1600 Broadway.
GRAND RAPIDS, MICH., Commercial Savings Bank Building.
HARTFORD, CONN., Hartford National Bank Building.
INDIANAPOLIS, IND., Traction Terminal Building.
JACKSONVILLE, FLA., Heard National Bank Building.
JOPLIN, MO., Miners Bank Building.
*KANSAS CITY, MO., Dwight Building.
KNOXVILLE, TENN., Burwell Building.
LITTLE ROCK, ARK., Southern Trust Building.
*LOS ANGELES, CALIF., Corporation Building, 724 S. Spring Street.
LOUISVILLE, KY., Starks Building.
MEMPHIS, TENN., Exchange Building.
MILWAUKEE, WIS., Public Service Building.
*MINNEAPOLIS, MINN., 410 Third Avenue, North.
NASHVILLE, TENN., Stahlman Building.
NEWARK, N. J., Wiss Building.
NEW HAVEN, CONN., Second National Bank Building.
*NEW ORLEANS, LA., Maison-Blanche Building.
*NEW YORK, N. Y., Equitable Building, 120 Broadway.
NIAGARA FALLS, N. Y., Gluck Building.
OMAHA, NEB., Electric Building.
*PHILADELPHIA, PA., Witherspoon Building.
*PITTSBURGH, PA., Oliver Building.
*PORTLAND, ORE., Electric Building.
PROVIDENCE, R. I., Turks Head Building.
RICHMOND, VA., Virginia Railway and Power Building.
ROCHESTER, N. Y., Granite Building.
*ST. LOUIS, MO., Pierce Building.
*SALT LAKE CITY, UTAH, Newhouse Building.
*SAN FRANCISCO, CALIF., Rialto Building.
SCHENECTADY, N. Y., G. E. Works.
SEATTLE, WASH., Colman Building.
SPOKANE, WASH., Paulsen Building.
SPRINGFIELD, MASS., Third National Bank Building.
SYRACUSE, N. Y., Onondaga County Savings Bank Building.
TOLEDO, OHIO, Spitzer Building.
WASHINGTON, D. C., Commercial National Bank Building.
WORCESTER, MASS., State Mutual Building.
YOUNGSTOWN, OHIO, Stambaugh Building.
*FOR TEXAS, Oklahoma and Arizona business, refer to SOUTHWEST GENERAL ELECTRIC COMPANY.
*DALLAS, TEXAS, Interurban Building.
*EL PASO, TEXAS, 500 San Francisco Street.
*HOUSTON, TEXAS, Third and Washington Streets.
*OKLAHOMA CITY., OKLA., 1 West Grande Ave.
*SAN ANTONIO, TEXAS, State National Bank Building.

EDISON LAMP FACTORIES:

AMPERE	N. J.
BELLEVILLE	N. J.
EAST BOSTON	MASS.
FT. WAYNE	IND.
HARRISON	N. J.
NEW BRUNSWICK	N. J.
NEWARK	N. J.
OAKLAND	CALIF.
ST. LOUIS	MO.
SCRANTON	PA.

*Stock of lamps at these points.

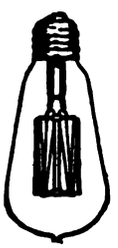


EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY

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WESTINGHOUSE MAZDA LAMPS

For Standard Lighting Service



S-19 Bulb
40 & 50
Watts



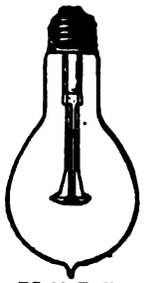
S-19 Bulb
25 & 50 Watts
Mill Type



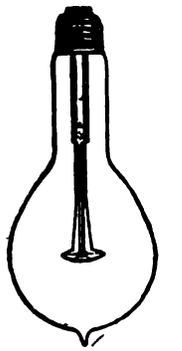
S-21 Bulb
60 Watts



PS-20 Bulb
50 Watts
White Mazda
Lamp



PS-22 Bulb
75 Watts



PS-25 Bulb
100 & 150
Watts

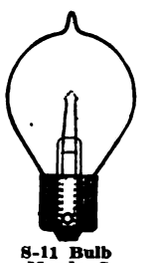
For Automobile and Flashlight Lighting Service



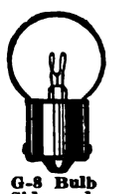
G-6 Bulb
Rear and
Speedometer
Lights



S-11 Bulb
Mazda B
Headlight and
Spotlight



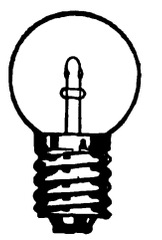
S-11 Bulb
Mazda C
Headlight and
Spotlight



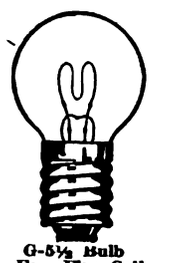
G-8 Bulb
Side and
Auxiliary
Headlights



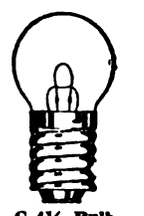
G-3½ Bulb
For Two-Cell
Flashlight
Batteries



G-5½ Bulb
For Two Cells
of Standard
Dry Batteries



G-5½ Bulb
For Five-Cell
Flashlight
Batteries



G-4½ Bulb
For One-Cell
Standard
Dry Batter[illegible]

Quality and Service

When you buy Westinghouse Mazda Lamps, whether Large or Miniature, not only do you obtain a high quality product, but you also secure the services of our illuminating engineers in any lighting problem, no matter how large or how small it is.

We have in this way helped innumerable industrial plants and commercial buildings to secure better and more efficient illumination.

Westinghouse Miniature Mazda Lamps are well known for their careful rugged construction. There is a Westinghouse Mazda Lamp for every Automobile lighting purpose and for every flashlight need.

Complete stocks of practically every type, size and voltage are carried in warehouses throughout the country.



WESTINGHOUSE LAMP COMPANY
165 BROADWAY, NEW YORK CITY

Sales Offices and Warehouses Throughout the Country

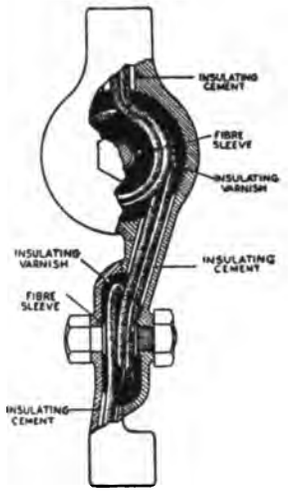


FOR CANADA—CANADIAN WESTINGHOUSE CO., LIMITED, HAMILTON, ONTARIO

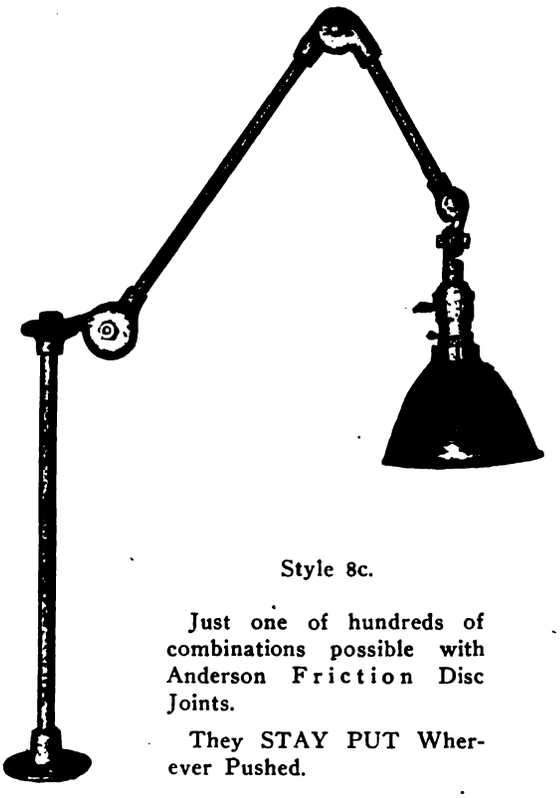
Westinghouse

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ANDERSON SELF-ADJUSTING ARMS



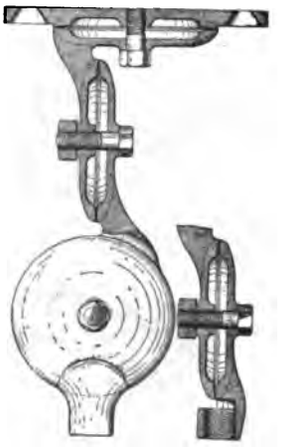
Patented Method of Wiring inside of the Friction Joints Approved by the National Board of Underwriters.



Style 8c.

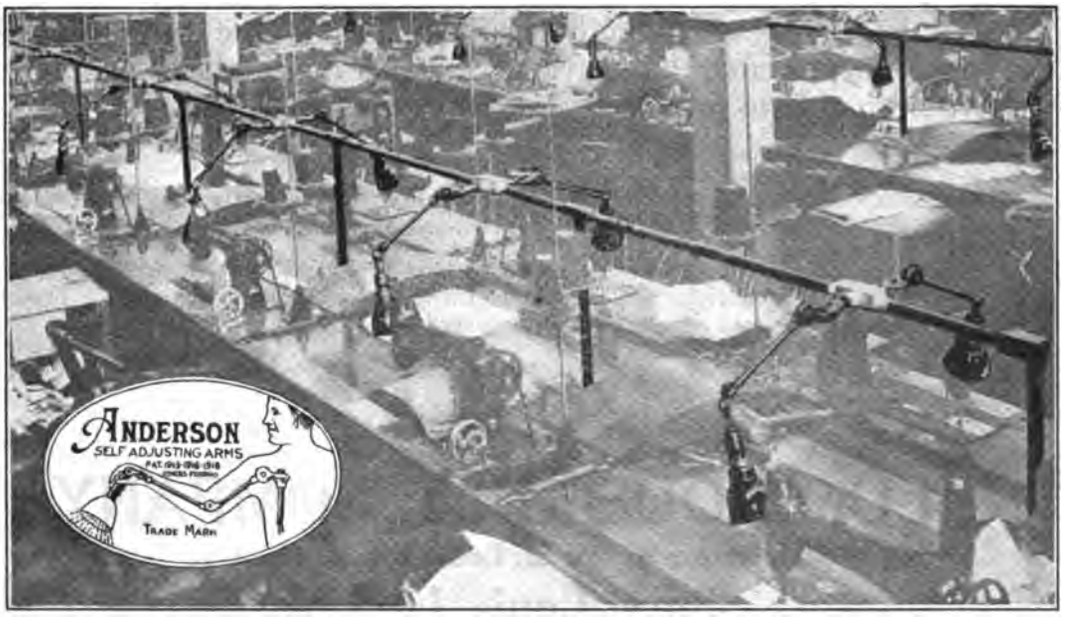
Just one of hundreds of combinations possible with Anderson Friction Disc Joints.

They STAY PUT Wherever Pushed.



In the accompanying illustration is shown the ceiling joint, the principle of this type applying to the scores of combination joints and sizes already in use. The maximum frictional resistance is obtained by having the point of contact at the extreme outer edge of the discs. The hollowed-out centers produce a resilient tension which remains constant for years without readjusting. The clamping screws pass through one disc and screw through the opposite disc. The nut locks the adjustment permanently.

CONCENTRATION IS EFFICIENCY AND ECONOMY



LOCALIZED LIGHTING CORPORATION

540 West 58th Street **New York, N. Y.**

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The Largest Selling Line of

The BRASCOLITE



TYPE W. F.



Parchment shade for living room—a complete line for Brascolites.

THE quality established and maintained in Brascolite Fixtures has become standard in the lighting field. Jobbers, jobbers' salesmen and retailers have come to understand through experience that buyers want just the qualities which they have been able to find always in Brascolite Fixtures.

There are no other fixtures just as good.

Appearance, compactness, efficiency, and quality in materials and workmanship mark every fixture produced under our trade names.

Moreover, every article produced by us is backed by willing service—a desire to achieve even more satisfactory relations throughout the lines which our products follow—the jobber, the dealer and the user.

A catalog and price list of our complete line of fixtures will be sent to you promptly upon request.

LUMINOUS UNIT COMPANY

Division of the St. Louis Brass Mfg. Co.

Saint Louis, U. S. A.

Branch Offices

New York	Denver	Atlanta	Cincinnati	Chicago	Detroit	Kansas City
Minneapolis	Boston	New Orleans	Philadelphia	Pittsburgh	Seattle	Los Angeles

Canadian Distributors: **NORTHERN ELECTRIC CO., Ltd., Montreal**

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Lighting Fixtures in the World

Fixtures for Every Purpose



Industrolite

This fixture is ideal for factory lighting—kills the glare and protects workmen's eyes.



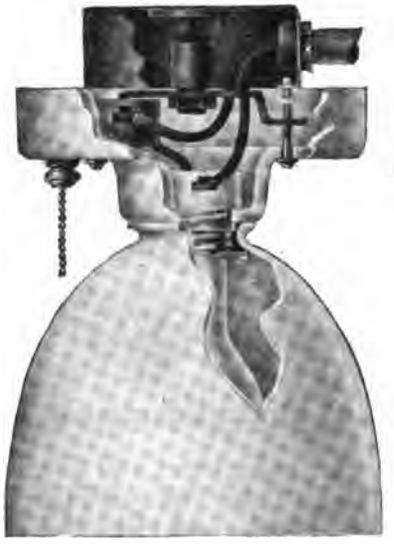
E-lite

Designed for use in the home—a highly efficient, decorative two-piece glass unit.



Jack-O Lantern

This light gives 100 hours of service for 1 cent—useful in bedrooms and nurseries.



Aglite All Glass

Cross section view showing the perfect insulation of the Aglite. Note the simplicity and ruggedness of construction—no splicing of wires necessary. Special pull switch; capacity, 660 Watts.



Aglite All Glass

Designed with particular regard for sanitation and cleanliness—essential in all modern hospitals.

The fixtures illustrated here are only a portion of our line. Every trade marked name has won an enviable reputation on sheer merit. A complete catalog of every fixture we make will be sent upon request together with price list.

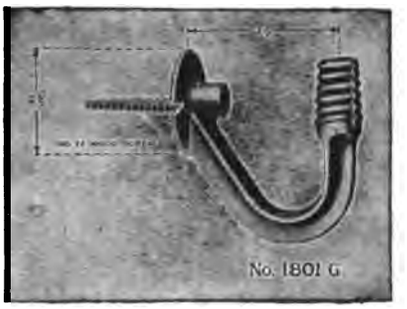


Of inestimable value in bank lighting. Full light—full protection.

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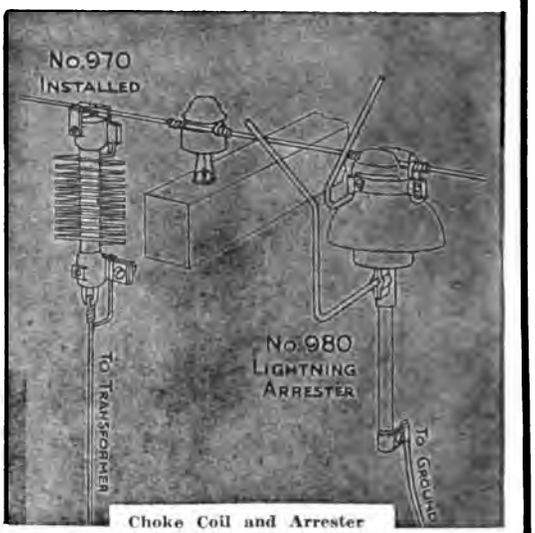
Strain Insulator Clevis



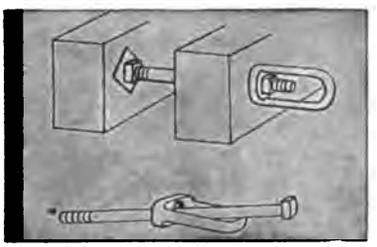
House Bracket



Transformer Pin



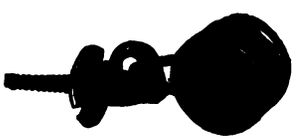
Choke Coil and Arrester



Bolt Clevis



Screw Rack



No. 1818-G "Nuf Sed"

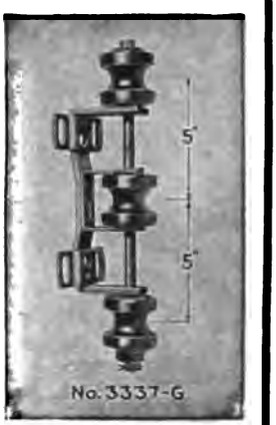
LINE MATERIAL COMPANY
SOUTH MILWAUKEE, WIS.

Eastern Branch—Albany, N. Y.

Out-Door Electrical Devices

Street Fixtures and Accessories
Mast Arms, Pulleys, Hangers, Etc.
House and Pole Brackets
Service and Secondary Racks
Primary and Secondary Fuses and Switches
Farm Line and High Tension Units
Pole Line Hardware

"Made as the Practical Man Wants Them Made"



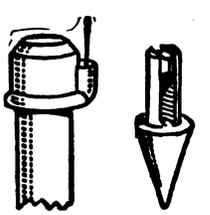
Service Rack



Primary Fuse



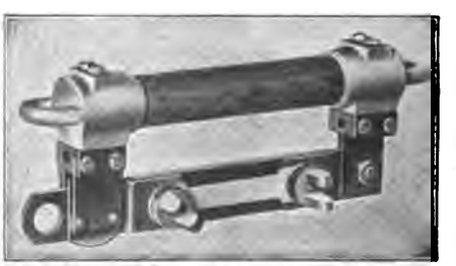
Hendee Tree Insulators



Ground-Cap and Point



Pulley



Secondary Fuse Switch



Street Fixtures

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Square D

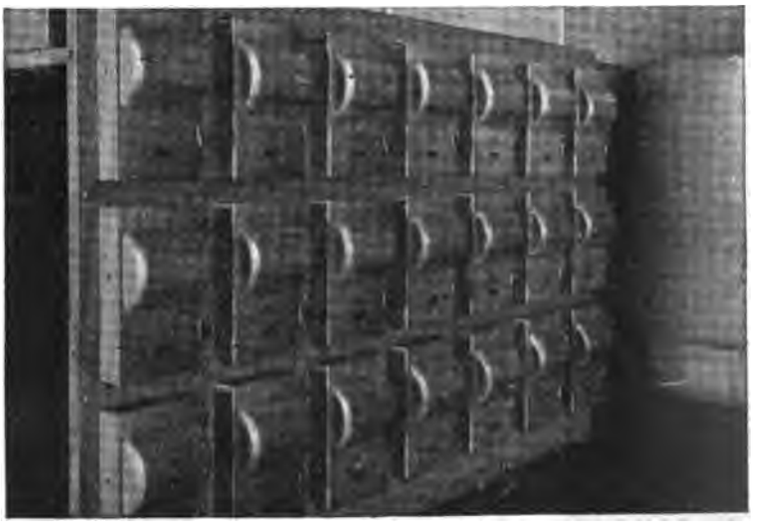
Safety Switches

SQUARE D Safety Switches eliminate all danger of accidents and fire due to open knife switches.

Nothing complicated—nothing to wear out or get out of order. Just a simple, easily operated safety device. The switch unit is completely enclosed in a metal box provided with a hinged cover. The switch is easily operated by a handle on the outside of the box. A safety locking off device prevents careless closing of the switch when anyone is working on the line or the equipment controlled by the switch, thus protecting workmen against death or serious injury caused by accidental starting of machinery.

Cover can also be locked shut to prevent unauthorized persons overfusing the switch or in any way tampering with the connections.

Square D Switches in a sugar refining plant.



SQUARE D COMPANY
DETROIT, MICH., U. S. A.

Write for Catalog

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Square D

Safety Switches

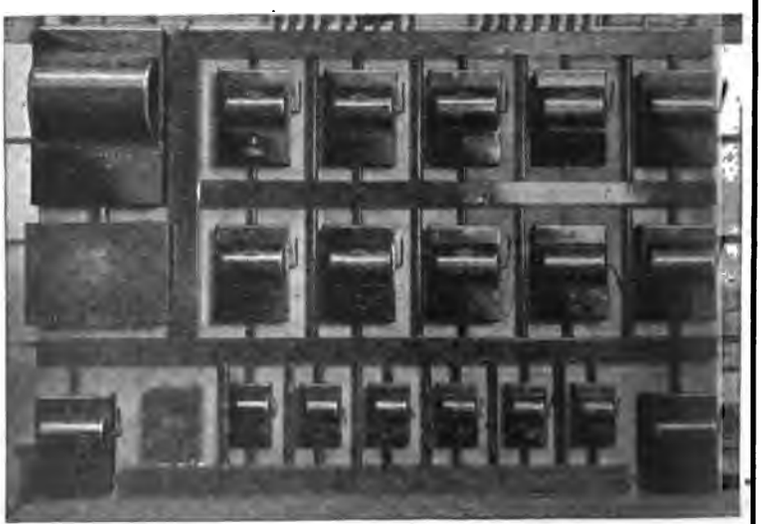
SQUARE D Safety Switches are built in two, three, and four-pole types, in standard voltages of 125, 250, 500 AC and 600 volts, and in capacities from 30 to 1200 amperes inclusive. There are more than 300 different types and sizes—a switch for every requirement.

The quick-break mechanism with which these switches are provided is positive and insures a simultaneous break at all blades. Great durability is thus assured.

All boxes contain ample wiring space and are furnished with convenient knockouts in back and side. By the insertion of the proper end plate, the switch can be adapted to any style of wiring instantly.

SQUARE D Safety Switches are shipped completely assembled ready for immediate installation.

Dead Front Switchboard. The Paraffine Companies.



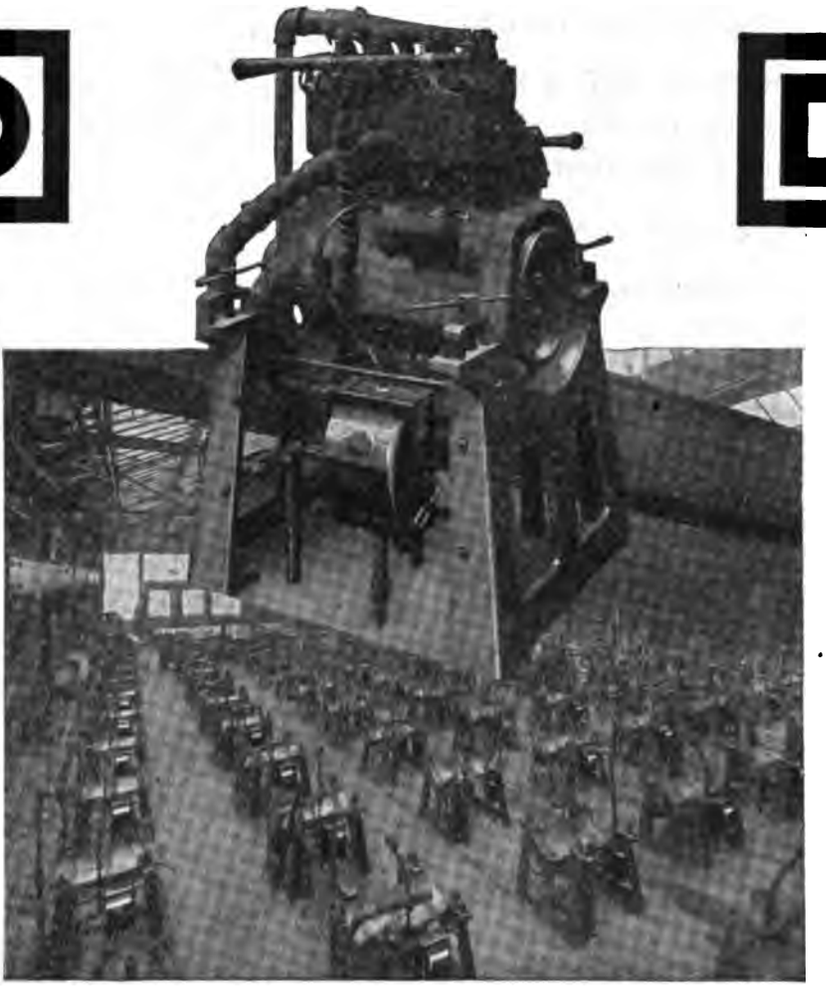
SQUARE D COMPANY
DETROIT, MICH., U. S. A.

Catalog on Request

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Square D

Safety Switches



Testing Automobile Motors. A Square D Switch on every stand.

SQUARE D Safety Switches are listed as standard for both fire and accident prevention by the Underwriters' Laboratories of the National Board of Fire Underwriters. They meet the requirements of the National Electrical Safety Code of the Bureau of Standards, Dept. of Commerce, Washington, D. C., and are sanctioned by the Workmen's Compensation Bureau.

New York
Pittsburgh
Atlanta
St. Louis

SQUARE D COMPANY
DETROIT, MICH. U. S. A.

Philadelphia
San Francisco

Chicago
Cleveland
Milwaukee
Toronto, Can.

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Making the Safety Switch Safe

There is nothing unusual in safety switches—or, should we say, safety *in* switches.

Some think that a safety switch is a highly specialized and mysterious article, calling for a great deal of exploitation and explanation.

Nothing is farther from the truth.

The enclosing of a switch, with external operation and interlocking safety features is to the switch what a guard is to a buzz saw. It is what fire or accident insurance is to the factory or individual—and it is just as essential.

It is just as inconsistent to have an open knife switch as it is to have an open elevator shaft, which in its own way invites accident and disaster.

Here are the features which the contractor or industrial plant specifies to insure absolute safety and a modern installation:

A—A switch enclosed in a box externally operated.

B—Interlocking features making it impossible for the operator to open on a live closed switch or to close switch with cover open.

C—The strongest possible switch inside the box, since an enclosed switch doing its work day in and day out, rarely opened or seen must be mechanically and electrically super-efficient.

THE TRUMBULL ELECTRIC MFG. CO., Plainville, Conn.

New York 114 Liberty St. Philadelphia | Chicago 40 S. Clinton St. Boston | San Francisco 595 Mission St.

Safety Switches

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Safety in Switches is the most logical form of insurance a man can buy. Life, fire and theft insurance are a part of everyday business—a man just naturally and logically secures such insurance or provides such insurance.

But these forms of insurance await the actual happening of the thing insured against to justify the insurance—to compensate the insured.

Safety in Switches is just that much more logical—it insures against accident and the accident doesn't happen.

Most other insurance is an investment against time. Safety in switches buys immediate and constant protection. You do not have to lose to win.

Making the Safety Switch Safe



1. The switch is in running position. He cannot open box until switch is in "off" position.



2. The Box is open. He cannot close the Switch until cover is down. Catch can be manipulated when necessary for expert to test line with cover open.

The line is complete. All requirements from the smallest to the largest sizes can be supplied in one line of uniform design and construction—every switch a real "Safety First" device.

Rule 24, Section A of the 1921 National Electrical Code, makes the use of enclosed switches for service entrance mandatory and recommends that they be externally operated and without exposing the live parts to accidental contact.

Circle T Safety Switches combine all these points—

1. **They are externally operated.**
2. **Case cannot be opened until switch is thrown to "OFF" position.**
3. **Switch contacts cannot be closed while case is open.**
4. **Switch blades and fuses are dead when case is open.**
5. **All live parts may be shielded when case is open.**

Write for copy "f" of booklet taking up vital points in real safety switch construction.

If it's Circle-teed it's guaranteed



3. This switch is covered by a 100% safety shield. He cannot touch a live part.

THE TRUMBULL ELECTRIC MFG. CO., Plainville, Conn.

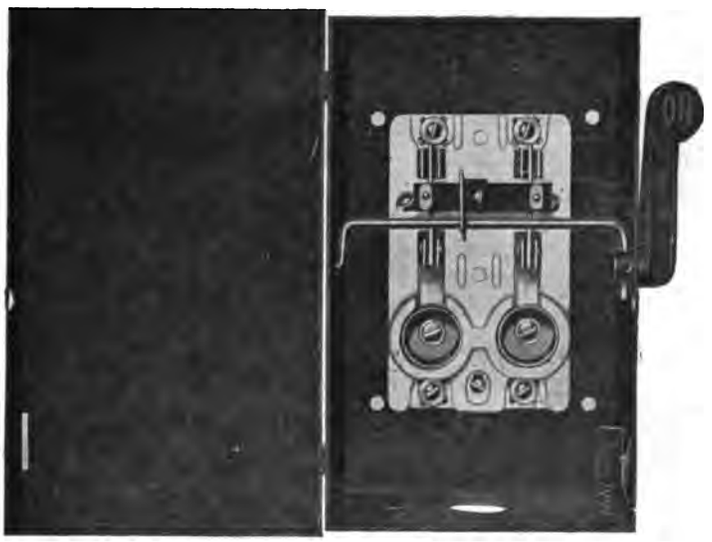
New York 114 Liberty St. | Chicago 40 S. Clinton St. | San Francisco 595 Mission St.
Philadelphia | Boston

T Safety Switches

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COMPRO

COMMERCIAL PROTECTION
CURRENT PROOF SWITCHES



CLASS B—OPEN



CLASS B—CLOSED



CLASS A—OPEN

COMPRO CURRENT PROOF SWITCHES AUTOMATICALLY PROTECT THE MEN WHO USE THEM.

ABSOLUTELY DEPENDABLE IN OPERATION. DESIGNED TO PREVENT ACCIDENTS.

COMPLETELY ENCLOSED AND EXTERNALLY OPERATED ONLY. WORKMANSHIP AND QUALITY THE BEST OBTAINABLE.

CLASS A SWITCHES—ALL SIZES ABOVE 30 AMPERES—PROVIDED WITH A QUICK BREAK ATTACHMENT SO DESIGNED AS TO BREAK THE SWITCH TO A FULL 90 DEGREES.

CLASS B SWITCHES ARE FUSED AT THE BOTTOM—RECOMMENDED BY THE AUTHORITIES AS THE BEST METHOD FOR ENCLOSED SWITCHES.

WRITE TODAY FOR SPECIFIC INFORMATION

THE WADSWORTH ELECTRIC MFG. CO.

INCORPORATED

COVINGTON, KENTUCKY

New York City
30 Church St.

Chicago, Illinois
559 W. Monroe St.

BRANCH OFFICES

Boston, Mass.
176 Federal St.

Pittsburgh, Pa.
422 First Ave.

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BULL DOG
Safety Switches
Externally Operated

Represent the highest standard in safety switch construction. In them are combined all those superior features of construction that have always identified the "Bull Dog" line of Knife Switches and a design of enclosure and external operation that insures maximum safety and service. Yet they are moderately priced. Write for descriptive literature and discounts.

TYPE A
Knife Switches

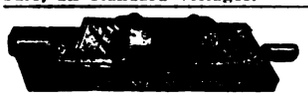


Not merely "a switch" but a better switch—the best we honestly believe, that good materials, modern manufacturing methods and expert and conscientious workmanship can produce. Current carrying parts amply proportioned assuring capacity in excess of rating. All standard voltages and capacities; one, two, three and four poles; front and back connected.

TYPE C
Knife Switches



Distinctive features;—Hinge and jaw clips interchangeable permitting arrangement for fuses on either hinge or handle end; VANDAM BRONZE strong spring Fuse Clips with reinforced contacts; COLD FLOWED TERMINAL LUGS; contact reinforcing spring and washer insuring uniform contact pressure; hinge screws that cannot loosen; black oiled finished (not painted) electrical slate base; extra heavy fibre cross bars, all standard voltages.



Fuse Blocks

We manufacture a complete line of Fuse Blocks in single, two, three and four poles—250, 500 and 600 volts. These are furnished with COLD FLOWED Lugs and incorporate other important features of our Switches.

Cable Terminal Lugs



Because of their method of formation our COLD FLOWED Lugs have a greater mechanical strength than the tubular type; their flat contact surface, which equals a milled surface, insures perfect contact; and they require approximately only one half the solder necessary with other lugs. COLD FLOWED Lugs are made in three sizes only, 60, 100 and 200 ampere capacity. We also manufacture a complete line of tubular type Lugs, 30 ampere to 1050 ampere inclusive.

Lug Assortment and Cabinet

To those who use or sell any quantity of Lugs, we recommend our Lug Assortment Cabinet. There are ten compartments, each containing a quantity of Lugs of one of the different sizes. This Cabinet is a wonderful convenience providing the means of keeping all Lugs in one container, showing at a glance which sizes are running low and enabling one to select in a moment just the Lug or Lugs wanted. As a time saver it will soon pay for itself.



Super Safety Lighting Panels and Cabinets



We make a complete line of Dead Face Safety Type Lighting Panels and Cabinets, arranged for either Plug or cartridge fuses with branch push Switches, or heavy 30 ampere Toggle Switches. The Cabinets are so arranged that exposed live metal parts are not accessible to others than authorized persons, but access may be gained so as to permit of the operation of the Switches without exposing the operator to dangerous live parts. For residential work push switches are satisfactory. For public buildings and industrial plants heavy 30 ampere Toggle Switches are recommended.

Bull Dog "Super-Safety" Switch Boards

The cut shows a Dead Face "Super-Safety" "Bull Dog" Theatre Board. There are no live metal parts on the face of the Board. The Switches are arranged with interlocking devices so that any group of Switches may be operated by master levers. The Switches are on the rear of the board and so arranged that the fuses and Switches are dead when open. Some of these boards have been in successful operation for ten years. "BULL DOG" "SUPER-SAFETY" INDUSTRIAL BOARDS are built on the same general principle as the Theatre Boards, except that they are not provided with interlocking mechanism, but Switches are provided with means for locking them in the "ON" or "OFF" position.



MUTUAL ELECTRIC AND MACHINE CO.
DETROIT, MICH.

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"THOMPSON-LEVERING"

T&L — THE WORLD OVER — ELECTRICAL TESTING INSTRUMENTS — RECOGNIZED STANDARD

ELECTRICAL
MEASURING
INSTRUMENTS

"The Recognized Standard"

We specialize in the following:

Testing Sets	Indicating Ohmmeters
Wheatstone Bridges	Tachometers
Condensers	Laboratory Standards
Galvanometers	of Precision
Pyrometers	

We shall be glad to have you write us your requirements.

THOMPSON-LEVERING CO.
PHILADELPHIA, PA., U.S.A.

CON-TAC-TOR

ABSOLUTE CONTACTORS

Switching Devices



THE heart of these devices consists of contacts hermetically sealed in a glass tube, with a quantity of fluid mercury. Operation is by tilting so that the mercury bridges the contact; or by magnetism in such mechanical way as to cause the mercury to form contact.

With the Absolute Contactor even large current values may be switched. It will last for an unlimited period with no deterioration, even with a contact frequency of 500 a minute. It is now in continuous use by many of the best known manufacturers in America.

Advantages: Unfailing dependability at all times; impossibility of corrosion or contamination, so that cleaning or adjusting are put absolutely out of consideration; absolute safety under all conditions of atmosphere; unprecedented facilities for automatic and relay control, requiring an almost inappreciable energy to operate.

Products include: Relays (Light and Power), Interruptors (Light and Power), Pressure Switches, Float Switches, Safety Switches, Thermostatic Contactors, Sign Flashers, Time Switches.

Contact making devices built for all purposes, general and special. Our engineers will consult with you without obligation.

Send for Bulletin "B"

ABSOLUTE CON-TAC-TOR CORPORATION
127 NORTH DEARBORN STREET, CHICAGO

UNEQUALLED—BUT COST NO MORE

★ THE NATIONAL RHEOSTAT ★

STANDARD EVERYWHERE

IMPROVED ELECTRIC CONTROL

Constant In Resistance	In the United States, nearly every great electric company is a purchaser of "NATIONAL" Electric Controlling Devices to some extent.
High In Efficiency	
Low in Temperature Co-Efficiency	THAT MEANS that the responsible engineers of this country have TESTED and tried out these ideal controllers and got SERVICE unequalled.
Long In Life	
Neat In Appearance	THIS widespread APPROVAL is the reward of SUPERIORITY and of that EXCELLENCE and DEPENDABILITY which makes SATISFIED customers.
Light In Weight	
Small In Size	THE USE of these instruments also means much in SAVINGS in express charges, in weight and in space.
Superior In Protection	ORDERS and communications receive prompt and careful attention.
Points 6f Control Many	*Ask for Price List No. 10*

14 Years of Increasing Business

National Electric Controller Co.
154-156 Whiting St. - - CHICAGO, U.S.A.

RECORDING ELECTRICAL INSTRUMENTS

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE.

Voltmeters, Ammeters, Wattmeters, Milli-Voltmeters, Shunt Ammeters, Frequency Meters, are made in both Round Chart and Strip Chart types, in Switchboard and Portable Models.



Wherever electrical current is used—in the central station or manufacturing plant, Bristol's Recording Electrical Instruments have an important function. They automatically and continuously record the various electrical units. The records furnished show variations from hour to hour and day to day; thus by the study of same it is possible to improve conditions and secure maximum results.

Get copy of Catalog 1501

THE BRISTOL COMPANY
Waterbury, Conn.

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The Newgard Combined Receptacle and Globe



Type A

The original Weatherproof Receptacle and Globe, and is exactly what the name implies—*WEATHERPROOF*. NEWGARD Receptacles give absolute protection to lamps and sockets. Made in two sizes—for lamps up to and including 60 watts; for lamps from 60 to 100 watts inclusive. These receptacles will be furnished with steel enameled reflectors if desired. Type A Pendant Type —Type B Bracket Type—Type C Flange Type. Manufactured under the rules of the National Board of Fire Underwriters, and inspected by them from time to time.

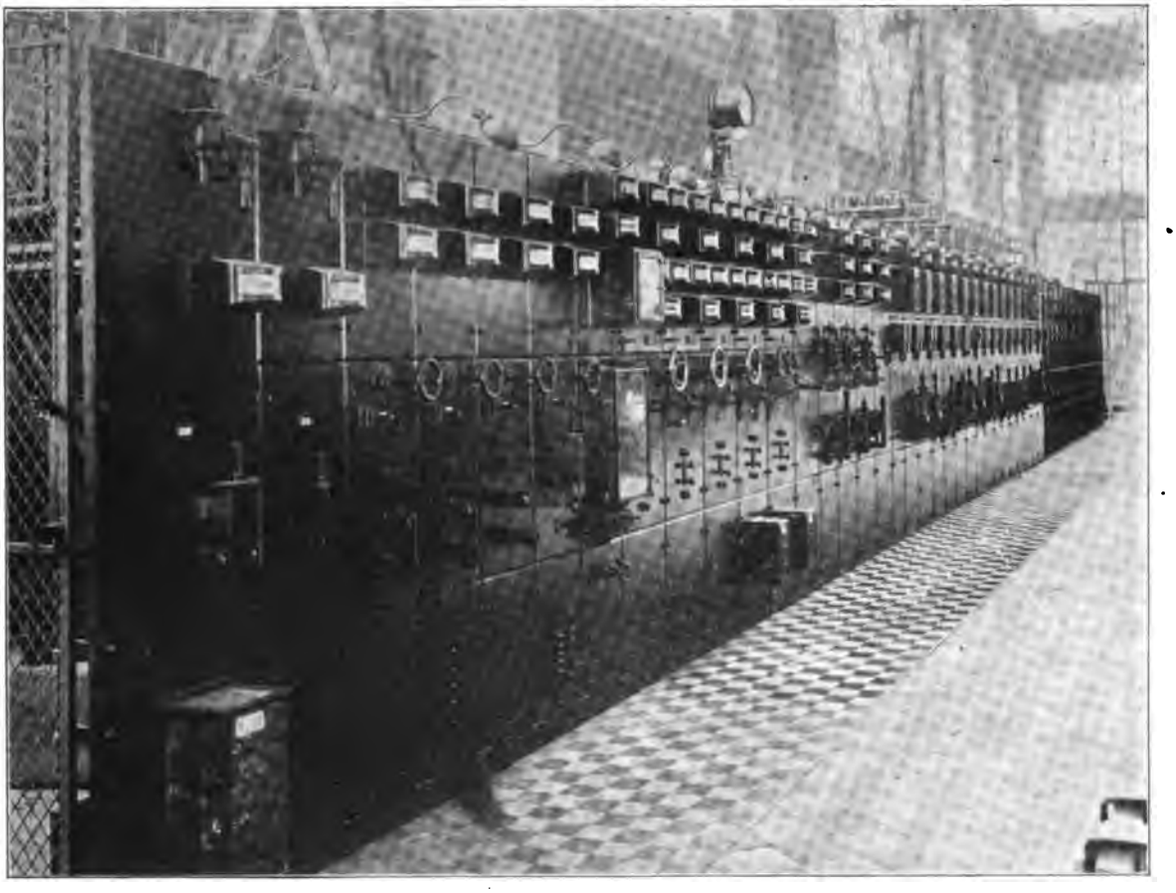


Type B

Newgard Receptacles Are Used in

Malt Houses	Packing Houses	Gas Plants
Cold Storage Plants	Lumber Mills	Ice Houses
Refineries	Paint Factories	Lumber Yards
Warehouses	Cotton Mills	Chemical Factories
Street Car Barns	Paper Mills	Distilleries
Railroad Shops	Grain Elevators	Soap Factories
Starch Mills	Card Board Factories	Garages
Mines	Powder Mills	Etc.
Boats	Coal Pockets	

SWITCHBOARD SPECIALISTS SINCE 1882



Switchboard Manufactured and Installed by Henry Newgard & Co. for the Corn Products Refining Co. at Argo, Ill.

HENRY NEWGARD & CO.

947-955 Washington Boulevard :: :: CHICAGO, ILLINOIS

Branch — 276 W. Water St., Milwaukee, Wis.

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Your Lasting Prosperity as Part of the Electrical Industry is Only as Secure as the Prosperity of the Industry as a Whole

Realizing this to be true, you can see that the Central Station Industry, the Keystone of the whole electrical industry, must be kept on a healthy financial and progressive basis.

The last three years have been lean ones for the Central Station. Every item which goes into the generation and transmission of power has increased in cost. The rates per unit of electricity have not, however, been raised to any great extent. As a result central station expansion has been retarded and at the same time the demand for power has greatly increased. Public Utility securities have gone begging because the public did not have faith in them. The Public has misunderstood the condition of the Central Station and in some cases has condemned them without knowing the true facts.

Telling the Public the True Facts offers great possibilities for the solution of the present problem.

And here is where you can help

Already a co operative advertising campaign is under way whereby many of the electrical manufacturers who use space in the technical and popular press are devoting a part of this space to tell the trade and the public the **true facts** about the Central Station. This educational work, to be effective, must be continuous; and over a period of time the cumulative effect will show good results.

Jobbers, contractor-dealers, engineers and all others engaged in the industry can also help in this co-operative work.

If you believe that the Central Station should prosper and expand, do your part to help

Write to the National Electric Light Association, 29 West 39th Street, New York City, for detailed information as to how you can do it.

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ECONOMY renewable FUSES

First commercially successful—First to gain great sales value—First to be given approval in all capacities by Underwriters Laboratories, Inc. of any type of renewable fuse using a bare renewal link for the purpose of restoring a blown fuse to its original efficiency—

IN THE WORLD WAR

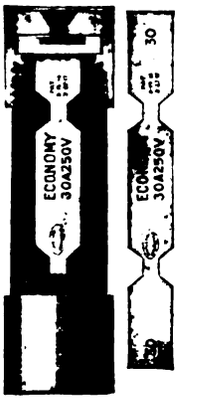
Economy renewable Fuses protected lighting and power circuits on every type of United States war vessels, in arsenals, navy-yards, fortifications, munition plants, hospitals, in the Panama Canal Zone and in all great industries essential to the successful prosecution of war. Today the Government is still one of the largest users of Economy renewable Fuses.

Economy Fuses are made in three general types (ferrule, plug and knife-blade) with a full line of capacity ranges for all commercial voltages. This was the first line of fuses employing an inexpensive bare link for restoring a blown fuse to its original efficiency, approved in all capacities by the Underwriters' Laboratories, Inc., established and maintained by the National Board of Fire Underwriters.



Knife-blade type disassembled showing the famous "Drop Out" renewal link and winged washer which securely locks fuse after renewal.

The fusible elements are of the "Drop Out" renewal link type, accurately rated and of definite design. Every part of an Economy fuse is built on the "safety first" principle, which means that the design is right from an electrical standpoint, and that material entering into the construction of the completed fuse is the best that money can buy.



Ferrule type fuse and "Drop Out" renewal link.

In consonance with the general readjustment of prices in all industrial markets, Economy Fuses were put on a new price basis on the 16th of May, 1921. The reduction to the user is 26 8/10%—which price is only 20% over the original pre-war basis. Standard package units today are List, less 40%. Complete stocks carried by all leading electrical jobbers.

ECONOMY FUSE & MFG. CO.

Greenview Avenue at Diversey Parkway CHICAGO, ILLINOIS

Atlanta, Ga.	Buffalo, N. Y.	Detroit, Mich.	Los Angeles, Calif.	New York, N. Y.	San Francisco, Calif.
Baltimore, Md.	Cleveland, O.	Denver, Colo.	Milwaukee, Wis.	Philadelphia, Pa.	Seattle, Wash.
Boston, Mass.	Cincinnati, O.	Kansas City, Mo.	Minneapolis, Minn.	Pittsburgh, Pa.	St. Louis, Mo.

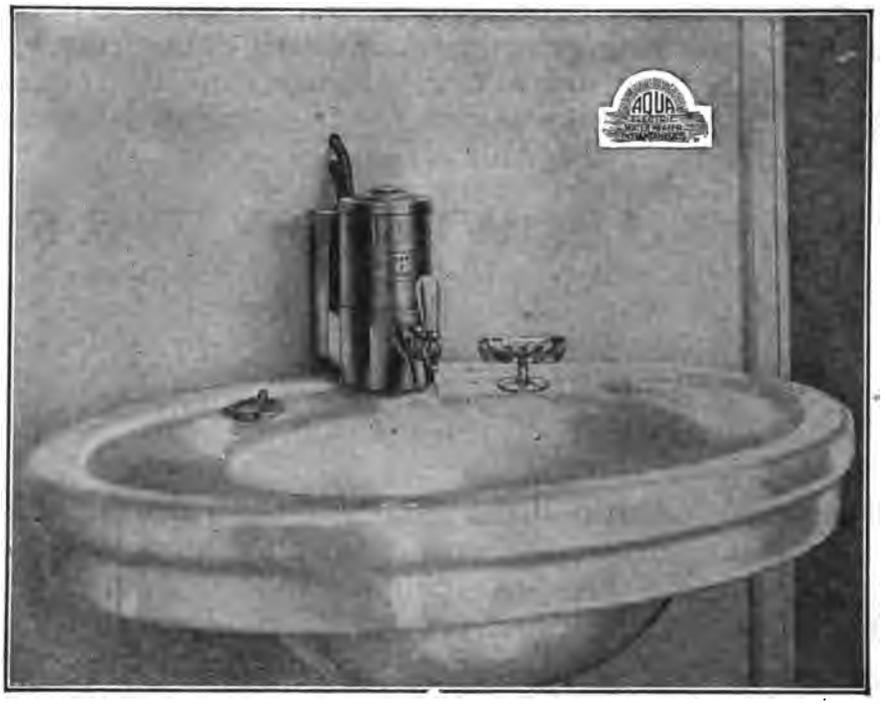
ECONOMY FUSE & MFG. CO. OF CANADA, Ltd., MONTREAL, CANADA.

Hang a Fixture Like a Picture

The Economy Fuse & Manufacturing Company is now actively producing and marketing, through its own sales organization, ECONOMY RECEPTACLES and PLUGS for Elexits, under license from the Electric Outlet Company, Incorporated, under patents of April 14th, 1914, December 7th, 1920, etc. The service and co-operation of our large sales organization is offered to the fixture manufacturer and dealer and the electrical trade in order to develop the universal standardization and use of this modern method of installation of electric fixtures.

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Primarily An Industrial Device



Are you still eating with wooden spoons?
Do you get your water from a well in the backyard?
Is most of our transportation done by mules?

Don't you think the telephone, automobile, aeroplane, as well as every modern thing you know of, is much greater than a century ago?

An Aqua Electric Water Heater produces hot water.

INSTANTANEOUSLY

Turn the handle to the left—cold water.
Turn the handle to the right—hot water.

FROM THE SAME FAUCET

Communicate with any

Electrician
Plumber
Dealer
Power Co.
Contractor
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Jobber
Yourself
Or Us.



AQUA ELECTRIC HEATER CO.

250 West 54th Street
NEW YORK, N. Y.

KEEP ABREAST WITH PROGRESS

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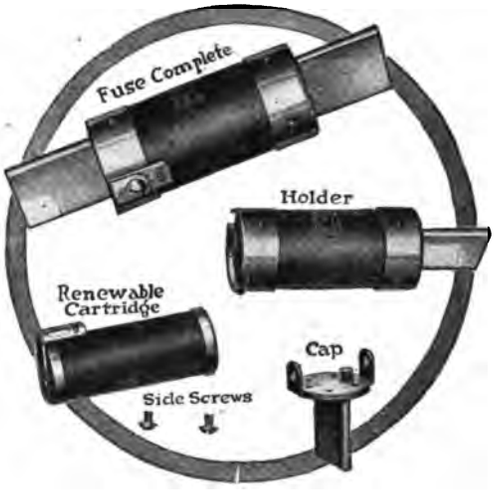
THE NATIONAL RENEWABLE FUSE



Only renewable fuse that is built to take surges in the line and still maintain proper rating under rules of Underwriters Association. It is not necessary to overload this particular fuse to handle high starting torque of induction motors. Only one renewable powder-packed cartridge can be used at a time. Jobbers and Distributors everywhere. Write for full details.



Knife Blade Type





Ferrule Type

THE FEDERAL ELECTRIC SIREN



For fire alarm, calling signal, starting and stopping signal, etc., gives a weird penetrating screech that sounds at the touch of a button. Instantly recognized by the men for whom it is intended. Can be used wherever there is electricity. In all sizes and styles for both exterior and interior use. Write today for bulletin, stating for what purpose you intend using the siren.

WE MANUFACTURE

"National" Renewable Fuses.
Fire Alarms.
Storage Batteries (Lantern Type).
Porcelain Clamp Bushings.
Vacuum Cleaners.
Federal Washing Machines.
Flashlights (Lantern Type).
Fuse Links or Renewals.
Railway Signal Lanterns.
Portable Dry Cell Lanterns.
Storage Battery Lanterns, Re-chargeable.
Electric Signs.
Electric Sirens.
Sockets — Weatherproof, Porcelain Clamp, Candelabra and miniature.
Electric Whistles.

FEDERAL ELECTRIC COMPANY

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Service

Service is synonymous with distinction. That distinctiveness in your field begins first with the quality of the electric appliance you carry; it takes in store conduct and in its scope, embraces every contact you make with your customer or prospect.

The Edison Electric Appliance Co., Inc., realizes what the sales value of service is to the jobber and the dealer—consequently maintains Service Stations in various cities throughout the country, as illustrated above. At these Service Stations, parts are furnished, repairs made and every thought given to render a genuine service on all of our devices.

Our Service Stations are not maintained as district sales offices or display rooms only, but largely to render service to Hotpoint jobbers and dealers and to assist them in rendering a superior service to their customers.

Edison Electric Appliance Co., Inc.

New York Boston	Chicago Salt Lake City	Ontario, Calif. Seattle	Atlanta Portland New Orleans	St. Louis San Francisco	Los Angeles Dallas

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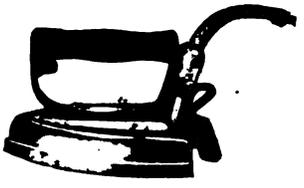




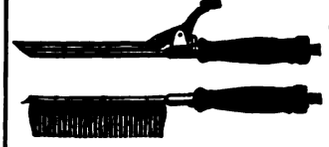
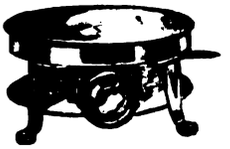
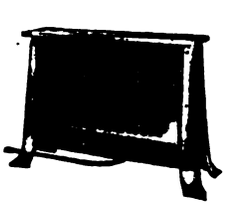














PIONEERS in the field, starting originally to manufacture a few appliances only, we now manufacture electric appliances for practically every need in the home.

In each appliance that we make, there is embodied some distinctive feature, either in design or in workmanship. That feature, beside giving the appliance greater utility. and emphasizing the real advantage of things electrical, raises it above the level of ordinary modern appliances through additional safety or convenience.

Another important development of this company is the perfection of electric cooking equipment for the Hotel and Restaurant. Years of intensive study and experimental work by electrical engineering experts, have produced a line of heavy duty equipment that includes practically every need for the hotel, restaurant or bake shop.

To the public, Hotpoint—Hughes and Edison appliances signify greater conveniences and bring about a more pleasant atmosphere in the home. To the jobber and the dealer, they have brought many satisfied customers and an ever-increasing volume of sales.

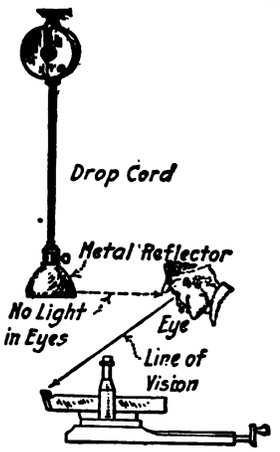
Edison Electric Appliance Co., Inc.

New York Chicago Ontario, Calif. Dallas New Orleans
Atlanta St. Louis Los Angeles Portland Seattle
Boston Salt Lake City San Francisco

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Reelite Flexible Industrial Lighting Fixtures

NATIONAL ELECTRIC CODE STANDARD



Correct position (recommended by authorities) of the light-unit can be assured if Reelite is used.

Reelite DROP CORD TYPE

250 V. 250 W.



WHEREVER FIXED DROP LIGHTS are used over work benches, tables, or machines, the lighting results are often unsatisfactory, due to the varying character of the work, which makes it impossible to pre-determine the exact height of the light source above the working plane.

"Flexible Lighting" with the Anderson Reelite permits instant adjustment of the distance of the light-unit with respect to the work.

Good local lighting demands light from the proper direction. The Reelite is the ideal flexible industrial lighting-unit and is suitable for large or small installations. Flexible local lighting is the modern and efficient method and its advantages will be immediately appreciated by all engineers.

Standard reflectors are recommended for use with the Drop-Cord Type Reelite, selecting the reflector to meet the requirements of the particular installation.

For lighting horizontal surfaces such as tables, desks, work benches, etc., cone or deep bowl reflectors are satisfactory.

Reelite industrial installations can be carried out according to reflector manufacturer's recommendations. Then, to meet subsequent varying manufacturing conditions of lighting requirements of certain operations, the Reelite may be instantly raised or lowered as required.

Construction: Black enamelled reel-unit 5½ inches in diameter, with base for attaching to 3-inch outlet box, or direct to ceiling; 12 feet of approved portable cord and key-switch socket; plural-spring patent cord winder insuring long life under most severe usage.

Cat. No.	Key Socket	Length of Cord	List Price	Cat. No.	Key Socket	Length of Cord	List Price
1534	Porcelain	12 ft.	$8.00	1533	Brass shell	12 ft.	$8.00

Prices are less lamps.

Standard Base for 3-in. outlet box; base for 4-in. box supplied if specified without extra cost.





Reelite MACHINE TOOL TYPE

250 V. 660 W.

Cord is equipped with a 2-pin plug connector which can be attached to any portable device, such as: soldering iron, grinder, drill, hammer, heavy laundry iron, etc.

Construction: Black enamelled reel-unit, 8-in. diameter, with base for attaching to 3-inch outfit box (4-inch, if specified) or direct to ceiling. 20 feet of approved cord.

Cat. No.	Description	List Price
1523	Complete, less tool	$12.50



Reelite PORTABLE TYPE

250 V. 250 W.

Portable extension lamps of the usual type are an important item of expense in factories owing to the comparatively short life of the cord, which is left lying on the floor subject to the deteriorating effect of oil and grease, and abuse through being walked on, run over, and similarly mistreated.

Workmen like to reel up the cord on a Reelite when through using same—it's just like raising or lowering a window shade.

Construction: Black enamelled reel-unit, 8 inches in diameter, with base for attaching to 3-inch outlet box (4-inch if specified) or direct to the ceiling, 25 feet of approved portable cord. With either heavy wire open guard or vapor-proof portable.

Cat. No.	Type of Portable	Length of Cord	List Price
1528.	Wire guard-key Socket	25 feet	$15.00
1529.	Vapor-proof	25 feet	16.50



ANDERSON ELECTRIC & EQUIPMENT CO.

154-160 Whiting Street, Chicago

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Easiest to Sell—Surest to Satisfy

Nationally Known *More Than a Million in Use*

Violetta Violet Ray Machines



Baby Violetta

Well Advertised Is Half Sold

The demand for Violet Ray machines has been created. Thousands of dollars have been spent by the manufacturer in national advertising. The universal interest aroused has far exceeded expectations. In addition thousands of dollars are being spent in aggressive dealer co-operation. We urge you to cash in on the surest SURE THING ever brought to your attention. Everybody needs and wants Violetta Violet Ray machines. Everybody will buy one.

Don't Make a Mistake

Don't pass up this opportunity to make a profit and build up a source of continuous income. Don't for a moment think that Violetta Violet-Ray machines are something new. Violet-Ray machines are being used and have the endorsement of the medical fraternity.

The general public knows this—and want to buy. Hundreds of inquiries are received daily asking for this machine. These inquiries are being turned over to local dealers. This feature alone spells profit for you. In addition, the various advertising helps given dealers will surely bring a steady flow of patronage.

Put in a representative stock of Nos. B, 3, and 9 Violetta Outfits.



Vio'etta Outfit No. 3



Violetta Multifrex, Type B

Helping You Sell Violetta

Among the aggressive co-operation helps to dealers are the following:

Attractive Window Trims showing machines and attachments. Store signs, Illustrations, Booklets, Catalogues, Mats for newspaper advertising, inquiries from your territory and an iron-clad protective guarantee from the manufacturer. You run no risk and no expense. Your profits are big and often.

Violetta De Luxe Outfit No. 9



BLEADON-DUN CO.

World's Largest Manufacturers

213 So. Peoria Street

CHICAGO, ILL.

Write for Further Details.

Additional Information Under Classification — VIOLET RAY High Frequency Apparatus, Electrodes and Attachments.

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Superior Eden Features

All Parts Enclosed—Absolutely Safe

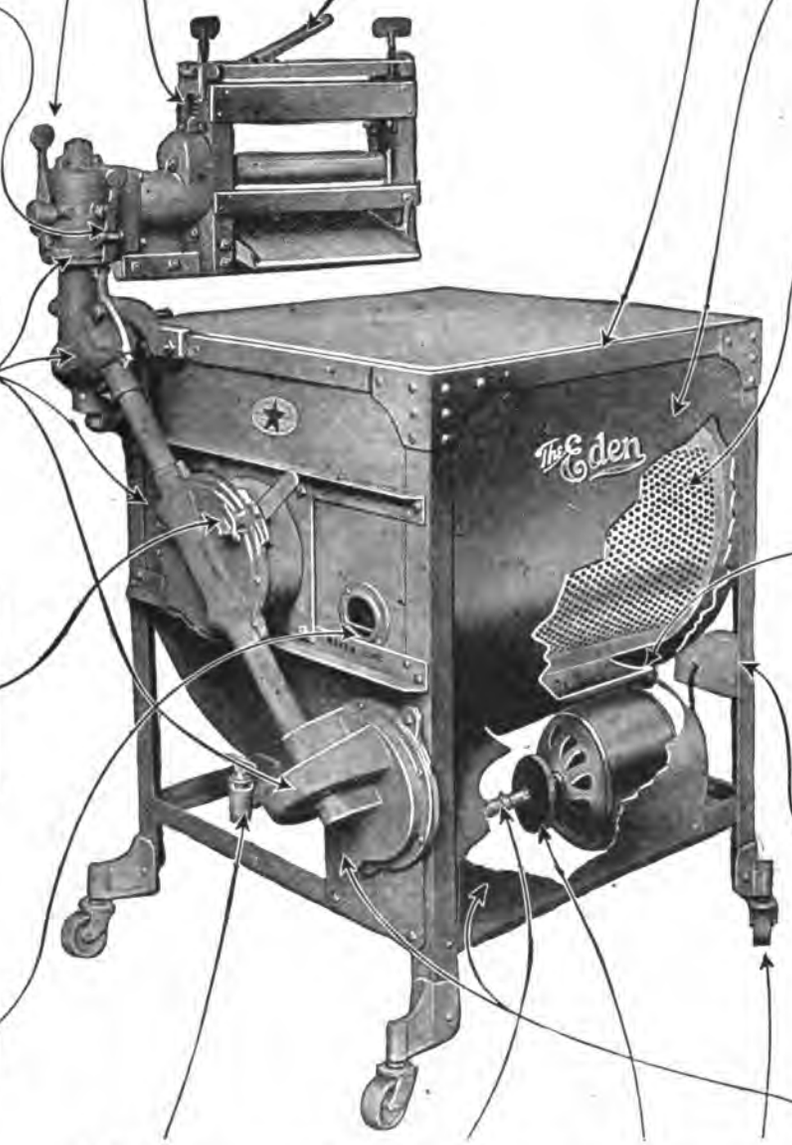
WRINGER CONTROL
SIMPLY PUSH LEVER TO OPERATE WRINGER. BOTH WRINGER AND WASHER OPERATE AT SAME TIME, OR SEPARATELY.

SWINGING WRINGER
RIGID, SELF-SUPPORTING, ELECTRICALLY OPERATED WRINGER. CAN'T SAG, SWINGS IN COMPLETE CIRCLE AND HAS 5 LOCKING POSITIONS. FULL 12-INCH WRINGER ROLLS WITH EXTENSION DRIP PAN AND SAFETY RELEASE.

TABLE TOP COVER
SMOOTH, STRONG COVER CRIMPED — MAKES TOP OF MACHINE AS HANDY AS A TABLE.

WRINGER LOCK LEVER
THIS INTERLOCKING LEVER HOLDS WRINGER IN ANY OF 5 POSITIONS WHILE WRINGING, AND THE SAFETY INTERLOCKING DEVICE PREVENTS WRINGER OPERATION UNTIL IT IS SECURELY LOCKED INTO POSITION.

THE EDEN TUB
TUB IS MADE IN HEAVY COPPER OR ARMCO GALVANIZED IRON. EITHER MATERIAL LASTS A LIFETIME.



SANITARY ZINC CYLINDER
HAS THOUSANDS OF SMALL SMOOTH HOLES. WEIGHS BUT 18 LBS. WET OR DRY. EASY TO LIFT OUT. WILL NOT WARP, GET WATER-SOAKED OR RUST.

SELF-LUBRICATING
THESE UNITS HAVE NO OIL HOLES. THEY ARE PACKED WITH A LONG-LIFE NON-FLUID GREASE. THE EDEN IS SELF-OILING.

SEDIMENT ZONE
(Exclusive Feature)
THE SEDIMENT ZONE—A CHANNEL OF QUIET WATER AT THE BOTTOM OF THE EDEN TUB—TRAPS ALL DIRT AS IT FALLS THROUGH THE PERFORATED WASHING CYLINDER, KEEPING THE WASH WATER ENTIRELY FREE FROM ALL THOSE DIRT-PARTICLES WHICH MAR THE SPOTLESSNESS OF CLOTHES WHEN PERMITTED TO MINGLE THROUGH THEM. THIS CONTINUOUS DIRT ELIMINATION IS WHAT MAKES EDEN-WASHED THINGS CLEANER.

AUTOMATIC START AND STOP
THE WASHER STARTING LEVER WORKS AUTOMATICALLY—SIMPLY PULL THIS LITTLE WING TO START, AND RELEASE TO STOP CYLINDER. DOORS ALWAYS STOP ON TOP READY TO OPEN. THIS UNIT CONTROLS THE REVERSING OF THE CYLINDER EVERY SIX REVOLUTIONS.

INSULATING BLOCK
WITH DETACHABLE PLUG.

WATER LINE WINDOW
WATER LEVEL VISIBLE AT A GLANCE. A VERY CONVENIENT FEATURE.

ALL MOVING PARTS ENCLOSED
EVERY WORKING PART IS COVERED. THE EDEN IS PERFECTLY SAFE WHERE THERE ARE CHILDREN PLAYING ABOUT. CLOTHING CANNOT BECOME ENTANGLED.

GILLESPIE EDEN CORPORATION

NEW YORK

ST. LOUIS DENVER SAN FRANCISCO TORONTO

Factories at Paterson, N. J., Lowell, Mass. and Alton, Ill.

SELF-DRAINING
BECAUSE OF THE DEEP DRAIN CHANNEL AND LOCATION OF DRAIN COCK, MACHINE IS SELF-DRAINING AND DOES NOT NEED TIPPING. OPEN DRAIN, CANNOT CLOG.

FLEXIBLE SHAFT
SECRET OF THE EDEN'S QUIET OPERATION. THIS SHAFT ELIMINATES VIBRATION AND INSULATES THE MECHANISM.

MOTOR CLUTCH
THE REASON THE EDEN DOESN'T BLOW FUSES. IF THE LOAD ON MOTOR BECOMES TOO GREAT THE CLUTCH RELEASES AUTOMATICALLY AND MOTOR RUNS FREE.

EXTRA LARGE ROLL SWIVEL CASTERS
HEAVILY GALVANIZED TO PREVENT RUSTING. MAKES MACHINE ROLL VERY EASY.

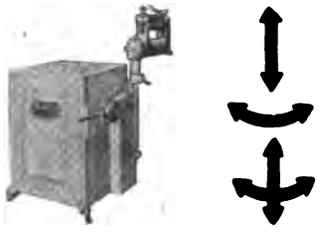
Your Judgment Is Never Questioned When You Buy an Eden

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A B C

The One Complete Line of Home Laundry Equipment

Built by the big and successful firm of Altorfer Bros. Company, pioneers in the industry; extensively advertised for years in magazines, newspaper and on billboards throughout the United States and Canada—as well as abroad; distributed by leading wholesale distributors, near to you, who allot exclusive dealerships; in the A B C **complete line**, as a dealer you are offered the opportunity to combine shipments of assorted washers and ironers, reducing freight costs—you have but one famous name, "A B C", to stress and to advertise—and you enjoy exceptionally liberal discounts together with unusually broad and willing selling and advertising assistance. Write for full particulars concerning any or all of the A B C products described below.



Some lift and dip.

Others rock and toss.

The A B C does both.

A B C
Super Electric Washer

Combined cylinder—vacuum—oscillating type washer. All the advantages of other washers in one for the price of one. Also equipped for power drive.



A B C
Electric Laundress

Washes Wrings Irons with a Single Motor

The *only* complete home laundry unit Detachable Wringer. Ironer shaft attaches to wringer post. Saves cost of extra motor.



A B C
Electric Ironer

Separate shoe, the "Ironall," irons the "other 15%" that cannot be handled by any single-shoe ironer. Foot pedals apply and release ironing pressure. One piece steel ironing roll; 8" diameter, 7"x45" non-warping ironing shoe. Result: faster, uniform work. Shoe drops back 4". Enclosed parts. Independently motored—or furnished to operate off any A B C washer.



A B C
"Alco" Washer

Dolly type. Single tub. Oversize motor. Quiet drive. Also furnished for power drive off gasoline engine.



A B C
"Twin Alco" Washer

12 Sheet Capacity

Twin tub, Dolly type. Tubs can be operated singly or in unison. Oversize motor. Very quiet. Also furnished for power drive.

ALTORFER BROS. COMPANY

Pioneer makers of power washers and ironers

Peoria, Ill.— New York City — San Francisco

Factories and executive offices at Peoria

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The Shadow of the Past–



"The Shadow of the Past"

TO the woman who battles dirt with yesterday's broom, dust pan and carpet-beater, "Spring Housecleaning" is only the "Spring" name for a never-ending nightmare.

In half a million happy homes the

Premier

"FIRST AMONG CLEANERS"

has made "Spring Housecleaning" only a shadow of the past.

ELECTRIC VACUUM CLEANER CO., Inc., CLEVELAND, OHIO
50 Service Stations in Leading Cities
Exclusive Canadian Distributors
Canadian General Electric Company, Limited, Toronto, Ontario, and Branches



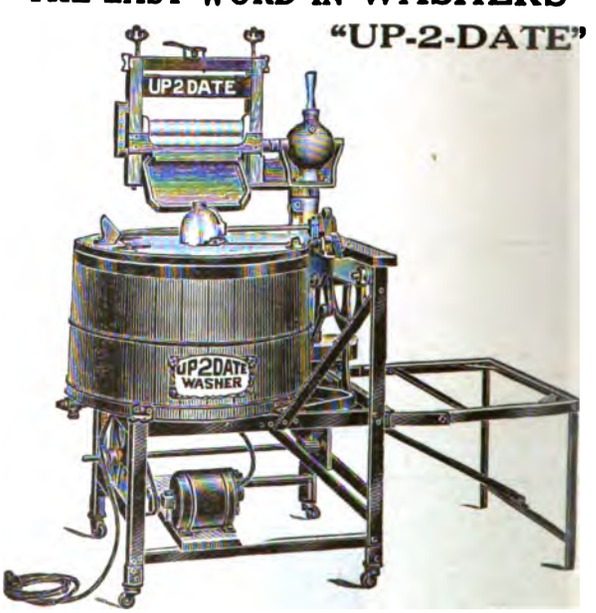


ANYONE CAN DESIGN
* * *
A-THREE-SIDED EMBLEM
* * *
OF QUALITY, SERVICE AND PRICE
* * *
BUT NOT MANY IN THE
* * *
BUSINESS OF MAKING
* * *
FLASH LIGHTS, BATTERIES AND
* * *
CHRISTMAS LIGHTING OUTFITS
* * *
CAN MAKE THOSE WORDS MEAN
* * *
AS MUCH TO YOU
* * *
AS WE WILL DEMONSTRATE
* * *
ON THE FIRST ORDER

Triangle Electro Trading Co.
79 Chambers St., NEW YORK CITY

THE LAST WORD IN WASHERS

"UP-2-DATE"



Our new model has the following points of superiority:

Heavy iron frame with folding tub stand.
Large cedar tub—6-sheet capacity.
All driving gears machine cut—insuring maximum life.
Swinging wringer—locks in 4 different positions.
Driving gear always in mesh—no clutch to get out of order.
Driving gears have double bearings, insuring smooth and noiseless running.
Mounted on heavy casters—washer can be moved from place to place.

Write for further particulars

THISTLE MFG. CO. 5716 Armitage Ave. CHICAGO

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AIRPLANE
ELECTRIC
HOUSECLEANER
WE, one of the world's largest vacuum cleaner manufacturers, have ready for immediate delivery a new and better electric vacuum cleaner, equipped with Robbins & Myers motor and a better type of motor-driven brush, which sells on first demonstration, and stays sold, because it does more and better work.
Write or wire today for territory and catalog
Kugro MFG. CO.
WARSAW, INDIANA

AIRPLANE WASHER



The Airplane Electric Washer

cabinet design, is a complete steam laundry in your home.

Gas burner, located directly underneath the boiler, keeps the water always at the temperature desired. It is the strongest, sturdiest, best built, fastest and longest lasting electric washer on the market. Has been tested and approved by the New York Edison Company and the New York Tribune Institute.

The Remmert Manufacturing Co.

of St. Louis, Mo., makers of the Airplane Electric Washer, have consolidated with the Hugro Manufacturing Company, of Warsaw, Ind., makers of the new Airplane Electric Vacuum Cleaner with motor-driven brush.

Write or wire today, for territory and catalogue, to headquarters, Warsaw, Indiana.

Hugro MFG. CO.

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ILLINOIS ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

MANUFACTURERS OF

Standard Porcelain



Trade Mark

Registered

The "Bull-Dog"

Assembled Split Knob
"Has a Grip Like Its Namesake"



Manufactured and sold under license U. S. Patent No. 829,392, February 3, 1920.

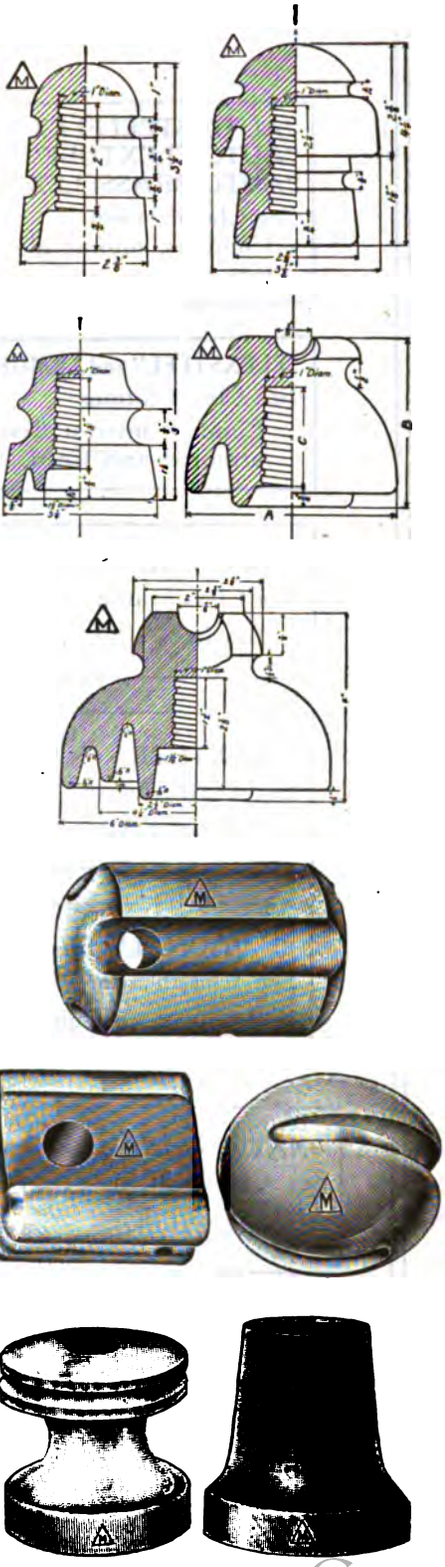
PROTECTION GUARANTEED

Special Porcelains Manufactured in Accordance with Specifications.

A Full Line of Export Types of Knobs, Tubes and Insulators Carried in Stock.

Pole Line Insulators

Strain Insulators, Secondary Rack Insulators and Pin Bases.



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INDEX TO NATIONAL PRODUCTS "All You Require When You Wire"

NOTE: This index is to aid the reader in locating description of NATIONAL PRODUCTS in the E. M. F. YEAR BOOK.

"AUTO-STEELFLEX"
"AUTO-FLEXTUBE"
"AUTO-BRASSFLEX"
See Classification
Conduits, automobile, and fittings therefor.

"FLEXSTEEL" and ARMORED CONDUCTORS
See Classifications
Conduit, interior flexible steel, Cables, armored and Cord, flexible, armored.

"NATIONAL" BRACKETS
See Classification
Brackets, wall, outdoor for insulators.

"FLEXTUBE"
See Classification
Tubing, flexible fabric, non-metallic.

"NATIONAL" Bushings
See Classification
Bushings, conduit, box and cabinet.

"SHERARDUCT" Rigid Steel Conduit
"ECONOMY" Black Enameled Rigid Steel Conduit
See Classification
Conduit, interior, rigid steel.

"NATIONAL" Locknuts
See Classification
Locknuts, conduit.

"NATIONAL" Metal Molding
See Classification
Raceways or moldings, metal for surface wiring.

"NATIONAL" Outlet Boxes and Covers
See Classification
Boxes, conduit outlet.

"NATIONAL" Metal Molding, Fittings, Tools and Devices
See Classification
Raceways or molding, metal fittings for.

"NATIONAL" Fixture Studs
See Classification
Studs, fixture.

"LIBERTY" Rubber Covered Wire and Cable
See Classification
Wire, rubber covered.

"NATIONAL" Switch Boxes
See Classification
Boxes, switch and cutout.

"All You Require When You Wire"

National Metal Molding Co.

General Offices: Fulton Bldg., Pittsburgh, Pa.

Atlanta, Boston, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, Buenos Aires, Havana, Manila, Mexico City, Lima, Peru, Rio de Janiero, Sao Paulo, Brasil, Santiago, Chile, Medellin, Colombia, Shanghai, China

Canadian Distributors: Canadian General Electric Co., Limited

Write for the National Catalogs

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A Book You Need

EVERY contractor and wireman in the business needs this new Hand-Book—the most complete book ever issued on the subject of metal raceways for surface wiring. It gives full instructions—with many illustrations—for using National Metal Molding under all conditions. It also lists and catalogs the various fittings and devices that are used in connection with Metal Molding. Because of its convenient size, the book can be easily carried and used right on the job. If you haven't got a copy, we will be glad to send you one, without charge. Just use the postcard enclosed with this book.

National Metal Molding Co.

Fulton Bldg., Pittsburgh, Pa.

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NATIONAL PRODUCTS

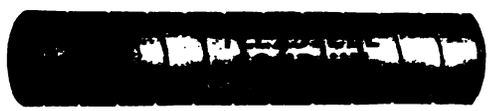
"All You Require When You Wire"



"SHERARDUCT" Sherardized Rigid Steel Conduit



"ECONOMY" Black Enameled Conduit



"FLEXSTEEL" Flexible Metallic Conduit



"FLEXSTEEL" Armored Conductors



"FLEXTUBE" Non-Metallic Flexible Conduit



"NATIONAL" METAL MOLDING. "Brings Electricity Where Needed"



"LIBERTY" Rubber Covered Wire and Cables, "FLEXCORD" Portable Electric Cord



"NATIONAL" Brackets



"AUTO-STEELFLEX"—Automobile Conduit and Fittings, Carburetor and Exhaust Tubing



"AUTO-FLEXTURE"—Non-Metallic Automobile Conduit



Fixture Studs



Locknuts and Bushings, Bush Caps





Outlet Boxes, Covers and Switch Boxes

"All You Require When You Wire"

General Offices: Fulton Bldg., Pittsburgh, Pa.

National Metal Molding Co.

Atlanta	Detroit	Portland	Buenos Aires	Rio de Janiero
Boston	Los Angeles	Salt Lake City	Havana	Sao Paulo, Brazil
Chicago	New York	San Francisco	Manila	Santiago, Chile
Denver	Philadelphia	Seattle	Mexico City	Medellin, Colombia
			Lima, Peru	Shanghai, China

Canadian Distributors: Canadian General Electric Co., Limited

Write for the National Catalogs

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"ZINKOTE" "NAVALITE"

Galvanized Pipe — Enameled Pipe



For Electric Wire Conduit

Made from the ore to the finished product in our plants

Inspected and Labeled under direction of Underwriters' Laboratories



MANUFACTURED BY
MARK MANUFACTURING CO.
General Office
111 W. WASHINGTON STREET
CHICAGO
Mills:
INDIANA HARBOR, IND. ZANESVILLE, OHIO
EVANSTON, ILL.

District Offices:
NEW YORK CITY
3148 Equitable Building
PITTSBURGH, PA.
538 Oliver Building
KANSAS CITY, MO.
1308 Commerce Building

District Offices:
LOS ANGELES, CALIF.
404 Security Building
NEW ORLEANS
701 Maison Blanche Bldg. Annex
MINNEAPOLIS, MINN.
608 Andrus Building

It's Built Right—It Stays Tight

It's Asbestine Composition



No. 43310

This is a wonderful heat resistant, excelling anything on the market.



No. 60666

We are manufacturers of all types of composition, water-proof sockets and plugs and molded insulation material of every description.

When you put in a Walsh weather-proof socket you can forget it as far as the weather is concerned. In a driving rain or a sizzling-hot summer sun, there is no socket like it.

Other points are its heavy socket shell, smooth finish, no seams on sides, and lugs which **reinforce** the contacts between wires and shells.



No. 1151

Stop and think whether you know of any other socket with all these qualities. Of course you don't.



Walsh Electrical Supply Co., Inc., 151-155 W. 18th St., New York City

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SPRAGUE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

TELEPHONE:
Longacre 900

527-531 West 34th Street
NEW YORK, N. Y.

BRANCH OFFICES

ATLANTA	Citizens & Southern Bank Bldg.	INDIANAPOLIS	Traction Terminal Bldg.
BALTIMORE	American Bldg.	KANSAS CITY	Dwight Bldg
BOSTON	84 State Street	MILWAUKEE	Public Service Bldg.
CHICAGO	Fisher Bldg.	PHILADELPHIA	Witherspoon Bldg.
CINCINNATI	Provident Bank Bldg.	PITTSBURGH	Oliver Bldg.
CLEVELAND	Illuminating Bldg.	ST. LOUIS	Pierce Bldg.

PACIFIC COAST REPRESENTATIVES

LOS ANGELES	Corporation Bldg.	SAN FRANCISCO	Rialto Bldg.
PORTLAND, OREGON	Electric Bldg.	SEATTLE	Colman Bldg.
SPOKANE	Paulsen Bldg.		

The Sprague Electric Works are pioneer manufacturers of wiring materials and of the following classes of electrical equipment in which they have specialized for years. These include:

WIRING MATERIAL

BX (Flexible armored conductor).
Greenfield flexible steel conduit.
Spragueduct (black enameled conduit).
Greenfielduct (hot galvanized conduit).
Outlet boxes and covers (complete line).
Spraguelets (all-combination bodies for exposed wiring).
Connectors, couplings and fittings for outlet boxes, etc.

APPARATUS

Electric hoists for all purposes.
Dynamometers (for testing gas engines, etc.).
Horizontal cargo winches.
Vertical car-pulling winches.
Ventilating Fans (for restaurants, hotels, etc.).
Printing press operating equipments (from the smallest to the largest).



MT Single Phase Motor with Foot Control Attached to Printing Press.

MISCELLANEOUS

Armored Hose (for steam, air and water).
Panelboards and Cabinets (specializing in safety first types).
Write for Bulletins and the name of the nearest distributor.



BX FLEXIBLE STEEL ARMORED CABLE

BX—Adapted to new building construction and remodeling work.



FLEXIBLE STEEL CONDUIT

Made of a single strip of galvanized steel interlocked and gasketed. For both fireproof and non-fireproof construction.



VENTURA VENTILATING FANS

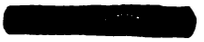
Furnished with capacities ranging from 750 to 1700 cu. ft. per minute, in sizes from 12 to 48 in. diameter.

Motors are wound for all Standard A.C. and D.C. voltages.



ARMORED HOSE

Armored high and low pressure air and steam hose, sizes ¼ to 2 in. Water hose and hot water hose, sizes ½ to 1½ in. Suitable for use on pneumatic tools, air drills, auto garages, etc.



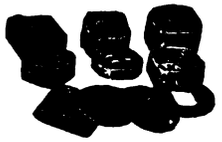
SPRAGUEDUCT

A cheaper rigid conduit, black enameled inside and out. All sizes in 10-ft. lengths.



GREENFIELDUCT

A rigid conduit distinguished by its heavy continuous galvanized coating from end to end, inside and out. Standard sizes, ⅜, ½, ¾, 1, 1¼, 1½, 2, 2½, 3, 3½ and 4 in., approximately inside.



OUTLET BOXES, COVERS AND FITTINGS

A complete line of outlet boxes with knock-outs in galvanized and black enameled finish, for concealed conduit wiring, including types for concrete work, with covers to match.



SPRAGUELETS

The all combination bodies for exposed wiring by which practically all branch combinations with standard wiring devices can be accomplished through the use of three knock-out bodies and a few standardized covers.



DYNAMOMETER

Electric dynamometers 1 to 1000 HP. for testing engines, transmissions, pumps, chassis, starters, tires, belts and motors.



DEAD FRONT PANELBOARDS AND CABINETS

For Edison plug fuses and N. E. C. fuses.

Standard or special types built to meet the most exacting specifications. Branch circuit switches are of tumbler type, 30-amp. 230-volt capacity, with quick break action.

Standard live front lighting and power panels also furnished.

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Sprague Electric Hoists



W TYPE. CAPACITIES 1 TO 6 TONS.



1-6. CAPACITIES ¼ TON, ½ TON.



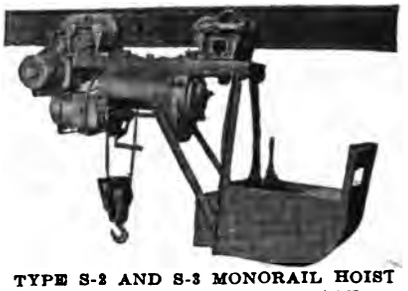
S-1. CAPACITIES ½ TON, 1 TON.



D-11 Spur Geared Winding Drum. Built in capacities from 1000 to 8000 lbs., pull at speed of 100 ft. per minute. Motor is direct or alternating current, geared to drum through triple reduction gearing.



S-1 MONORAIL HOIST WITH OPEN TRAILING CAGE



TYPE S-2 AND S-3 MONORAIL HOIST WITH OPEN ATTACHED CAGE.



VERTICAL WINCH

Capacities, 1 to 6 tons; speeds, 25 to 150 r.p.m. For general application.

HORIZONTAL WINCH

Capacities, 1 to 4 tons; speeds, 100 to 200 r.p.m. For general application.



W-2 MONORAIL HOIST WITH OPEN TRAILING CAGE.



GB-7 GRAB BUCKET MONORAIL HOIST WITH ENCLOSED CAGE

RATINGS AND WEIGHTS, STANDARD MONORAIL HOISTS, CASE CONTROLLED

Load, tons.	Hoist: Speed, ft. per min.	Hoist: Lift ft.	Hoist: No. of ropes	Hoist: Hoist type	Hoist: Motor: Frame	Hoist: Motor: H.P.	Trolley: Speed, ft. per min.	Trolley: Motor: Frame	Trolley: Motor: H.P.	Trolley: Minimum radius of curve ft.	Weight of monorail hoist complete, lbs.: With open cage	Weight of monorail hoist complete, lbs.: With enclos'd cage
Direct Current												
½	30	28	1	S1	H½	1½	350	M1	2	8	1835	1960
1	15	13	2	S1	H½	1½	350	M1	2	8	1865	1990
1	20	40	2	W1	M1	3	350	M1	2	8	1925	2050
1	40	40	2	W1	M2	6	350	M1	2	8	2045	2170
1½	26	50	2	W2	M2	6	350	M2	4	8	2435	2560
2	10	20	4	W1	M1	3	350	M2	4	8	1975	2100
2	20	20	4	W1	M2	6	350	M2	4	8	2095	2220
2	30	50	2	W2	M3	9	350	M2	4	8	2535	2660
2	35	31	2	S2	M2	6	350	M2	4	6	2660	3470
2	50	31	2	S2	M3	9	350	M2	4	6	2760	3370
3	13	25	4	W2	M2	6	350	M2	4	8	2525	2650
3	23	21	3	S2	M2	6	350	M3	6	6	2670	3280
3	33	21	3	S2	M3	9	350	M3	6	6	2770	3480
3	50	48	2	S3	M4	12	350	M3	6	6	4640	5300
4	15	25	4	W2	M3	9	350	M3	6	8	2635	2750
4	17	15	4	S2	M2	6	350	M3	6	6	2710	3420
4	25	15	4	S2	M3	9	350	M3	6	6	2810	3520
4½	33	31	3	S3	M4	12	350	M4	8	6	4660	5320
6	25	23	4	S3	M4	12	350	M5	10	6	4730	5390
Alternating Current												
1	40	40	2	W1	5180	5	350	5160	2	8	2125	2250
1½	26	50	2	W2	5180	5	350	5180	3	8	2485	2610
2	20	20	4	W1	5180	5	350	5180	3	8	2175	2300
2	21	50	2	W2	5180	5	350	5180	3	8	2525	2650
2	35	31	2	S2	5180	5	350	5180	3	6	2840	3550
2	50	31	2	S2	5201	10	350	5180	3	6	2890	3600
3	13	25	4	W2	5180	5	350	5180	3	8	2595	2720
3	23	21	3	S2	5180	5	350	5200	5	6	2850	3560
3	33	21	3	S2	5201	10	350	5200	5	6	2900	3610
3	50	48	2	S3	5008	15	350	5201	6.5	6	4790	5450
4	10	25	4	W2	5180	5	350	5201	6.5	8	2635	2760
4	17	15	4	S2	5180	5	350	5201	6.5	6	2890	3600
4	25	15	4	S2	5201	10	350	5201	6.5	6	2940	3650
4½	33	31	3	S3	5008	15	350	5008	10	6	5010	5670
6	25	23	4	S3	5008	15	350	5008	10	6	5080	5740

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RATTAN
CONDUIT FITTINGS



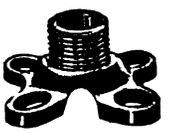
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National Code Standard. Made of malleable iron, galvanized, and packed in strong pasteboard cartons.



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National Code Standard. Made of malleable iron, galvanized, and packed in well made cartons.



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Made of malleable iron, galvanized, larger and heavier than others with hexagonal shoulder.



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Jaws specially shaped giving great leverage and allowing quick and easy application to conduit.



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Repulsion Induction Type
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For All Standard D. C. or A. C. Circuits

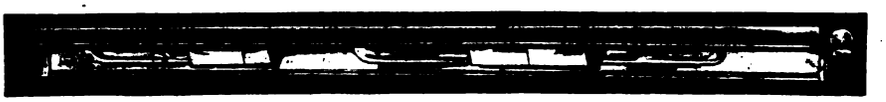
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If It's Made of Felt—Ask Booth

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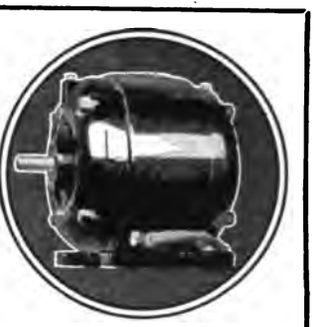


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Domestic Electric

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Motors



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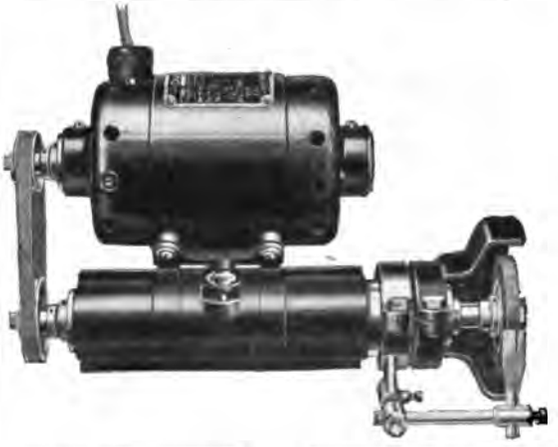
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One of our most popular stock sizes. Especially adapted for jewelers, dentists and laboratory work. Equipped with 8 ft. of cord and attachment plug. Five speed rheostat in base. Tapered shaft ends. Will take Ritter chucks and wheel arbors. Net weight, 12 pounds. Can be furnished with 5-32" Goodell Pratt chucks if desired.



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Handy, efficient, economical. For fast drilling and countersinking. Capacity, steel 3-16"; brass and alloys 13-64". Universal motor. Helical gear drive. Aluminum handle. 10 ft. cord, plug, switch and chuck. Shipping weight, 7 pounds.







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For tool room and production work requiring extreme accuracy. Seven interchangeable pulleys and spindles give exactly right cutting speed for all jobs. Motor swivels to five positions. Light and powerful.

Specifications

Motor—¼ H. P. Universal; spindle speeds, 3,600 to 50,000 R. P. M.; selected, dust-proof ball-bearings; length of travel, 5½"; shipping weight, 45 pounds.

Equipment

Twelve grinding wheels, from ¼" to 5" diameter; two ⅜" round emery pencils; seven extension spindles; cutter grinding rest; cross feed lever; two shanks; 10 ft. cord and attachment plug.

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Sensitive bench type. Very accurate on fine work. Saves time on small parts. 18" high, stroke 3¼". Rack and pinion feed. Capacity, steel 3-16", brass and alloys 13-64". Universal motor. Adjustable table. Shipping weight, 28 pounds.



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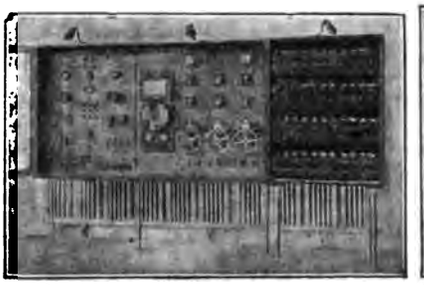
Big and growing fleets are proving the economy of electric delivery in laundry, bakery and similar lines.



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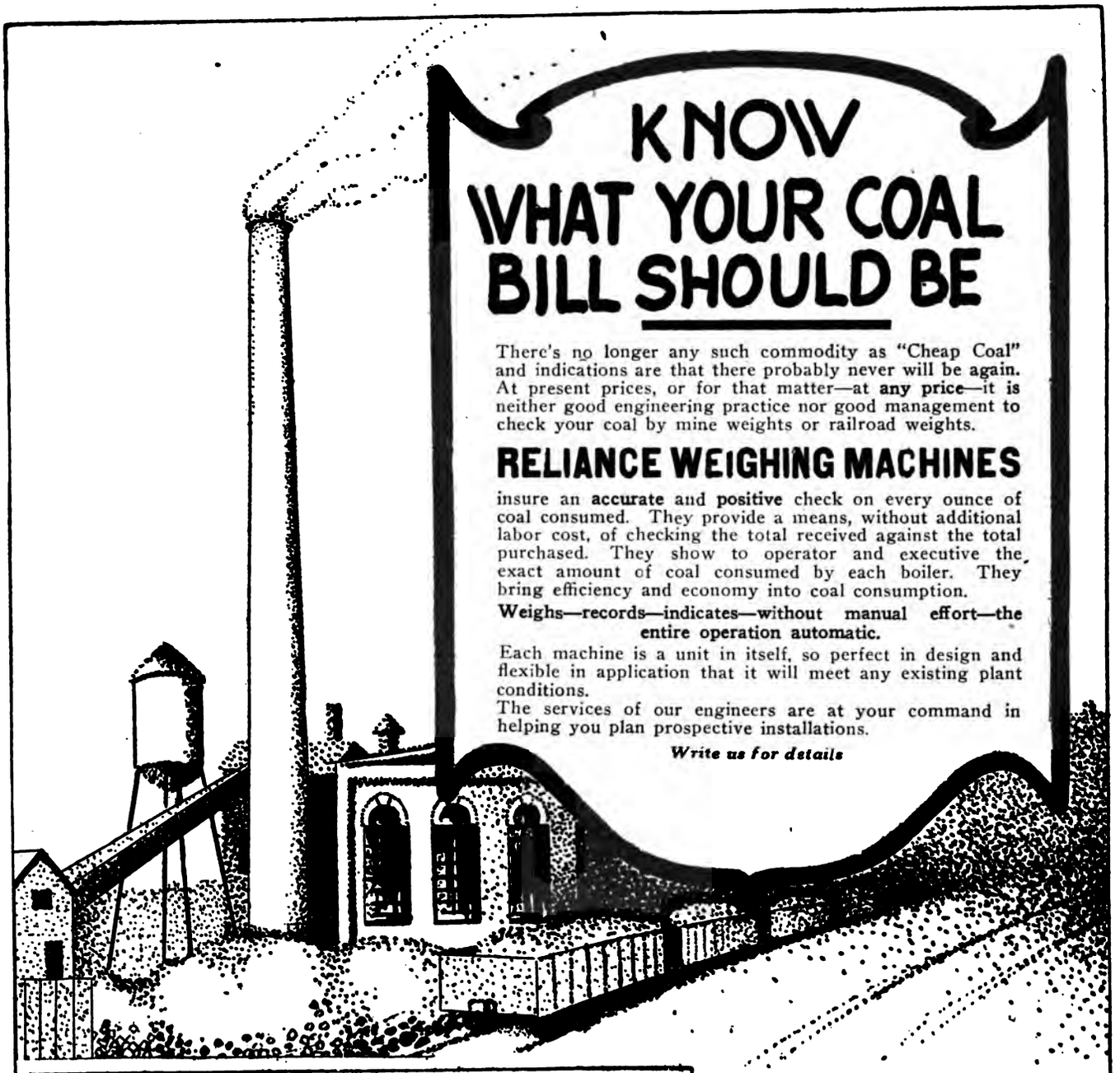
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There's no longer any such commodity as "Cheap Coal" and indications are that there probably never will be again. At present prices, or for that matter—at **any price**—it is neither good engineering practice nor good management to check your coal by mine weights or railroad weights.

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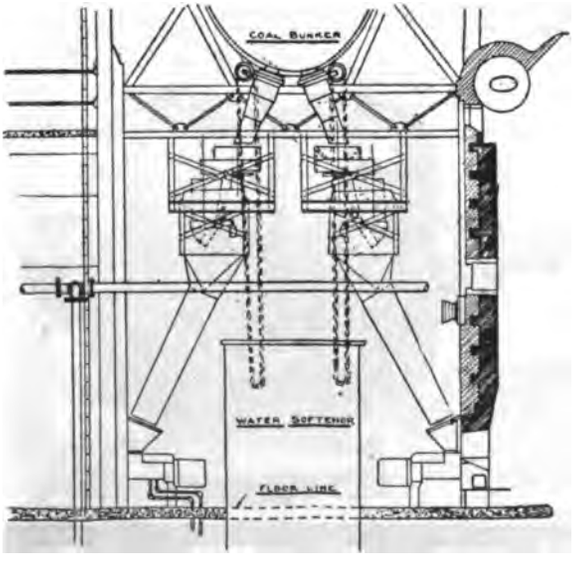
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Weighs—records—indicates—without manual effort—the entire operation automatic.

Each machine is a unit in itself, so perfect in design and flexible in application that it will meet any existing plant conditions.

The services of our engineers are at your command in helping you plan prospective installations.

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Worm and Spur Gear Speed Reducers

Effecting Economy in Power Transmission

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Inferior transmission loses hundreds of dollars in power for the plant in which the item of conservation is neglected.

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It is a known fact that a good type of speed reducer affords the most efficient and economical means of reducing the speed between motor and machine.

A good speed reducer is simple of construction; there are few moving parts to be driven. Consequently it offers the least resistance to the driving unit.

It is strong; a steady, rigid, well-ribbed body and good quality of material give greater strength than an over-abundance of metal.

Ganschow Speed Reducers embody all the points of economical speed reduction. They are made for reductions from 4 to 1 to 250 to 1, from ½ to 100 h.p.

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Chicago

Rawhide and Bakelite Noiseless Pinions
Bevel, Spur, Spiral and Worm Gears.

Ganschow Direct Drive Speed Reducer. Driving plates are firm and well balanced. They act as driving gears, and establish a momentum, saving a large degree of power.



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Universal Winding Company

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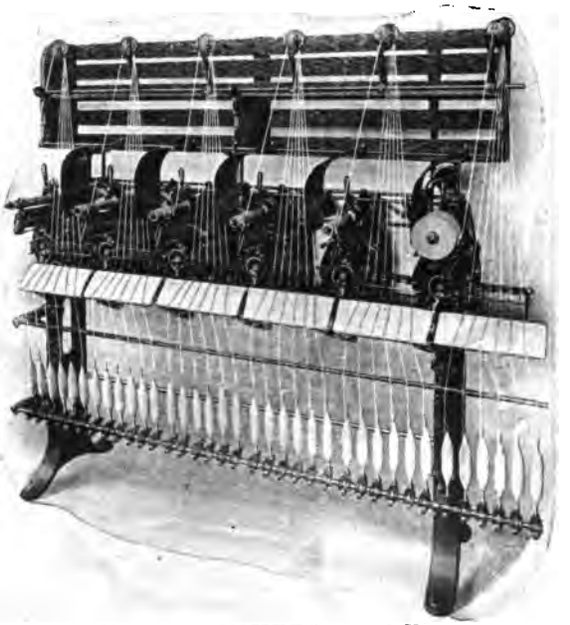
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No. 14 "UNIVERSAL"



No. 50 "UNIVERSAL" 6 Way

These machines in combination multiply fine yarn

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Typical of Hilo Quality is No. 934 Black Baking Japan. It gives a high gloss finish that stays on permanently. Final operations on equipment may be done after japanning,—Hilo "934" allows no smudging or dimming of the surface when holes are drilled or final assembly completed. No time-loss necessary for touching up.

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Makers of Enamels and Varnishes for 58 Years

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HIGH DIELECTRIC STRENGTH—Added protection for the same construction.

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FLEXIBILITY—The flexible nature of the material increases speed and efficiency of production without reduction of standards.

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Micabond Commutator Segment Plate
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We can fill any requirements — and solicit your inquiries and specifications

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The Standard Mica Insulation

PEERLESS MICA INSULATION
(IS STANDARDIZED)

Mica for Every Electrical Purpose

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11—Commutator Segments
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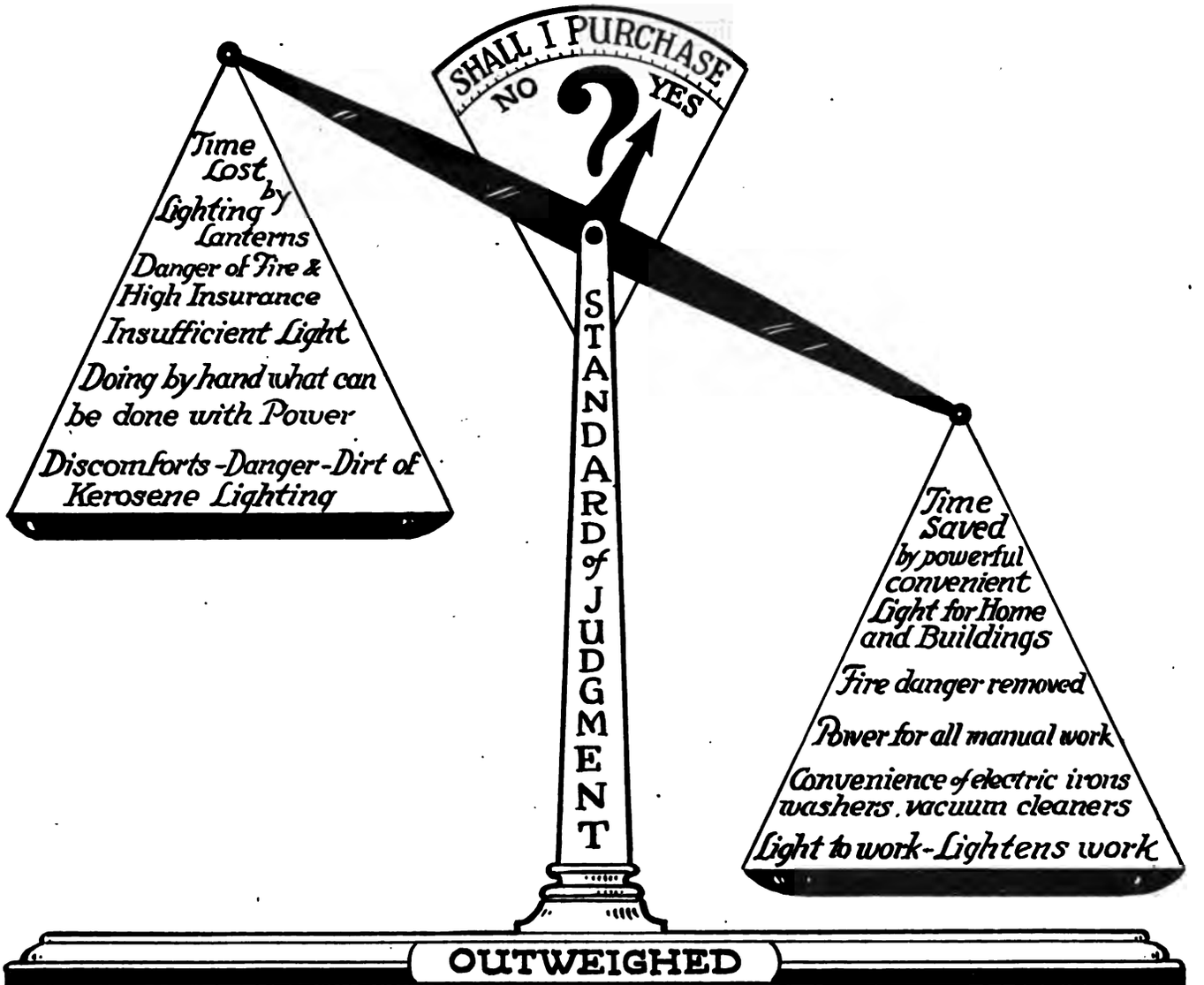
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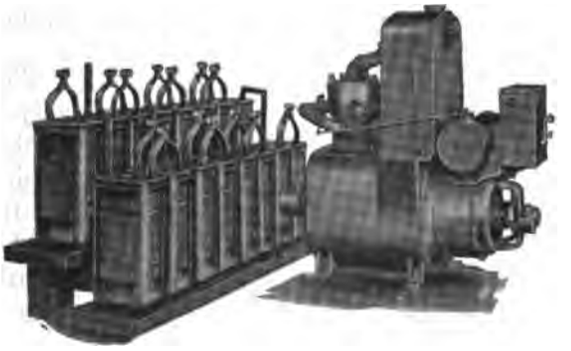
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Light When and Where You want it

3-H.P. L-type engine. 1250 watt Westinghouse generator. Simple, Compact, Durable. Engine and generator guaranteed 1 year, batteries, 5 years.

Semi-automatic control.

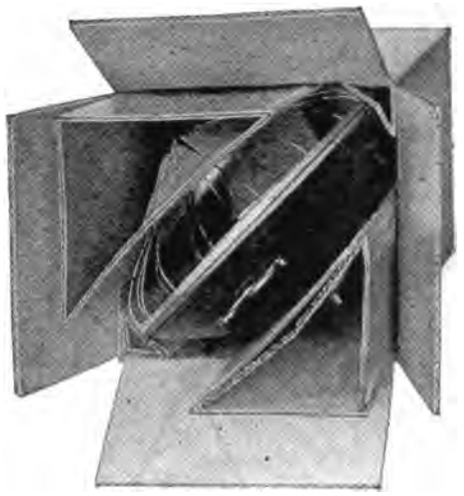
Switchboard of simplest design included in unit.



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THE sale and handling of larger units are greatly facilitated by a clean, litterless individual package such as the one illustrated. The box shown here was specially designed by H & D engineers and it is but one of hundreds of sturdy, strong, lightweight containers built to the specifications of a certain product. H & D Corrugated Fibre Board is unequalled in its adaptability to the packing requirements of electrical goods, and it offers a practical solution to almost every packing problem.

Make Your Packing Serve a Double Purpose

THE first office of packing is protection. But have you ever thought of it as a factor in sales?

The tendency is toward well-designed, attractive, individual containers, for larger standard units; clean, convenient cartons for the quantity packing of smaller products; standardization in packing to make handling, checking and sales easier.

Untidy, paper-wrapped and straw-embedded electrical merchandise in clumsy boxes and barrels is being fast left behind in the race for sale. It is discriminated against in favor of conveniently handled, easily checked goods in clean, standardized fibre containers. Pack *your* merchandise not only for its protection but with a thought to its sales.

Hinde & Dauch Corrugated Fibre Board Boxes, Containers and Packing Materials in an unlimited variety of design are at the service of the electrical trade everywhere.

The Hinde & Dauch Paper Company maintains a special department whose work is the designing of containers to fit a given product. Send us, collect, a typical sample shipment of any of your products and let us design, free of charge, a practical method of packing. Your goods will be packed as we think they should be and returned to you prepaid. Take advantage of this free service today.

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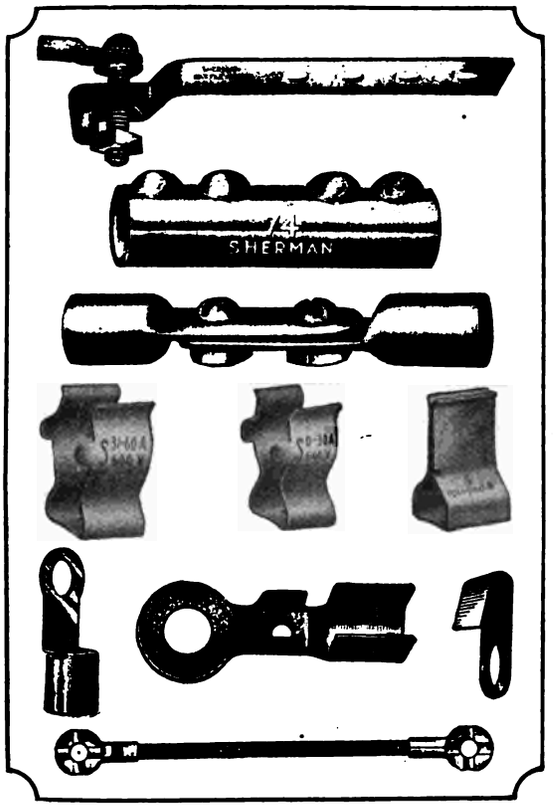
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If It's Made of Felt—Ask Booth

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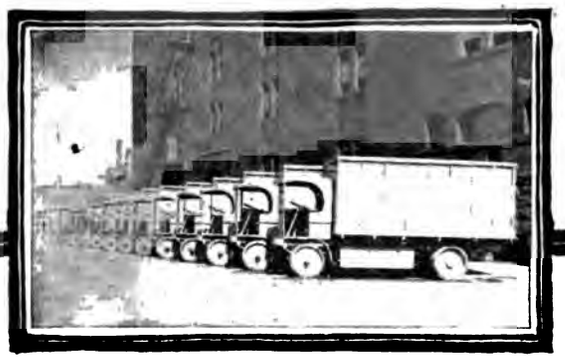
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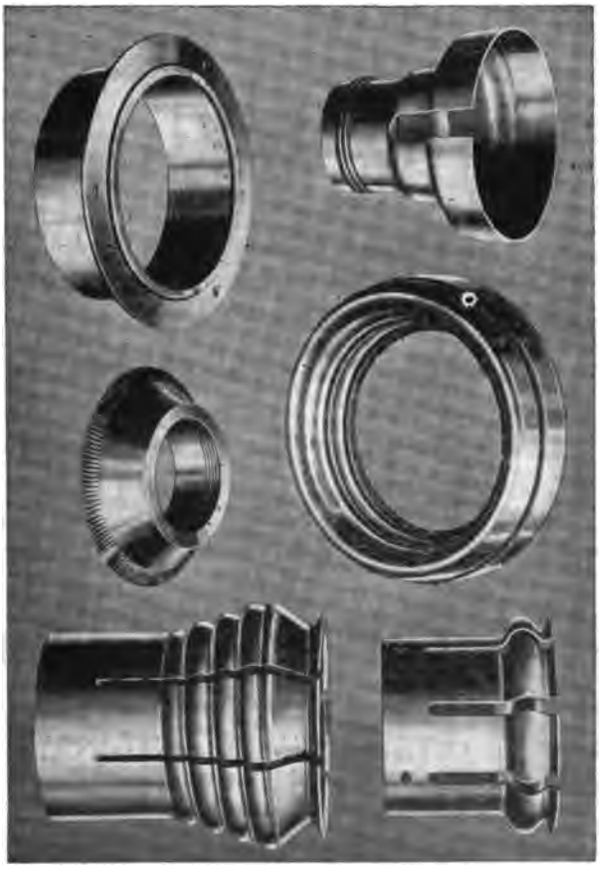
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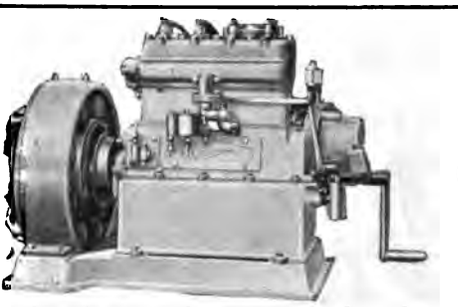
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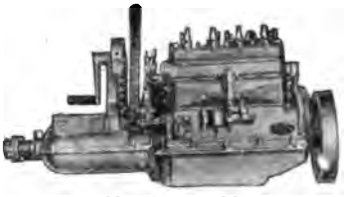
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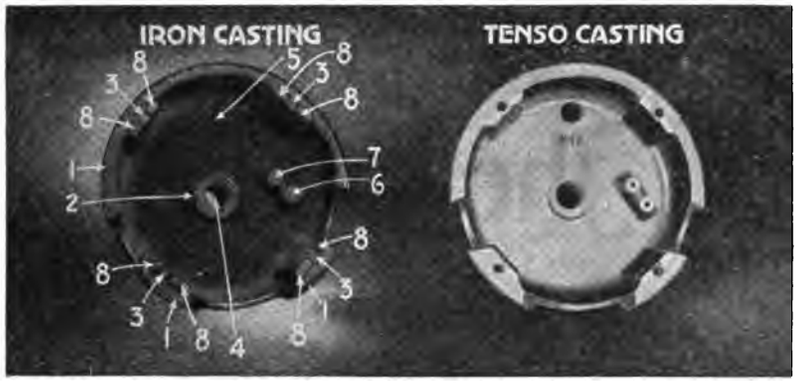
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MACHINE OPERATIONS ON THE IRON CASTING

1. Turning Face of Flange all round.
2. Spot Facing Boss around Bearing.
3. Drilling 4 Holes for Assembling Bolt.
4. Boring and Reaming Hole for Bushing.
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8. Machining 8 Bosses to fit Body Housing.

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He Cut Out Cast Iron Parts

When he found a better and less costly way—because he was the progressive, resourceful type of manufacturer, alert for changes in methods that would help him to master the changed conditions of today

The part illustrated is the End Shield of an Electric Motor. This is only typical of what can be done. The more intricate the part, the greater the saving as a rule. The tensile strength of the Iron Casting is 20,000 pounds per square inch —that of the Tenso part 45,000 pounds. The weight of the Iron Casting is 2 pounds 8 ounces —that of the same part in Tenso 1 pound 13 ounces



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Send sample parts or blue prints and find out what we can do for you in replacing parts of Iron, Malleable, Brass and ordinary White Metal with Tenso

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DIE CASTING DIVISION — Monroe and Throop Streets — CHICAGO

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Have there been any changes in personnel?

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East Pittsburgh, Pa.

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METERS

The Westinghouse type OA single and polyphase switchboard watthour meters, are noted for their initial and continuous accuracy, low maintenance cost, low losses, ready testing facilities, and the many other desirable features found in high grade watthour meters. All parts of the meter element are mounted on a supporting casting, and can be removed from the case as a unit without changing the calibration. The electromagnetic punchings are clamped so as to form one piece, which obviates the shifting of parts and assures the permanency of calibration because of the closed magnetic circuit. (1) The main (lower) bearing is a highly-polished hardened steel ball, resting between two sapphire cup jewels. (2) The one-piece case is of cast-iron, and made dustproof. (3) Micrometer adjustment is provided for both full load and light load. (4) Terminals on the front permit testing of switchboard meter elements while in service or the disconnection from the circuits and the connection to a test load if desirable. Westinghouse type OA polyphase switchboard meters are designed to indicate the true power in a two-phase, three-wire or four-wire, or a three-phase, three-wire circuit, regardless of the power factor or the degree of unbalance between phases. The rated current capacity of the polyphase meter is the current in each wire of the circuit; and the rated voltage, the voltage across one phase. The approximate dimensions of the single-phase meter are width, 6½ ins., height, 8⅞ ins., and depth, 6½ ins.; of the polyphase, width, 10 ins., height, 12 ins., and depth, 5½ ins.



Switchboard Type

The Westinghouse type OA alternating-current watthour meters, operate on the induction principle. The torque that rotates the disk is proportioned to the product of voltage, current and power factor of the circuit, and is counterbalanced by a retarding force exactly proportional to the speed. (1) A one-piece cast-iron case; parts mounted on central frame; dustproof covers easily removed and sealed; ball-bearing moving element; two permanent magnets clamped together as a unit; low speed worm. (2) High ratio of torque compared to weight of moving element, assuring long life accuracy within close limits over a wide range; accurate on varying frequencies and voltages. Not affected by wave form, power-factor, or external fields; permanent magnets shielded from electromagnets; low shunt loss. (3) The four dial index is arranged in a straight straight line; micrometer full-load and light-load adjustments; both accessible from the front of the meter; shunt field connections made in terminal chamber. (4) The disk-type moving element is acted on by the electro-magnets at one edge, and the permanent magnets at the opposite edge. The electro-magnet punchings are in one piece, and form a closed magnetic circuit that makes the meter remarkably free from the effects of stray fields. (5) The cover is of pressed zinc with dead black finish, or of glass. The glass windows are sealed and cover is fitted with a dustproof gasket—an important and significant feature. Installation of meter can be made without removing cover. (6) A sealed terminal chamber is provided at bottom, separated from the meter chamber by a dustproof partition. (7) The registering mechanism is designed for minimum friction. (8) The bearings are similar to those employed in the switchboard meters. The minute gyrations of the shaft give the ball a rolling action, maintaining a very low coefficient of friction, which constantly presents a new bearing surface. Three-wire meters are identical in appearance with the two-wire.



House Type

The type RA recording demand watthour meter indicates on a four-counter dial the total kilowatt-hours consumed and records in a permanent form the integrated demand over successive predetermined time intervals. It is entirely self-contained, and is installed as an ordinary watthour meter and requires no additional apparatus or wiring. The measuring and recording elements are mechanically interconnected; and there are no electrical contacts to become inoperative. The recording element is controlled by an exceptionally high grade clock, good for at least 85 days on one winding. The recording paper is of sufficient length

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The Westinghouse Electric & Manufacturing Company

METERS—Continued



to last 86 days, and the self-inking feature provides sufficient ink for 85 days, thus reducing the maintenance cost to a great degree. The measuring element is the standard Westinghouse type OA watthour meter with special gear train, which under load, advances the counters in the regular manner, and at the same time, causes the pen to advance across the record paper in exact proportion to the energy registered. These meters are all polyphase.

INSTRUMENTS

Westinghouse Type SX switchboard ammeters and voltmeters are intended for general switchboard applications wherever the highest grade instruments are required. They have 6¼ in. dials and 5¼ in. scales. (1) The movements are made very light, assuring the minimum of pivot and jewel wear and no injurious effects from shock or vibration. (2) The scales are designed for maximum legibility. (3) The covers are of flat glass which renders the entire pointer visible, and makes the instrument easy to read. Metal covers can be supplied, having a small window over the scale, if desired. All instruments have external zero adjusters, and are dust and moisture proof. These instruments operate on the D'Arsonval principle, and embody the latest improvements in design. The movement complete, with core and pole pieces assembled, can be removed as a unit, thus facilitating inspection and repairing. Westinghouse Type SX ammeters are regularly furnished with rear connections and with standard finish of dull black marine. When desired they can be supplied with black dials having white figures, pointer and markings.



Type SX Voltmeter

Westinghouse Type PX, medium-sized portable instruments, for use on D-C. circuits, are direct reading instruments for general testing purposes. They are very handy and serviceable for central station analysis tests, for trade schools, high school and college equipment tests, and for radio battery tests. The Type PX are particularly adapted for automobile and battery testing. Movements are very light, assuring minimum pivot and jewel wear and no injurious effects from shock or vibration. Scales are made of metal and subtend an arc of 110 degrees, giving large open divisions which are uniform throughout. Cases are made of moulded composition, which is not only strong, but is acid resisting, making the instrument particularly desirable for battery testing. The light metal frame on which the coil is wound moves through the air gap of the permanent magnet and makes the reading inherently dead beat. All instruments are dust and moisture proof, and have external zero adjusters. Type PX instruments operate on the D'Arsonval principle. Westinghouse Type PX ammeters have shunts contained in the case except where such heavy capacities require an external shunt.



Type PX Voltmeter

Westinghouse portable graphic instruments are especially desirable for service where records that are as accurate and reliable as those obtained on large switchboard graphic instruments are necessary. These instruments are applicable for analysis of motor operation, typical consumption curves of large industrial consumers, and records showing power distribution. All such purposes require graphic records covering long periods of time, and these records are as accurate as it is possible to obtain. The Type M portable graphic wattmeter, being an adaption of the Westinghouse switchboard type of instrument, fulfills all these requirements. A hand-wound clock is used for speeds up to 4 ins. per hour.



Portable Graphic Wattmeter

Westinghouse switchboard graphic instruments make an accurate and permanent record of the electrical quantities involved in power-house operation. The indicating dial makes separate indicating instruments on the same circuit unnecessary. Westinghouse instruments operate on the relay principle, the measuring element actuating only contacts, and not moving the pen directly. In turn, these contacts energize a device arranged to move the pen, and the use of resistances prevents harmful sparking at the contacts, which are made of special alloy. The power required for the measuring element is no greater than that required for Westinghouse indicating instruments. The record is made by the pen moving in a straight horizontal line, at right angles to the motion of the rectangular co-ordinate paper. The pen is self-feeding and will hold one month's supply of ink. The record paper is supplied in a long roll, providing continuous records for any desired period. The clock which turns the paper rolls is of the electric self-winding type. It requires no attention.



Switchboard Graphic Wattmeter

INSTRUMENT TRANSFORMERS

Westinghouse portable current transformers are generally used for emergency tests in the field, and are therefore, made smaller in size and lighter in weight than the switchboard instrument transformers. These transformers are of the improved core type, mounted in wood cases, with a leather handle. They have insulated binding-posts for the secondary connections. and uninsulated binding-posts for the primary. For 660 and 2200 volt transformers, the primary winding will stand a test of 10000 volts. For 440 volt transformers, the primary winding will stand a test of 5000 volts. The secondary winding, in all cases, is tested at 2000 volts. The ratio accuracy of these transformers is guaranteed to be within ½% of the full load voltage rating when used with a load of 20 volt-amperes on the secondary. They will carry a load of 100 volt-amperes continuously. All Westinghouse portable voltage transformers are compensated for 20 volt-amperes at 115 volts secondary. Without appreciable change in accuracy, the 25 cycle transformers may be used on 60 cycle, and the 60 cycle transformers on 133 cycles.



Portable Current Transformer

Westinghouse indoor, oil-insulated type, voltage transformers are designed for use on voltages from 200 to 70,000 volts. Types up to 14,000 volts are mounted in cases made to fit in cells, or in the limited space behind switchboards. For voltages up to 8500, they are mounted in cast-iron cases provided with mounting lugs. For voltages above 8500, they are built for floor mounting. For voltages of 4000 to 12000 inclusive, the transformers are so designed that the high voltage leads can be brought through either the top, or the sides of the case, by means of the extra bushing holes and flanges provided. For protection against line surges Westinghouse transformers designed for voltages of 22000 and above



Voltage Transformer (Oil-insulated).

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The Westinghouse Electric & Manufacturing Company

INSTRUMENT TRANSFORMERS—Continued

(such as the one illustrated) have choke coils mounted in their cases, and connected between the transformer windings and the line.

The Type K, two and three-wire transformers, comprise a line of low-priced transformers of good accuracy, available over a wide range of application. This type is listed for ammeter, wattmeter, or watthour meter use, but may also be used for operating relays and circuit breaker trip coils, where the load at 4 amperes does not exceed 25 volt-amperes at 25 cycles, or 65 volt-amperes at 60 cycles. These transformers should not be used with relays where the circuit-breaker trip coil is connected in series with the relay.



Voltage Transformer (Dry Type)

A high degree of accuracy in the ratio of primary to secondary current, and a minimum phase displacement error, are obtained in Westinghouse Type KA, semi-portable transformers. This type is recommended for indoor service in all cases where highest accuracy is required. The transformers are arranged with the primary leads on the opposite ends of the coils, an arrangement well adapted for switchboard service. Lugs are provided for mounting purposes. In the ordinary form of portable current transformer, extreme accuracy is usually sacrificed to obtain portability, and convenience of application. The Type KA, semi-portable transformer is the standard type KA, fitted with a special carrying handle, and equipped with terminals.



Semi-Portable Voltage Transformer

TRANSFORMERS



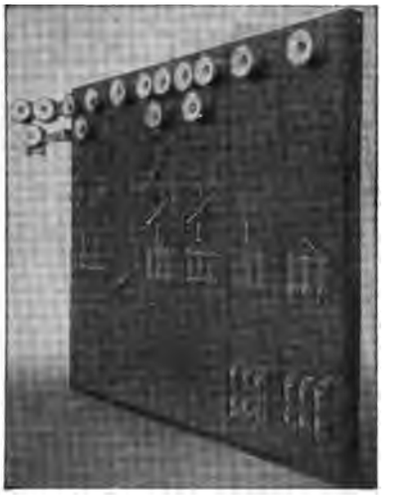
Westinghouse distribution transformers range in capacity from 1 to 200 kilovolt amperes, and are listed for voltages from 460 to 84,500 volts, both 25 and 60 cycle. As no one form of construction is best adapted for this wide range of capacity and voltage, Westinghouse distribution transformers are assembled in four different forms, the particular construction being in accordance with the voltage, capacity, and frequency used. To distinguish, not only the form of construction but also the class of service, these transformers are made in eleven different types. Types S and SA are for single-phase pole or platform mounting, SM is for single-phase man-hole mounting. These have the distributed-shell form of construction for 460, 575 and 2300 volt distribution service. Types SK and SKA, for single-phase pole or platform mounting, and SKM for single-phase manhole mounting, and ST for three-phase pole or platform mounting, and STM for three-phase manhole mounting, all have the rectangular core form of construction for service on 4600 to 2300 volt lines. Types SC for single-phase and SCT for three-phase platform mounting, have the cruciform-core construction for 84,500 volt service. The SS type, for single-phase platform mounting, have the simple shell form of construction and are large capacity, 25 cycle transformers, for distributing service from 2300 to 13800 volts.

REGULATORS

The Westinghouse type C, motor-operated, induction feeder voltage regulators are equipped complete. These regulators are built for single or polyphase service, and are used for maintaining constant normal voltage, on each feeder of a transmission, or distributing system, independently of all other feeders on the system. They are also finding economical use on feeder circuits on which it is desirable to increase the normal load, it being less expensive to install a regulator to obtain normal voltages under the new load conditions than to install a heavier feeder. Type C feeder regulators have especially high electrical performance; are very rugged, and operate at low maintenance expense. Compounding coils on the primary relay prevent "hunting" of the regulator, and practically eliminate sparking of the relay contacts. In the standard regulators, the rotor is turned by a small a-c. induction motor, driven through a pinion, spur-gear, worm, and worm segment.



SWITCHBOARDS



Westinghouse switchboards can be furnished to meet any commercial requirement, for controlling and applying the electric current. Standard panels, equipped with standard apparatus for various classes of service, intended primarily for light and power systems of small industrial plants, public garages, hotels and central stations of small capacity, are designed to meet practically all ordinary requirements in switchboard installations. For special conditions and installations, switchboards can be built to specifications, and in all cases, the maximum degree of safety to life and property is assured by the careful workmanship and proper selection of equipment by Westinghouse engineers. Black marine-finished slate and black marine-finished blue Vermont marble are the standard for all Westinghouse panels. The instruments regularly included in the panel equipment are of the highest grade. The meters supplied are of the 7 in. round-pattern type, except in the case of the smaller switchboards, where the 5 in. round type meters are furnished. Field rheostats are operated by means of a hand wheel on the front of the panel. Indicating ground detectors can be furnished if desired for systems up to 600 volts and static detectors for voltages of from 1100 to 2200. All Westinghouse panels are accurately rated in accordance with the N. E. Code and will carry their rated amperage continuously.

CIRCUIT-BREAKERS

Westinghouse oil circuit-breakers afford the best insurance against costly interruptions of service. They are made in many types, single-throw or double-throw, manually

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The Westinghouse Electric & Manufacturing Company

CIRCUIT-BREAKERS—Continued

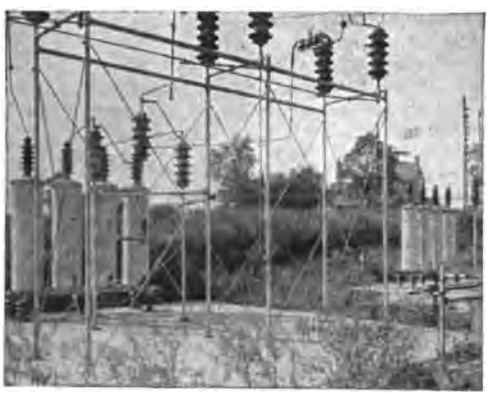


Illustration shows Type F3, indoor, electrically operated, wall-mounting, automatic three-pole single-throw 500 ampere circuit-breaker.

or electrically operated. The Type F, oil circuit-breakers comprise a complete line of moderate capacity, non-automatic and automatic, manually or electrically operated breakers. Type F3 is particularly adapted to controlling lines, where they enter buildings; for controlling branch feeders from main lines; for sectionalizing feeders; for cutting out transformers; or for many of the other numerous purposes for which an outdoor form of breaker may be utilized on distribution systems.

LIGHTNING ARRESTERS

Westinghouse electrolytic lightning arresters are recommended for stations of large capacity operating at 1000 volts and above, particularly where generators are to be protected. The distinctive features of the Type AK arrester are as follows: An inorganic electrolyte that is more stable chemically, less affected by heat, and which causes less dissolution of the film between charging periods than has heretofore been possible with electrolytes. A double cone-shaped aluminum tray, the area exposed to the electrolyte being double that of any other arrester; the trays are spaced by porcelain pieces, and not touching wood. Ventilating duct in center of tray stack for additional circulation of oil. Tank linings are of bakelite micarta, impervious to moisture. Charge and discharge



resistor on all arresters. The use of sphere gaps on arresters of 15000 volts and above. All listed three-phase arresters are adapted for grounded or ungrounded neutral service. These arresters consist of four elements, one connected to each phase, with the fourth element connected between the common point of the three and ground. The Type AL impulse gap, for lightning arresters, is recommended for use in connection with those arresters that protect stations of large capacity operating at 11000 volts and above. The development of the sphere gap partly increases the efficiency of the arrester, and is superior to the old-fashioned plain horn gaps formerly used. The previous time lag is eliminated so that all frequencies are discharged at the same voltage. The new Westinghouse impulse gap has a negative time lag; that is, the higher the frequency, the lower the voltage at which the gap discharges. Thus the impulse gap automatically selects the dangerous surges, and gives protection more quickly than any other known form of gap. It should be particularly noted that this impulse gap will protect insulation against a steep-wave-front surge of reverse potential, that is, a sudden drop in voltage. The high-frequency discharge voltage may be as low as two-thirds, or even one-third, of the normal frequency value. The Westinghouse impulse gap consists of standard porcelain insulators (two of which are used as condensers), unbalancing resistor, auxiliary electrode or tickler, a sphere gap, a short circuiting clip, a charge and discharge resistor, and a supporting framework. The framework is equipped with feet which can be mounted upon an existing structure, if inverted feet or other standard pipe connections and fittings are supplied.

VOLTAGE REGULATORS

Westinghouse voltage regulators are designed for both A-C. and D-C. generators. They are arranged in a suitable case, and constructed for bracket, panel, or pedestal mounting as installation conditions may require. Regulator parts are arranged in the case for the control system located in the upper part supported on a small cast base with the rheostat shunting relays arranged in horizontal rows at the bottom. Both the control element and the relays are self-contained units, and either can be removed from the base without disturbing its adjustment. Any size regulator can be designed for mounting on a 16 in. panel. The control system for A-C., and separately-excited D-C. generators, consists of the main control magnet and the vibrating magnet, with the main contacts between them. These magnets, of the solenoid type, are very sensitive, and are provided with adjustable dash-pots which permit adjustment of regulation to suit the characteristics of the system. The vibrating-magnet relay is used to govern the operation of the vibrating magnet. On the larger size regulators, one or more master relays are used to control a group of rheostat-shunting relays, thus relieving the main contacts of handling control currents beyond their capacity. The use of the master relay is made possible by the A-C control, and permits of the construction of regulators with as many as 60 rheostat-shunting relays. The vibrating magnet relay and the rheostat-shunting relays operate simultaneously in response to the regulator. Disconnecting and transfer switches of improved design are located below the case.



SAFETY SWITCHES

Krantz enclosed switches are used extensively wherever the ordinary knife-blade switches may be applied, with the difference that the enclosed switch provides safety to the operator. They are especially desirable in steel mills, factories, mines, and similar places employing men having practically no knowledge of electricity and its attendant risk, where switches must be located in exposed places subject to damage from loaded trucks, or from heavy material being carried past such locations. The Krantz safety switches offer particular advantage in that they are 100 per cent safe under all conditions of service, brush moving contacts take the place of the knife blade form of contact which has previously been standard for all switches. (1) The impossibility of coming in contact with a live part either in operating the switch, or in replacing the fuse. (2) The double-break brush type, movable switch contacts, which cannot weld shut from slow closing by incompetent operators. (3) Arcing tips on brushes, which protect brush leaves. (4) Easily replaceable contacts. (5) Heavy sheet steel box of No. 12 gauge steel or of heavy cast-iron as required. The switch parts are so



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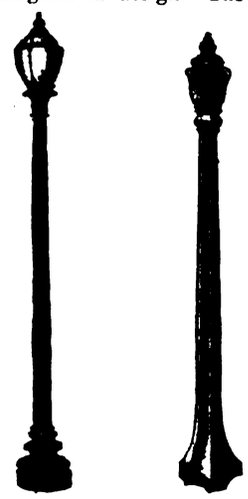
SAFETY SWITCHES—Continued

mounted inside the box that the door over the fuses is automatically locked when the switch is in the closed position. When the switch contacts are open, the door can be opened after turning the handle to the "off" position, thus opening the auto-lock device. All fuse connections are provided for the use of N. E. Code Standard enclosed fuses, up to 400 amperes inclusive. Switches of higher capacities are arranged to take copper link fuses. The insulation of the brushes from cross-bar and movement is water and acid proof, and does not warp or shrink. Handle is of black-enameled wood.



STREET POSTS

Cutter posts are manufactured by pioneers in the field of outdoor electric lighting. They are both artistic and original in design. The best quality grey iron, the recognized standard material for ornamental posts, is used exclusively in their construction. These posts are struck from metal patterns, thus ensuring clean castings, with ornaments true to design. There are many designs of Cutter street posts to select from, one exactly suitable for any city or suburban requirement. Until recently the single-light standard has been used almost exclusively in residential portions of cities, for park lighting, boulevards, and entrances to private grounds as well as public buildings. The development of the high efficiency incandescent units of high candle power has made it possible to install single-light posts in business districts, so spaced that the illumination is adequate for all purposes, and the cost of installation and maintenance reduced to a minimum. These new lamps are more efficient in the 15 and 20 ampere class. As it is usually not practical to supply power to the lamps at these values, compensators are mounted in the tops of the posts to take power from a 6.6 or 7.5 ampere line and deliver it to the lamps at 15 or 20 amperes.

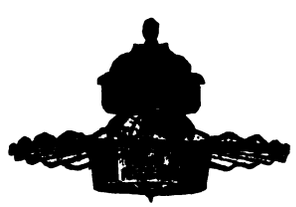


Parkview **Suburban**

The Suburban post has a 16-inch octagonal base. The height from ground to center of light source is 10 feet and 6 inches, without extension capitol. The Parkview post is designed especially for lighting parks, boulevards, and entrances to public places. It has a base of 16 inches, with a column of 5½ inches; diameter, 17 inches above the base and tapering to 3½ inches near the top. The height to top of column is 9 feet and 5 inches; to light center, 10 feet and 9 inches.

STREETHOODS

The design of Cutter streethoods is the result of many years of experience in the development of street-lighting equipment. Every detail in their construction has been planned, so that they can be easily installed and wired, and provide efficient and lasting service. Copper heels on Cutter street-hood reflectors insure maximum life, because they prevent chipping of the enamel from contact with screw or clip supports. When enamel is chipped, the metal body of the reflector is exposed to the air; rust sets in and spreads rapidly over the surface of the reflector, reducing the efficiency and shortening the life. The beaded edge on Cutter reflectors also prevents rusting. The three coats of enamel on both inside and outside surfaces, are lapped over the beaded edge, forming a protective covering that is extremely durable. In Cutter street hoods, the parts are interchangeable, permitting combinations for every requirement.



INDUSTRIAL FIXTURES

For industrial fixtures, the Cutter holder socket reflector consists of one-piece porcelain enameled steel reflector fastened securely to the porcelain body of the holder socket. Gaskets between the porcelain sockets and reflectors make the fixtures weatherproof. Cutter holder sockets are easy to wire. One complete fixture can be installed in two minutes, only a few operations being necessary. They have watertight cast-iron covers, heavily galvanized and painted which will not corrode. These reflectors are insulated from the conduit, and the terminals are protected from accidental short-circuits. The holder socket reflectors are held in a level position, correct with respect to the lamp filament, thereby securing the distribution of light for which they are designed. They are well protected from dust accumulation, and are easily cleaned. They are also interchangeable. Reflectors of the various Cutter types may be substituted at any time, and reflectors for medium base and mogul base lamps may be interchanged respectively with medium screw and mogul screw sockets.



AUTOMATIC RANGES

Westinghouse automatic electric ranges are equipped with a clock which automatically starts the cooking and a heat indicator which automatically turns off the current. The thermostat, or heat indicator, in the door of each oven, can be set to utilize just the necessary amount of heat, and when that point is reached, will automatically turn off the current. The cooking requires no attention. Hence these ranges are known as the Automatic Silent Servant. All Westinghouse electric ranges are approved by the National Board of Fire Underwriters and by the Good Housekeeping Institute. They are especially noted for their economy in operation because the automatic control saves current. The ovens are properly ventilated, and there are no disagreeable odors from the cooking. All parts are accessible for cleaning and repairing, and can be easily removed, even the oven burners. The ovens have a special aluminized finish, and are heat-insulated with the highest grade of mineral wool. The doors are tight-fitting. The thermostats and thermometers are positive and reliable. All burners have three-heat snap switches. The dials show the switch position, and the porcelain buttons indicate the burner controlled. Dirt, soot and fumes are eliminated. All ranges are finished in black japan, baked on. The ovens in Westinghouse ranges utilize the heat-storage principle. The good results obtained in the modern type of gas range can be surpassed by the electric range owing to improved internal ventilation of the ovens, and the efficient application of heat. Meats, pies, bread, cakes, etc., can be evenly browned to any degree, top, bottom and sides. Surplus moisture is carried off, condensed and deposited in drip cups provided for the purpose, but no heat is allowed to



Type 3-19B Automatic Electric Range

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AUTOMATIC RANGES—Continued

escape. The stove top burners have no automatic control, but each is equipped with a three-heat switch, a turn of which brings the burners to a red heat almost instantly. Cooking can be done on these burners with the same ease and rapidity as with any other fuel, without the usual disagreeable fumes. The legs and door frames of the range are metal castings. The front of the range door is sheet steel coated with vitreous enamel. Other parts are of selected sheet steel. The Westinghouse ranges are sturdy and well-constructed throughout, parts are practically unbreakable and cannot work loose. Ovens are built of rust-resisting sheet steel, and are coated on all sides with a special aluminum paint which increases the efficiency and further protects the ovens from rusting. A heat shield, especially designed, produces an even temperature. All joints are double-seamed and steam tight. Glides fit over studs inside the ovens, and are easily removable. A panel at the rear of the stove can be removed, uncovering all receptacles, contacts, wires and connections. The back of the circuit box can likewise be removed, making accessible all working parts of the circuit breaker, clock, switch, and every wire terminating in the box. Top of range can be lifted up and back for repair or inspection, disclosing every contact and connection to the burner and switches. The Type 3-19B and 2-19B can be furnished with combination gas and electric equipment. These are exactly the same in construction as the straight electric, except the stove top burners, which in the combination ranges are replaced by four gas burners. This combination permits the use of gas-burners on the stove top, and electricity for the ovens. Instructions are given with each range, and complete wiring diagram is pasted on the back for permanent reference. The Type M-2 electric range is a new addition to the Westinghouse line, comprising the best features of all the other types together with a number of new developments. It is built in three distinct types, (1) Full-automatic, having clock to turn the oven burners on, and thermostat to turn current off. (2) Semi-automatic, having only a thermostat to turn off the oven burner. (3) Non-automatic, having no automatic features. The No. 515 is a small electric range, especially adapted for use in apartment houses, bungalows, and kitchenettes.



Type 2-19B Half Automatic Electric Range



Type M-2 Electric Range



Type 515 Electric Range With High-Back Warming Shelf.

ELECTRIC FANS

The attractive appearance of Westinghouse fans, due to the symmetry of the drawn steel motor and base, is universally conceded. The same feature that gives the pleasing smooth surface, and makes possible the attractive finish, gives added strength and marked reduction in weight. Their strong guard, protecting felt base covering the entire bottom of the fan, their perfect oiling system, adaptability to either desk or bracket mounting, and their new black blades and guard which will not tarnish, are all distinguishing and desirable features of Westinghouse types. The new design of the single-phase A-C. induction motors in the 12 and 16 in. fans, gives a wider range of operating speed than has hitherto been found possible even with a split-phase winding, which uses reactance and resistance to secure a modified form of three-phase current, and requires considerable energy in the resistance and reactance coils without a corresponding gain in the efficiency of the motor. The new Westinghouse design uses a current transformer in the base of the motor, in place of a choke coil. The starting winding is energized by this transformer, and is in the circuit continuously, no centrifugal switch being used. The careful design of this transformer makes it possible to vary the speed of the motor within wide limits, without sacrificing the starting voltage, and therefore the starting torque, a very important feature. This change renders the motor less liable to injury through lack of attention or careless handling. All fans are guaranteed against original defects. The Whirlwind 8 in. fan, is extensively used in homes and offices where low operating cost is of importance. It has the same pleasing outline as the more expensive fans, its lower cost of operation being due to the absence of the speed control switch, and the omission of other refinements, not required for durability. Base, motor body, and end brackets are of drawn steel, blades and guard of steel. The whole fan is finished a dull black. It is furnished to operate on all standard voltages. This fan is provided with a separable plug, with 6 foot cord. It has a hinged joint for tilting at the desired angle. The base, motor body, and end brackets of the 10 in. desk and bracket fan, are drawn from sheet steel. The frame part of the oscillator which is a die casting, forms the motor body and oscillator case. Induction motors are used for 60 cycle fans, series motors for 40 cycle, 50 cycle, and 25-30 cycle A-C. and D-C. fans. The standard finish is dull black, smooth and lustrous, no joints, ridges or rough spots existing. Fan and guard blades are lacquered a dull black. This fan has three speeds—high, medium and low. Grease cups have spring operated felt wicks. Non-oscillating fan can be tilted 15 degrees forward or 90 backwards. Oscillating fan, 20 degrees forward in bracket position and 20 both forward and backward in desk position, with a set screw to prevent slipping beyond this angle. Arc of oscillation can be changed from 90 to 45 degrees as desired. Regularly equipped with 8 foot cord and separable attachment plug.



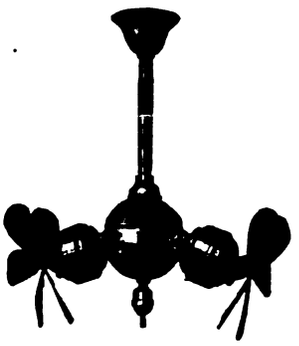


Westinghouse gyrating fans move all the air without a strong draft. Each of the two fans produces a continuous flow of air outward, at any desired angle from the horizontal,

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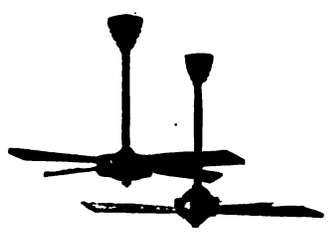
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ELECTRIC FANS—Continued



the direction of the flow is continuously gyrating about the central axis. The diverging current from the fans sweeps about, cooling and refreshing the atmosphere. These fans have a wind sweep of 20 to 25 feet, and can be spaced that far apart with excellent results. The fan blades are 12 ins. in length, having drawn steel frames. Special bearings absolutely prevent the escape of oil, and no guards are necessary. A gear on one of the fan motors meshes with a stationary gear mounted on the vertical shaft. The drive is therefore positive, and does not vary with air reaction. The mechanism does not slow down, and cannot revolve at excessive speed—a unique feature. The current is conducted to the moving part by two carbon brushes in contact with slip rings. There is practically no friction in the revolving part as it is carried on a ball bearing. This fan is furnished complete with suspension details, and finished in a dull black.

Westinghouse 56 in. ceiling fans are for use in large spaces, such as theatres, restaurants, stores, etc. These fans move a large volume of air with a very small current consumption. They operate quietly and require but little attention. The A-C motors are of the induction type, and the D-C. motors, series-wound. A-C. motors have external rotors, which give neater outlines, simpler construction, and lighter weight as compared with those having internal rotors. The speed control coils are placed inside the motor; ball-bearings are used in the A-C. motors, properly spaced, preventing noise, and are held in correct position by the ball race, in case motor must be dismantled. Shafts are of hardened steel. D-C. fans have a combination fibre and tool-steel thrust bearing, immersed in oil. There are four wooden blades, having a mahogany finish.



Westinghouse exhaust fans are efficient removers of foul air or odors from kitchens, lavatories, theatres, restaurants, school-rooms, and buildings requiring permanent ventilation. These fans should be mounted in walls or partitions, and should discharge directly into open spaces. Intake and exhaust pipes should be avoided. Where such pipes are necessary, they should be made as straight and short as possible. These fans have six blades. The motors are single-speed, but can be supplied with regulators if desired. The regulator is mounted separately from the fan, at any convenient location. Self-lubricating bearings are used in vertical exhaust fans which require no oiling or other attention.



ELECTRIC WARE



The Westinghouse type M-9 lb. iron is similar to the type M-6½ lb. iron. It is especially desirable for heavy pressing.

The Westinghouse 8 pound iron, although designed especially for the use of travelers, is extensively used for all kinds of light pressing. The base casting is flared to give greater ironing surface. The iron is finished in highly polished nickel, with a black ebonized handle. The heating element consists of resistance ribbon, wound on a mica form and insulated with a plate of mica on each side. The cord is permanently attached to the iron, and is reinforced by a non-kink spring. The terminal consists of a moulded asbestos terminal block, in which the connections are made. A fireproof stand is furnished which has an opening between the top and middle plates, in which an old-style curling iron may be heated. The 8-pound iron is made for two voltages, 100-125 and 200-240 volts, and consumes 250 watts.



The Westinghouse type H 6-lb. iron is similar to the type M. The heating element, although not steel clad, is of a single piece construction.



Westinghouse 6½ pound irons, Type M, are suitable for general household work and laundry service. The heating element is of the totally enclosed sheeted type and easily replaceable. Radiation from the top is prevented by dead-air space. The heat storage plates stores the surplus heat, keeping the iron hot longer. The current may be disconnected by pulling the connector away from the terminals. A non-kink spring prevents bends in cord. It is furnished for 100-110, 111-120, 210-230, and 231 to 250 volts, 550 watts in each case.



The Westinghouse turnover toaster is substantially built of pressed sheet steel, and finished in highly polished nickel, having a very attractive appearance. The toast can be turned without danger of burning the fingers, by means of an insulated knob. The flat surface on top of the toaster can be used for heating food or plates. A flexible cord with a separable plug is attached by a heavy white porcelain connector. For 100-120 and 200-240 volts, 550 watts.



The Westinghouse Waffle Iron is the latest addition to our line of Electric Ware. The griddles are cast aluminum and permit the baking of three waffles at one time. A handsome tray makes the apparatus complete. A special feature is the handle which raises and lowers the top griddle and also permits easy carrying. No grease is required on the griddles. The waffles are crisp and delicious.



The Westinghouse toaster-stove is a complete and practical stove that will cook anything that can be cooked on a double-burner gas stove. The frame and legs are of pressed steel, heavily nickel plated and polished. The griddle is of heavy gauge sheet aluminum. The tray is made of cold rolled steel, heavily nickel plated. A flexible cord is permanently connected. A through switch controls the current as desired. This stove is of similar wattage and voltage as the turnover toaster.



Westinghouse coffee percolators will make the coffee in 10 to 20 minutes, according to the strength desired. The coffee basket can be removed and the vessel used for boiling water. The vessel is made of spun sheet metal. The pot type percolator has a sheet metal spout, and black ebonized handle. The urn and loving-cup style percolators have a neat metal spigot. The specially heat-treated glass top can be removed for cleaning. The coffee basket is of aluminum and the valve of nickel silver. All Westinghouse percolators are fitted with



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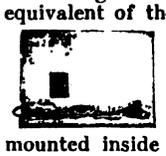
ELECTRIC WARE—Continued



an automatic cut-out. This is enclosed in base of the percolator and adjusted to open the circuit when the temperature of the heater approaches the danger point. All outside metal parts are nickel plated and polished. Inside of vessel is heavily tinned. Furnished complete with flexible cord, separable plug and receptacle.

The Westinghouse electric curling iron is simple, reliable and economical. The heating element is in the form of a rod inserted directly in the barrel, and can be removed easily. The swivel plug, which fits into the end of handle, is moulded of specially prepared composition which is unbreakable. Strong spring contacts in the plug assure a good connection. The cord is attached to the contacts within the swivel plug, there are no exposed terminals or live parts. All metal parts are nickel plated and polished; wooden handle is black ebonized. Can be furnished for 32, 100-125, or 200-240 volt, 15 watt service.

Westinghouse electric warming pads are the modern equivalent of the hot water bottle. They are made in two sizes and incased in fawn-colored felt cases. The larger pad is equipped with a three-heat switch, the current being turned on or off at the socket. To prevent overheating, automatic thermostats are mounted inside these pads, which cut off the current before the temperature can become excessive and automatically closing the circuit again when the pad has cooled off to normal temperature. Two cutouts are located in different parts of the pad; if one fails to operate, there is another to perform its duty.





The Westinghouse Type C chafing dish consists of a stand, water pan, food pan and cover. The heater is a standard 6 in. disc stove with the feet inserted in a reverse position. The disc stove may be used by itself if desired, and will perform any light cooking that a single burner gas stove will do. Type C vessels are finished in highly polished nickel, or copper. The 6 in. disc stove can be furnished separately. A 12 in. tray, finished to match the vessel, can also be supplied, to prevent any food that is accidentally spilled from damaging the table or table linen.



The Westinghouse cozy-glow radiator is a substantially built heating appliance that will throw heat in any direction. A trunnion yoke allows adjustability and controls the heat rays. A heavy cast iron base insures firmness without excessive weight. The heating unit, easily removable, is wound on a porcelain cylinder and is protected by a stout copper wire guard which can be removed for cleaning reflector. The reflector, which aids in the proper spread of the heat rays, is built of polished copper, neatly finished. For 100-120 or 200-250 volts, 550 watt capacity.



The Westinghouse disc immersion heaters may be used to heat liquids in almost any vessel. No special wiring is required. It is portable and very efficient when the heat requirements do not exceed 250 degrees F. The heater should always be completely immersed. The heating element is enclosed in a sealed disc, which offers a large heating surface.



Westinghouse hot plates are designed for hotel, restaurant and domestic use. No special flat-bottomed utensils are needed. The radiant heaters, with all the heat at the top, are very efficient with ordinary cooking vessels. The heat elements are non-corrosive and water and food spilled on the heater will not damage it in any way. The porcelain brick on which the heating element is assembled, will stand rough usage. Deflector plates below the heaters prevent scorching the table, protect the connection, and increase the heater's efficiency. Westinghouse Type 31 has a three-heat switch, and Type 32 has one heat only. In the 10 in. heater, three separate switches are used. These light up the areas of 6, 8, and 10 ins. respectively, making this heater equivalent to three plates in one.



Westinghouse electric air-heaters are suitable for heating residences and particularly adapted for isolated rooms or small buildings that cannot be conveniently or safely heated by other methods. The heating element is fully protected from electrical or mechanical injury. These air heaters have substantial terminals, heavy copper connections, are finished in black japan with polished aluminum trimmings, and are of very light construction. They are made for 1000, 2000 and 3000 watt capacities. The heater complete is provided with a three-heat snap switch but no attachment plug; for wall receptacle connection.

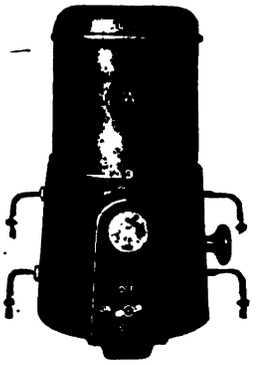


BATTERY CHARGERS

The Westinghouse rectigon is especially designed for charging run-down batteries. It is ruggedly built, reliable, simple, and economical. The charger has no moving parts, requires no oil or grease, and is not affected by heat or cold. All parts are supported on a circular cast-iron base with three feet. A cover of pressed steel fits over all parts and is secured to the base by three machine screws. The cover is shaped with handle at top for easy handling. The transformer with a fuse panel on top is mounted vertically on the cast iron base. The bulb is mounted in a socket in front of the transformer. Bulb installation is simple; just clip a wire lead to the wire projecting from the top of the bulb. Leads for A-C. and D-C. connections come out through base and are well protected from injury by encasing metal. The A-C. lead is provided with a separable attachment plug, and the D-C. leads with convenient clips for connecting to the battery. The Westinghouse rectigon, installed in a private garage, assures the automobilist an accessory, moderate in price and economical to operate, averaging about one cent an hour while in use. Above all, it is safe. Each rectigon is thoroughly tested and measures up to the high standard set for its performance. The Westinghouse garage type rectigon for charging, starting, lighting, and ignition batteries, affords an extremely flexible equipment for garage and service stations, where the number of batteries to be charged is variable. This type is mounted on a cast aluminum base and is protected by a pressed steel cover. Both A-C. and D-C. circuits are protected against overloads and shortcircuits by means of plug fuses which can be easily replaced. Current output is indicated on D-C. or battery side, by a flush type, B X ammeter. A snap switch controls both circuits. The handle of the dial switch controls the D-C. voltage. Leads for the A-C. and D-C. are brought out on opposite side of the base and are plainly marked. The garage type is a 6 ampere, 75 volt rectigon, furnished complete with two bulbs.



For Private Garage



For Service Stations

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What the E M F Electrical Year Book Contains

IT COVERS every activity of an electrical nature from the various methods of generating electricity to its utilization for every conceivable need, and all related subjects (both practical and theoretical) bearing thereon. A few of the principal classes of subjects included are the following:

Production and Distribution:

Generating stations.
Power transmission.
Substations and distribution systems.
Central station service.
Manufacturing of electrical and related machinery, apparatus, appliances and supplies.
Jobbing of electrical equipment and supplies.
Merchandising of electrical appliances and supplies.

Applications:

Electric lighting of streets, factories, stores, residences, etc.
Motor drive of all kinds of machinery and appliances and control therefor.
Electric heating in industry, households, etc.
Electrochemistry and electrometallurgy.
Electric railways (urban and inter urban).
Electrification of steam railroads.
Electric vehicles, trucks and tractors.
Telephony (manual and automatic).
Telegraphy (landline and submarine).
Radio telegraphy and radio telephony.
Miscellaneous electric signaling.
Marine and naval applications.
Household applications.
X-rays and their application.
Electrotherapeutics.

General:

Electrical engineering.
Electrical contracting and wiring.
Electrical colleges and schools.
Electrical theory and science.
Electrical instruments and testing.
Electrical testing laboratories.
Electrical associations and societies.
Electrical periodicals and libraries.
Electrical industry statistics.
Electrical codes and regulations.
Electrical invention and patents.

Each of these classes of subjects, as well as countless others, is subdivided into many topics giving valuable facts and data.

All electrical and allied terms are clearly defined. All of the equipment, apparatus, and supplies produced by the electrical industry, or used by it, are completely classified and the manufacturers of each classified product are listed. Facts are given about each manufacturer and all trade names are separately listed.

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How to Use the E M F Electrical Year Book

All text entries are arranged alphabetically throughout the book. No index is necessary. The range of topics on each page is indicated in the upper corners. Entries are made by the principal noun instead of adjective, unless the latter is more commonly used. General definitions are usually entered under the singular noun; classified products under the plural noun. Thousands of cross-references aid in locating any topic.

For example, to find facts on electric welding, see Welding, electric, review and status of; to find statistics on electrical merchandising, see Merchandising, electrical, present status and prospects of; to find an explanation of the electron theory see Electron, theory; to find a biography of Benjamin Franklin and description of his famous kite experiment, see Franklin, Benjamin; for a list of libraries with large collections of electrical books, see Libraries, electrical.

To find the names of manufacturers of any electrical product, such as renewable cartridge fuses, see Fuses, cartridge, renewable; or of rigid steel conduit for interior wiring, see Conduit, interior, rigid metallic; or of synchronous motors, see Motors, a-c, synchronous. Suppose one of the manufacturers listed was the X. Y. Z. Mfg. Co. of Boston, Mass., and a reader in Kansas City, Mo., wished to get in touch with that company quickly. By looking up the separate company entry under the letter X he might find that it had a branch office and warehouse in St. Louis, Mo., which he could quickly reach by long distance 'phone in case of an urgent order. Other facts about the manufacturer are also given in this company entry where these were available.

To find the name of the manufacturer using a particular trade name, look up the trade name in its proper alphabetical order. For example, suppose an architect specifies "Eye Rest" indirect lighting fixtures for a hospital. If this name were used, the manufacturer employing it would be quickly found and a contractor bidding on the job could get necessary price quotations, etc., from the manufacturer or his nearest branch office or sales representative by looking up the separate company entry of the manufacturer. Likewise, a dealer asked to repair an old type of flatiron, say "Unxld," can find who its manufacturer is, provided it is still made.

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Advertisements

In the lists of manufacturers under the various classified products will be found occasionally descriptive advertisements (sometimes illustrated) instead of simple listings. Such advertisements are marked with the abbreviation "Adv." at the end and serve to point out particular features of the manufacturer's product in that classification that should aid in the selection of the maker.

If the advertisements appear in the Display Advertising Section that follows, reference is made to the pages on which they appear.

On pages 1403 and 1404 there is also given an index to this Display Advertising Section. It should be noted that the advertisements in this section supplement those in the main text, or are inserted instead of advertisements in the text.

The primary function of all the advertisements is to educate the reader on the merits of the manufacturer's product, the various types and ratings in which it is made, and his facilities for producing same.

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Revision and Addition

The E M F ELECTRICAL YEAR BOOK will be completely revised each year and thousands of additional topics included. Suggestions as to the nature of additional topics are welcomed by the editor. Also suggestions for correction of any of the entries published.

Manufacturers are requested to keep the editor supplied with their latest catalogs, descriptive leafltes of new products and other announcements to the trade, and to advise of changes in executive officers, main and branch or district offices and sales representatives. Communications respecting all text entries should be addressed to the editor.

Advertisements for the second annual edition should be arranged for early. Communications respecting advertising rates, reservations for space, etc., should be addressed to the advertising manager.

Electrical Trade Publishing Co.
53 West Jackson Boulevard
CHICAGO, ILLINOIS
Eastern Office: 116 Nassau St., New York, N. Y.

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The asterisk * indicates manufacturers whose classified advertisements appear in the classified section. Folio numbers relate to display advertising pages only.

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X-Ray Lighting

FROM ZOSTRA TO SOLUTES

The result of years of study and research. Successful for illumination of every type of interior where harmonious and efficient lighting is demanded.

X-Ray Reflectors

EVERLASTING BRILLIANCY

for Show-Window Lighting
Show-Case Lighting
Factory Lighting
Flood Lighting

Produced by means of a powerful reflector that redirects and diffuses the light from brilliant lamps, yet conceals the dazzling light-source. There is an X-Ray Reflector for every lighting need.

NATIONAL X-RAY REFLECTOR CO.

NEW YORK CHICAGO SAN FRANCISCO
Resident Engineers in all Principal Cities

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Apex
ELECTRIC SUCTION CLEANER





The ROTAPEX ELECTRIC CLOTHES WASHER

2 Two Exclusive Apex Features

1. Inclined Nozzle Cleans Under Things as Well as Around Them.





2. Divided Nozzle Cleans Uniformly Across the 13-inch Opening.

THE WASHER

The ROTAPEX Electric Clothes Washer is strictly a quality product, combining details of design based on the best engineering knowledge with the finest materials and the best manufacturing skill and workmanship.

The simplified control of the Rotapex rotary washer comprises only four major units: (1) The motor with friction clutch; (2) the worm and gear transmission; (3) the cylinder operating mechanism; (4) wringer control.

THE MOTOR—¼ h. p. ball bearing, cool-running motor of splash proof design insulated from frame, 1,800 r. p. m., with maximum starting torque, ample capacity to insure surplus power in handling unusually heavy loads and universal jointed main shaft. Friction clutch prevents any possible damage through overloading.

WATER-TIGHT BEARINGS—All bearings are enclosed in water-tight casings; no open seams or joints to permit water seeping in. An important protection against rust-frozen bearings.

THE WHEELS—The swivel-type casters include bronze wheels held in position by malleable iron horns, insuring easy turning and extreme strength.

THE CYLINDER—The self-reversing perforated cylinder revolves 5½ times in each direction and is made of heavy zinc with galanized ends. It measures 18 inches in diameter by 18¾ inches long. Its tumbling ribs are of wood—its entire construction rust-proof. It is light-weight and is easily removed (when through washing) to rinse out the tank.

THE INSULATION—All electric wiring is enclosed in armored conduit. The cord is detachable from the washer by separable plug.

THE CLEANER

The Apex is a true electric suction cleaner.

Apex suction is applied evenly across the 13-inch nozzle by reason of the exclusive divided or twin chamber design. The inclined nozzle gets under radiators and low furniture, hooks around table legs, goes up close to baseboards and pokes into corners.

A removable stationary bristle brush is fitted across the nozzle opening for picking up thread, hair, lint and litter.

The thin slot opening of the nozzle concentrates the suction so that it gets the most deeply imbedded dirt.

Practically unbreakable construction; motor housing and nozzle complete in only two sections, both of polished aluminum.

Weight, 10½ lbs. Only two places to oil through spring closed ball oilers; felt wick feeds oil automatically.

Swivel type rear wheel. Forward wheels do not interfere with nozzle front getting into corners and cleaning along baseboards.

Handle stop locks handle in a horizontal position for cleaning stairways, etc. Entire machine stands erect without support when handle is thrown forward.

Wire runs through handle to turn switch at end of pistol grip.

Air-tight coupling for attachment hose conveniently located on face of nozzle.

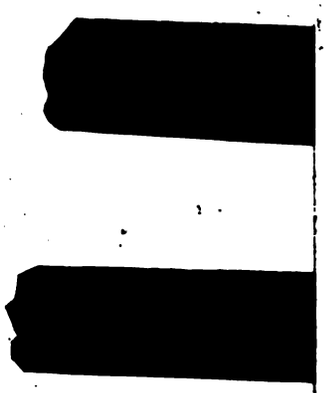
THE APEX ELECTRICAL DISTRIBUTING CO., 1067 East 152d Street, CLEVELAND, OHIO

EXPORT OFFICE AND SHOW ROOM: 461 Eighth Avenue, NEW YORK CITY, U. S. A.

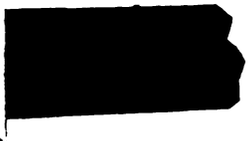
Canadian Factory: APEX ELECTRICAL MANUFACTURING CO., Ltd., 162-4 Atlantic Ave., Toronto, Ontario.

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Shipping Data — Standard Types and Sizes

Inside Diameter Inches	Approximate Weight, Per Foot, Net Lbs.	Standard Crate Contains in Feet	Approximate Gross Weight Standard Crate Lbs.	Approximate No. of Feet Minimum Carloads 30,000 Lbs.	Maximum No. of Feet in 36 Foot Car	Approximate Gross Weight Maximum Quantity 36 Foot Car, Lbs.	Standard Crate Bends Contains Pieces	Approximate Gross Wt., Standard Crate Bends Lbs.
Socket Joint Conduit							**Bends**	
2	0.90	200	270	33000	35000	31800	25	255
2½	1.10	200	320	27000	30000	33250	25	295
3	1.30	150	285	22800	25000	32800	20	280
3½	1.50	125	290	19800	21000	31800	15	295
4	1.85	100	280	16000	16500	30800	12	295
4½	2.25	100	330	13200	13300	30250	9	250
Harrington Joint Conduit							**Bends**	
2	0.95	200	295	31300	33000	31600	25	265
2½	1.20	200	355	24750	27000	32700	25	310
3	1.40	150	320	21250	23000	32500	20	290
3½	1.65	125	320	18000	20000	33300	15	310
4	2.00	100	320	14850	16000	32300	12	305
4½	2.50	100	380	12000	12000	30000	9	260

Prices of
"ORANGEBURG FIBRE CONDUIT"
will be furnished on application

THE FIBRE CONDUIT CO. REG. U. S. ORANGEBURG PAT. OFF ORANGEBURG, N. Y.

For additional data concerning
"ORANGEBURG FIBRE CONDUIT"
See Conduit, Underground, Fiber

The Fibre Conduit Company

New York Orangeburg, N. Y. Chicago

THE STANDARDIZED FIBRE CONDUIT "ORANGEBURG"







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